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JUL 30 1998

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Mr. James A. Saric, Remedial Project Manager
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Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL: FINAL SITEWIDE EXCAVATION PLAN, CHANGE PAGES TO AREA 1, PHASE I CERTIFICATION REPORT, FINAL AREA 2, PHASE I INTEGRATED REMEDIAL DESIGN PACKAGE, AND DRAFT CERTIFICATION REPORT FOR AREA 8, PHASE I

The purpose of this letter is to transmit, for your review and approval, the following Soils Remediation documents and reports:

- Final Sitewide Excavation Plan
- Change Pages finalizing the Area 1, Phase I Certification Report
- Final Area 2, Phase I Integrated Remedial Design Package including a draft comment response package addressing comments received on the characterization addendum (final construction drawings will be submitted by August 14, 1998).
- Draft Certification Report for Area 8, Phase I

Recycled and Recyclable

If you should have any questions or comments, please contact Robert Janke at (513) 648-3124.

Sincerely,

Johnny Reising

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Johnny W. Reising
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# SITEWIDE EXCAVATION PLA

## FERNALD ENVIRONMENTAL MANAGEMENT P
## FERNALD, OHIO

**VOLUME I**
**SECTIONS 1 through 7**

**JULY 1998**

**U.S. DEPARTMENT OF ENERGY**
**FERNALD AREA OFFICE**

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# SITEWIDE EXCAVATION PLAN

## FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

## FERNALD, OHIO

VOLUME I

SECTIONS 1 through 7

INFORMATION ONLY

JULY 1998

U.S. DEPARTMENT OF ENERGY

FERNALD AREA OFFICE

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FINAL

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# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ACA | Amended Consent Agreement |
| ACGIH | American Conference of Governmental and Industrial Hygienists |
| ALARA | as low as reasonably achievable |
| ARAR | applicable or relevant and appropriate requirement |
| ASCOC | area-specific constituent of concern |
| ASL | analytical support level |
| AWWT | Advanced Wastewater Treatment (Facility) |
| BAT | best available technology |
| BOD | biological oxygen demand |
| BTV | benchmark toxicity value |
| CAMU | Corrective Action Management Unit |
| CDL | Certification Design Letter |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CMD | construction management data |
| COC | constituent of concern |
| COD | chemical oxygen demand |
| COEC | constituent of ecological concern |
| CRP | Community Relations Plan |
| CU | certification unit |
| DAC | derived air concentration |
| dBA | decibels on the A-weighted scale |
| D&D | decontamination and dismantlement |
| DF&O | Director's Findings and Orders |
| DOE | U.S. Department of Energy |
| DQO | data quality objective |
| EPA | U.S. Environmental Protection Agency |
| ESH&TRM | Environment, Safety, Health, and Training Requirements Matrix |
| FC&DP | Facilities Closure & Demolition Project |
| FDF | Fluor Daniel Fernald |
| FEMP | Fernald Environmental Management Project |
| FFAPR | full-face air purifying respirator |
| FFCA | Federal Facilities Compliance Act |
| FFPARR | full-face powdered air purifying respirator |
| FRL | final remediation level |
| FS | feasibility study |
| FTF | Fire Training Facility |
| FTL | Field Tracking Log |
| GC/MS | gas chromatography/mass spectroscopy |
| GIS | Geographic Information System |
| GMA | Great Miami Aquifer |
| HDPE | high-density polyethylene |
| HEPA | high-efficiency particulate air (filter) |
| HPGe | high-purity germanium |

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## LIST OF ABBREVIATIONS AND ACRONYMS
**(Continued)**

| | |
|---|---|
| HSO | Health & Safety Officer |
| HWMU | hazardous waste management unit |
| ICP | inductively coupled plasma emission spectroscopy |
| IEMP | Integrated Environmental Monitoring Plan |
| IIMS | Integrated Information Management System |
| IMPP | Impacted Materials Placement Plan |
| IRDP | integrated remedial design package |
| LDR | land disposal restriction |
| LTRA | long-term response action |
| MDA | minimum detectable activity |
| $mg/m^3$ | milligram per cubic meter |
| MM | mask mounted |
| mph | mile per hour |
| MSDS | Material Safety Data Sheet |
| MTL | material tracking location |
| MTR | minimum technology requirement |
| NaI | sodium iodide |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NEPA | National Environmental Policy Act |
| NESHAP | National Emissions Standards Hazardous Air Pollutants |
| NIOSH | National Institute for Occupational Safety and Health |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| NRC | U.S. Nuclear Regulatory Commission |
| NRRDP | Natural Resource Restoration Design Package |
| NRRP | Natural Resource Restoration Plan |
| O&M | operations and maintenance |
| OAC | Ohio Administrative Code |
| OEPA | Ohio Environmental Protection Agency |
| OSDF | On-Site Disposal Facility |
| OSHA | Occupational Safety and Health Act |
| pCi/g | picocurie per gram |
| PEL | permissible exposure limit |
| PID | photoionization detector |
| PPE | personal protective equipment |
| PQL | practical quantitation limit |
| PSHASP | Project-Specific Health and Safety Plan |
| PSHSRM | Project-Specific Health and Safety Requirements Matrix |
| PSP | project specific plan |
| PWID | Project Waste Identification Document |
| QA | quality assurance |
| QAjSP | Quality Assurance Job Specific Plan |
| QC | quality control |
| RA | remedial action |
| RAR | Remedial Action Report |

## LIST OF ABBREVIATIONS AND ACRONYMS
**(Continued)**

| | |
|---|---|
| RCRA | Resource Conservation and Recovery Act |
| RD | remedial design |
| REM | Radiological Environmental Monitoring |
| RI | remedial investigation |
| ROD | Record of Decision |
| RTRAK | Real Time Radiation Tracking System |
| SARA | Superfund Amendment and Reauthorization Act |
| SCEP | Soil Characterization and Excavation Project |
| SCQ | Sitewide CERCLA Quality Assurance Project Plan |
| SCR | Site Closeout Report |
| SED | Sitewide Environmental Database |
| SEP | Sitewide Excavation Plan |
| SERA | Sitewide Ecological Risk Assessment |
| S/RID | Standards/Requirements Identification Document |
| STP | Sewage Treatment Plant |
| SWIFTS | Sitewide Waste Information Forecasting and Tracking System |
| SWPPP | Storm Water Pollution Prevention Program |
| SWRB | Storm Water Retention Basin |
| TBC | to be considered |
| TCLP | toxicity characteristic leaching procedure |
| TSS | total suspended solids |
| TWA | time-weighted average |
| UCL | upper confidence limit |
| U.S.C. | United States Code |
| UST | underground storage tank |
| VOC | volatile organic compound |
| WAC | waste acceptance criteria |
| WAO | Waste Acceptance Operations |
| WL | working level |
| WMP | Waste Management Programs |
| XRF | x-ray fluorescence |

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# EXECUTIVE SUMMARY

The Sitewide Excavation Plan (SEP) for the Fernald Environmental Management Project (FEMP), Fernald, Ohio, addresses sitewide planning for remediation of soil and at- and below-grade structures and debris at the FEMP. The SEP is identified in the Operable Unit 5 Remedial Design Work Plan as the document that will provide the management strategy and technical guidelines necessary to govern sitewide soil remediation. A Sitewide Sequencing Plan for remediation (Appendix B) is provided to guide the long-term planning and phasing of soil remediation and to facilitate sitewide coordination with the other activities at the FEMP. Other information included in the SEP consists of remediation drivers, restoration goals, methods/protocols, and related requirements (e.g., health and safety, environmental controls and monitoring, recordkeeping, and data management) that are applicable to each remediation project. The general steps of each remediation project are described in the SEP and include: predesign investigation, remedial design, remedial action (including material handling and disposal), precertification, certification, and postremediation activities. Figure E-1 provides an overview of the SEP organization.

Area-specific conditions may limit the applicability of available measurement, monitoring, and construction technologies to be used during remediation. Examples of such conditions include depth and extent of excavation, types and levels of contamination, and existence of above-grade structures. To accommodate the area-specific conditions, the SEP also defines representative conditions expected to be encountered throughout the FEMP and provides conceptual implementation approaches for efficiently complying with the general remedial requirements. These area-specific conditions will be addressed as work elements during the design process for each remediation project.

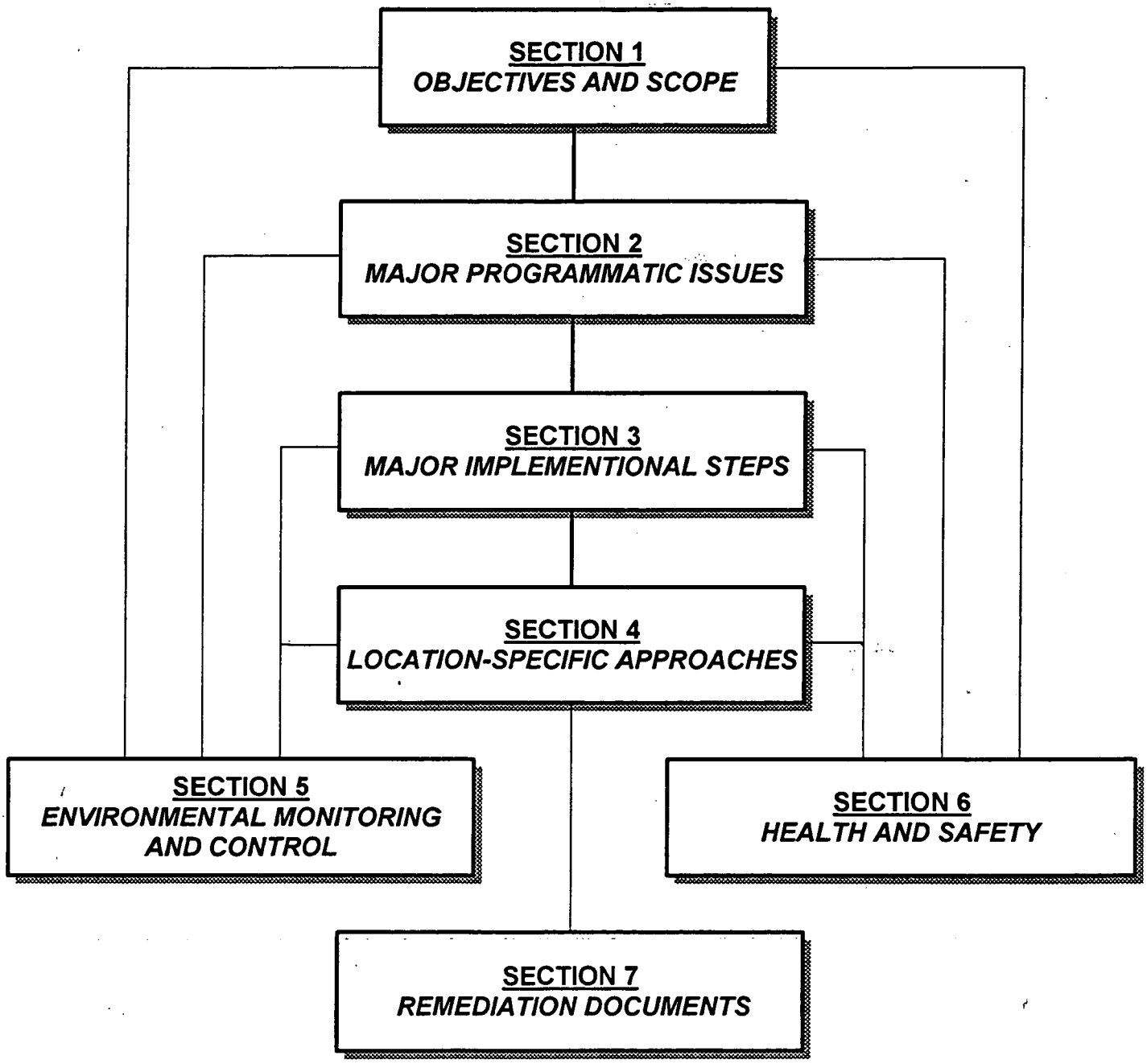
A remediation document hierarchy is also proposed in the SEP. Area-specific remediation documents that will be required for each remediation project include: Project-Specific Plans (PSPs), the Integrated Remedial Design Package (IRDP), the Certification Design Letter (CDL) and the Certification Report. Development of PSPs for sampling and analysis purposes will occur throughout the remediation cycle as characterization and sampling activities are needed. The IRDPs will present area-specific contamination data, a detailed design of the area-specific remediation elements, and the lessons learned during previous phases of the sitewide remediation process. After completion of the soil remedial actions, an area-specific CDL and a Certification Report will be prepared according to specifications

provided in the SEP. The letter and the relevant standard procedures described in the SEP will be used to guide the certification sampling and statistical analysis processes necessary to demonstrate attainment of all the applicable remedial requirements summarized in the SEP. The Certification Report will document activities and results of the certification.

After completion of all the individual remediation projects, final grading and restoration of the site will be guided by the Natural Resource Restoration Plan, which will be submitted separately from the SEP. Additionally, a Remedial Action Report will be prepared for each of the five FEMP operable units to document the completion of all the remedial actions within the scope of the specific operable unit. After completion of sitewide remediation and restoration, a Site Closeout Report will be submitted to summarize all the activities conducted and the final conditions at the site.

By defining the general sitewide management strategy, major technical guidelines, representative area-specific implementation approaches, and hierarchy of all the remediation documents, the SEP will facilitate the development and review/approval of all future deliverables required during remediation. Specifically, the SEP will achieve this objective by providing accepted resolutions to any outstanding and expected global issues and by providing a template/guide for future documents and procedures.

# SITEWIDE EXCAVATION PLAN

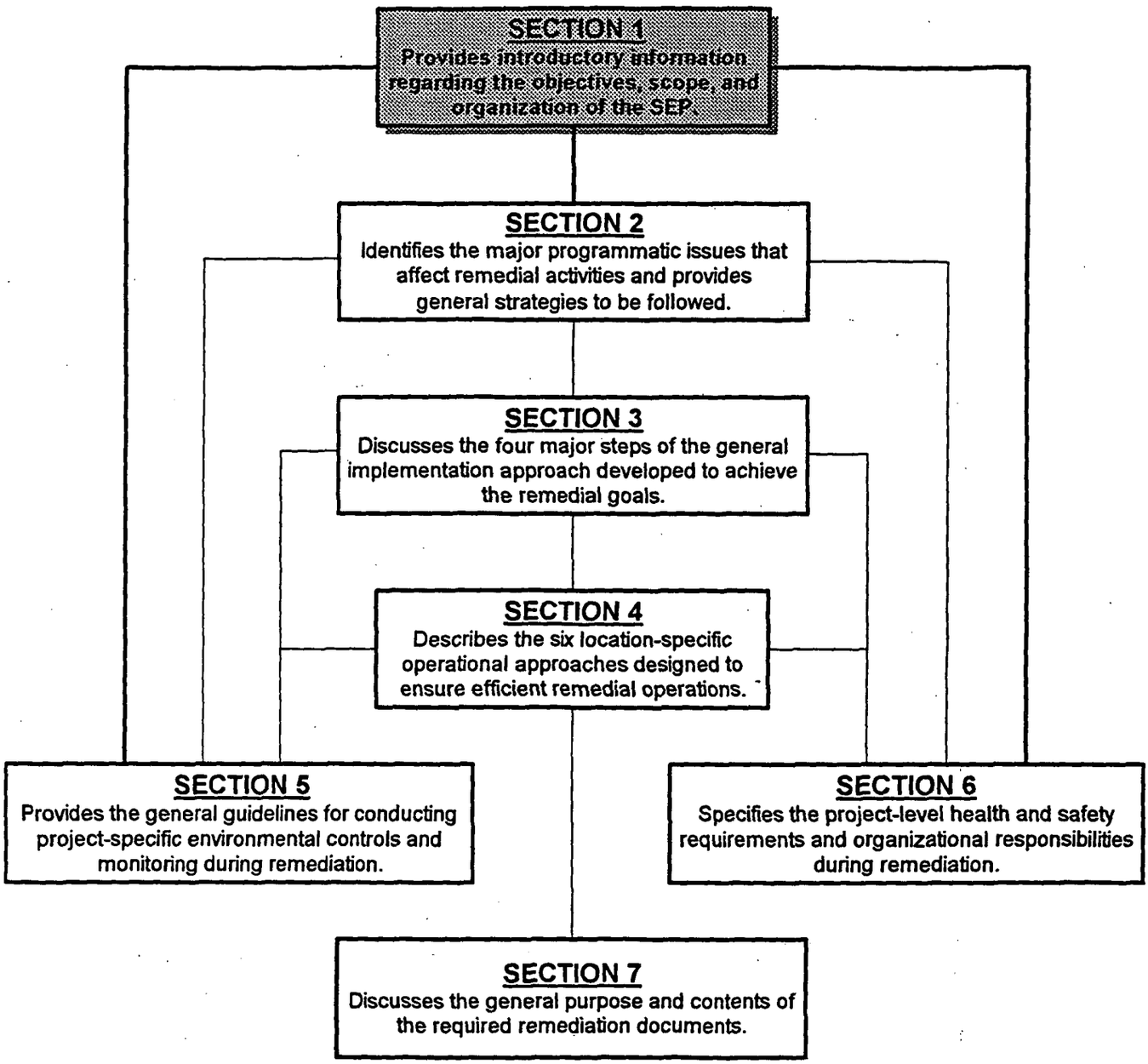



**APPENDIX A** - Soil Remediation ARARs and TBCs
**APPENDIX B** - Sitewide Sequencing Plan
**APPENDIX C** - Constituent of Ecological Concern Selection
**APPENDIX D** - Wood Sampling Program
**APPENDIX E** - SEP Quality Assurance Project Plan (QAPP)
**APPENDIX F** - Implementation of Construction and Waste Management Practices
**APPENDIX G** - Certification Design Rationale
**APPENDIX H** - Summary of Field Measurement and Laboratory Analytical Technologies
**APPENDIX I** - Sitewide Extent of Contamination by Constituent

**FIGURE ES-1 SITEWIDE EXCAVATION PLAN ORGANIZATION**

# SITEWIDE EXCAVATION PLAN



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# 1.0 INTRODUCTION

This Sitewide Excavation Plan (SEP) provides technical guidance for activities related to the excavation and disposition of soil and at- and below-grade structures and debris at the Fernald Environmental Management Project (FEMP).

The SEP was prepared in accordance with Section XI of the 1991 Amended Consent Agreement (EPA 1991) between the U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA). It was also prepared, where feasible, using Superfund Remedial Design and Remedial Action Guidance (EPA 1986), Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties (EPA 1990a), and the Remedial Design/Remedial Action Handbook (EPA 1995). These guidance documents and agreements identify the requirements for the FEMP remedial design/remedial action phase of remediation, as regulated by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (40 CFR 300).

Because of its general complexity and various area-specific conditions, soil remediation at the FEMP will require a "learn as you go" approach throughout the implementation period. Lessons learned from previous soil remediation conducted at the FEMP (i.e., Remediation Area 1, Phase I Project) that are applicable to future projects have also been incorporated in the SEP. Necessary modifications to the technical approaches and/or project schedules presented in the SEP will be developed with regulatory concurrence and documented in future change pages to the SEP, area-specific design packages or other appropriate official correspondences.

## 1.1 OBJECTIVES AND SCOPE OF THE SITEWIDE EXCAVATION PLAN

The remediation of soil and at- and below-grade structures and debris at the FEMP will be organized into ten remediation areas, as listed in Section 1.2.2. The SEP is the mechanism for promoting integration and consistency for site excavation activities, including project-specific planning and documentation and ensuring that project goals, procedures and activities address commitments and regulations. The overall objectives of the SEP are to provide guidance for:

- All planning, design, and remedial activities related to the excavation and disposition of soil and at- and below-grade debris, including the decontamination and demolition (D&D) of at- and below-grade structures and utilities

- Integration of soil excavation activities at the FEMP.

The following activities must be completed for area-specific excavation projects as part of the remedial design/remedial action process:

- Predesign investigations
- Remedial design
- Remedial action
- Precertification and certification
- Postremediation activities.

The relationships among these activities are shown on Figure 1-1 and discussed in detail in Section 3.0. The SEP provides programmatic guidance for completion of these activities. This programmatic guidance also provides a model for the development of Project-Specific Plans (PSPs), Integrated Remedial Design Packages (IRDPs), Certification Design Letters (CDLs), and Certification Reports for individual excavation documents which are described in Section 7.0. PSPs will detail the additional sampling and analysis activities needed to provide information for the IRDPs. The IRDPs will provide details on remediation activities, issues, and conditions in construction drawings, specifications, and Implementation Plans. CDLs will describe the sampling and design process to demonstrate compliance with remediation goals. The Certification Reports will document attainment of these goals.

The SEP also defines the sequencing of all remediation projects (Appendix B). Major sitewide and operable unit-specific documents and reports to be developed during and after remediation are identified on Figure 1-2.

Specifically, as described in the Operable Unit 5 Remedial Design Work Plan (DOE 1996a), the SEP addresses the following:

- **Decision Criteria.** The overall logic for remediation decisions, including identifying the extent of excavation due to contamination (Section 3.1.3), establishing sitewide constituent of concern (COC) screening criteria, and area-specific COCs (ASCOCs) (Section 2.5.2.2), addressing waste acceptance criteria (WAC) for the On-Site Disposal

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Facility (OSDF) (Section 2.2.1), and identifying methods for certifying attainment of final remediation levels (FRLs) (Section 2.2.2).

- **Excavation of At- and Below-Grade Structures.** Integration between Operable Unit 3 and Operable Unit 5 for excavation of at- and below-grade slabs, foundations, piping, and other structures (Sections 2.3.3 and 4.4).

- **Contingency Plan.** The strategy for implementing a contingency plan (Section 2.3.4 and Appendix F).

- **Closeout Requirements.** The documentation, or procedures, that will be necessary during remedial action to successfully complete the goals of the selected remedy for soil (Section 2.3.7 and 7.0).

- **Impacted/Excavated Materials Management.** General protocol for soil segregation, stockpiling, staging, maintenance, and disposition (Section 3.3.2 and Appendix F).

- **Sampling and Analysis Methods and Requirements.** Data quality objectives, analytical requirements, sampling methods, representative sampling, sampling rationale (Section 2.4 and Appendices E, G and H).

- **Excavation Control.** Monitoring of excavation areas to achieve WAC (Section 2.2.1), and protocols for perched water dewatering (Section 2.5.4), slope stability (Sections 3.1.3 and 4.4.2), dust control (Section 5.1.2.2 and Appendix F), and soil management and staging requirements (Section 3.3.2 and Appendix F).

- **Site Health and Safety Matrix.** Health and Safety Protocols that remain the same for all IRDPs (Section 2.3.8 and 6.0).

- **Quality Assurance/Quality Control.** Outline of requirements for roles and responsibilities, standard operating procedures, document control, change notices, and sampling and analysis (Appendix E).

- **Access Controls.** Appropriate access controls to support soil remediation (Section 3.5.1.1).

- **Operation and Maintenance.** Guidelines for performing operations and maintenance for managing equipment and storage/staging areas, performing dust suppression (Section 5.1.2.2), and implementing erosion and storm water controls (Section 5.1.3 and Appendix F).

- **Excavation Monitoring.** General project-specific monitoring requirements for air, noise, and surface water to meet environmental (Section 5.0) and occupational (Section 6.0) regulatory standards.

- **Regulatory Considerations.** The compliance strategy for applicable, relevant, and appropriate requirements (ARARs), site agreements, and other regulatory criteria that may affect procedures for conducting remediation (Section 1.3.1.1 and Appendix A).

- **Baseline Grading.** The guidelines for site grading to control surface run-off after remediation, as a basis for developing final land use options, wetland mitigation, and associated institutional controls (Section 3.5.1 and Appendix F).

- **Technology Studies.** Potential use of technology studies (Section 1.4.2).

- **Measures to Minimize Impacts.** Identification of potential measures to ensure protection of threatened and endangered species, and protocol for ensuring protection of archeological and cultural finds during remediation (Sections 1.3.2.8 and 5.0).

In addition, the SEP addresses the following:

- Achievement and demonstration of the closure of hazardous waste management units (HWMUs) and underground storage tanks (Sections 2.1.1.1 and 2.1.1.2, respectively)

- Identification of toxicity characteristic hazardous waste (Section 2.1.1.3)

- Implementation of environmental and occupational "as low as reasonably achievable" (ALARA) strategy (Section 2.1.5.3)

- Demonstration of WAC attainment (Section 2.2.1)

- Demonstration of FRL attainment (Section 2.2.2).

It is important to note that several remediation and remediation-related activities are excluded from the SEP because other projects are responsible for completing them. These activities include:

- Excavation associated with nonremedial activities, such as minor maintenance-related excavation

- Design, construction, and placement of materials into the OSDF

- Design, construction, and operation of groundwater restoration and wastewater treatment facilities

- D&D of above-grade structures and utilities

- Removal, treatment, and disposition of materials stored in the Operable Unit 1 Waste Pits

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- Removal, treatment, and disposition of the Operable Unit 4 silos and their content
- Monitoring during postremediation.

The following subsections provide background information on remediation activities at the FEMP, the factors that are driving remediation, and a description of the remainder of the contents of the SEP.

## 1.2 BACKGROUND

The FEMP is a DOE-owned, contractor-managed facility located in southwestern Ohio. It is located north of the small community of Fernald, Ohio, approximately 20 miles northwest of Cincinnati, Ohio. Formerly known as the Feed Materials Production Center, the facility was in operation from 1951 through 1989 to produce metallic uranium fuel elements, target cores, and other uranium products for use in weapons, production reactors, and other DOE programs.

The DOE began to focus resources on environmental issues at the site in 1986 and halted production in 1989. At this point, available resources were devoted to environmental restoration initiatives. One of the first initiatives was the CERCLA remedial investigation and feasibility study (RI/FS) process. As work progressed from the investigation/planning phases to the implementation phase, a more integrated approach to remediation activities was adopted. The following paragraphs of this subsection discuss the transition from the operable unit concept to the integrated approach.

### 1.2.1 Transition from the Operable Unit Concept

For the purposes of investigation and study, remedial issues and concerns that were similar in location, history, type/level of contamination, and inherent characteristics were grouped into operable units. This management approach was seen as the most efficient way to gather information about the condition of the site. The site was divided into five operable units, which are defined in the Amended Consent Agreement (EPA 1991) as follows:

- Operable Unit 1: Waste Pit Area. Waste Pits 1 through 6, Clearwell, Burn Pit, berms, liners, and soil within the operable unit boundary.
- Operable Unit 2: Other Waste Units. Flyash Piles, other South Field disposal areas, Lime Sludge Ponds, Solid Waste Landfill, berms, liners, and soil within the operable unit boundary.

- Operable Unit 3: Former Production Area. Former Production Area and production-associated facilities and equipment (including all above- and below-grade improvements), including, but not limited to, all structures, equipment, utilities, drums, tanks, solid waste, waste, product, thorium, effluent lines, a portion of the K-65 transfer line, wastewater treatment facilities, fire training facilities, scrap metal piles, feedstocks, and coal pile.

- Operable Unit 4: Silos 1 through 4. Silos 1, 2, 3, and 4, berms, decant sump tank system, and soil within the operable unit boundary.

- Operable Unit 5: Environmental Media. Groundwater, surface water, soil not included in the definitions of Operable Units 1 through 4, sediment, flora, and fauna.

During the RI/FS process, human health and environmental concerns were identified and remedial alternatives were evaluated for each of these operable units. A Record of Decision (ROD) was produced for each operable unit after the RI/FS process was completed. Each ROD reviewed the results of the RI/FS documentation and identified the selected remedy. The remedy selected for soil remediation consists of excavation and disposition of contaminated soil and associated debris.

As the RODs were issued, it became apparent that successful and efficient remediation of the site depended upon developing sitewide remediation plans that reintegrated the operable units. For instance:

- Remediation of Operable Units 2, 3, and 5 at the FEMP involves the excavation of soil, at- and below-grade debris, and disposal of this material in the OSDF

- Excavation within the OSDF footprint has to be completed and areas certified before the OSDF can be constructed

- The sequencing of construction, building D&D and final soil and groundwater remediation must be closely coordinated among all operable units through remedial design and remedial action

- The Operable Unit 5 scope includes excavation of all contaminated soils left after the remediation of the other operable units.

Therefore, integration with activities in other projects is essential to the successful excavation of contaminated soil and FRL certification of remaining site soil. The operable unit concept did not provide the required level of integration.

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An integrated site remediation strategy was developed and discussed with the Ohio Environmental Protection Agency (OEPA) and EPA in September 1995; DOE then proceeded with implementation of the agency-approved integrated approach. This approach integrates former operable units into remediation projects. For example, contaminated soil from Operable Units 2 and 5 was integrated into the Soil Characterization and Excavation Project (SCEP). The integrated implementation process refocused remedial activities planned under the operable unit concept into primary projects based on the selected remedy.

Organizing remediation in recognition of "the way the work will be performed" fosters improved project integration. The remediation responsibilities of the project and the relationship between the project and the operable unit concept are shown in Table 1-1. The projects are as follows:

1) Waste Pits Remedial Action Project (Operable Unit 1, for waste pit residue)
2) OSDF Project (Operable Units 2, 3, and 5)
3) Facilities Closure and Demolition Project (Operable Unit 3)
4) Silos Project (Operable Unit 4)
5) Aquifer Restoration Project (Operable Unit 5)
6) SCEP (Operable Units 2, 3, and 5)
7) Wastewater Treatment Project (Operable Unit 5).

These projects were then placed into three remedial action divisions within the FEMP organization:

- Facilities Closure and Demolition Projects Division (Project 3)
- Soil and Water Projects Division (Projects 1, 2, 5, 6, and 7)
- Waste Management Technology and Silo Projects Division (Project 4).

1.2.2 Integrated Implementation Approach

The SCEP is included in the Soil and Water Projects Division and has responsibility for the characterization and excavation of soil, which includes:

- Further characterization/confirmation of the nature and extent of contamination (predesign investigation beyond RI/FS activities)
- Remedial design
- Construction

- Procurement
- Operations
- Maintenance of response activities and material stockpiles
- Excavation, segregation, and treatment of materials
- Disposition of material based on WAC and FRLs
- Treatment and disposition of toxicity characteristic hazardous wastes
- Management of remediation wastewaters generated during soil excavation activities including contaminated perched water
- Certification of FRL attainment
- Demonstration of WAC attainment
- Control and monitoring of project-specific environmental conditions
- Management of cultural resources
- Maintenance and enhancement of natural resources
- Coordination with stakeholders.

The SCEP is also responsible for producing documentation for planning and controlling these activities. The associated documentation includes:

- the SEP (this document)
- PSPs to support IRDP development (Section 7.1)
- IRDPs for each remediation area and phase (Section 7.2)
- CDLs and Certification Reports (Sections 7.3 and 7.4)
- Remedial activity completion documents (Section 7.5).

Figure 1-2 shows the relationship and hierarchy of these documents.

The responsibilities of the SCEP have been categorized according to the following components, based on specific remediation activities as they relate to soil, water and debris:

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- Soil and sediment
- Perched water

- Storm water/wastewater
- Remediation debris
- Impacted materials from Operable Unit 2 subunits.

The general strategy for remediation of each component is presented in Section 1.3.2. Table 1-2 identifies each remedy component, the operable unit(s) associated with that component, and cross-references the section of the SEP (or other relevant documentation) that discusses the component in detail.

The remediation work has been organized into ten remediation areas that correlate to the sequence in which work will be performed. Nine of the ten soil remediation areas are shown on Figure 1-3 (Remediation Area 10 corresponds to utility and road corridors and has not been shown for clarity). When remediation area boundaries are significantly modified from Figure 1-3, DOE will justify the changes and submit the revised area map for regulatory review and approval. A summary of the ten remediation areas is provided below:

- **Remediation Area 1, North and East Regions of the FEMP (three phases).** This area includes the footprint of the OSDF, the North Entrance Road, the Trap Range, soil and at- and below-grade debris that will remain after D&D of the Sewage Treatment Plant (STP) and on-property portion of the old outfall line, and limited shallow excavation of the wetlands just north of the northern boundary line of Remediation Area 6.

- **Remediation Area 2, Southwestern Region of the FEMP (three phases).** Remediation Area 2 consists of the southern Operable Unit 2 waste units and material under these that exceeds the FRLs. The waste units consist of the South Field and the Active and Inactive Flyash Piles, as well as suspect areas of contamination within Remediation Area 2 but outside the boundaries of the Inactive Flyash Pile, South Field, and Active Flyash Pile.

- **Remediation Area 3, North Portion of the Former Production Area.** Remediation Area 3 requires removal of soil and at- and below-grade debris exceeding FRLs following D&D of Operable Unit 3 above-grade structures within the northern portion of the Former Production Area. Deep excavation is expected in portions of Remediation Area 3. The Operable Unit 2 Lime Sludge Ponds are also included in Area 3. Remediation of the Lime Sludge Ponds will involve removal of all sludges and soil exceeding FRLs.

- **Remediation Area 4 (A and B), Central Portion of the Former Production Area.** Remediation Area 4 (A and B) includes impacted soil and at- and below-grade debris remaining after D&D of the middle portion of the Former Production Area (Operable Unit 3).

- **Remediation Area 5, Southern Portion of the Former Production Area.** The scope of work in Remediation Area 5 includes residual soil and at- and below-grade debris subsequent to D&D of the southern portion of the Former Production Area (Operable Unit 3), and potential remediation of the storm water retention basin.

- **Remediation Area 6, Waste Pits and Vicinity.** The scope of work for Remediation Area 6 consists of remediating soil and at- and below-grade debris in the vicinity of the waste pits, including rail lines, after removal of the Operable Unit 1 waste pit material. Remediation activities also include removal of above-grade structures associated with remedial treatment facilities and the Operable Unit 2 Solid Waste Landfill. Remediation of the SWL will involve removal of all landfill material and soil exceeding FRLs. Remediation of the Fire Training Facility (FTF), which is also included in Area 6, will involve removal of soil and at- and below-grade debris exceeding FRLs, which may involve deep excavation.

- **Remediation Area 7, Silos and Vicinity.** Remediation Area 7 consists of the soil and at- and below-grade debris remaining after removal of the Operable Unit 4 materials and silos, the above-grade structures associated with remedial treatment facilities, the Advanced Wastewater Treatment (AWWT) facility, and miscellaneous corridors.

- **Remediation Area 8 (three phases), West Bank of Paddys Run.** The west side of Paddys Run (including sediment in Paddys Run) has been separated from other FEMP remediation areas to emphasize the facts that contamination has not been detected and that process knowledge does not indicate the potential for contamination. Although this area must be certified, only a minimal amount of spot excavation is expected.

- **Remediation Area 9 (two phases), Off-Property Areas.** Off-property areas that may require remediation include the following:

  - Potentially impacted land adjacent to the northeast corner of the site
  - Land adjacent to the eastern fenceline north of the STP
  - Abandoned outfall line
  - Abandoned outfall structure
  - Great Miami River sediment.

- **Area 10, Corridors and Utilities.** When all other remediation areas have been certified, corridors such as access roads, utility lines, and underground piping will remain. These features will be excavated and certified after other excavations are complete. The electrical substation located within the boundaries of Area 5 will also be excavated as part of Area 10.

As presented on Figure 1-3, the Former Production Area is divided into four general remediation areas (i.e., A3, A4A, A4B, and A5) according to the D&D sequence. Remediation areas in the production area will be designed and remediated in sequence from northeast toward southwest to prevent

recontamination of remediated areas. Each remediation area may be further divided into phases and/or sectors that will be remediated in sequential construction seasons. The exact boundaries between remediation areas, phases/sectors, and any specific deep excavation sites will be finalized in the area-specific IRDPs. These detailed boundaries will be delineated to simplify potential dewatering needs and to prevent recontamination of an excavated area by inflow of perched water from adjacent unexcavated areas. Additional detail on each remediation area and the excavation sequence is provided in Appendix B (Sitewide Sequencing Plan).

## 1.3 FACTORS DRIVING REMEDIATION

Three primary factors are driving remediation at the FEMP and dictating its direction:

- Regulatory drivers
- The components of selected remedies identified in the RODs for each operable unit
- Final land use plans, which will be described in the Natural Resource Restoration Plan (NRRP) (Section 1.4.2).

The following paragraphs of this subsection summarize the issues associated with each of these factors that affect remediation.

### 1.3.1 Regulatory Drivers

Several regulatory criteria and legal obligations provide the basis for remediation activities at the FEMP. These include:

- ARARs and To Be Considered criteria (TBCs)
- Permits
- Agreements
- Natural Resources Trusteeship.

The following paragraphs summarize the requirements of each of these.

#### 1.3.1.1 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

The ARARs and TBCs pertinent to the excavation of soil and at- and below-grade debris are included in Appendix A. ARARs and TBCs from the Operable Units 2 and 5 RODs will be used as the basis for conducting soil remediation within Operable Unit 5 and beneath Operable Units 1, 2, 3, and 4;

those from the Operable Unit 3 ROD will be used as the basis for conducting excavation of at- and below-grade structures and debris.

Area-specific IRDPs (Section 7.2) will identify the subset of ARARs and TBCs that are pertinent to each remediation area. Implementation of soil remediation will comply with these ARARs. Procedures are provided in Section 2.1 for addressing the significant ARARs and TBCs at the FEMP.

1.3.1.2 Permits

The remedial actions to be performed at the FEMP are regulated under CERCLA. Section 121(e)(1) of CERCLA states that no federal, state, or local permit shall be required for the portion of any removal or remedial response action conducted entirely on site, where such response action is selected and carried out in compliance with Section 121. Although on-site response actions are exempt from the administrative requirements associated with a permit (e.g., administrative reviews, reporting and record-keeping requirements, etc.), such actions are not exempt from the substantive requirements that would have been imposed by each permit.

To determine if a permit is required for a remedial action, an evaluation must be made as to whether the action is conducted entirely on site, as stated in Section 121(e)(1) of CERCLA. Discussions with the EPA and OEPA have established a consensual strategy for permitting activities at the FEMP (Craig 1995). This consensual strategy determined that air releases, fill/dredging of wetlands, excavation of soil and associated debris, and remediation management (through either disposal in the OSDF or transportation for off-site disposal) are considered on-site activities and are not subject to the administrative requirements of a permit. It was decided that wastewater and storm water discharges to the Great Miami River and Paddys Run are considered off-site activities and are subject to both the administrative and substantive requirements of the National Pollutant Discharge Elimination System (NPDES) Permit for the FEMP.

The Amended Consent Agreement (EPA 1991) for the FEMP requires that the compliance strategy for addressing the substantive requirements of permits, as well as other ARARs, be initiated at the start of remedial action. The Amended Consent Agreement requires the following specific information:

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- Identification of each permit that would have been required in the absence of the CERCLA 121(e)(1) permitting exemption
- Identification of the standards, requirements, criteria, or limitations that would normally have to be met to obtain the permits
- Explanation of how the remedial action will meet the substantive requirements, criteria, or limitations identified above.

The Amended Consent Agreement further states that a permitting plan containing the above items should be submitted as a design deliverable. However, to address these requirements, DOE provided a letter to EPA and OEPA on June 12, 1995, which described the FEMP's strategy for compliance with substantive permit-related regulatory requirements for remedial actions at the site (Craig 1995). EPA and OEPA concurred with the strategy DOE outlined in the letter and agreed to the development of a compliance cross-reference (including substantive permitting requirements) as a substitute for a formal permitting plan. These compliance cross-references are to be supplied along with the ARARs in the remedial design submittals. Approval of the design documents by EPA and OEPA will constitute approval that the compliance strategy meets the intentions of the Amended Consent Agreement and fulfills the FEMP's obligation to address ARARs and TBCs in the remedial design process.

1.3.1.3 Agreements

In addition to the pertinent ARARs and TBCs, there are other legal agreements between DOE, EPA, and OEPA. These agreements, as discussed below, introduce additional requirements for soil remediation.

The Consent Agreement for the FEMP was originally signed in 1990 (EPA 1990b) and was amended in 1991 (EPA 1991). In addition to defining the schedule and documentation for remedial design and remedial action, the consent agreement also requires that a five-year review process be initiated, in accordance with Section 121 of CERCLA. The first five-year review will be conducted in the third quarter of fiscal year 2002, which is five years from the initiation of remedial action in Area 1 Phase I. Subsequent reviews by EPA will occur in at least five-year increments to ensure that human health and the environment are being protected by the remedial actions being implemented.

The Amended Consent Agreement requires that certain project plans be included in the remedial design or remedial action work plan. Table 1-3 outlines these requirements and identifies where the requested information will be documented.

On June 4, 1996, the OEPA and DOE agreed to an OEPA Director's Findings and Orders (DF&O) regarding Resource Conservation and Recovery Act (RCRA)/CERCLA Integrated Closure (OEPA 1996). This agreement covered requirements for closure of HWMUs at the FEMP that had not already been closed under RCRA. The DF&O allows closure to be deferred until CERCLA remediation for HWMUs, and allows RCRA closure performance standards for these HWMUs to be addressed as part of CERCLA remediation and documentation. Several active and inactive HWMUs were deferred to the D&D process under CERCLA because they cannot be reasonably removed/closed independent of the D&D process. Other inactive HWMUs were deferred to closure under CERCLA because of their potential for soil contamination due to a release of hazardous waste. Many units that will be closed under the D&D process also have the potential for soil contamination. Section 2.1.1.1 discusses the HWMU closure process under CERCLA in greater detail.

1.3.1.4 Natural Resources Trusteeship

Two mechanisms drive protection of natural resources during remediation. These include the Natural Resource Trusteeship process and compliance with pertinent federal and state regulations. Both of these mechanisms will be incorporated into Operable Unit 5 soil remediation planning and implementation.

CERCLA, Executive Order 12580, and the National Contingency Plan collectively require certain federal and state officials to act on behalf of the public as trustees for natural resources. The Natural Resource Trustees for the Fernald site are the Secretary of the DOE, the Secretary of the U.S. Department of the Interior, and officials of OEPA, appointed by the governor of Ohio.

Aspects of natural resource management and monitoring are mandated through the incorporation of National Environmental Policy Act (NEPA) values into remedial action planning. In June 1994, a revised secretarial policy on NEPA compliance was issued by DOE. This policy called for the integration of NEPA values into the CERCLA decision-making process. Therefore, values such as the protection of threatened and endangered species and cultural resources are to be considered throughout



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remedial activities to be consistent with the Operable Unit 5 ARARs, the Amended Consent Agreement, and agreements made with EPA, OEPA, and Natural Resource Trustees.

The Trustees act as guardians for natural resources at or near the Fernald site. The Trustees are responsible for determining whether natural resources have been injured as a result of a release of a hazardous substance or oil from the site and, if so, how to restore, replace, or acquire the equivalent natural resources to compensate for the injury. DOE is responsible for costs related to natural resource injury, in addition to costs associated with remediation of the site. The Fernald Natural Resource Trustees are responsible for resolving the FEMP's compensatory restoration requirements on behalf of the public.

The Fernald Site Natural Resource Trustees Council has been meeting since June 1994 to evaluate and determine the feasibility of integrating the Trustees' concerns with future remedial design activities. The Trustees have identified their desire to fulfill their obligations by integrating their concerns with remedial design and restoration activities.

### 1.3.2 Components of the Sitewide Selected Remedy

Project implementation under the SCEP will be conducted through specific remediation activities as they relate to affected media (soil and sediment, debris, waste, perched water, storm water, and wastewater). Measures will be taken to minimize the environmental impacts of remediation for each medium. This section summarizes the 11 components of the selected remedy for soil and debris, as presented in the RODs for Operable Units 1, 2, 3, 4, and 5. Implementation will be focused to meet the FRLs specified in the Operable Units 2 and 5 RODs for soil, and the Operable Unit 3 ROD for excavation of debris. In addition, soil FRLs within Operable Unit 1 will be applied when they are more stringent. Table 1-2 identifies each remedy component and the operable unit(s) associated with each component, and cross-references the section of the SEP (or other relevant documentation) that discusses the component.

#### 1.3.2.1 Soil and Sediment

Soil and sediment exceeding WAC for the OSDF, including material from the seven areas described in Section 1.3.2.7 that exhibits the hazardous waste toxicity characteristic (40 CFR 261), will be excavated and dispositioned according to one of the following methods: 1) transported to an off-site

disposal facility for treatment and disposal, as required to meet WAC for the off-site facility; 2) treated on site, as required to meet WAC for the off-site facility, and transported off site for disposal; or 3) treated on site for organic and/or inorganic contaminants, as required to meet the WAC for the OSDF, and dispositioned in the OSDF. However, method 3 is not an option for toxicity characteristic hazardous soil from the South Field Firing Range. This soil was specifically excluded for disposal into the OSDF by the Operable Unit 2 ROD. Additionally, as stated in the Operable Unit 5 ROD, on-site treatment/disposal will not be considered for soil that exceeds radiological WAC for the OSDF. Off-site disposal will be conducted in accordance with the terms of the Amended Consent Agreement (EPA 1991) and EPA's Off-Site Rule.

Following removal of material exceeding the OSDF WAC, soil and sediment exceeding FRLs will be excavated and placed in the OSDF. Table 1-4 presents the WAC for the OSDF and FRLs for soil and sediment at the FEMP. Figure 1-4 provides a planning-level estimate of the projected footprint of soil and sediment requiring excavation as part of the remedy for Operable Unit 5. Details regarding the completion of WAC- and FRL-driven excavation activities are included in Sections 3.0 and 4.0.

Remediation of soil and sediment will require deep excavations (i.e., greater than 6 feet) in the Former Production Area. Where deep excavations are planned, the preferred excavation approach will be to construct multiple benches in the side slope. When access to an area is limited and the development of benches is not possible, driven vertical barriers (e.g., sheet pilings) or other means of maintaining the open excavation will be used. Additional discussion of deep excavations is provided in Sections 3.1.3 and 4.4, while scanning and sampling of the excavations are discussed in Section 2.4.2.

Appropriate mitigative measures will be used during excavation activities to minimize the resuspension of dust particles (Section 5.0). Worker health and safety monitoring will be provided during excavation activities as part of the health and safety program described in Section 6.0.

Some facilities at the FEMP, including the AWWT facility, service roads, and other long-term remedial action facilities (e.g., silos and groundwater restoration facilities), will not be decommissioned before the OSDF is closed. The remediation of soil beneath these facilities will be included in an IRDP that addresses long-term remedial actions.

1.3.2.2 Perched Water

Perched water zones in the Former Production Area and the STP that present an "unacceptable" threat to the underlying aquifer will be extracted and/or excavated with contaminated soil. An unacceptable threat is defined as one having a cross-media impact to the underlying Great Miami Aquifer that would produce concentrations of contaminants in groundwater exceeding the FRL. In this area, perched water will be removed during the dewatering operation necessary for deep excavation and during excavation of contaminated soil and soil necessary for foundation removal. When necessary for deep excavations, a sump with a cut-off drainage ditch will be installed along the toe of the side slope tied to the appropriate bench level. The collection of perched water and rain water at each bench perimeter ditch will reduce the amount of water in the bottom of the excavation. This approach to controlling perched water will reduce the potential impact to the Great Miami Aquifer during deep excavations. Perched water extracted from the Former Production Area that contains organic contamination will require treatment at the AWWT facility before it can be discharged to the Great Miami River.

Perched water zones that can be excavated with the contaminated soil will be represented on diagrams submitted with area-specific IRDPs (Section 7.2). Additional details regarding perched water control are provided in Section 2.5.4.

1.3.2.3 Storm Water/Wastewater

The FEMP maintains a storm water collection system that includes conveyance systems and retention basins. This system is designed for a 10-year, 24-hour storm event. This system can prevent most storm water from entering the Storm Sewer Outfall Ditch and Paddys Run. As remediation of the site progresses, the storm water collection system will be decommissioned in stages to ensure continued storm water collection from the portions of the site not yet remediated. Run-on and run-off controls are addressed in Section 5.0 and Appendix F, and storm water collection systems are included with the Sitewide Sequencing Plan (Appendix B).

Sanitary and process wastewater continues to be generated at the FEMP because of the occupancy of the site by the work force and ongoing cleanup activities, such as building decontamination. Additionally, process wastewater is expected to be generated as a consequence of the implementation of remedial actions for all operable units. The FEMP will continue to collect and direct this wastewater for treatment, as necessary, as part of the selected remedy.

For the deep excavations anticipated in the Former Production Area, dewatering is likely to be required after large storm events. This water will be treated, as necessary, through the AWWT facility prior to discharge.

1.3.2.4 Remediation Debris

Debris is expected to be generated throughout remediation by the Facilities D&D Project (above-grade) and SCEP (at- and below-grade). Initial planning has identified that debris will be generated from D&D of the STP, FTF, structures in the Former Production Area, Operable Unit 5 groundwater extraction system, service roads, and AWWT facility. Additionally, any PPE or spill material generated during remediation activities will be managed and dispositioned as discussed in Section 3.3.1 and Appendix F. The Operable Unit 3 ROD has identified specific debris from the Former Production Area that is designated for off-site disposal. This includes acid brick, because of potentially elevated concentrations of several RCRA constituents, and several areas of surface concrete containing elevated levels of technetium-99. Excavation, management, and disposal of at- and below-grade debris from the site are addressed in Sections 2.5.8, 3.3.2, and 3.6.4.

1.3.2.5 Waste from Operable Unit 2 Subunits

The Operable Unit 2 subunits (Solid Waste Landfill, Lime Sludge Ponds, Inactive Flyash Pile, South Field, and Active Flyash Pile) will be remediated as described in the "Remedial Design Work Plan for Remedial Actions at Operable Unit 2" (DOE 1995a). Sampling and analysis will be performed in the excavated area to confirm removal of material with contamination above the FRLs established in Table 1-4. If the results of the certification sampling and analysis indicate that contamination above FRLs remains, then additional excavation will be performed. All waste material that meets the on-site WAC will then be transported to the OSDF for final disposition. Material exceeding the on-site WAC will be transported off-site for disposal. Excavation, management, and disposal of these wastes are addressed in Sections 2.1.2, 2.5.8, 3.3.2, and 3.6.4.

1.3.2.6 Corrective Action Management Unit Rule

The Corrective Action Management Unit (CAMU) and Temporary Unit Final Rule (58 CFR 865829) was promulgated to meet the objectives of a cleanup program under RCRA, as amended. Management of remediation (and investigation) waste within a CAMU is not subject to the strict land disposal restrictions and minimum technology requirements contained in Subtitle C of RCRA.



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The CAMU rule permits the on-property disposal of both RCRA listed and characteristic waste provided a protective, implementable remedy is identified through the following three decision steps, cited in 40 CFR 264.552.

1. The remedy must be protective of human health and the environment.

2. The remedy must minimize the potential for future release.

3. The remedy must enhance long-term effectiveness through the application, as appropriate, of treatment technologies that reduce toxicity, mobility or volume of wastes that will remain in place following closure of the CAMU.

The Operable Units 2, 3, and 5 RODs acknowledged that EPA's CAMU rule is an ARAR for the FEMP's on-property disposal remedy that provides the regulatory framework for determining the treatment and on-property disposal requirements for RCRA-regulated constituents in the materials destined for on-property disposal. While only limited portions of the FEMP site are intended for long-term waste management and disposal (i.e., the OSDF), the entire FEMP property is designated a CAMU under the Operable Unit 5 ROD. Consolidation or management of on-site remediation wastes into or within the CAMU will not constitute creation of a unit subject to minimum technology requirements and will not invoke land disposal restrictions. Additionally, the TU concept may be used during remedy implementation to further facilitate the remediation process. Temporary units, such as tanks and container storage areas, may be used for short-term management of wastes generated during remediation. Alternative requirements which are protective of human health and the environment may be used in lieu of the design, operating or closure requirements that would otherwise apply to such units under RCRA.

RCRA characteristic soils identified and excavated to meet the OU2 and OU5 ROD requirements will be containerized and placed on an approved RCRA storage facility (Plant 1 Pad). The RCRA characteristic soils will not be placed in stockpiles designated for above-WAC materials. The need for a new temporary RCRA storage facility will be evaluated as part of the Area 3 remedial design process to replace the Plant 1 Pad after its removal. The new temporary RCRA storage facility may be designed for bulk storage of RCRA characteristic soils if the volume of the waste exceeds available storage capacity using containers.

1.3.2.7 RCRA Characteristic Waste Disposal

Based on a review of the FEMP's site characterization data and historical process knowledge, DOE, EPA, and OEPA collectively agreed that several of the FEMP's potentially identified RCRA toxicity-characteristic waste streams may be suitable for additional cost-effective treatment prior to on-property disposal. These waste streams and their geographic areas were designated in the RODs as:

- The estimated several hundred cubic yards of lead-contaminated soil located at the FEMP's firing range (Figure 1-5). (Under the terms of the Operable Unit 2 ROD, this material is designated for off-site disposal.)
- RCRA toxicity characteristic soil from six geographic areas within Operable Unit 5 (Figure 1-5): the abandoned sump west of the pilot plant; the area between the KC-2 warehouse and railroad tracks; the FEMP's trap range; the fill material west of the silos along Paddys Run stream bank; the scrap metal pile area; and the area north of the maintenance building.
- Operable Unit 3 lead sheeting (formed as flashing, window sills, and door moldings) and acid brick. In accordance with the Operable Unit 3 ROD, the acid brick will be sent off site for disposal because of possible technetium-99 contamination.

As stated in the Operable Unit 5 ROD, DOE, EPA, and OEPA agree that sufficient existing data and historical process knowledge are available to identify the boundaries of the above geographic areas as those that represent a reasonable opportunity for cost-effective soil treatment. Outside of these geographic areas, DOE, EPA, and OEPA all concur that there is no reasonable basis to conclude that the presence of RCRA toxicity characteristic waste exists to an extent that would allow additional opportunity for cost-effective soil treatment. Therefore, outside the boundaries of the designated geographic areas, no additional analytical data will be required to screen for the presence of toxicity characteristic waste before placement in the OSDF. Only the site-specific WAC developed for the OSDF, as listed in Table 1-4, will be applied to excavated soil outside the six areas identified in the Operable Unit 5 ROD. The Operable Unit 5 ROD states that the EPA's toxicity characteristic leaching procedure is the mechanism to guide the identification of soil requiring treatment within the boundaries of the designated geographic areas.

Viable technologies for treating the FEMP's RCRA toxicity characteristic soil were specified in the Operable Unit 5 ROD. The technologies cited include EPA-approved stabilization technologies (for inorganic constituents) and low temperature thermal desorption techniques (for organic

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constituents). Stabilization technologies are also contemplated for treatment of the Operable Unit 3 RCRA toxicity characteristic waste streams prior to their disposal. The decision to treat the FEMP's RCRA toxicity characteristic materials on site (and dispose of them in the OSDF) versus sending them off site for treatment and disposal will be a case-by-case, cost/benefit decision that will be made as part of the detailed remedial design processes for both soil and debris. These decisions will be communicated in the IRDPs for soil and at-and below-grade structures and in the D&D Implementation Plans for debris.

The FEMP is committed to identifying, segregating, and treating, as needed, the contaminated soil from within the six designated geographic areas (i.e., Operable Unit 5 areas in Figure 1-5) that exhibits the RCRA toxicity characteristic, as well as the lead sheeting and acid brick from the Operable Unit 3 D&D waste stream. Lead shot and associated soil from the Operable Unit 2 firing range that exhibits the toxicity characteristic will be dispositioned off site. This commitment satisfies the requirements of the Operable Units 2, 3, and 5 RODs regarding the disposal of RCRA toxicity characteristic waste in the OSDF.

Figure 1-6 summarizes the treatment and disposition requirements for RCRA toxicity characteristic waste to be identified and segregated from the six Operable Unit 5 areas. Decisions regarding on-site versus off-site treatment for the toxicity characteristic waste from these areas will be made during the area-specific design process when considering the availability of any on-site treatment facility and the results of cost-benefit evaluation. When treatment of the toxicity characteristic waste for on-site disposal is the preferred remedial option, the temporary unit concept will be used to facilitate the construction/permitting process for the on-site treatment facility. The characterization, treatment, and disposition of soil from these areas are described in greater detail in Section 2.1.1.3.

1.3.2.8 Measures to Minimize Environmental Impacts

DOE has factored environmental impacts into the plans for excavation. Measures to minimize environmental impacts to on-property natural resources (e.g., wildlife and wildlife habitat, wetlands, floodplains, surface water, groundwater) have been identified in the Operable Unit 5 Feasibility Study Report and Proposed Plan (DOE 1995b, 1995c). Impacts to on-property vegetation and wildlife habitat will result from the removal and movement of contaminated soil and sediment and from construction of support facilities. Measures taken to minimize impact are discussed in Sections 3.0

and 5.0 but will ultimately be decided on a project- and/or area-specific basis and addressed in the IRDPs.

1.3.2.9 Sitewide Environmental Monitoring

Sitewide environmental monitoring of air, sediment, surface water, and groundwater will be conducted during all sitewide remedial actions. Monitoring will be designed to detect and quantify releases from the site attributable to the implementation of all the remedial actions at the FEMP. Monitoring will also be conducted following the completion of remedial actions to assess the continued performance of the remedy. Sitewide environmental monitoring activities will be implemented by the sitewide monitoring program discussed in the Integrated Environmental Monitoring Plan (IEMP). Section 1.4.2 contains a summary of this plan and other parallel programs that tie in with the SEP. The IEMP describes the sitewide monitoring strategy and will be revised every two years (DOE 1997a). SCEP project-specific monitoring activities will supplement the site-wide environmental monitoring program and are discussed in greater detail in Section 5.0.

1.3.2.10 Institutional Controls/Monitoring

One element of the selected remedy that will be used to ensure protectiveness of human health and the environment is institutional controls. Institutional controls were identified as requirements in each of the operable unit RODs and include continued access controls at the site during the remediation period, continued federal ownership of the FEMP property including the OSDF and necessary buffer zones, and deed restrictions to preclude residential and agricultural uses of the remaining regions of the FEMP property. Additionally, proper notifications, as mandated by CERCLA, will be provided before the transfer of any federal property that is known to contain or has been used in the processing of hazardous substances. These measures will minimize the potential for human exposure to soil and groundwater contamination. These measures will also minimize exposure to the contaminated material contained in the OSDF following completion of remedial activities at the site (DOE 1997b). Specific institutional control measures to be implemented at the site will be established in the NRRP (Section 1.4.2).

1.3.2.11 Community Involvement

The DOE and EPA are committed to continuing the active community involvement program at the FEMP throughout the duration of remedial activities and post-remediation monitoring at the site. This program will include public meetings, public comment periods (as needed), newsletters, tours, and small focused group sessions assessing specific cleanup issues.

The Community Relations Plan (CRP) for DOE-Fernald (DOE 1995d) was revised in September/ October 1994 and approved by OEPA in December 1994 and by the EPA in January 1995. The CRP complies with the public participation requirements of all applicable laws and regulations, including CERCLA, Federal Facilities Compliance Act (FFCA), NEPA, and the National Contingency Plan (NCP), and also reflects EPA guidance in Community Relations in Superfund: A Handbook (EPA 1992a). Throughout the duration of FEMP remediation activities, the CRP may be revised to reflect changing community concerns, as well as changes in the law, regulations, or regulatory agreements.

The CRP describes how FEMP management will involve the public in decisions related to the site during the remedial action phase of CERCLA. Required activities are as follows:

Required Public Involvement Activities During Remedial Design

Upon completion of the final engineering design, prepare a fact sheet describing the remedial design (NCP 300.435).

Required Public Involvement Activities During Remedial Action

- Provide a public briefing upon completion of the engineering design and prior to the beginning of the remedial action (NCP 300.435).
- Publish in a local newspaper of general distribution a Notice of Availability of documents submitted to the EPA under the remedial action (DOE commitment/directive).

The DOE has surpassed regulatory requirements in offering public involvement opportunities at the FEMP and will continue to do so throughout the remedial action phase of site cleanup.

### 1.3.3 Final Land Use

The NRRP identifies the natural resource restoration strategy for the site and will serve as the final land use plan. The final land use currently planned for the FEMP is an undeveloped park. Therefore, it is not expected that extensive backfilling or regrading will be required following remediation activities. Some small, localized deep excavations will be backfilled and regraded to provide proper drainage or support to permanent facilities such as the OSDF. The current strategy is to leave larger areas where deep excavation is necessary as ponds (i.e., in the Former Production Area) or as a bench along Paddys Run (i.e., in the Silo, Waste Pit, and South Field areas). In addition, vegetation will be established on the remaining earthen areas of the site.

## 1.4 ORGANIZATION OF THE SITEWIDE EXCAVATION PLAN

This subsection describes the remaining contents of the SEP and other documents related to the SEP.

### 1.4.1 Contents of the Sitewide Excavation Plan

The remainder of the SEP consists of the following sections:

- **Section 2.0, Remediation Issues and General Strategies,** which presents the major programmatic issues that affect remediation activities (e.g., WAC attainment and certification requirements) and discusses the general approaches to address them.
- **Section 3.0, General Implementation Approach,** which discusses the steps for implementing remediation and describes how the issues in Section 2.0 will be addressed.
- **Section 4.0, Location-Specific Approaches,** which describes the location-specific guidelines for addressing excavation in the ten remediation areas.
- **Section 5.0, Environmental Controls and Monitoring,** which discusses the management strategy for implementing project-specific procedures to control and monitor environmental conditions during remediation of impacted soils.
- **Section 6.0, Project Health and Safety,** which discusses the health and safety requirements and procedures to meet these requirements on remediation projects.
- **Section 7.0, Soil Remediation Documents,** which discusses the general purpose and content of the PSPs, IRDPs, CDLs, and Certification Report. Three other documents required to complete the sitewide soil remediation and restoration are also described (Remedial Action Report, NRRP, and Site Closeout Report).

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Additional information used to support the materials in the SEP is included in the following appendices:

- **Appendix A, Soil Remediation ARARs and TBCs.** The regulatory requirements applicable to the SCEP, both ARARs and TBCs, are presented in this appendix in table form, with a crosswalk provided to the sections of the SEP where the requirements are met.

- **Appendix B, Sitewide Sequencing Plan.** This appendix presents the sequence of excavation activities for the major areas of the FEMP.

- **Appendix C, Selection of Ecological Constituents of Concern.** This appendix summarizes the results of the evaluation of ecological impacts presented in the Operable Unit 5 RI. It identifies the COCs that may have an adverse impact on ecological receptors if they are not monitored. In addition, the appendix evaluates potential constituents of ecological concern for source areas not considered in the Sitewide Ecological Risk Assessment (DOE 1995e).

- **Appendix D, Wood Sampling Program.** This appendix presents the results of the on-site tree tissue sampling program to support plans to manage plant material.

- **Appendix E, SEP Quality Assurance Job Specific Plan.** This appendix discusses those elements of the FEMP Quality Assurance Plan which are applicable to implementation of the SEP and contains the additional criteria needed to ensure that remediation subcontractors perform excavation activities properly.

- **Appendix F, Implementation of Construction.** This appendix presents the details of activities that will take place as part of the actual implementation of remediation tasks and the management of materials removed during excavation.

- **Appendix G, Certification Design Rationale.** This appendix presents the statistical background for determining the number of samples required in each certification unit to demonstrate compliance with FRLs.

- **Appendix H, Summary of Field Measurement and Laboratory Analytical Technologies.** This appendix presents available and commonly used field measurement and laboratory technologies to support selection decisions for specific applications at the FEMP during soil remediation.

- **Appendix I, Sitewide Extent of Contamination by Constituent.** This appendix includes maps which provide the basis for selection of area-specific constituents of concern.

### 1.4.2 Related Documents

The SEP is intended to provide overall guidance for excavation activities and will be applied throughout the remediation process. The SEP documents an approach to sitewide excavation to be agreed upon by DOE and the regulatory agencies. Area-specific requirements and conditions will be addressed in the IRDPs, and may vary slightly from those presented in the SEP based on new data or information. Some of the reference documents for the development of the SEP have already been submitted, are being submitted concurrently with it, or will be submitted at a later date. Changes to these documents or to sitewide strategies may necessitate changes to the SEP, and the subsequent submittal of changes pages to keep the SEP current with site documents and strategies. These documents and their relationship to the SEP are as follows:

Existing or In Preparation

- **Impacted Materials Placement Plan (IMPP) (DOE 1998a).** Describes the impacted materials acceptance, placement, compaction, and quality assurance/quality control activities associated with construction, waste placement, and closure of the OSDF.

- **WAC Attainment Plan for the On-Site Disposal Facility (DOE 1998b).** Provides the sitewide strategy for demonstrating OSDF WAC attainment and detail regarding material-type-specific requirements in one centralized document. For soil and at- and below-grade structure and debris, the WAC Attainment Plan provides the WAC attainment approaches summarized in the SEP.

- **Remedial Action Work Plan (the IRDP) for Area 1, Phase I (DOE 1996b).** Describes the implementation plan for remediation in the northernmost area of the OSDF. This document was submitted in December 1996 to allow construction of the OSDF to proceed on schedule. Because it was submitted prior to approval of the SEP, many of the concepts and procedures contained in it may be repeated in the SEP.

- **Certification Report for Area 1, Phase I (DOE 1997c).** Demonstrates that FRLs in Area 1, Phase I, have been attained. Area 1, Phase I was completed prior to development of the SEP.

- **Site Preparation Package for Area 2, Phase I (DOE 1997d).** Details site preparation activities to be completed in Area 2, Phase I, prior to excavation work.

- **Technology Reports.** Four separate project reports describing the potential application of physical separation to reduce soil volumes, vacuum extrusion/compaction of soil, phosphate soil stabilization, and geochemical barrier placement amendment, and recommending their application during remediation were submitted to EPA and OEPA on May 24, 1996. Additional technology reports on in situ gamma spectroscopy and

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their addendums (DOE 1997e; 1997f) were submitted to EPA to demonstrate the capabilities of high-purity germanium (HPGe) and sodium iodide detector technologies. During remediation, additional technology reports to support area-specific and/or sitewide treatment and disposition decisions may be needed.

- **Integrated Environmental Monitoring Program (IEMP) (DOE 1997a).** Provides the central mechanism for ongoing groundwater, surface water, and air monitoring and reporting activities at the FEMP.

- **Storm Water Pollution Prevention Plan (DOE 1996c).** Identifies potential sources of storm water pollution and describes the practices that will be employed to control these, including engineering, construction, and inspection procedures (Section 5.0). NPDES permit requirements are also addressed.

- **Aquifer Restoration and Wastewater Treatment Project Operation and Maintenance Plan (DOE 1997g).** Specifies the capacity (hydraulic, chemical, and biological) of the AWWT, prioritizes streams for treatment (including remediation-related streams), and provides waste acceptance criteria for those streams. This plan was approved by the EPA in November 1997.

To Be Prepared for Each Remediation Area (Figure 1-1)

- **Project-Specific Plans (PSPs).** Project-specific plans will be prepared for each remediation area to collect the needed information and analytical data to support IRDP development and certification activities. The content of PSPs is discussed in Section 7.1.

- **Integrated Remedial Design Packages (IRDPs).** An IRDP will be prepared for each remediation area. Each IRDP will provide area-specific information and detail that is not fully addressed in the SEP. The IRDP will present important results of all the predesign investigation, including the estimated extents of excavation and certification information necessary for borrow material to be used during the construction. Each IRDP will include an area-specific implementation plan, design drawings, and specifications. The content of the IRDPs is discussed in greater detail in Section 7.2.

- **Natural Resource Restoration Design Package (NRRDP).** The area or zone-specific NRRDP will include the implementation plan for final restoration, design drawings, and specifications for remediated areas.

- **Certification Design Letters (CDLs).** Subsequent to completion of remediation and precertification survey activities (Section 3.0) in each area, in accordance with the IRDP, a Certification Design Letter will be issued. This letter will detail the certification survey design, including certification unit boundaries, number of samples to be collected and analyzed, and the analyses to be performed on each sample. This letter may become part of the complete Certification Report (Section 7.3).

- **Certification Reports.** Following completion of certification activities in each area, a Certification Report will be issued (Section 7.4). This report may incorporate the Certification Design Letter and demonstrate FRL attainment. In addition, the report will detail, as applicable, closure of HWMUs and USTs. The Certification Report will also include a section summarizing the WAC attainment procedures. Information will be provided to demonstrate that all material exceeding the WAC for the OSDF in each area has been removed, staged for shipment to an off-site disposal facility, or disposed of in an off-site facility, rather than placed in the OSDF. This section will be prepared in accordance with the requirements specified in the WAC Attainment Plan.

Operable-Unit-Specific Documents To Be Prepared (see Figure 1-2)

- **Remedial Action Reports (RARs).** A Remedial Action Report is required for each operable unit after the operable unit specific remedy is completed. The report will summarize all the remedial actions conducted for the operable unit and describe the residual conditions, using information generated and submitted during remediation. Remediation of the Operable Unit 2 waste units, Operable Unit 5 soil, and Operable Unit 3 at- and below-grade debris will be covered under a single RAR.

Sitewide Documents To Be Prepared (see Figure 1-2)

- **Natural Resource Restoration Plan (NRRP).** The NRRP documents the natural resource restoration strategy to be employed at the site and describes the institutional controls necessary to implement restoration goals under the site's selected remedy. This document also serves as the final land use plan for the site. This plan also summarizes the anticipated final contours for the FEMP, generally based on future land use as an undeveloped park.

- **Site Closeout Report (SCR).** A Site Closeout Report will be prepared for the site after all the operable unit-specific remedies are completed. The report will summarize all the remedial actions conducted for the FEMP and will describe the residual conditions, using information provided in the individual Remedial Action Reports.

## 1.5 SCHEDULE FOR AGENCY SUBMITTALS

The schedule shown in Table 1-5 was established in the Operable Unit 5 Remedial Design Work Plan (DOE 1996a) for formal submittal of remedial design documents. Parts of the original schedule have been modified to reflect the sequencing of remediation areas described in Appendix B. In Area 1 Phase III, Area 2 Phase III, Area 8 and Area 9, no excavation is anticipated and the first document delivered to EPA will be the CDL. The schedule for the IRDPs for Areas 3, 4, 5, and 6 have been reset to provide time to remove materials and hazardous waste from the Plant 1 Pad (Area 3), and to be consistent with the D&D schedule proposed for the Former Production Area (Areas 4, 5, and 6). The



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Area 7 IRDP has been rescheduled to allow a reevaluation of treatment alternatives for materials in the silos. Corridors and roadways (Area 10) were not specifically scheduled for an IRDP submittal in the Operable Unit 5 RD Work Plan; this IRDP submittal date is now scheduled for March 2007. Submittal dates for CDLs will be posted in the IRDPs, unless otherwise noted in Table 1-5.

**TABLE 1-1**
**FEMP OPERABLE UNIT REMEDIES AND ASSOCIATED PROJECT RESPONSIBILITIES [a]**

| OU Description | Remedy Overview [b] | Project Organization/Responsibilities | Planning Documents |
|---|---|---|---|
| Operable Unit 1<br><br>Waste pits 1 - 6<br><br>Clearwell<br><br>Burn pit<br><br>Berms, liners, caps and soil within the operable unit boundary | ROD Approved: March 1995<br><br>Excavation of materials within the waste pits, caps, liners, and surrounding contaminated soils; off-site transportation for disposal at the permitted commercial disposal facility, or disposal at NTS if the waste fails to meet the PCDF WAC; the disposition of contaminated soils; and the D&D of the remediation facility<br><br>Waste processing and treatment by thermal drying (as necessary)<br><br>Off-site disposal of waste materials at a permitted facility<br><br>Restoration | Primary Project:<br><br>Waste Pits Remedial Action Project (WPRAP) is responsible for rail upgrade, excavation of Operable Unit 1 waste units, waste processing and drying, loading, rail transport, and off-site disposal of contaminated soil and debris that exceed the waste acceptance criteria for the On-Site Disposal Facility. (Note: This project will be performed by the WPRAP, SCEP and the ARASA subcontractor.)<br><br>Related Projects:<br><br>Soil Characterization and Excavation Project is responsible for sampling, excavation, and disposition of impacted soil beneath the rail construction area and the waste pits, as well as at- and below-grade remediation facilities, including the railroad. Soil excavation will be coordinated by SCEP and the ARASA subcontractor.<br><br>AWWT and Wastewater Project is responsible for treating contaminated runoff and perched water collected during waste pit excavation; each project is responsible for containing and transporting remediation wastewater to the AWWT facility for treatment.<br><br>Facilities D&D Project is responsible for D&D of all above-grade Operable Unit 1 remediation facilities. | Operable Unit 1 RA Work Plan<br><br>SEP and Area 6 IRDP for underlying soil excavation and certification<br><br>IEMP for sitewide environmental monitoring<br><br>A D&D Implementation Plan will be developed for above-grade facilities within Operable Unit 1. |

**TABLE 1-1 (Continued)**

| OU Description | Remedy Overview [b] | Project Organization/Responsibilities | Planning Documents |
|---|---|---|---|
| Operable Unit 2<br><br>Solid waste landfill<br><br>Inactive flyash pile<br><br>Active flyash pile (now inactive)<br><br>North and south lime sludge ponds<br><br>Other South Field disposal areas<br><br>Berms, liners and soil within the operable unit boundary | ROD Approved: May 1995<br><br>Excavation of all materials with COCs above FRLs<br><br>Treatment for size reduction and moisture control as required<br><br>Establishment of on-site WAC<br><br>OSDF construction<br><br>WAC attainment certification<br><br>FRL certification<br><br>Collection and treatment of Operable Unit 2 subunit and OSDF construction water<br><br>On-site disposal in the OSDF<br><br>Off-site disposal of a small fraction of excavated material that exceeds the WAC for the OSDF and lead-contaminated soil from the South Field Firing Range.<br><br>Restoration | Primary Project:<br><br>Soil Characterization and Excavation Project is responsible for excavation and disposition of waste from all Operable Unit 2 subunits.<br><br>Related Projects:<br><br>On-Site Disposal Facility Design Project is responsible for design, installation, and closure of the OSDF that will contain Operable Unit 2 subunit wastes, Operable Unit 5 soil and debris, and Operable Unit 3 debris; responsible for monitoring leachate within the OSDF and perched groundwater in the till beneath the OSDF.<br><br>AWWT and Wastewater Project is responsible for treating contaminated runoff and perched water collected during excavation of Operable Unit 2 subunit wastes; each project is responsible for containing and conveying remediation wastewater to the AWWT facility for treatment. | Operable Unit 2 Remdial Design and Remedial Action Work Plan for OSDF construction, management, and closure<br><br>SEP, Area 2, Phase I IRDP and Area 2, Phase 2 IRDP for waste unit contents removal and soil excavation and certification, respectively<br><br>IEMP for sitewide environmental monitoring |



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**TABLE 1-1 (Continued)**

| OU Description | Remedy Overview [b] | Project Organization/Responsibilities | Planning Documents |
|---|---|---|---|
| Operable Unit 3<br><br>Former Production Area and associated facilities and equipment (includes all above-, at-, and below-grade improvements) including, but not limited to:<br><br>All structures, equipment, utilities, effluent lines, K-65 transfer line<br><br>Wastewater treatment facilities<br><br>Fire training facilities<br><br>Coal pile<br><br>Scrap metal piles<br><br>Drums, tanks, solid waste, waste product, feedstocks, thorium | ROD Approved: September 1996<br><br>Adoption of Operable Unit 3 IROD<br><br>Alternatives to disposal through the unrestricted or restricted release of materials, as economically feasible for recycling, reuse, or disposal<br><br>Treatment of material for on-site or off-site disposal<br><br>Required off-site disposal for process residues, product materials, process-related metals, acid brick, concrete from specific locations, and any other material exceeding the on-site WAC<br><br>On-site disposal for material that meets the WAC<br><br>Restoration | Primary Project:<br><br>Facilities D&D Project is responsible for D&D of all above-grade buildings and facilities at the FEMP.<br><br>Related Projects:<br><br>Soil Characterization and Excavation Project is responsible for removal of at- and below-grade facilities. Responsible for certification sampling beneath excavated facilities.<br><br>AWWT and Wastewater Project is responsible for treating contaminated and other wastewater during D&D activities. Each project is responsible for containing and conveying remediation wastewater to the AWWT facility for treatment.<br><br>On-Site Disposal Facility Design Project is responsible for design, installation, and closure of the OSDF that will contain Operable Unit 3 debris, Operable Unit 2 subunit wastes, and Operable Unit 5 soil. | SEP and Areas 3, 4, and 5 IRDPs under SCEP: Removal of all Operable Unit 3 at- and below-grade structures (building foundations, roadways, underground utilities, in-ground basins within Former Production Area, Sewage Treatment Plant, and the Fire Training Facility) and WAC attainment and debris management.<br><br>Facilities D&D Project Operable Unit 3 Integrated RD/RA Work Plan for D&D of above-grade facilities and applicable Implementation Plans.<br><br>IEMP for sitewide environmental monitoring. |

**TABLE 1-1 (Continued)**

| OU Description | Remedy Overview [b] | Project Organization/Responsibilities | Planning Documents |
|---|---|---|---|
| Operable Unit 4<br><br>Silos 1 and 2 (containing K-65 residues)<br><br>Silo 3 (containing cold metal oxides)<br><br>Silo 4 (empty and never used)<br><br>Decant tank system<br><br>Berms and soil within the operable unit boundary | ROD Approved: December 1994<br><br>Removal of silo residues and decant sump tank sludges with on-site vitrification of residues and sludges followed by off-site disposal<br><br>Demolition and decontamination, to the extent possible, of silos and vitrification facilities<br><br>Excavation of contaminated soil above the FRLs with on-site disposal for contaminated soil and debris that meet the on-site WAC<br><br>Contaminated soil and debris that exceed the on-site WAC will be disposed of off-site<br><br>Restoration | Primary Project:<br><br>Silos Project is responsible for silo content removal, treatment, and transport off site.<br><br>Related Projects:<br><br>Soil Characterization and Excavation Project is responsible for certification, excavation and disposition of contaminated soil beneath the silos that exceed to on-site WAC, and for removal of subsurface structures (i.e., sub-grade silo decant system).<br><br>AWWT and Wastewater Project is responsible for treating decontamination and other wastewater during D&D activities; each project is responsible for capturing and transporting remediation wastewater to the AWWT facility for treatment.<br><br>Facilities D&D Project is responsible for D&D of all Operable Unit 4 remediation facilities. | Operable Unit 4 RD documents - planning for removal of silo contents and their transport for off-site disposal<br><br>SEP and Area 7 IRDP - planning for excavating remaining contaminated soil, attainment of FRLs, final site restoration of Operable Unit 4.<br><br>IEMP for sitewide environmental monitoring<br><br>Implementation plans for above-grade D&D |



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**TABLE 1-1 (Continued)**

| OU Description | Remedy Overview [b] | Project Organization/Responsibilities | Planning Documents |
|---|---|---|---|
| Operable Unit 5 | ROD Approved: January 1996 | Primary Projects: | SEP and all IRDPs. |
| Groundwater<br><br>Surface water and sediments<br><br>Soil not included in the definitions of Operable Units 1-4<br><br>Flora and fauna | Extraction of contaminated groundwater from the Great Miami Aquifer to meet FRLs at all affected areas of the aquifer<br><br>Treatment of contaminated groundwater, storm water, and wastewater to attain mass-based discharge limits and FRLs in the Great Miami River<br><br>Excavation of contaminated soil, rubble, and sediment to meet FRLs<br><br>Excavation of contaminated soil containing perched water that, through contaminant migration, presents an unacceptable threat to the underlying aquifer<br><br>On-site disposal of contaminated soil and sediment that meet the on-site WAC<br><br>Soil and sediment that exceed the WAC for the OSDF will be treated, where possible, to meet the on-site WAC or will be disposed of at an off-site facility<br><br>Site restoration, institutional controls, and post-remediation maintenance | Soil Characterization and Excavation Project is responsible for precertification and certification of sitewide soil; excavation and disposition of contaminated soil, sediment, impacted perched groundwater and at- and below-grade facilities; and final site restoration.<br><br>Aquifer Restoration Project is responsible for designing, installing, and operating the pumping systems for the Great Miami Aquifer groundwater restoration; responsible for groundwater monitoring in the Great Miami Aquifer, including the groundwater monitoring program for the On-Site Disposal Facility.<br><br>AWWT and Wastewater Project is responsible for designing, constructing, and operating all treated effluent discharge systems, and for treating and discharging contaminated groundwater, storm water, run-off water, and remedial action wastewater at the FEMP.<br><br>Related Projects:<br><br>Facilities D&D Project is responsible for D&D of all Operable Unit 5 remediation facilities.<br><br>On-Site Disposal Facility Design Project is responsible for design, installation, and closure of the On-Site Disposal Facility that will contain Operable Unit 3 debris, Operable Unit 2 subunit wastes, and Operable Unit 5 soil. | Groundwater Monitoring and Sitewide Environmental Monitoring: Integrated Environmental Monitoring Plan.<br><br>OU5 AWWT and ARP RAWP<br><br>OHMMP<br><br>Groundwater Monitoring and Sitewide Environmental Monitoring: Integrated Environmental Monitoring Plan. |







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## TABLE 1-1 (Continued)

Notes: [a] Source of information is from each operable unit's ROD and RD work plan.
[b] Each remedy includes institutional controls that will be managed for the site through the NRRP.

| | |
|---|---|
| AWWT | Advanced Waste Water Treatment |
| D&D | Decontamination and Dismantlement |
| IEMP | Integrated Environmental Management Project |
| IRDP | Integrated Remedial Design Project |
| NTS | Nevada Test Site |
| PCDF | Permitted Commercial Disposal Facility |
| RA | Remedial Action |
| ROD | Record of Decision |
| SEP | Sitewide Excavation Plan |
| SCEP | Soil Characterization and Project |
| WAC | Waste Acceptance Criteria |
| WPRAP | Waste Pits Remedial Action Project |

## TABLE 1-2

## CROSS-REFERENCE BETWEEN OPERABLE UNIT REMEDY COMPONENTS AND THE SITEWIDE EXCAVATION PLAN

| Remedy Component | Operable Unit | SEP Section Reference |
|---|---|---|
| Soil and Sediment | 2, 5 | 2.0, 3.0 and 4.0 |
| Perched Water Treatment | 2, 5 | 2.0, 3.0 and 4.0 |
| Regional Groundwater Aquifer | 5 | See Operable Unit 5 RD Work Plan |
| Storm Water/Wastewater | 2, 3, 5 | 2.0 and 3.0 |
| Treatment of Discharges | 2, 5 | 2.0, 3.0, and Operable Unit 5 RD Work Plan |
| Debris | 3, 5 | 2.0, 3.0, and 4.0 |
| Operable Unit 2 Subunits | 2 | 1.0 and 4.0 |
| Measures to Minimize Environmental Impacts | 1, 2, 3, 4, 5 | 1.0 and 5.0 |
| Institutional Controls/Monitoring | 2, 5 | 2.0 and 5.0 |
| Corrective Action Management Unit (CAMU) Rule | 1, 2, 3, 5 | 1.0 |
| Community Involvement | 1, 2, 3, 4, 5 | 1.0 |

RD - Remedial Design

## TABLE 1-3

## REQUIRED PROJECT PLANS [a]

| Requirement | Cross-Reference |
|---|---|
| Sampling and Analysis Plan, including quality assurance project plan(s) and field sampling plan(s) | SEP (Appendices G&H)/PSPs IRDPs/QAjSP/SCQ |
| Health and Safety/Contingency Plan | SEP (Section 2.3.8)/Project-Specific Health and Safety Plans (SEP Section 6.0) |
| Permitting Plan (ARARs) | SEP (Section 1.3.1.2)/IRDPs |
| Groundwater Monitoring Plan | IEMP |
| Operations and Maintenance Plan | SEP (Section 3.5)/IRDPs/NRRP |

Note: [a] As listed in the Amended Consent Agreement (EPA 1991).

ARARs Applicable or Relevant and Appropriate Requirments
IEMP Integrated Environmental Management Project
IRDP Integrated Remedial Design Project
NRRP Natural Resource Restoration Plan
QAjSP Quality Assurance Job Specific Plan
SCQ Sitewide CERCLA Quality Assurance Plan
SEP Sitewide Excavation Project



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TABLE 1-4

# SUMMARY OF CONTAMINANT LEVELS PERTINENT TO SOIL REMEDIATION AT THE FEMP

| Constituent | Practical Quantitation Limit[a] | Background[b] | | | Waste Acceptance Criteria for Soil and Sediment in the On-Site Disposal Facility[c] | Benchmark Toxicity Value | Final Remediation Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Operable Unit 5[d] | | | Operable Unit 2[e] | | | | | | |
| | | Surface Soil | Subsurface Soil | Sediment (Paddys Run) | | | On-Property Soil | Off-Site Soil | Sediment | Solid Waste Landfill | Lime Sludge Ponds | Inactive Flyash Pile (over GMA) | Inactive Flyash Pile (>16 ft natural soil) | South Field (over GMA) | South Field (>16 ft natural soil) | Active Flyash Pile |
| **Radionuclides (pCi/g)** | | | | | | | | | | | | | | | | |
| Cesium-137+1d | 2.00E-01 | 7.10E-01 | ND | | | 1.20E+04 | 1.40E+00 | 8.20E-01 | 7.00E+00 | | | | | | | |
| Lead-210+2d | 5.00E-01 | 1.30E+00 | 8.50E-01 | | | | 3.80E+01 | 2.20E+00 | 3.90E+02 | | | | | | | |
| Neptunium-237+1d | 2.00E-01 | | | | 3.12E+09 | | 3.20E+00 | 4.90E-01 | 3.20E+01 | | | | | | | 4.99E+00 |
| Plutonium-238 | 2.00E-01 | | | | | 3.80E+06 | 7.80E+01 | 9.30E+00 | 1.20E+03 | | | | | | | |
| Plutonium-239/240 | 2.00E-01 | | | | | 4.10E+06 | 7.70E+01 | 9.00E+00 | 1.10E+03 | | | | | | | |
| Radium-226+8d | 2.50E-01 | 1.42E+00 | 1.47E+00 | 5.00E-01 | | 6.70E+02 | 1.70E+00 | 1.50E+00 | 2.90E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 |
| Radium-228+1d | 5.00E-01 | 1.25E+00 | 1.31E+00 | ND | | 3.40E+05 | 1.80E+00 | 1.40E+00 | 4.80E+00 | 2.00E+00 | 2.00E+00 | 2.00E+00 | 2.00E+00 | 2.00E+00 | 2.00E+00 | 2.00E+00 |
| Strontium-90+1d | 5.00E-01 | 4.20E-01 | 4.40E-01 | | 5.67E+10 | 2.80E+03 | 1.40E+01 | 6.10E-01 | 7.10E+03 | | | | | | | |
| Technetium-99 | 1.00E+00 | ND | ND | | 2.91E+01 | 9.30E+04 | 3.00E+01 | 1.00E+00 | 2.00E+05 | | | | | 7.10E+01 | 7.10E+01 | |
| Thorium-228+7d | 1.00E-01 | 1.43E+00 | 1.38E+00 | | | 1.40E+06 | 1.70E+00 | 1.50E+00 | 3.20E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 | 1.80E+00 |
| Thorium-230 | 1.00E-01 | 1.97E+00 | 1.91E+00 | | | 2.10E+05 | 2.80E+02 | 8.00E+01 | 1.80E+04 | | | | | 6.97E+00 | 6.97E+00 | |
| Thorium-232+10d | 1.00E-01 | 1.36E+00 | 1.26E+00 | | | 2.40E+05 | 1.50E+00 | 1.40E+00 | 1.60E+00 | 1.50E+00 | 1.50E+00 | 1.50E+00 | 1.50E+00 | 1.50E+00 | 1.50E+00 | 1.50E+00 |
| Uranium-234 | f | 1.24E+00 | 1.04E+00 | | | | | | | 6.29E+01 | 1.96E+02 | 8.68E+00 | 4.24E+00 | 8.68E+00 | 4.24E+00 | 8.64E+00 |
| Uranium-235/236 | f | 1.60E-01 | 1.50E-01 | | | | | | | 6.31E+01 | 1.95E+02 | 7.79E+00 | 3.35E+00 | 7.79E+00 | 3.35E+00 | 7.75E+00 |
| Uranium-238 | f | 1.24E+00 | 1.12E+00 | | 3.46E+02 | 1.20E+04 | | | | 1.29E+01 | 4.53E+01 | 6.12E+00 | 3.22E+00 | 6.12E+00 | 3.22E+00 | 6.12E+00 |
| Uranium, total (mg/kg) (High $K_d$)[g] | 1.00E-01 | 3.73E+00 | 3.69E+00 | 3.00E+00 | 1.03E+03 | 2.30E+02 | 8.20E+01 | 5.00E+01 | 2.10E+02 | 3.86E+01 | 1.36E+02 | | | | | 2.80E+01 |
| Uranium, total (mg/kg) (Low $K_d$)[g] | 1.00E-01 | | | | | | 2.00E+01 | NA | | | | 2.48E+01 | 2.48E+01 | 2.48E+01 | 2.48E+01 | |
| **Inorganics (mg/kg)** | | | | | | | | | | | | | | | | |
| Antimony | 5.00E-01 | ND | ND | | | 1.00E+01 | 9.60E+01 | 6.10E-01 | | | | | | | | |
| Arsenic | 1.30E+00 | 8.20E+00 | 9.57E+00 | 7.00E+00 | | 3.00E+01 | 1.20E+01 | 9.60E+00 | 9.40E+01 | | | 1.69E+01 | 1.69E+01 | | | 1.69E+01 |
| Barium | 1.30E+00 | 9.41E+01 | 1.19E+02 | 2.10E+01 | | 5.00E+02 | 6.80E+04 | 1.20E+02 | | | | | | | | |
| Beryllium | 5.00E-02 | 6.00E-01 | 6.20E-01 | 5.00E-01 | | 5.60E+01 | 1.50E+00 | 6.20E-01 | 3.30E+01 | | | | | | | |
| Boron | 4.00E+00 | | | | 1.04E+03 | | 7.40E+03 | 4.00E+00 | | | | | | | | |
| Cadmium | 1.00E-01 | 8.70E-01 | 9.10E-01 | 3.70E+00 | | 5.00E+00 | 8.20E+01 | 9.10E-01 | 7.10E+01 | | | | | | | |
| Chromium VI | 2.70E+00 | 1.55E+01 | 2.07E+01 | 1.83E+01 | | 5.00E-02 | 3.00E+02 | 1.10E+01 | 3.00E+03 | | | | | | | |
| Cobalt | 3.00E-01 | 1.42E+01 | 1.57E+01 | 4.90E+00 | | | 7.40E+02 | 2.60E+01 | 3.60E+04 | | | | | | | |
| Copper | 5.00E-01 | 1.41E+01 | 2.00E+01 | 1.08E+01 | | 1.00E+02 | 2.20E+05 | 2.00E+01 | | | | | | | | |
| Cyanide | 3.30E-01 | 2.70E-01 | 1.70E-01 | | | | 1.20E+05 | 8.00E-01 | | | | | | | | |
| Fluoride | 7.00E-01 | | | | | | 7.80E+04 | 8.50E+02 | | | | | | | | |
| Lead | 5.00E-02 | 2.64E+01 | 1.56E+01 | | | 2.00E+02 | 4.00E+02 | 4.00E+02 | | | | | | 4.00E+02 | | |
| Manganese | 1.00E+00 | 1.35E+03 | 1.30E+03 | 4.11E+02 | | 1.50E+03 | 4.60E+03 | 1.40E+03 | 4.10E+02 | | | | | | | |
| Mercury | 1.30E-01 | 3.00E-01 | 2.90E-01 | ND | 5.66E+04 | 5.00E+00 | 7.50E+00 | 3.00E-01 | | | | | | | | |
| Molybdenum | 1.30E+01 | ND | 2.70E+00 | ND | | 1.00E+01 | 2.90E+03 | 1.30E+01 | | | | | | | | |
| Nickel | 4.00E+00 | 2.09E+01 | 3.43E+01 | 1.37E+01 | | 1.00E+02 | 1.50E+04 | 3.40E+01 | | | | | | | | |
| Selenium | 1.30E+00 | 7.20E-01 | ND | ND | | 3.00E+00 | 5.40E+03 | 2.50E+00 | | | | | | | | |
| Silver | 1.30E+00 | ND | ND | ND | | 1.00E+01 | 2.90E+04 | 1.00E+00 | | | | | | | | |
| Thallium | 1.00E+00 | 5.80E-01 | 4.90E-01 | ND | | 6.30E+00 | 9.10E+01 | 1.00E+00 | 8.80E+01 | | | | | | | |

# TABLE 1-4
## (Continued)

| Constituent | Practical Quantitation Limit[a] | Background[b] | | | Waste Acceptance Criteria for Soil and Sediment in the On-Site Disposal Facility[c] | Benchmark Toxicity Value | Final Remediation Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Operable Unit 5[d] | | | Operable Unit 2[e] | | | | | | |
| | | Surface Soil | Subsurface Soil | Sediment (Paddys Run) | | | On-Property Soil | Off-Site Soil | Sediment | Solid Waste Landfill | Lime Sludge Ponds | Inactive Flyash Pile (over GMA) | Inactive Flyash Pile (>16 ft natural soil) | South Field (over GMA) | South Field (>16 ft natural soil) | Active Flyash Pile |
| Vanadium | 1.00E+00 | 3.04E+01 | 3.78E+01 | 1.24E+01 | | 1.50E+02 | 5.10E+03 | 5.80E+01 | | | | | | | | |
| Zinc | 1.00E+00 | 5.96E+01 | 8.20E+01 | 1.35E+01 | | 5.00E+02 | 1.20E+05 | 8.20E+01 | | | | | | | | |
| **Organics (mg/kg)** | | | | | | | | | | | | | | | | |
| Acetone | 7.00E-03 | | | | | | 4.30E+04 | 4.30E-01 | | | | | | | | |
| Aroclor-1254 | 4.00E-02 | | | | | 1.00E+00 | 1.30E-01 | 4.00E-02 | 6.70E-01 | | | | | | | |
| Aroclor-1260 | 4.00E-02 | | | | | 1.00E+00 | 1.30E-01 | 4.00E-02 | 6.70E-01 | | | | | 2.50E+01 | 2.50E+01 | |
| Benzene | 1.00E-03 | | | | | | 8.50E+02 | 4.30E-01 | | | | | | | | |
| Benzo(a)anthracene | 7.00E-04 | | | | | 1.00E+00 | 2.00E+01 | 1.60E-01 | 1.90E+02 | | | | | 4.55E-01 | 4.55E-01 | |
| Benzo(a)pyrene | 7.00E-04 | | | | | 1.00E+00 | 2.00E+00 | 9.00E-02 | 1.90E+01 | | | | | 7.77E-01 | 7.77E-01 | |
| Benzo(b)fluoranthene | 7.00E-04 | | | | | 1.00E+00 | 2.00E+01 | 1.60E-01 | 1.90E+02 | | | | | 5.13E-01 | 5.13E-01 | |
| Benzo(k)fluoranthene | 7.00E-04 | | | | | 1.00E+00 | 2.00E+02 | 9.00E-02 | 1.90E+03 | | | | | 6.03E-01 | 6.03E-01 | |
| Bis(2-chloroisopropyl)ether | 2.20E-01 | | | | 2.44E-02 | | 4.20E+02 | 2.00E-01 | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | 2.20E-01 | | | | | 7.00E+01 | 8.20E+02 | 2.60E+01 | 5.00E+03 | | | | | | | |
| Bromodichloromethane | 1.00E-03 | | | | 9.03E-01 | | 4.00E+00 | 1.80E-01 | | | | | | | | |
| Bromoform | 1.00E-02 | | | | | | 3.10E+01 | 1.60E+00 | 1.60E+02 | | | | | | | |
| Bromomethane | 1.00E-02 | | | | | | 8.20E+03 | 2.40E-02 | | | | | | | | |
| Carbazole | 4.00E-02 | | | | 7.27E+04 | | 1.20E+01 | 3.10E+00 | 6.30E+01 | | | | | | | |
| Carbon disulfide | 1.00E-03 | | | | | 7.80E+03 | 5.00E+03 | 6.20E+00 | | | | | | | | |
| Carbon tetrachloride | 1.00E-03 | | | | | | 2.10E+00 | 9.10E-02 | | | | | | | | |
| Chlordane | 2.00E-03 | | | | 2.89E+00 | | 1.90E-01 | 3.80E-02 | | | | | | | | |
| Chlorobenzene | 1.00E-03 | | | | | | 3.40E+02 | 1.90E+00 | | | | | | | | |
| Chloroethane | 1.00E-03 | | | | 3.92E+05 | | | | | | | | | | | |
| Chloroform | 1.00E-03 | | | | | | 4.50E+01 | 5.00E-01 | | | | | | | | |
| Chrysene | 2.00E-03 | | | | | 1.00E+00 | 2.00E+03 | 1.60E+01 | 1.90E+04 | | | | | | | |
| Dibenzo(a,h)anthracene | 5.00E-04 | | | | | | 2.00E+00 | 1.60E-03 | | | | | | 1.57E-01 | 1.57E-01 | |
| 3,3'-Dichlorobenzidine | 2.00E-01 | | | | | | 5.50E-01 | 2.00E-01 | | | | | | | | |
| 1,1-Dichloroethene | 1.00E-03 | | | | 1.14E+01 | | 4.10E-01 | 5.90E-02 | | | | | | | | |
| 1,2-Dichloroethene | 1.00E-03 | | | | 1.14E+01 | | 1.60E-01 | 1.30E-01 | | | | | | | | |
| Dieldrin | 4.00E-03 | | | | | 4.00E-02 | 1.50E-02 | 8.80E-03 | | | | | | 9.57E-03 | 9.57E-03 | |
| Di-n-octylphthalate | 2.00E-01 | | | | | | 1.10E+03 | 2.00E-01 | | | | | | | | |
| Ethylbenzene | 1.00E-02 | | | | | | 5.10E+03 | 1.00E-03 | | | | | | | | |
| Heptachlorodibenzofuran | 6.00E-06 | | | | | | 8.80E-04 | 5.00E-05 | | | | | | | | |
| Heptachlorodibenzo-p-dioxin | 6.00E-06 | | | | | | 8.80E-04 | 5.00E-05 | | | | | | | | |
| Indeno(1,2,3-cd)pyrene | 4.00E-03 | | | | | 1.00E+00 | 2.00E+01 | 1.60E-02 | 1.90E+02 | | | | | 4.96E-01 | 4.96E-01 | |
| 4-Methyl-2-pentanone | 7.00E-03 | | | | | | 2.50E+03 | 9.40E-01 | 2.10E+03 | | | | | | | |
| Methylene chloride | 3.00E-03 | | | | | 8.50E+01 | 3.70E+01 | 6.30E-01 | | | | | | | | |
| 4-Methylphenol | 2.00E-01 | | | | | | 2.50E+02 | 2.70E-01 | | | | | | | | |
| 4-Ni[illegible]ne | 9.00E-01 | | | | 4.42E-02 | | 1.50E[illegible] | 8.00E-01 | | | | | | | | |

TABLE 1-4 (Continued)

| Constituent | Practical Quantitation Limit[a] | Background[b] | | | Waste Acceptance Criteria for Soil and Sediment in the On-Site Disposal Facility[c] | Benchmark Toxicity Value | Final Remediation Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Operable Unit 5[d] | | | Operable Unit 2[e] | | | | | | |
| | | Surface Soil | Subsurface Soil | Sediment (Paddys Run) | | | On-Property Soil | Off-Site Soil | Sediment | Solid Waste Landfill | Lime Sludge Ponds | Inactive Flyash Pile (over GMA) | Inactive Flyash Pile (>16 ft natural soil) | South Field (over GMA) | South Field (>16 ft natural soil) | Active Flyash Pile |
| N-nitrosodiphenylamine | 2.00E-01 | | | | | | 5.10E+01 | 1.30E+01 | 2.60E+02 | | | | | | | |
| N-nitrosodipropylamine | 2.00E-01 | | | | | | 2.00E-01 | 2.00E-01 | | | | | | | | |
| Octachlorodibenzofuran | 1.30E-05 | | | | | | 8.80E-03 | 1.00E-05 | | | | | | | | |
| Octachlorodibenzo-p-dioxin | 1.30E-05 | | | | | | 8.80E-03 | 1.00E-05 | | | | | | | | |
| Pentachlorophenol | 9.00E-01 | | | | | | 2.30E+00 | 9.70E-01 | | | | | | | | |
| Phenanthrene | 1.00E-03 | | | | | | | | 3.00E-03 | | | | | 1.90E-01 | 1.90E-01 | |
| Tetrachloroethene | 1.00E-03 | | | | 1.28E+02 | 2.50E+01 | 3.60E+00 | 1.00E+00 | | | | | | | | |
| Toluene | 1.00E-03 | | | | | | 1.00E+05 | 2.70E+01 | | | | | | | | |
| Toxaphene | | | | | 1.06E+05 | | | | | | | | | | | |
| Tributyl phosphate | 4.00E-02 | | | | | | 2.50E+02 | 2.90E+00 | | | | | | | | |
| 1,1,2-Trichloroethane | 1.00E-03 | | | | | | 4.30E+00 | 1.90E-01 | | | | | | | | |
| Trichloroethene | 1.00E-03 | | | | 1.28E+02 | | 2.50E+01 | 1.50E+00 | | | | | | | | |
| Vinyl chloride | 1.00E-03 | | | | 1.51E+00 | | 1.30E-01 | 2.30E-03 | | | | | | | | |
| Xylenes, total | 1.00E-03 | | | | | | 9.20E+05 | 4.00E+02 | | | | | | | | |

Notes: [a] From Operable Unit 5 FS (DOE 1995b)

[b] From Operable Unit 5 RI (DOE 1995e).

[c] From *Impacted Materials Placement Plan - On-site Disposal Facility* (DOE 1996d).

[d] From Operable Unit 5 ROD (DOE 1996e).

[e] From Operable Unit 2 ROD (DOE 1995f).

[f] See Appendix H for practical quantitation limits

ND = Not Detected

NA = Not Applicable

## TABLE 1-5 SCHEDULE OF REMEDIAL DESIGN DELIVERABLES

| Remediation Area | Revised Schedule | OU5 RD Work Plan |
|---|---|---|
| Area 1 Phase I | Submitted | 17 Jul 96 |
| Area 1 Phase II | Submitted | 21 Nov 97 |
| Area 1 Phase III | 31 Mar 00 - CDL | 15 Jan 01 |
| Area 2 Phase I | Submitted | 14 Mar 97 |
| Area 2 Phase II | 31 Dec 01 - IRDP | 15 Jan 01 |
| Area 2 Phase III | 31 Mar 99 - CDL | NA |
| Area 3 | 31 Mar 00 - IRDP | 02 Jul 98 |
| Area 4A | 31 Dec 01 - IRDP | 15 Nov 00 |
| Area 4B | 01 Apr 02 - IRDP | 15 Nov 00 |
| Area 5 | 01 Jul 02 - IRDP | 15 Nov 00 |
| Area 6 | 01 Dec 03 - IRDP | 15 Jan 01 |
| Area 7 | 31 Mar 08 - IRDP | 15 Jan 01 |
| Area 8 Phase I | Submitted | NA |
| Area 8 Phase II | 30 Sep 98 - CDL | NA |
| Area 8 Phase III | 30 Jun 03 - CDL | NA |
| Area 9 Phase I | 29 Aug 99 - CDL | NA |
| Area 9 Phase II | 27 Aug 00 - CDL | NA |
| Area 10 | 30 Mar 07 - IRDP | NA |

CDL= Certification Design Letter
IRDP= Integrated Remedial Design Package
NA= Not applicable

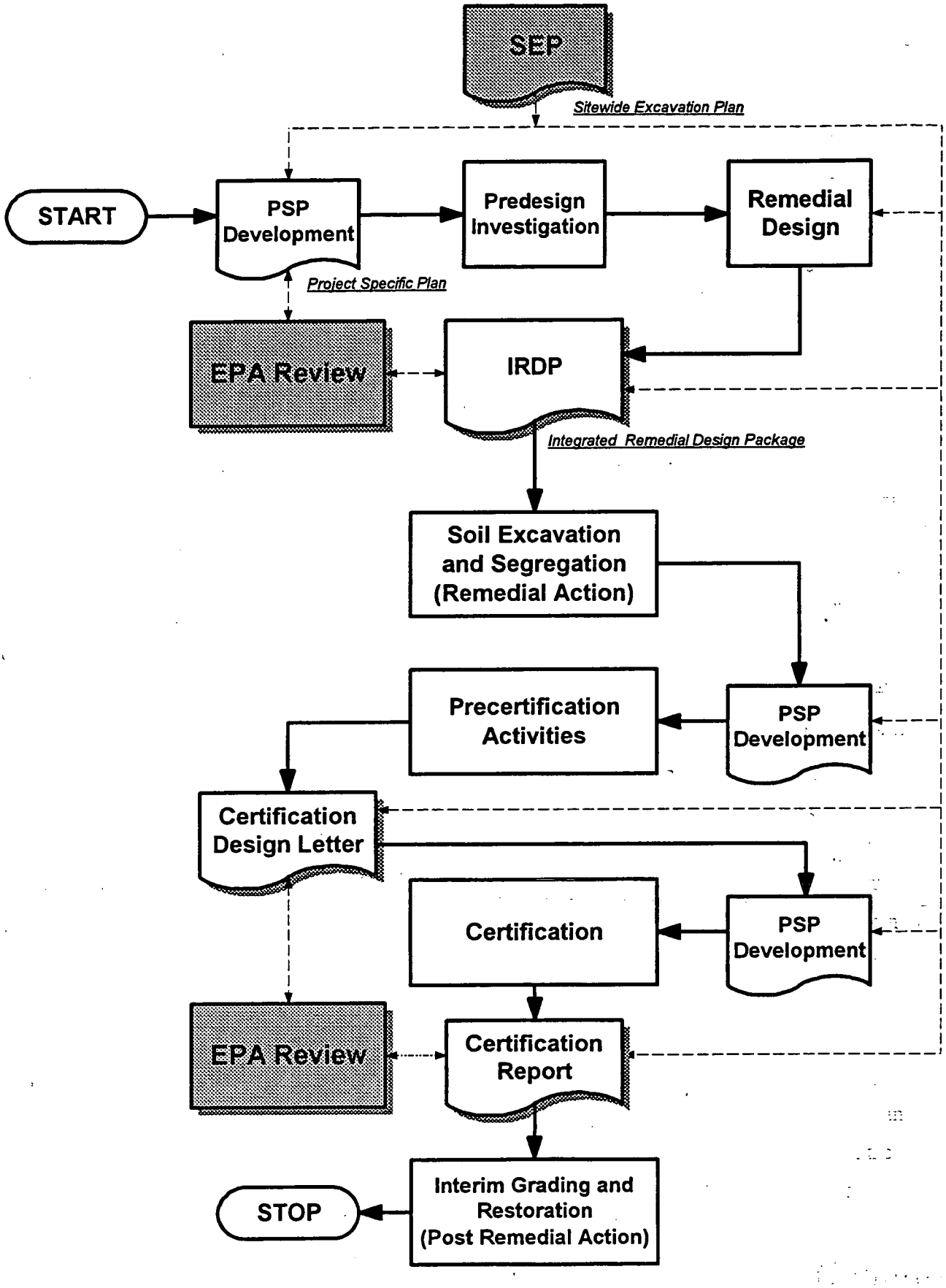


FIGURE 1-1 GENERAL AREA-SPECIFIC SOIL REMEDIATION PROCESS

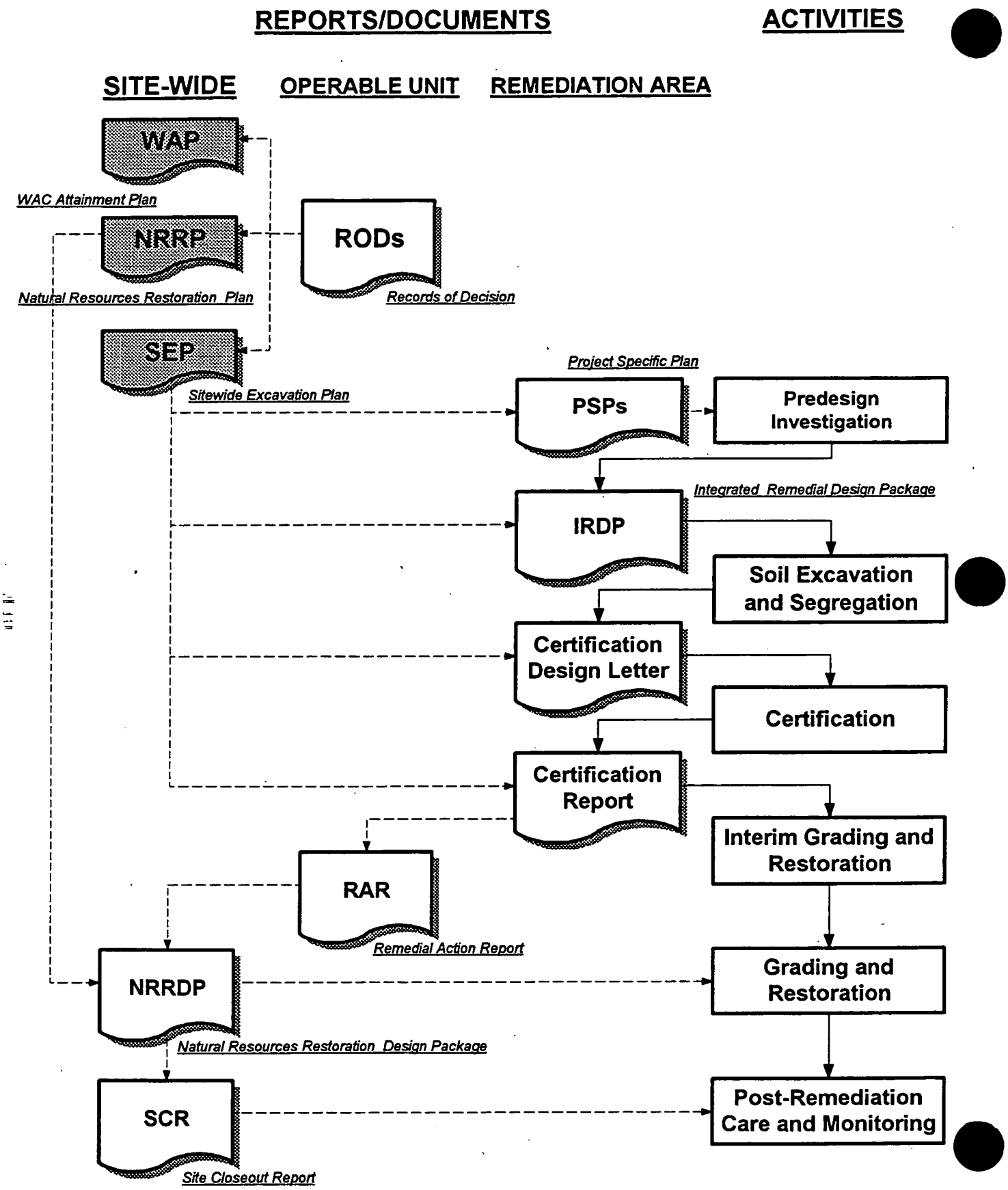


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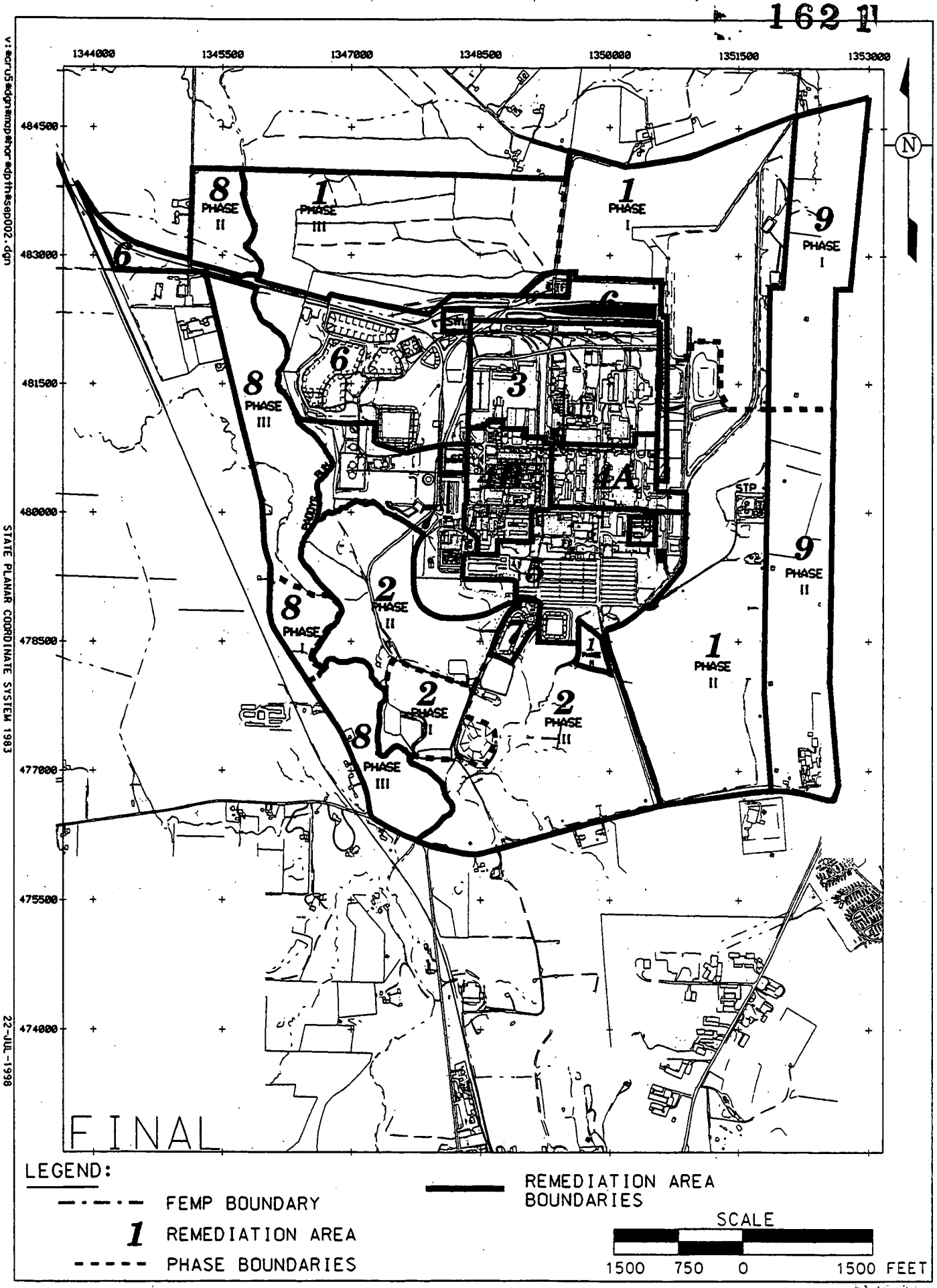
FIGURE 1-2 HIERARCHY OF SOIL REMEDIATION DOCUMENTS




v:\cru5\dgn\map\for\dpthlsep002.dgn

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FIGURE 1-3. GENERALIZED SITEWIDE REMEDIATION AREAS

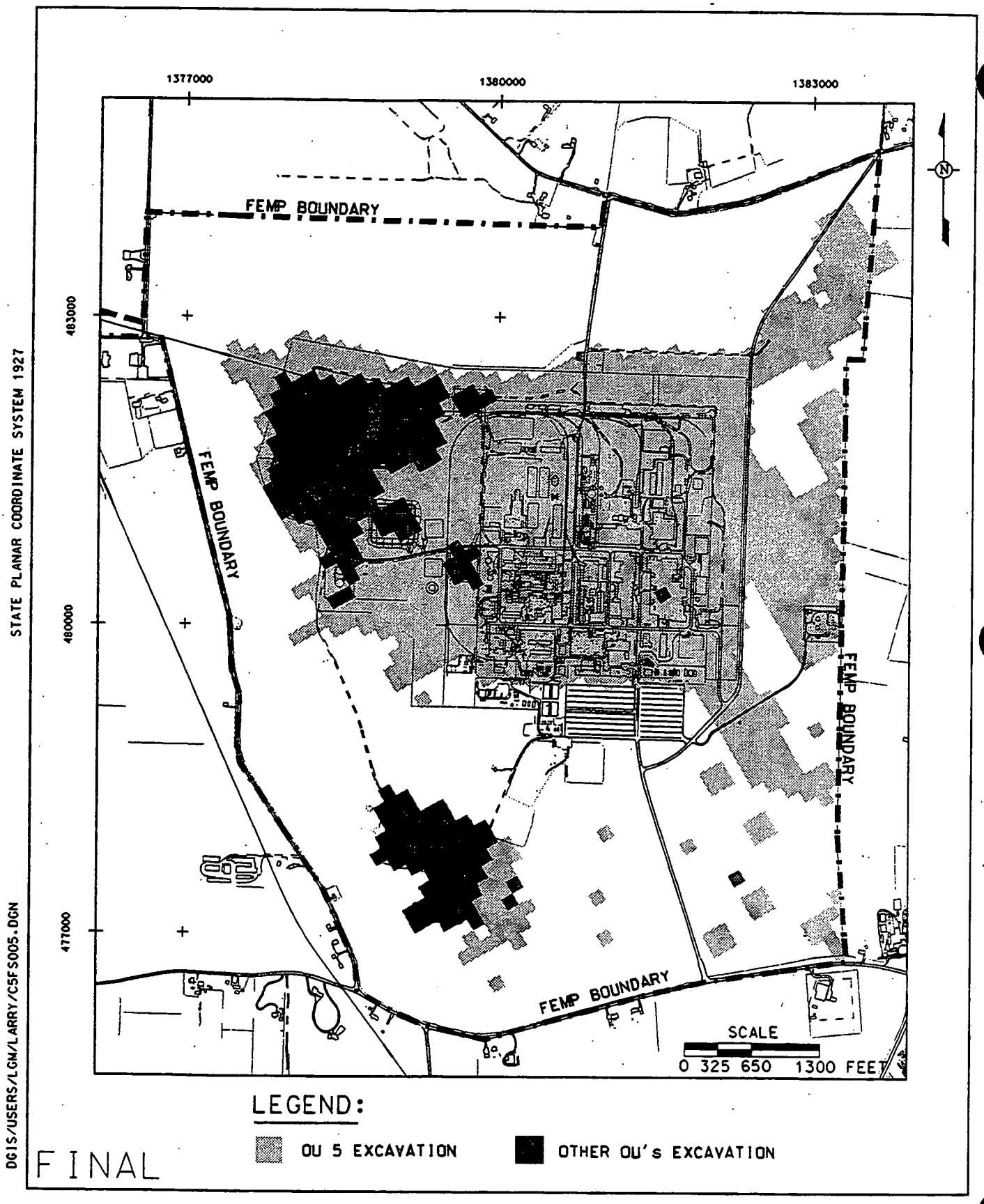
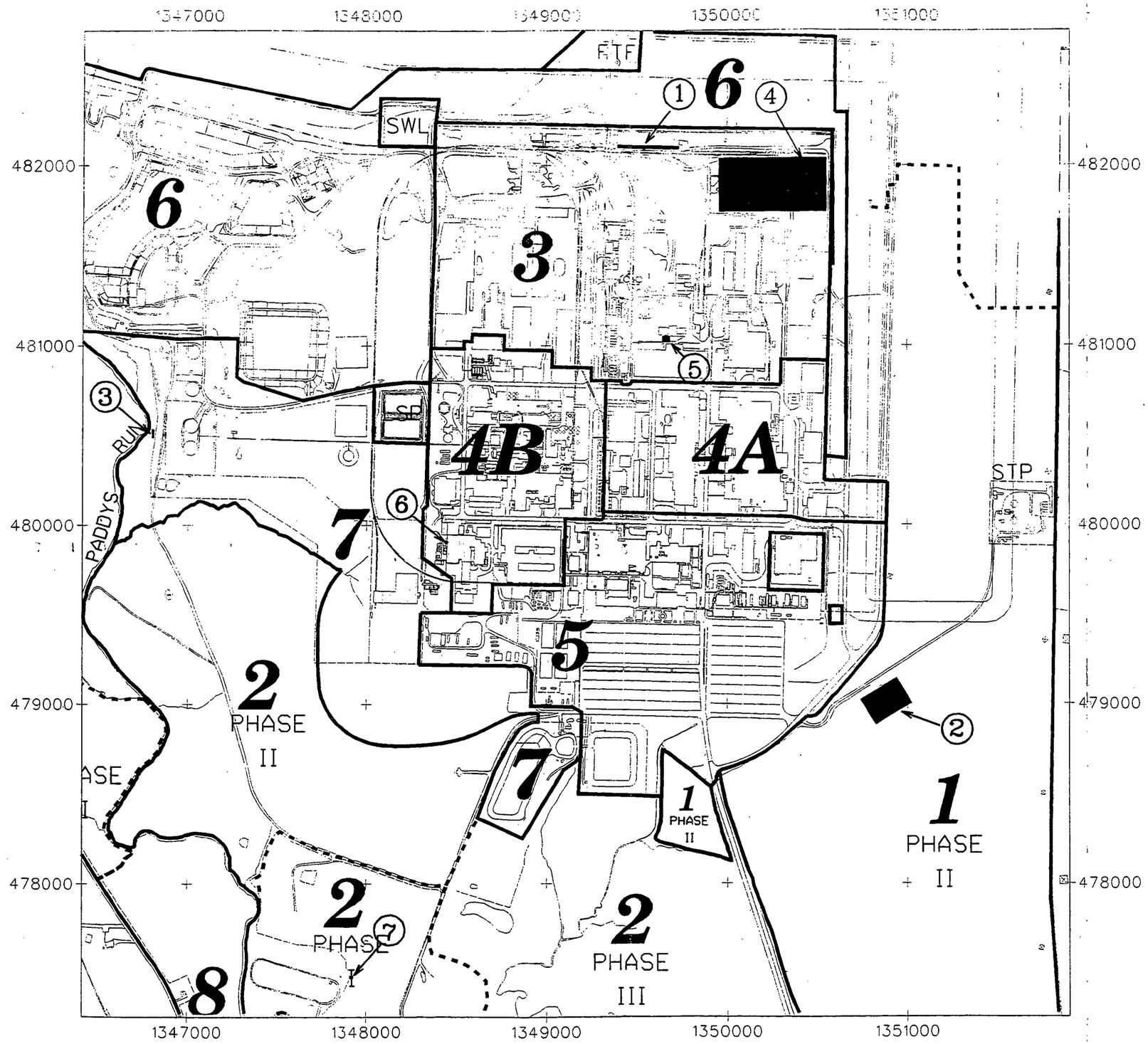



FIGURE 1-4. POTENTIAL EXCAVATION FOOTPRINT, BASED ON OPERABLE UNIT 5 FS

DGIS/CRU5/DGN/MAP/HOR/DPTH/SEP005.DGN




LEGEND

RCRA AREAS

LOCATION IDENTIFIERS :

1. AREA BETWEEN KC2 WAREHOUSE AND RAILROAD TRACKS
2. TRAP RANGE
3. PADDYS RUN STREAMBANK FILL MATERIAL WEST OF SILOS 1-4
4. SCRAP METAL PILE AREA
5. AREA NORTH OF MAINTENANCE BUILDING
6. ABANDONED SUMP WEST OF PILOT PLANT (HWMU #22)
7. SOUTH FIELD FIRING RANGE

FIGURE 1-5. AREAS REQUIRING FURTHER CHARACTERIZATION AND POTENTIAL TREATMENT OF RCRA TOXICITY CHARACTERISTIC WASTES

FINAL

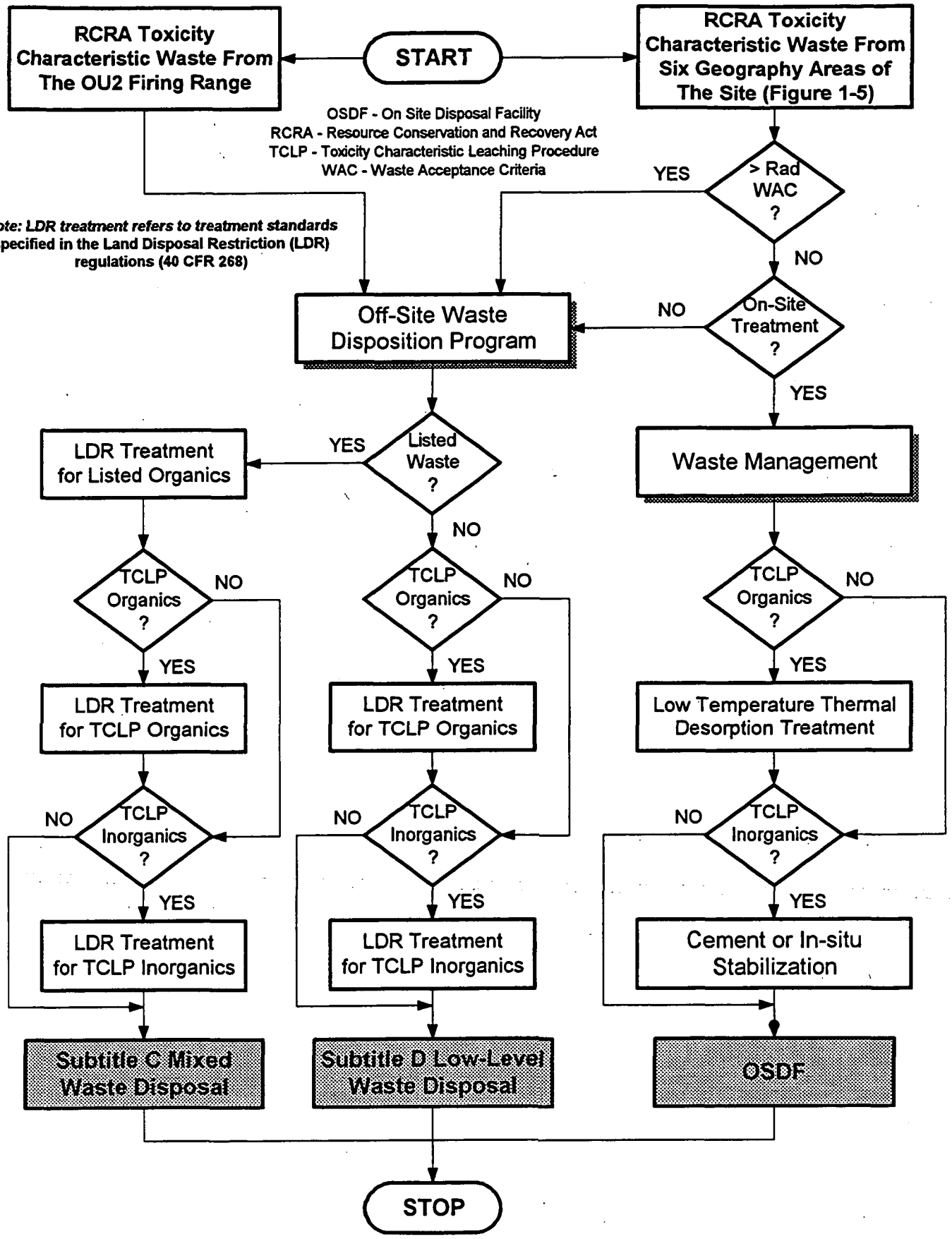
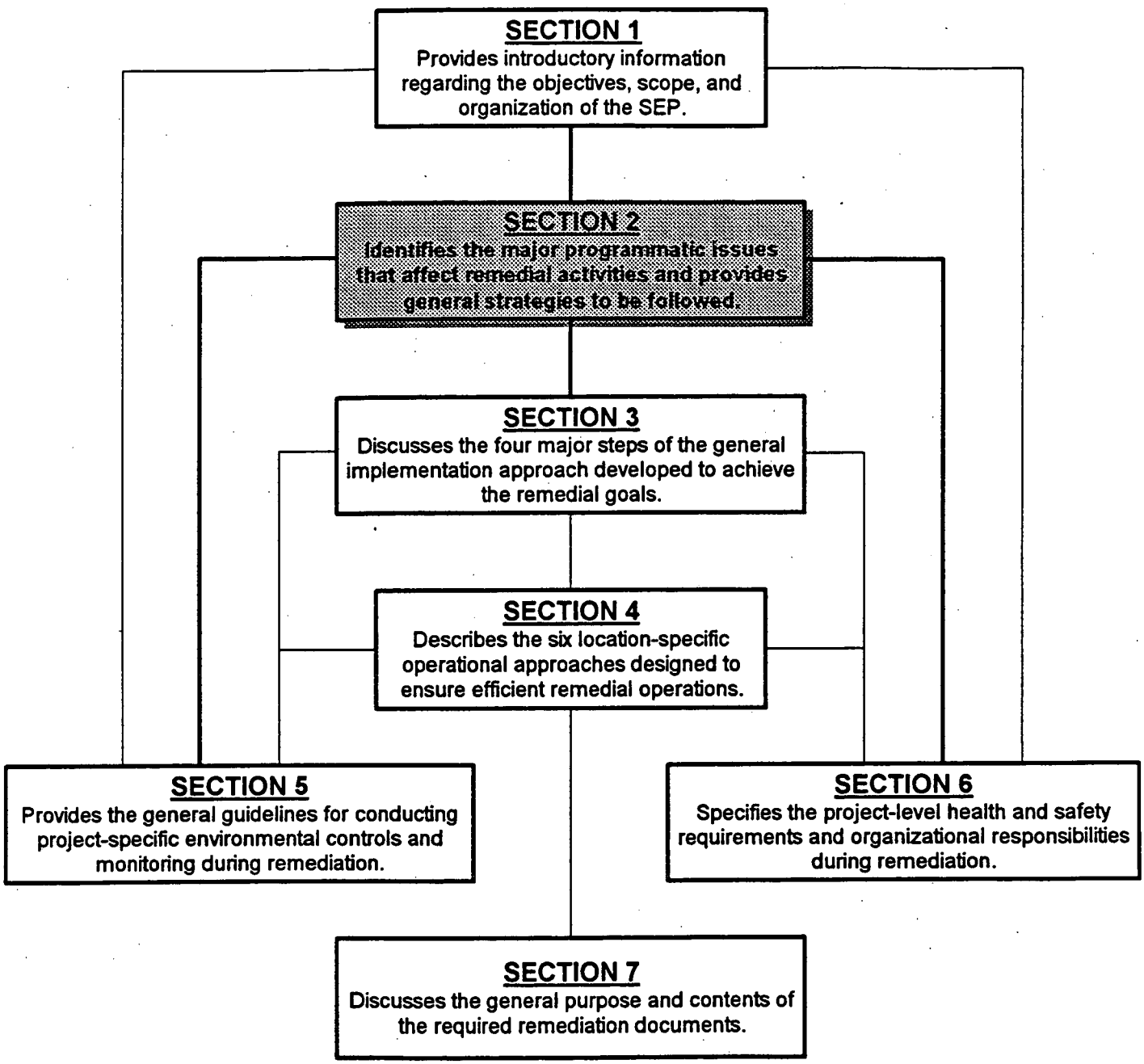



FIGURE 1-6 RCRA-REGULATED SOIL TREATMENT AND DISPOSAL REQUIREMENTS

# SITEWIDE EXCAVATION PLAN




**APPENDIX A** - Soil Remediation ARARs and TBCs
**APPENDIX B** - Sitewide Sequencing Plan
**APPENDIX C** - Constituent of Ecological Concern Selection
**APPENDIX D** - Wood Sampling Program
**APPENDIX E** - SEP Quality Assurance Project Plan (QAPP)
**APPENDIX F** - Implementation of Construction and Waste Management Practices
**APPENDIX G** - Certification Design Rationale
**APPENDIX H** - Summary of Field Measurement and Laboratory Analytical Technologies
**APPENDIX I** - Sitewide Extent Of Contamination By Constituent

# 2.0 REMEDIATION ISSUES AND GENERAL STRATEGIES

Throughout the remedial investigation/feasibility study (RI/FS) at the Fernald Environmental Management Project (FEMP), certain implementation decisions were deferred to the remedial design/remedial action phase. During the development of the remedial design/remedial action, additional issues were identified that must be addressed during implementation. This section describes the issues regarding remediation activities associated with the Soil Characterization and Excavation Project (SCEP) at the FEMP; discusses the general strategy for addressing each; and, as applicable, references the subsequent section in this Sitewide Excavation Plan (SEP) where each is discussed in detail.

The factors that influence remediation activities are grouped into five categories:

1. Remediation regulatory drivers
2. Attainment of remediation goals
3. General implementation guidelines
4. Field measurements and laboratory analytical techniques
5. Logistical concerns.

The issues associated with each of these groupings are presented and discussed in the following five subsections.

## 2.1 REMEDIATION DRIVERS

The following requirements/factors are driving remediation activities at the FEMP:

- Applicable or relevant and appropriate requirements (ARARs) and to-be-considered criteria
- Permits
- Agreements
- Natural Resource Trusteeship.

Five aspects of these general categories are of particular interest in terms of the remediation of soil and at- and below-grade structures and debris:

- The Resource Conservation and Recovery Act (RCRA)
- Waste Acceptance Criteria (WAC)
- Final Remediation Levels
- Benchmark Toxicity Values
- DOE Orders.

The issues regarding each of these, and their respective impact on remediation activities, are discussed in the following paragraphs.

### 2.1.1 Resource Conservation and Recovery Act

RCRA regulations (40 CFR 260 and 280) and Ohio Environmental Protection Agency (OEPA) regulations (Ohio Administrative Code Chapters 3745-55) specify criteria for the identification and listing of hazardous wastes; regulations concerning the handling, treatment, and disposal of hazardous wastes; requirements for the closure of inactive hazardous waste management units (HWMUs) and underground storage tanks (USTs); and procedures for closing sites that have treated, stored, or disposed of hazardous wastes. These regulations affect three areas related to SCEP remediation activities:

- HWMUs
- USTs
- Toxicity characteristic hazardous wastes.

#### 2.1.1.1 Hazardous Waste Management Units

A HWMU is defined as

> *... a contiguous area of land on/in which hazardous waste is placed, or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area. (40 CFR 260.10)*

RCRA regulations require closure of HWMUs that are no longer in service. There were originally 54 HWMUs at the FEMP. Of these, 11 have been reclassified as solid waste management units and 14 have been or are being closed under RCRA; these require no further action under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). The remaining 29 are planned

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to be closed under the RCRA/CERCLA integrated remedial response (Table 2-1). As presented in Table 2-1, 15 of these are anticipated to be closed only by the Facility Closure and Demolition Project (FC&DP), while the remaining 14 will be finally closed by SCEP. Of those 14, the above-grade portion will be decontaminated and dismantled by FC&DP, and the at- and below-grade portion and underlying contaminated soil will be excavated by SCEP. To facilitate planning of those activities, the HWMUs in Table 2-1 are grouped by implementing project (SCEP vs. FC&DP), then sequenced within the grouping by the soil remediation area. The procedures to be used by the SCEP to demonstrate attainment of soil final remediation levels (FRLs) and HWMU closure are summarized in Section 2.2.5.

2.1.1.2 Underground Storage Tanks

An UST is defined as

> *... any one or combination of tanks (including underground pipes connected thereto) that is used to contain an accumulation of regulated substances, and the volume of which (including the volume of underground pipes connected thereto) is 10 percent or more beneath the surface of the ground. This term does not include any ... storage tank situated in an underground area (such as a basement, cellar, mineworking, drift, shaft, or tunnel) if the storage tank is situated upon or above the surface of the floor.* (40 CFR 280.12)

RCRA regulations (40 CFR 280.71 through 280.73) and corresponding Ohio regulations (OAC 1301) describe permanent closure requirements for USTs:

> *To permanently close a tank [UST], ... empty and clean it by removing all liquids and accumulated sludges. All tanks taken out of service permanently must also be either removed from the ground or filled with an inert solid material .* (40 CFR 280.71)

This is generally accomplished by removing the UST's contents and residues, either removing the tank structures/equipment or filling them with inert material, and removing contaminated soils from the UST excavation.

There were originally 13 underground storage tanks at the FEMP (Table 2-2). All 13 USTs have been closed under RCRA Subtitle I to the satisfaction of the Ohio Fire Marshal, as presented in Table 2-2 and summarized below:

| RCRA Subtitle I Tank Closure Status | | Soil FRLs Attainment | |
|---|---|---|---|
| | | Certified | Needed |
| Closed by Removal | 12 | 0 | 12 |
| Closed In Place | 1 | 0 | 1 |
| In Place and Awaiting Closure | 0 | Not Applicable | Not Applicable |

Thus, attainment of soil FRLs and completion of final closure will be demonstrated during soil excavation activities. To facilitate planning of those activities, the USTs in Table 2-2 are grouped by the tank closure status categories above, then sequenced within the grouping by the soil remediation area. The procedures to be used by the SCEP to demonstrate attainment of soil FRLs and final UST closure are summarized in Section 2.2.6.

2.1.1.3 Toxicity Characteristic Hazardous Wastes

The RI/FS program at the FEMP identified seven geographic areas where a reasonable potential exists for the presence of soil that qualifies as RCRA toxicity characteristic waste and also presents a reasonable opportunity for cost-effective treatment. These areas are shown on Figure 1-5 and their potentially hazardous constituents are given in Table 2-3. The first six geographic areas listed in Table 2-3 are identified in the Record of Decision (ROD) for Operable Unit 5 (DOE 1996e), whereas the seventh area, the South Field Firing Range, was identified in the ROD for Operable Unit 2 (DOE 1995f). Screening for the presence of characteristic wastes will not be performed outside of these areas. It is conservatively estimated that approximately 28,000 cubic yards of material from these areas could be considered toxicity characteristic hazardous waste.

The potential for toxicity characteristic hazardous waste in these seven areas was identified using validated data in the Sitewide Environmental Database (SED) for constituents with concentrations that exceed 20 times the respective toxicity characteristic leaching procedure (TCLP) limit (40 CFR 261.24). The 20 times rule accounts for the dilution effects of the TCLP test (i.e., 1 liter of diluent per 50 grams of sample). A sample with a contaminant content less than 20 times the TCLP limit cannot possess the toxicity characteristic. If the contaminant concentration is greater than

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20 times the TCLP limit, it may be hazardous, depending on the leachability of the contaminant as measured by the TCLP test.

Identified characteristically hazardous waste from six of these geographic areas will be treated and disposed of in either an off-site facility or the On-Site Disposal Facility (OSDF). Toxicity characteristic hazardous waste from the seventh area, the South Field Firing Range, will be dispositioned off site, as required in the OU2 ROD. If waste from the six areas also exceeds the WAC for the OSDF, it will be dispositioned off site. The toxicity characteristic hazardous wastes that are dispositioned off site must be treated to meet land disposal restriction (LDR) treatment standards (40 CFR 268.40) prior to disposal. Any toxicity characteristic hazardous wastes from the six geographic area that will be dispositioned to the OSDF will be treated to remove the identified toxicity characteristic before disposal. The decision as to whether such wastes that do not exceed the radiological WAC for the OSDF will be dispositioned to the OSDF or off site will depend on such factors as the availability of appropriate on-site treatment and the cost differential between on-site and off-site treatment/disposal.

The procedures to be used to identify, excavate, and handle these toxicity characteristic hazardous wastes are similar to those for material with contaminant concentrations that exceed the WAC for the OSDF (Section 2.2.1). Figure 1-6 shows the decision points and treatment options for RCRA toxicity characteristic wastes excavated from any of the seven areas listed in Table 2-3.

### 2.2.2 Waste Acceptance Criteria

WAC are physical and chemical/radiological characteristics of material that must be achieved if the material is to be disposed of in an acceptable manner. WAC are established by waste disposal facilities to assure that design constraints are not exceeded.

Waste generated during remediation of FEMP facilities will be disposed of in both off-site disposal facilities and the OSDF. Two issues are of primary interest in terms of WAC attainment at the FEMP:

- Material shipped to an off-site disposal facility must not exceed the WAC for that facility.
- Material known to exceed the OSDF WAC must not be placed in the OSDF.

2.1.2.1 Waste Acceptance Criteria for Off-Site Disposal Facilities

WAC for potential off-site disposal facilities, and procedures for demonstrating compliance with them, are listed in Appendix E of the Operable Unit 5 Feasibility Study (FS) (DOE 1995b). The conceptual waste disposition process described in Appendix F.5 provides conceptual procedures for managing and tracking the materials to be dispositioned off site during soil remediation.

2.1.2.2 Waste Acceptance Criteria for the On-Site Disposal Facility

The OSDF WAC apply to materials which fall into three basic categories: debris, soil/soil-like material, and ancillary waste. The WAC Attainment Plan (DOE 1998b) provides both the rule book for WAC attainment and a description of the strategies for complying with the rules for all of the materials that will be placed in the OSDF. Therefore, details on the WAC for the OSDF are provided in the WAC Attainment Plan and information in the SEP is limited to a brief overview of the WAC Attainment Plan.

Summary of Waste Acceptance Criteria for the On-Site Disposal Facility

The OSDF WAC are derived from the FEMP RODs (for radiological and chemical WAC; Table 2-4) and from the OSDF remedial design requirements (for physical WAC and prohibited items; Table 2-5). In accordance with the RODs, the primary material types destined for on-site disposal include all contaminated in-place soil and soil stockpiles (Operable Unit 5); the waste materials present in the South Field, Active and Inactive Flyash Piles, the Lime Sludge Ponds, and the Solid Waste Landfill (Operable Unit 2); and the debris resulting from sitewide facility decontamination and dismantlement (D&D) efforts (primarily Operable Unit 3, with small contributions from other operable units). Taken together, these primary materials represent an on-site disposal volume estimated at 2.5 million cubic yards.

Each of the operable units will also generate a smaller volume of remediation-support waste as a consequence of the cleanup effort, such as personal protective equipment (PPE), Water Treatment Plant residue, analytical laboratory sample returns, and other miscellaneous solid wastes associated with the cleanup. All of these smaller-volume, remediation-support wastes are destined for disposal in the OSDF, provided the WAC are met.

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Where the RODs categorically exclude a material type from placement in the OSDF, the material will be sent to an off-site facility for disposal. The management, control, and off-site disposal of these materials is not part of the scope of the WAC Attainment Plan for the OSDF. For example, the primary categorically-excluded materials include the waste pit contents, covers, and liners (Operable Unit 1); nuclear material products, residues, and other special materials (part of Operable Unit 3); and waste materials contained in Silos 1, 2, and 3 (Operable Unit 4). These designated materials will be shipped for off-site disposal, along with the portions of the non-designated waste streams that are determined to exceed one or more of the OSDF WAC.

Application of Waste Acceptance Criteria to Soil Remediation

The 18 WAC constituents of concern (Table 2-4) are considered in the development of area-specific constituents of concern (ASCOCs) for WAC attainment in soil remediation areas.

The process for developing and gaining the U.S. Environmental Protection Agency (EPA) and OEPA approval of the proposed ASCOCs for WAC attainment involves several steps; final approval for proposed ASCOCs within a particular remediation area is gained with approval of the Integrated Remedial Design Package (IRDP). Prior to beginning pre-excavation characterization activities for a given remediation area, the FEMP will produce project-specific plans (PSPs) that initially propose the list of area-specific WAC constituents of concern for the area. The initial proposal will result from a detailed review of the FEMP's environmental databases for soil and sediment to identify those WAC constituents that have been detected within the given remediation area. Based on the concentration ranges and frequencies of detection seen in the existing database, coupled with a review of the overall completeness and representativeness of the WAC constituent data for the area, a short list of constituents will be developed for EPA and OEPA's consideration. Other information from the RI/FS databases that will be used to develop the lists and assess the extent of affected areas includes underlying perched groundwater and the Great Miami Aquifer and nearby surface water analytical results; process knowledge; and any existing real-time analytical results that may be available for a given area.

The justification of the adequacy of the short list will be provided as part of the PSPs. EPA and OEPA will be furnished the PSP for information purposes so that all parties are familiar with the

information used to derive the lists. Actual approval of the lists, however, rests with the approval of the follow-up IRDP, that will generally be submitted to the agencies following completion of the pre-excavation characterization step. The intent of sharing the results of the database searches and area-specific constituent list justifications at the PSP stage is to help alleviate concerns over the adequacy of the FEMP's existing RI/FS data for design purposes, and to allow for the mutual identification of known database shortcomings early in the process before detailed design documents are prepared. If there are any future remediation areas that are found to not require a pre-excavation characterization step, the proposed list of area-specific constituents of concern for WAC attainment, and appropriate justification for them, will be provided at the IRDP step.

Generally speaking, the proposed list of ASCOCs for WAC attainment for a given remediation area will consist of 1) the principle constituents of concern (for example, total uranium and technetium-99) that drive the overall extent of WAC-related excavation; and 2) the secondary constituents of concern (for example, a nonradiological constituent) that are found to be in association with the primary constituent(s).

Several different screening approaches will be applied to soil to verify WAC. In areas where soil is known to exceed the WAC for one or more constituents, soil will be screened with a combination of real-time instruments and physical samples to delineate the extent of above-WAC excavation. For secondary COCs that may be above WAC, physical samples will be collected from the surface and subsurface to the extent necessary to characterize the above-WAC material. Remediation areas suspected to contain soil above the WAC (e.g., some soil piles), will undergo physical sampling and real-time monitoring, if possible. Areas that contain uranium near the WAC will be evaluated for possible WAC exceedance with real-time scanning. In areas that are known to contain soil with COCs below WAC (e.g., west of Paddys Run), real-time instruments, after EPA approval of necessary real-time documentation, will be used to confirm the absence of above-WAC material.

Details on the use of real-time instruments and collection of physical samples will be provided in area-specific predesign PSPs and IRDPs. In general, existing data for the relevant area will be pulled from the SED and evaluated to determine the number of samples with COCs above their WAC (Section 3.1). If the number of existing sample results (RI-based) are deemed insufficient to make a decision on

WAC excavation, due to limited coverage or excessive results at a detection limit above the WAC, additional physical samples and/or real-time measurements will be proposed to ascertain the horizontal and vertical extent of contamination during implementation of the predesign PSPs.

Uranium is the predominant contaminant at the site and will drive the excavation of most soil. However, there are also seven regions of the site with the potential to contain technetium-99 above the WAC. A preliminary identification of the areas that potentially exceed the OSDF WAC for total uranium and technetium-99 is provided on Figures 2-1 and 2-2. The extent of excavation will be determined by implementing the PSPs during the pre-design phase (Section 3.1). Within each area, data from the Operable Unit 5 RI/FS and additional validated data from the SED will be reviewed to determine whether the area to be excavated contains contaminant levels above the WAC. If the data show contaminant levels above the OSDF WAC, the extent of above-WAC material will be determined in the manner described in Section 3.1.3. In such cases, the above-WAC materials will be excavated prior to excavation of the below-WAC/above-FRL soil to be disposed of in the OSDF. If the data evaluation indicates no contaminant levels above the WAC, the soil will be excavated and transferred to the OSDF for disposal. The data substantiating that the contaminant levels in the soil are below the WAC will be documented for the soil and will serve as a basis for acceptance of the soil transfer at the OSDF, as described in the conceptual waste disposition process provided in Appendix F.5.

Application of Waste Acceptance Criteria to At- and Below-Grade Structures and Debris

Remedial planning performed under the SEP for at- and below-grade debris excavation will include an evaluation of the debris to be generated in order to determine handling, treatment, and disposition requirements (Appendix F). This evaluation, which is similar to that used in planning above-grade dismantlement of Operable Unit 3 materials (DOE 1996f), identifies debris for which there may be particular handling concerns. However, based on an initial evaluation of Operable Unit 3 materials that will remain after above-grade D&D, it is anticipated that most debris will not require special handling, treatment, or off-site disposal.

The bulk of the debris anticipated to be encountered during excavation includes concrete pads, asphalt roads, below-grade piping and storm sewers, and structural steel (e.g., supports remaining in basements, etc.). All excavated debris destined for the OSDF will be size-reduced, as necessary, in

accordance with the WAC. Acid brick will be removed as part of Operable Unit 3, above-grade building dismantlement and is generally not expected to be encountered in the below-grade portions of Operable Unit 3. Concrete in four process areas will be scabbled as part of above-grade building dismantlement to ensure that the mass-based technetium-99 limit for Operable Unit 3 debris dispositioned in the OSDF will be met (DOE 1996g). It has been demonstrated in the Operable Unit 3 RI/FS (DOE 1995g) that all remaining concrete to be excavated as part of at- and below-grade remediation meets the OSDF radiological/chemical WAC. As a best management practice for soil excavation, the FEMP will segregate and send off site the vast majority of actual and/or suspected acid bricks that may be unearthed during the excavation of Operable Units 2 and 5, to further reduce the chance that process-related residuals are placed in the OSDF. This best management practice will result in the direct removal and off-site shipment of those bricks that can be readily identified and safely removed during soil excavation and/or placement at the OSDF.

Below-grade piping that is not process-related (e.g., storm sewers, steam lines, potable water lines, conduit, etc.) will be size-reduced, as necessary, in accordance with the WAC and dispositioned in the OSDF. If these non-process pipes are excavated from areas of soil that do not meet the OSDF WAC, the debris will, as a general practice, be sent off site for disposal along with the above-WAC soil.

Below-grade piping that is or has historically been process-related will be managed in accordance with the conceptual waste disposition process described in Appendix F.5. In general, this piping will be inspected to ensure the piping is free from "visible process residues." The definition of visible process residues (green salt, yellow cake, etc.) is material on the interior surface of the pipe that is obvious and that, if rubbed, would be easily removed. Stains, rust, and corrosion do not qualify as visible process material. If a pipe fails visual inspection, a determination will be made either to decontaminate the piping or to containerize it for off-site disposition.

### 2.1.3 Final Remediation Levels

FRLs are the cleanup goals for the FEMP site. As defined for the FEMP, the FRL is the average concentration of a contaminant that can remain in an area under a given exposure scenario and still be protective of human health and the environment. Remediation at the FEMP will remove contaminated

soil until the average residual concentration in any potential certification unit (CU) is at or below the respective FRL.

The FEMP FRLs are listed in Table 1-4. A summary of how FRL attainment will be demonstrated is provided in Section 2.2.2. Several issues regarding FRLs at the FEMP should be noted:

- Five contaminants listed in Table 1-4 (alpha-chlordane, chlorobenzene, tetrachloroethene, toxaphene, and trichloroethene) have an associated chemical/radiological WAC, but no corresponding FRL. This is because WAC were developed for all RCRA hazardous constituents, regardless of whether the contaminant was detected in environmental media at the FEMP or not.

- The FRL for several contaminants [technetium-99, bis(2-chloroisopropyl)ether, boron, bromodichloromethane, and 4-nitroaniline] is equal to or greater than the corresponding chemical/radiological WAC. This means that all material with contaminant levels that exceed the respective FRL also exceed the WAC. Except for material contaminated with technetium-99, such material must either be transported off-site for disposal, or treated, as required, for disposal in the OSDF. All material with technetium-99 levels above the WAC/FRL will be dispositioned off site. The fact that the FRL is less than or equal to the WAC does not change the approach to be used to excavate such contaminated material. As described in Section 3.3.1.2, the general procedure is to delineate and excavate material that exceeds the WAC first. If all of the material that exceeds the WAC for these contaminants is removed, all of the material that exceeds the respective FRL will also be removed.

- The FRL for several contaminants (3,3'-dichlorobenzidine, heptachlorodibenzofuran, heptachlorodibenzo-p-dioxin, and n-nitrosodipropylamine) is at or below the respective practical quantitation limit (PQL). This is because the PQL was not taken into account when developing the FRL for these contaminants.

- The FRL for total uranium is very low (20 mg/kg) in certain portions of the Former Production Area and at the Sewage Treatment Plant (STP; Figure 2-3 and Table 1-4) because the uranium handled and stored in these areas is more mobile. Uranium mobility in these areas is attributed to the purification process used at the FEMP which involved solubilizing the uranium with strong oxidizing acid to separate it from the ore impurities. This low FRL will require the exclusive use of the HPGe for radiological field surveys during excavation control and precertification activities.

- The FRLs for several radionuclides are very low in certain portions of the Inactive Flyash Pile and the South Field (Table 1-4) because the glacial till (which serves to retard the movement of contaminants) is very thin or nonexistent in these areas. These low FRLs will require special consideration during excavation control, pre-certification, and certification activities.

- The FRLs for select members of the thorium-232 decay chain (i.e., thorium-232, radium-228, and thorium-228) will be assessed using the gamma photon energies given in Appendix H. In the case of surface water samples, analytical data for radium-228 will be used to assess the radium-228 FRL.

- As indicated on Tables 2-1 and 2-2, there are several constituents associated with HWMUs and USTs for which there are no FRLs, as these constituents were screened out during the RI/FS process. In addition, for the active HWMUs, the final list of constituents is to be determined. In all such cases, the nature and extent of contamination associated with HWMUs/USTs will be determined as part of remediation activities to the extent necessary for excavated waste management decisions (e.g., contaminated soil exceeding the OSDF WAC and also containing RCRA F-listed constituents must be disposed at an off-site facility as a RCRA-regulated hazardous waste). To the extent possible, this determination will be made by implementing PSPs during the pre-design investigation (Section 3.1). In some cases, this may be unsafe, impractical or infeasible, in which event the determination of the nature and extent of contamination will be made after the HWMU/UST is removed.

- As discussed in the following paragraphs, a limited list of FRLs for COCs in Table 1-4 is widely applicable to soil and soil-like material (i.e., primary COCs), while a more inclusive list is applicable to certain areas (i.e., secondary COCs).

#### 2.1.3.1 Primary and Secondary Constituents of Concern

Primary COCs are considered to be the widespread contaminants which represent approximately 90 percent of the human health risk from soil. Secondary COCs are those which have localized contamination above the FRL, but the extent of contamination is limited to smaller areas or intermittent hits marginally above the FRL which may or may not reside entirely within the footprint of the primary constituents. Initial sitewide primary and secondary COCs are listed in Table 2-6.

This preliminary list is not intended to serve as a final list of COCs sitewide, and this list will be revised within each remediation area via the screening approach noted in Section 2.5.2.2. Area-specific constituents of concern (ASCOCs) will include both primary and secondary COCs, and are described in the following section.

#### 2.1.3.2 Area-Specific Constituents of Concern

ASCOCs will be established during the excavation design for each remediation area. ASCOCs represent the primary and secondary COCs that have been demonstrated to impact a specific work area and for which concentrations will be certified in that specific work area.

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The sitewide spatial extent of the constituents will be determined with respect to FRLs, Benchmark Toxicity Values (BTVs), and OSDF WAC. To illustrate the approach to this analysis, a series of maps (Appendix I) has been assembled using the RI/FS data which display the known distribution of contamination within the on-property remediation areas (Figure 1-3). These maps also indicate if a COC distribution is confined to a limited area or if it impacts larger areas. The ASCOCs for each of the remediation areas (Table 2-7) have been preliminarily identified based on the sample results represented by these maps, as augmented by process knowledge. Ecological COCs are also included in Table 2-7 to provide a complete, area-specific list of constituents that affect remediation, and are described further in the following section. A more thorough screening of COCs will be performed for each remediation area during the design phase.

### 2.1.4 Ecological Constituents of Concern

As part of the process of restoring the site to its final land use, DOE must ensure that ecological receptors are not adversely impacted by residual contamination that may remain after remediation is complete. Appendix C provides a means of ensuring the protection of ecological receptors by establishing a screening process for identifying ecological COCs. The results from this screening process are given in Table 2-7 as ecological COCs.

At the time of the Operable Unit 5 ROD, DOE recognized the need to evaluate the impact of contaminants to ecological receptors on and around the property. This was accomplished with the publication of the Sitewide Ecological Risk Assessment (SERA), which was conducted as part of the Operable Unit 5 RI. The SERA contains a preliminary evaluation of potential risks to all organisms that may be exposed to contaminants within Operable Unit 5, exclusive of humans and domestic animals.

Consideration of the information developed in the SERA was deferred when developing human health driven remediation goals (DOE 1995b). However, as negotiations with the FEMP Natural Resource Trustees progressed, it became clear that in order to resolve all trustee concerns, ecological impacts must also be considered before remedial activities are completed.

Appendix C was developed to accomplish this, using the SERA screening approach. For each potential ecological COC, a BTV was established. BTVs are literature-derived, media-specific concentrations that are considered protective of ecological receptors. Maximum sitewide concentrations were compared to these BTVs for all potential ecological COCs with FRLs higher than their corresponding BTV. After eliminating all potential ecological COCs where maximum concentrations were less than corresponding BTVs, the remaining ecological COCs were evaluated against anticipated remnant COC concentrations after soil excavation achieved FRL attainment. From these evaluations, a sampling strategy is established to investigate any ecological COCs that may be a concern after FRL-driven remedial activities have been completed.

The purpose of these sampling efforts will be to further characterize the concentrations of the ecological COCs at the completion of remediation. Because of the very conservative screening methodology used, post-excavation BTV exceedances do not necessarily indicate that impact to ecological receptors will occur. Instead, post-excavation exceedances indicate only that further investigation may be warranted. Therefore, FRL certification will not be dependent on characterization of ecological COCs. Appendix C provides details on the screening process.

### 2.1.5 Department of Energy Orders

U.S. Department of Energy (DOE) orders provide generic guidelines for residual radioactive material. Of particular interest in terms of soil excavation at the FEMP are those sections which relate to the size of CUs and sitewide criteria for radiological hot spots, and which specify As Low as Reasonably Achievable (ALARA) requirements. Other orders which affect soil excavation activities are listed in Appendix A and will be incorporated into the area-specific IRDPs.

#### 2.1.5.1 General Guidelines for the Size of Certification Units

Guideline levels of radionuclide contaminants are calculated levels that are expected to ensure protectiveness of human health and the environment. Guidelines are expressed in terms of activity per unit mass and are averaged over a predetermined area. Depending upon the regulatory agency, the methodology used to calculate the guidelines, the impacted medium, and the specific type of site, the area used as the basis for the cleanup guideline generally ranges from 100 to 10,000 square meters (or larger) for land areas.

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DOE guidelines for soil are defined as contaminant levels averaged over a surface area of 100 square meters (DOE Order 5400.5, Chapter IV, Section 4, Paragraph a). This surface area was originally adopted to ensure consistency of DOE decommissioning activities (in particular, the Uranium Mill Tailings Remedial Action Program) with the EPA mill tailings regulations (40 CFR 192) and the Nuclear Regulatory Commission (NRC) Branch Technical Position, "Disposal or On-Site Storage of Thorium or Uranium Wastes from Past Operations" (NRC 1981). With the exception of sites where the contaminant is mill tailings, an averaging area other than 100 square meters may be established as an integral condition of site-specific guidelines (DOE Order 5400.5, Chapter IV, Section 5, Paragraph a). Conditions and methods for establishing site-specific guidelines are provided in "A Manual for Implementing Residual Radioactive Material Guidelines" (DOE 1989). Development of the CU size during FEMP certification activities is discussed in Section 3.3.3.2.

2.1.5.2 Radiological Hot Spots

Potential radiation doses are influenced by contaminant distribution patterns. Subareas which are significantly smaller than the averaging area will result in a smaller potential dose than would result if the entire averaging area were contaminated at that level. The relationship between acceptable contaminant levels in small areas and the average guideline level varies, depending on the radionuclide, the exposure pathway and scenarios, and the size of the area. DOE Order 5400.5 requires that site-specific limits for such hot-spot areas be developed for situations where the contaminant level in any area of less than 25 square meters exceeds the average guideline level by a factor of $(100/A)^{0.5}$, where A is the area in square meters (DOE Order 5400.5, Chapter IV, Section 4, Paragraph a[1]). From this guidance, it is evident that small areas of residual activity exceeding the average guideline levels may be present while still ensuring that the basic dose criteria are met. The development of radiological hot-spot criteria for the FEMP is discussed in Sections 2.2.3 and 3.4.6, as well as Appendix G.

2.1.5.3 As Low As Reasonably Achievable Requirements

The ALARA philosophy states that potential radiological exposures should be kept as low as reasonably achievable. Therefore, radiological release criteria for equipment, structures, and environmental media must be established as part of the decommissioning planning process (DOE/EM-0246). The document "A Manual for Implementing Residual Radioactive Material Guidelines" (DOE

1989) is identified as the guidance document for developing DOE release criteria (DOE Order 5400.5, Chapter IV). In addition to being protective of human health and the environment, this guidance requires that socioeconomic and technical feasibility issues be considered when establishing ALARA levels for residual contamination. The guidance specifies that, for ALARA purposes, reasonable efforts must be made to remove residual contamination that exceeds 30 times the average guideline level (DOE Order 5400.5 and DOE/CH-8901).

The human-health-derived FRL for total uranium in more than 80 percent of on-property soil is 82 mg/kg. The HPGe instrument used for field measurements during the pre-excavation survey can identify areas of soil containing 50 mg/kg of uranium. Because this material is readily discernible and easily excavated, HPGe measurements can be used to establish the extent of excavation at 50 mg/kg uranium. The ALARA goal of 50 mg/kg will be used to guide the excavation plan development in areas where excavation is required as a result of soil exceeding the uranium FRL of 82 mg/kg, but it is not intended to replace the certification requirement, which will remain set at the FRL of 82 mg/kg in these areas.

## 2.2 ATTAINMENT OF REMEDIATION GOALS

Prior to final restoration of the site, the remediation goals established for soil excavation activities at the FEMP include: 1) WAC attainment, 2) FRL attainment, 3) hot-spot attainment, 4) RCRA-characteristic-waste compliance, 5) HWMU closure, and 6) UST closure. The general procedures for attaining these goals are discussed in the following paragraphs.

### 2.2.1 Demonstrating On-site Disposal Facility Waste Acceptance Criteria Attainment

The objective of compliance demonstration is to provide an acceptable level of confidence that a criterion, in this case WAC for the OSDF, has not been exceeded. WAC for the OSDF are presented in the WAC Attainment Plan for the OSDF (DOE 1998b). The WAC are based upon criteria established and approved in the Final ROD for Remedial Actions at Operable Unit 2 (DOE 1995f), the Final ROD for Remedial Actions at Operable Unit 5 (DOE 1996e), and the Operable Unit 3 ROD for Interim Remedial Action (DOE 1996g).

As indicated in these documents, the radiological/chemical WAC were generally developed by:

- Starting with an acceptable concentration of contaminants in the groundwater of the Great Miami Aquifer
- Making a series of conservative assumptions to determine, through transport modeling, the effective concentration of contaminants in the leachate from the OSDF that would produce the acceptable concentrations in the Great Miami Aquifer
- Making additional, conservative assumptions to determine the maximum average solid phase concentration, or total mass of contaminant, in the entire OSDF that would produce the leachate concentrations.

It is estimated that the assumptions used to develop the WAC for the OSDF provide at least an order of magnitude of conservatism in protecting human health and the environment. This built-in conservatism was acknowledged in the WAC Attainment Plan when establishing procedures to demonstrate attainment of WAC for the OSDF. For soil remediation activities, WAC attainment will be demonstrated with RI/FS data, predesign characterization data, real-time excavation-control monitoring of gamma radioactivity and organic vapor levels, and by verifying that the excavations were carried out in accordance with the conservative design specifications. Each excavation approach (Section 4.0) may use a unique combination of excavation sequence, field measurements, and analytical testing to demonstrate WAC attainment.

RI/FS and predesign characterization data will establish the area and depth extent of above-WAC material in all remediation areas, if present. The data will be collected using in situ high-purity germanium (HPGe) detectors, laboratory gamma-spectrometry and other analytical techniques for uranium, as well as laboratory analysis of discrete samples for technetium-99 and metal and organic COCs. The use of HPGe for Analytical Support Level (ASL) B measurements has been established in the "User's Guidelines and Measuring Strategies and Operational Functions for the Deployment of In Situ Gamma Spectrometry at the Fernald Site" (DOE 1998c), referred to as the User's Manual. Therefore, analytical data will be of sufficient quality (i.e., ASL B or higher) to demonstrate that all ASCOCs in soil are below WAC values. Normally, predesign data can be used to tighten the above-WAC excavation extent. However, the number of predesign analytical samples needed to establish the excavation extent will be determined by the nature and extent of ASCOCs and by balancing the cost between laboratory analysis and additional above-WAC soil excavation and disposition. Area-specific

sampling and analysis plans that address pre-excavation and excavation activities will be presented in the PSPs.

Predesign analytical results will be used to set the area and depth of excavation at the first sample location showing all ASCOCs in soil to be below their respective WAC values. For determining the area boundary, the first sample location with all ASCOCs below the WAC values means the nearest perimeter sample along a radial line to the center of the area. In determining the depth of excavation, the shallowest sample showing all ASCOCs below the WAC values will be used to establish the excavation floor. Additional information on the delineation of excavation volumes is provided in Section 3.1.3.

After selection of the samples which bound the excavation volume, the analytical results for these samples will be used in a kriging or appropriate 3-D interpolation model to develop an excavation boundary. The modeled boundary will be provided to engineering design to prepare a final construction drawing of the excavation. Final construction drawings will show the excavation as a series of cut steps located outside the modeled boundary. Because the modeled boundary will be based on sample results shown to be below the WAC values and the final construction drawing steps outward from this boundary, a very high level of confidence is placed in the approach to remove all above-WAC material prior to excavating material destined for the OSDF. After excavation is completed, a survey with NaI instruments or discrete measurements with the field HPGe will be conducted to demonstrate that the remaining soil is below the uranium WAC level. Details on WAC attainment compliance are provided in Section 8.0 of the WAC Attainment Plan (DOE 1998b).

### 2.2.2 Certifying Final Remediation Level Attainment

Another goal of the soil remediation activities at the FEMP is to remove contaminated soil such that the average residual concentration of any contaminant in a CU is at or below the respective FRL. Documentation of FRL attainment must provide an acceptable level of confidence that this has occurred. Complete, or 100 percent, confidence cannot be obtained because it is impossible to sample every cubic foot of soil and, even if it were, there would still be some level of uncertainty in the analytical results. Therefore, to provide a quantitative estimate of the probability that the average residual concentration of a contaminant in a CU does not exceed the respective FRL, it is necessary to

use statistical methods. Statistical methods provide for specifying (controlling) the probability of making decision errors and for extrapolating from a limited set of measurements to a specified area in a scientifically valid fashion. Appendix G provides a discussion of statistical methods to be applied to the certification process at the FEMP.

FRLs were developed during the RI/FS process for each operable unit in a manner similar to that used to develop WAC for the OSDF (DOE 1996e). The exception is that specific conditions outside the OSDF, including the hydrogeology and area-specific thickness of underlying formations, were used for the fate and transport modeling process in developing FRLs. Like the WAC for the OSDF, the assumptions used to determine the FRLs also provide a very significant level of conservatism in protecting human health and the environment.

To certify FRL attainment, evidence must be provided to demonstrate that the average concentration of any ASCOC does not exceed the respective FRL. Therefore, the general approach for demonstrating attainment of FRLs is to identify locations where contaminant concentrations exceed the FRL for any ASCOC, remove that material for disposition in the OSDF, and certify, with a specified level of confidence, that the average residual concentration of each ASCOC is below the respective FRL. Additional information on certification is provided in Section 3.4.

FRL attainment will be demonstrated using RI/FS and predesign characterization data, post-excavation NaI surveys and HPGe measurements, physical certification samples, and verifying that the excavations were carried out in accordance with conservative design specifications in a manner analogous to establishing the WAC excavation boundaries. FRL attainment for primary COCs will also be demonstrated with RTRAK and/or HPGe measurements during precertification activities prior to the sampling and analysis activities conducted during the final certification process.

### 2.2.3 Detection of and Criteria for Hot Spots

FRLs are designed to limit risks incurred by various human receptors from direct and indirect exposures to contaminants in a large area. These risks are calculated using the assumption that contaminants are distributed approximately uniformly across a source area. This assumption is the basis for assessing the residual concentration of contaminants within each CU. As described in

Section 3.4.4 and Appendix G, statistical methods will be used to determine the attainment status of the CU based on the average level of each ASCOC compared to the FRL. However, there is a finite possibility that small areas of elevated residual contamination (i.e., hot spots) will be missed by the sampling program. It is desirable to identify and remove these hot spots, if possible.

The concept of hot spots may be applied to all COCs. However, some primary COCs (Table 2-6) can be detected in situ using field scanning technologies and experience has shown that other secondary COCs at the site are often co-located with the primary COCs. This in situ scanning technology (DOE 1998c) provides an additional capability to look for hot spots in real time, which is beyond that normally used for chemical contaminants. A real-time capability allows the field survey teams to look for hot spots actively during precertification activities. By identifying and excavating hot-spots containing the primary COCs, this method also reduces the probability that hot spots of secondary COCs will remain.

Currently the radiological scanning instrumentation discussed in the User's Manual (DOE 1998c) allows hot spots of uranium, thorium-232, and radium-226 to be identified and delineated at values of two or three times their FRLs. An area average of three times the FRL will designate a hot spot when the area is smaller than 10 $m^2$, whereas two times the FRL will be used when the area is greater than 10 $m^2$. Specific detection limits of the HPGe instrument are also provided in the User's Manual. The proposed radiological scanning provides additional confidence that all primary COCs will be remediated to health protective levels.

Scanning as much of the remediated surface as possible will reduce the possibility that radiological hot spots are missed. However, such scanning may not be possible near obstructions such as trees and water, and in deep, narrow excavations, such as those for pipelines. In the case of deep excavations where scanning of side slopes may be difficult to impossible, additional emphasis will be placed on the collection of certification data from side slopes, benches, and the bottom of the excavation (Section 3.1.3).

2.2.4 RCRA Characteristic Waste Compliance

There are seven locations delineated where the potential exists for preferential treatment of soil that may exhibit the toxicity characteristic (Figure 1-5). Characteristic waste compliance under the SEP means that excavated soil exhibiting the characteristic of toxicity that is derived from any of the seven designated site RCRA areas will be segregated and treated prior to disposal. Toxicity characteristic waste from the South Field Firing Range will be sent off site for disposal in accordance with the Operable Unit 2 ROD. In these seven locations, the subsurface FRL excavation boundary will be established, and the areal footprint of the potential RCRA toxicity characteristic area will be extended to the subsurface FRL boundary to establish the volume of soil requiring screening via the 20-times rule or TCLP test for the toxicity characteristic to identify the need for treatment prior to disposal.

In each of the seven locations, discrete surface- and subsurface-soil samples will be collected as described in Section 3.1.3. Collected samples will undergo the 20-time rule screening and/or TCLP testing, and samples that fail the TCLP test will be used to determine the lateral extent and depth of the toxicity characteristic material. In addition, a contiguous area surrounding the administrative boundary of the defined source area (i.e., a boundary identified in the Operable Unit 5 ROD) will be investigated with the 20-times rule screening or TCLP test to ensure all above-TCLP material is identified for excavation. The excavation depth will be set at the first sample location below the deepest sample failing the TCLP test or the FRL boundary, whichever is shallower. The established depth will be extrapolated to the lateral extent of the waste characteristic footprint determined by surface samples, including the contiguous area, to set the volume of soil requiring treatment for the toxicity characteristic. Treatment prior to OSDF disposal may consist of in situ stabilization followed by excavation or excavation followed by on-site treatment. If a portion of this designated volume contains radiological COCs above the WAC, it will be excavated first and set aside for off-site treatment and disposal. The options for treatment and disposal of toxicity characteristic waste from the RCRA areas are shown on Figure 1-6. Excavated RCRA material will be containerized and placed on the Plant 1 Pad or an equivalent approved RCRA storage facility. If all samples pass the TCLP test, the excavation of soil in the location will be driven by WAC and FRL criteria, and no special treatment will be required prior to disposal.

### 2.2.5 Hazardous Waste Management Unit Closure

Twenty-nine (29) HWMUs at the FEMP remain to be closed under the CERCLA remedial response action (Table 2-1). RCRA regulations (40 CFR Part 265) and OEPA regulations (OAC Chapter 3745-66) describe closure requirements for various types of HWMUs, including tank systems, surface impoundments, waste piles, land treatment units, container storage areas, landfills, and miscellaneous units. These regulations require closure in a manner that

> . . . *controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.* (40 CFR 265.111 and OAC 3745-66-11)

This is generally required to be accomplished by removing the hazardous waste residues, and removing or decontaminating structures/equipment contaminated with the waste or leachate, contaminated containment system components, and contaminated soils.

Closure of a HWMU under the SCEP indicates that the constituents for which the waste managed in the unit was deemed hazardous, and for which the unit itself was declared a HWMU (COCs in Table 2-1), are below established site-specific FRLs in soil remaining in the HWMU footprint. The soil FRL attainment certification/closure process for a HWMU to be closed under the SCEP is briefly described in the next paragraph, then presented in a bullet format to serve as a check-list to facilitate future planning.

Predesign PSPs for soil remediation areas containing HWMUs will identify whether unit-specific COC sampling and analysis will be conducted during predesign to define/refine the extent of excavation. The IRDP for a particular soil remediation area (or that for a subdivided phase — e.g., Area 1, Phase II) will present findings of investigations to that point, reference those investigations, and present the excavation strategy for the area. The Certification Design Letter (CDL) for a soil remediation area will address each (if any) of the HWMUs contained therein, and the specifics of sampling and analysis required to satisfy demonstration of soil FRL attainment and closure. Discussion of the sampling design, analytical results, and the statistical analysis conducted for the HWMUs undergoing soil FRL

attainment certification/closure under the SCEP will be presented in a dedicated section of the area-specific Certification Report (Section 7.4).

The closure process for HWMUs will:

- Bound the needed excavation during the predesign investigation using predesign sampling and analysis as needed
- Complete above-WAC-driven excavation in the area first
- Complete large-scale FRL-driven excavation in the area second
- Delineate each HWMU footprint as a distinct CU
- Combine multiple HWMUs within a building footprint can be combined into a CU
- Provide details of the HWMU(s) certification/closure sampling approach in a dedicated section of the CDL (Section 7.3)
- Provide for at least eight physical samples from the HWMU footprint and sidewalls of the excavation (if present)
- Include the HWMU COCs (Table 2-1) in the CU-specific COC list developed for certification sampling and analysis
- Provide methodology for computing the upper confidence limit on the mean and comparing it to the soil FRL as the criterion for HWMU(s) certification/closure (Section 3.4.4)
- Provide discussion of the sampling and analytical results, and the statistical analysis, for the HWMU(s) certification/closure in a dedicated section of the Certification Report (Section 7.4)
- Include analytical results for the HWMU(s) in the Certification Report
- Document final closure of the HWMUs via Ohio EPA acceptance of the certification report for a soil remediation area containing HWMU(s).

### 2.2.6 Underground Storage Tank Closure

Thirteen (13) USTs remain in need of demonstrating soil FRL attainment and completion of closure under the CERCLA remedial response action. Like the HWMUs, all of these USTs are relatively shallow with respect to the anticipated depth of excavation to achieve FRLs; unlike most of the

HWMUs, all of these USTs are relatively small. Thus, the mechanism for demonstration of soil FRL attainment and completion of closure for an UST under the SCEP is analogous to that presented for HWMUs (i.e., substitute UST for HWMU, and Table 2-2 for Table 2-1). Completion of UST closure under the SCEP indicates that the hazardous constituents of its former contents (Table 2-2) are below established site-specific FRLs in soil remaining in the UST footprint.

## 2.3 GENERAL IMPLEMENTATION GUIDELINES

One of the purposes of the SEP is to establish guidelines for the implementation of remediation activities at the FEMP. Issues include remediation priorities, procedures for implementation of remediation activity, sequencing and coordination, planning for unexpected conditions, tracking of data, audit and assessment procedures, reporting requirements, and health and safety. Each of these is discussed in the following paragraphs.

### 2.3.1 Remediation Priorities

There are a variety of issues that drive and influence soil remediation activities at the FEMP and to avoid potential conflicts and unacceptable mixing of materials during the excavation, segregation, handling, and disposal processes, these issues have been prioritized as follows:

1. Health and Safety (Section 6.0)
2. WAC attainment (Section 2.2.1)
3. FRL attainment (Section 2.2.2).

The health and safety of personnel associated with remediation activities has to be the prime consideration during remediation activities. After that, removal, segregation, and proper disposal of material with the highest levels of contamination (e.g., above WAC) is of major importance. This priority is followed by removal, segregation and proper disposal of material with lower levels of contamination (e.g., FRLs). The final priority is the demonstration that long-term residual risk has been minimized by removal of material exceeding the FRLs. Additionally the ALARA concept is addressed during excavation of the above-FRL soils. Achievement of these goals will satisfy other related issues, including meeting ARARs and complying with DOE orders.

2.3.2 Implementation Procedures

Remedial action implementation under the scope of the SCEP includes all activities associated with planning, design, excavation, management, and disposition of at- and below-grade soil, structures, and debris at the FEMP. As described in Section 7.2, implementation plans, design, and construction specifications will be used to prepare area-specific IRDPs. Lessons learned during the Area 1, Phase I remediation project have been incorporated into the SEP. All future IRDPs developed pursuant to the SEP will incorporate lessons learned from previous projects. Based on the information contained in the IRDPs, construction contractor(s) will be selected to complete the excavation. The general construction implementation and material handling procedures are provided in Appendix F.

2.3.3 Sequencing and Coordination

Effective sequencing and coordination of remediation activities at the FEMP depend on a complex relationship between a wide variety of activities, including:

- D&D of above-grade facilities
- Construction of the OSDF
- Excavation of soil and at- and below-grade structures and debris
- Placement, and proper mix ratios of soil and debris, in the OSDF
- Schedules for waste pit and silo remediation activities
- Availability of storm water and remediation wastewater treatment capacity.

The objective of excavation activities is to remediate the FEMP in a safe, timely and cost-effective manner that is protective of human health and the environment, and the purpose of sequencing and coordination is to facilitate this objective. The following paragraphs describe how sequencing and coordination will occur on both a sitewide basis and within each remediation area during remediation activities.

2.3.3.1 Sitewide Sequencing Approach

The sitewide sequencing and coordination described in Appendix B will be protective of human health and the environment by minimizing potential exposure to contamination during remediation. In addition, sequencing will minimize the potential for cross-contamination and recontamination. These goals will be achieved by:

- Prioritizing the excavation of contamination source areas

- Excavating from upgradient toward downgradient surface drainage areas to prevent cross contamination and recontamination

- Controlling haul routes to minimize cross-contamination of all areas and recontamination of clean areas

- Using paved roads and dust control methods, to the extent practical, to minimize dust generation, avoid cross-contamination between areas, and prevent recontamination of clean areas.

Also, sitewide sequencing and coordination activities will be cost effective by:

- Minimizing double handling of material
- Establishing large work areas to provide efficient utilization of equipment
- Minimizing haul distances, to the extent possible
- Minimizing unneeded treatment of water from excavation activities
- Minimizing sheeting and shoring of excavated slopes.

The remediation areas and phases shown on Figure 1-3 and described in Appendix B were established to achieve the stated objective and implementation strategies.

2.3.3.2 Sequencing Within a Remediation Area

Excavation within each remediation area will, in general, be governed by the same objectives and implementation strategies upon which sitewide activities are based. In addition, excavation within each remediation area will generally progress by:

- Removing at- and below-grade foundations and structures and transferring them to the Waste Acceptance Operations (WAO) for decontamination, size reduction and disposition

- Removing material that exceeds WAC for the OSDF

- Removing underground utilities and plugging potential pathways for the migration of contaminants

- Removing material that exceeds FRLs.

This sequence is necessary to efficiently address remediation and to minimize the mixing of contaminated material that requires segregation because of different handling and disposition

requirements. Specific details regarding the sequencing and coordination of activities within each remediation area, as well as other site activities, will be included in the IRDPs (Section 7.2).

### 2.3.4 Contingency Plans

Contingency plans are required for unexpected conditions. The three general categories of unexpected events are:

1. Unearthing of materials that require special handling
2. Discovery of unexpected cultural or historic resources
3. Encountering environmental or material conditions that may pose a risk to human health or the environment if standard excavation practices are used.

Typically, these circumstances cannot be managed through standard excavation guidelines. The procedures to be used in these circumstances are described in Appendix F.

### 2.3.5 Material Information Tracking

It is important to track excavated material to provide an audit trail demonstrating proper handling and disposition. The Integrated Information Management System (IIMS) will be used to track excavated material, including its characterization data, from its original location, through interim staging/storage, to final disposition. The IIMS interfaces with the SED to retain connections to the RI/FS, historical, and newly generated data when excavated material is moved from the source location. The information data tracking system currently used at the FEMP is summarized in Section 2.5.2.

### 2.3.6 Quality Assurance

The programmatic QA controls that are applicable to the implementation of the SEP are described in the "Sitewide CERCLA Quality Assurance Project Plan" (SCQ; DOE 1993b) and SEP Quality Assurance Project Plan (QAPP) in Appendix E. The objective of the QAPP is to ensure FEMP and EPA QA/QC programmatic requirements flow down to PSPs, IRDPs, data quality objectives (DQOs), procedures, subcontracts and other documents necessary to control soil excavation activities. Independent assessments will be conducted through auditing, surveillance, inspections, and surveying practices that measure quality, performance, and process compliance. Objective evidence of assessment activities will be part of project records.

### 2.3.7 Reporting Requirements

The record keeping and reporting requirements for the SCEP remedial activities will be met through submission of four documents:

1. A Certification Report, demonstrating attainment of all remediation drivers for each remediation area

2. A Remedial Action Report, which transfers further closeout responsibilities after remedial activities in each operable unit are completed

3. A Site Closeout Report, which will summarize all of the Remedial Action Reports and certify that site remedial goals specified in the RODs have been achieved

4. The Natural Resource Restoration Design Package, which will specify the necessary restoration activities to achieve the final land use in the remediation area as defined in the NRRP.

Details regarding the contents of these documents are included in Section 7.0.

### 2.3.8 Health and Safety

Health and safety is a priority at the FEMP at all times, and especially during construction activities. To emphasize this, the subcontractor for each project will prepare a Safe Work Plan, which will describe how the work is to be performed, including training requirements, an analysis of hazards, procedures for exposure monitoring, and radiological requirements. The Safe Work Plan will be prepared in accordance with the contract documents utilizing the Project-Specific Health and Safety Requirements Matrix (PSHSRM). The PSHSRM is prepared by DOE's prime site management contractor as an aid in identifying hazards associated with the project. It includes a hazard analysis for each project task and required mitigators, such as personal protective equipment, engineering and administrative controls, planning and permits, personnel and air monitoring, medical monitoring and surveillance, and decontamination and disposal procedures. In addition, the prime DOE contractor will prepare a Project-Specific Health and Safety Plan (PSHASP), which will specify health and safety procedures to be used by the subcontractor and his subcontractors, as well as all personnel on the project site, including visitors, vendors, and prime contractor and DOE employees (DOE 1995h). More discussion regarding project health and safety is included in Section 6.0.

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## 2.4 MEASUREMENT APPROACHES

One primary task during a soil remediation project is to identify contaminated soil and to quantify the amount of contamination present. An array of field and laboratory instruments and methods will be used at the FEMP to accomplish this task. Each of the methods has advantages and disadvantages, and the selection of a method for a specific task is related to the ASCOC list and the task's DQOs. Specific remedial action applications are discussed below and a detailed presentation of field and laboratory instruments and their application is provided in Appendix H.

### 2.4.1 Remedial Action Applications

Soil remediation at the FEMP will require the collection of additional data on specific contaminants for many purposes. Some of the more important phases of data collection are listed below:

- Pre-Design Surveys and Sampling and Analysis - The nature and extent of contamination at the site must be quantified to delineate the excavation footprint and estimate the excavation volume. Characterization data will be used to plan the ultimate disposition of the material removed. Examples include soil containing more than 29.1 pCi/g technetium-99, soil from the seven areas with the potential to exhibit RCRA toxicity characteristics, and soil containing ASCOC concentrations that might exceed the OSDF WAC.

- Excavation Control Surveys - As surface soil is removed, the soil beneath it is exposed. In areas where the depth profiles of contaminant concentrations cannot be efficiently determined before excavation, information on the status of this residual soil must be gathered to determine whether the soil is above or below the removal criteria for that task. This information will be used in the decision to continue excavating or to stop at the current grade level and/or lateral extent.

- Precertification Surveys - Once excavation is complete in an area, the residual soil concentrations of the contaminants that governed the excavation can be determined. This information will be used to verify that the remediation objectives for the area have been met prior to initiating final certification activities.

- Certification Sampling and Analysis - After the precertification survey has indicated the remedial objectives have been met, additional data will be collected on physical samples to confirm this. This confirmatory data will be the data of record that defines the area's final status and will be used to certify that the area is suitable for release to its final land use.

Each of the phases listed above requires characterization of the concentrations and extent of COCs in soil and sediment. Data collection during each of these phases will be supported through a coordinated

and integrated combination of direct instrument measurements in the field and laboratory analysis. Table 2-8 presents a list of the data collection phases and the measurement methods that can be used during each remediation phase. Instrumentation and survey methods will be selected based on area-specific physical conditions and COCs, and the selected approach will be presented in each IRDP. Appendix H presents details on the analytical methods and a summary of design considerations that will be incorporated into the selection process.

### 2.4.2 Field Measurements

Field measurements will be performed to identify and quantify (ASL A or ASL B) many of the sitewide COCs listed in Table 2-6 during the predesign, excavation, and precertification phases of the remediation. NaI detectors (a.k.a. gross beta/gamma friskers, RSS and RTRAK) and the in situ high-purity germanium detectors (a.k.a. HPGe) will be used routinely to identify and quantify isotopes of uranium, thorium, and radium (i.e., the primary COCs). The screening process to be used with these instruments is described in the User's Manual (DOE 1998c). A field portable x-ray fluorescence instrument is capable of screening for metals and can be useful as a quantitative tool when metal concentrations of interest are significantly higher (e.g., WAC levels) than the detection limit of the instrument. Photoionization detectors (PIDs) and/or immunoassay techniques will be used to screen for the presence of volatile organic compounds and specific organic compounds at all excavation locations. Several of the secondary COCs listed in Table 2-6 can only be detected or quantitated by sampling and analysis (e.g., plutonium-238, technetium-99, strontium-90, fluoride, dieldrin, etc). Additional information on the capability and application of field and laboratory instruments is provided in Appendix H.

### 2.4.3 Discrete Sampling and Laboratory Analysis

Although effective guidance is provided by field measurements, final remedial and certification decisions for ASCOCs will be linked directly to analytical laboratory determinations. Field data will help ensure the optimum use of laboratory analysis, including identification of the appropriate analytical requirements and performance. Table 2-8 summarizes the anticipated use of laboratory analytical methods during remedial activities.

Gamma spectroscopy is the easiest laboratory method for quantifying the primary radiological COCs listed in Table 2-6 because sample digestion is not required prior to analysis. However, other analytical techniques may be more appropriate (e.g., alpha spectroscopy or ICP/MS) if a low minimum detectable activity (MDA) is required or if large batches of samples are submitted. In the case of a large batch of samples (e.g., 20 samples), alpha spectroscopy or ICP/MS may provide a turn-around time more rapid than gamma spectroscopy. Radiochemistry laboratories are generally set up with 20 or more detectors to count alpha decay while their capability for counting gamma photons is limited to several detectors. In a similar fashion, mass measurements using the ICP/MS are carried out very rapidly relative to gamma spectroscopy once the samples have been digested and prepared for analysis. Therefore, the time spent preparing the sample for alpha spectroscopy or ICP/MS is recovered by the simultaneous count or short analytical time of 20 or more samples. Additional information on laboratory techniques and their application are provided in Appendix H.

Alpha spectroscopy can be used to quantify uranium and thorium isotopes of interest as well as the secondary COCs plutonium-238 and neptunium-237, after a chemical digestion and separation is performed to isolate the element of interest. For beta emitting isotopes (e.g., strontium-90, technetium-99, radium-228, etc) liquid-scintillation and gas-proportional counting techniques are used to quantify beta emitting isotopes following the digestion and chemical separation of the element. Additional information on the methods and applications is provided in Appendix H.

For metal and organic COCs, the common laboratory methods of interest are inductively coupled plasma atomic emission spectroscopy (ICP) and gas chromatography/mass spectroscopy (GC/MS). These techniques will be used to quantify the secondary COCs listed in Table 2-6. Additional information on the instruments and capabilities are provided in Appendix H.

The number of laboratory samples and the ASCOCs to be analyzed will be determined in the area specific PSPs, IRDPs, and CDLs. In accordance with the requirements of the SCQ, the sampling plans will specify the appropriate number and type of QA/QC samples to be collected, based on the analytical methods and number of samples. Samples collected for analysis will be submitted to an approved laboratory and analyzed for the indicated contaminants at ASL B when sampling is used to support the pre-excavation and excavation activities and at ASL D for certification. Additional

information on the use of ASLs to support remediation activities is provided in the SEP QAPP (Appendix E).

2.4.4 Design Considerations for Area-Specific Measurement Approach

The selection of the instrumentation and measurement approach will depend on a number of considerations including:

- Which COCs are in the area? Certain analytical techniques are better suited to quantify some COCs, while other technologies will be better for others. For example, uranium concentrations can be characterized in soil using gamma spectroscopy, alpha spectroscopy, and ICP/MS, whereas plutonium-238 is limited to alpha spectroscopy.

- What is the appropriate number of samples to collect? The number of samples required to satisfy the sampling program's objectives is determined by the specific COCs expected in the area and their projected distribution. As a general rule, areas with a history of past contamination, or areas with a heterogeneous concentration distribution will require more samples per unit area to characterize them than will areas with no history of contamination or with a homogeneous distribution. Further guidance on determining the appropriate number of certification samples is provided in Appendix G.

- What is the lowest detection limit that is acceptable? If the purpose of the measurements are to determine if uranium concentrations in surface soil are above or below the WAC, the HPGe or portable XRF instruments can be used to determine the uranium concentration. If the purpose is to certify the remediation area as being below the FRL of applicable COCs, then sampling and analysis will be needed to meet MDAs and MDLs.

- What are the physical conditions in the area? Very rough terrain, trees, structures, and steep slopes may preclude the use of vehicle mounted measurement systems like the RTRAK. Gamma spectroscopy systems calibrated for planar (flat) geometries will not give reliable results in trenches or pits unless properly calibrated for those geometries.

- What are the data quality objectives of the data collection program? The data quality objectives of a program will determine which methods are acceptable. For example, if the purpose of the data collected is to screen samples to determine if they require special handling, ASL A quality data will be sufficient. If the purpose of the program is to provide predesign information on COCs all data must meet acceptance criteria for ASL B. When certifying the remediation area for FRL attainment, all data must meet acceptance criteria for ASL D. Additional details on specific ASLs applied to the remediation activity are presented in the SEP QAPP (Appendix E).

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- How quickly will the analytical results be needed? A rapid turn-around time may limit the number of analytical options available. Additionally, the batch size submitted for analysis must be considered when turn-around time is important (see the example given for alpha versus gamma spectroscopy under Section 2.4.3).

When the COCs have been selected, the MDAs and MDLs determined, and validation criteria have been set, the SCQ will specify which analyses are acceptable and set the sampling and analytical criteria. Table E-2 in Appendix E of this Plan provides a quick reference guide to pertinent sections of the SCQ, and Appendix H provides details on matching instruments to remediation activities.

## 2.5 LOGISTICS

Several logistical issues are important to implementing soil remediation activities at the FEMP. These include:

- Accounting for area-specific conditions
- Data queries associated with the SEP
- Dealing with data gaps
- Handling perched water, deep pile foundations, and subsurface utility lines
- Managing deep pile foundations
- Managing subsurface utility lines
- Cross-contamination/recontamination
- Handling special materials
- Capacity of the OSDF
- Concerns with off-site shipments
- Weather
- Access to off-property areas
- Grading and restoration.

Each of these issues is discussed in the following paragraphs.

### 2.5.1 Area-Specific Conditions

Because of its size and complexity, the SEP cannot address all of the area-specific conditions anticipated at the FEMP. Therefore, the SEP only provides programmatic guidance and area-specific conceptual approaches for completion of excavation activities. The IRDPs for individual excavation projects will provide details of project-specific activities, issues, and conditions (Section 7.2).

### 2.5.2 Sitewide Environmental Database

The SED was created to serve as a central repository for all environmental data collected in support of RI/FS and remediation activities. In addition to this central repository, there are several related but distinct data subsets or tables contained within the same database system. This section of the SEP will discuss the subsets of the SED and present the screening approach to be employed for compiling the list of ASCOCs.

#### 2.5.2.1 Subsets of the SED

The subsets of the SED that are of interest to performing COC screening for the SEP include the live SED tables, frozen RI datasets, historical soil data, and the construction management data (CMD) set. Each subset is defined and briefly described below.

Live SED Tables

These are the core data tables in the SED, into which all data entry and electronic data loading is done. The intent is to maintain this dataset as the most complete and up-to-date set of environmental and remediation data possible. If properly documented corrections are required, they are made in these tables with sufficient backup records that document the changes. New data is continually added to these tables.

Frozen RI Datasets

These datasets were developed in accordance with criteria that was established for the respective operable unit. The Operable Unit 2 RI data was first assembled in the live SED tables and then copied into 'frozen' tables upon completion of Operable Unit 2 RI report. The Operable Unit 5 RI data, which includes some Operable Unit 2 samples, was first assembled in the live SED, then exported to finalize the Operable Unit 5 RI and finally, in June 1994, exported back to the SED into 'frozen' tables. 'Frozen' means the data in the tables is not changed. The purpose of these tables is to have an electronic snapshot of the data that was used to create the RI.

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Historical Soil Data

There are overlaps among the previously described datasets. All of the Operable Unit 5 and Operable Unit 2 samples also remain in the live SED. In addition, a large number of the Operable Unit 2 samples were included in Operable Unit 5. In large measure the overlapping samples are the same in each dataset. However, there are some differences due to:

- Different or changing validation criteria
- New information requiring a correction to an existing sample (not a common occurrence)
- Historical data from other identified sources
- Differences in the way calculated "Uranium, Total" was used.

For these reasons it became apparent that some effort was required to standardize the data that was to be used in the soil remediation design.

The Historical Soil tables represent the best efforts to incorporate all soil samples collected on site into one comprehensive data set to support remedial design activities. Data that was included in these tables included Operable Unit 5 RI, Operable Unit 2 RI, SED, removal actions, and project data. In order to present a clear summary of the in situ soil conditions, Operable Unit 5 and Operable Unit 2 results were excluded from these tables based only on the following:

- Excavated sample
- Geotechnical sample
- TCLP sample
- Analytical data were rejected in data validation
- Multiple samples collected from the same depth (highest validated result used)
- Samples collected from the waste pit berms
- Sludge samples.

Summary reports can be generated that demonstrate the extent of the changes for each COC.

Construction Maintenance Database

The Construction Maintenance Database (CMD) set contains data that was collected in support of various construction projects that were conducted at the FEMP. This data was not collected in support of any RI/FS activity, was not validated and previously had not been entered into the SED. This data was entered into the SED in 1996 in order to supplement existing soil data.

### 2.5.2.2 Screening Approach for Waste Acceptance Criteria and Final Remediation Level Area-Specific Constituents of Concern

The proposed methodology for screening soil data to generate a move conservative list of ASCOCs for WAC and FRL attainment involves defining a set of search criteria (i.e., media, project, area, depth of samples, parameters) and then applying these criteria to the live SED tables (which contain all subsets and newly acquired data). The proposed query criteria are as follows:

1) The entire remediation area will be considered.

2) All soil and sediment results will be queried, including results from areas where soil or sediment has been removed by a remedial action.

3) All detection limit values will be reported at the detection limit value (i.e., detection limit values will not be halved)

4) When field duplicate samples are reported, the highest value will be passed forward for evaluation.

5) When multiple results exist for the same sample (e.g., off-site and on-site analyses), the highest value is selected, with preference given to validated data.

6) TCLP results are considered in and around the seven designated RCRA toxicity characteristic areas.

7) When available, the total uranium calculated from the uranium isotopes is used, otherwise the mass uranium total is used.

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COCs returned by implementing these query criteria will be retained as ASCOCs if they exceed WAC or FRL levels. However, the number of samples requiring characterization and the type of analysis to perform for each COC will be determined on an area-by-area basis and documented in the PSPs.

### 2.5.3 Data Gaps

As demonstrated in the RI/FS reports and RODs for the various operable units, the RI/FS data are generally sufficient for determining the nature and extent of contamination at the FEMP and for selecting the remedy. However, there are known deficiencies associated with these data that will affect remedial design. For instance:

- Data for previously sampled material that has been moved or removed through removal actions and other activities remain in the SED. Although conditions at the source areas may have changed as a result of removal action, this information will be used to establish the list of potential COCs.

- Data for many COCs may be reported at detection limit values that exceed FRL or WAC levels. These values will be retained as part of the COC screening process.

As other deficiencies are identified, they will be considered in the design process. In addition, all data gaps will be used to focus PSPs implemented during the predesign investigation, the results of which will then supplement the existing RI/FS data to fill in the identified data gaps and deficiencies. Revisions and additional data will be presented in the area-specific IRDPs and reflected in the remedial designs.

### 2.5.4 Perched Water

Perched water will be encountered during excavation in most areas of the FEMP, depending on the depth of excavation. Perched water control actions will include:

- Investigate potential perched water yield, quality, and AWWT facility compatibility in the excavation area during the predesign investigation

- Schedule deep excavations in high-yield areas during dryer seasons (if possible)

- Collect perched water by using dewatering wells (i.e., pressure relief), interception trenches, and/or sumps within or around the excavated area to maintain the working area as dry as possible

- Delineate and sequence deep excavation zones to simplify potential dewatering needs and to prevent recontamination of an excavated area by inflow of perched water from adjacent unexcavated areas

- Consider potential impacts of perched water on excavation stability during the design process

- Prevent full penetration of the glacial till layer overlying the GMA to minimize the introduction of perched water into the GMA (Note: deep excavations that penetrate the unsaturated sand and gravel above the GMA will be lined with clay)

- Minimize mixing of perched water from different stratigraphic levels until sampling and analysis have determined the treatment option

- Coordinate treatment schedule and capacity requirements with the AWWT facility

- Provide efficient and cost-effective transport systems to send the collected water to designated treatment and/or discharge points (e.g., maximize the use of existing, overland, mobile, and/or reusable piping/hoses, pumping, and/or trucking systems)

- Suspend excavation when the collection, storage, and/or treatment capacities are exceeded

- Provide engineering details of the perched water control system in the area-specific IRDPs

- Document the perched water volume and water quality information collected during excavation

- After receiving regulatory approval of the certification report, divert storm water via existing or new drainage channels to Paddys Run and stop the local perched water collection systems (Note: selected deep excavation areas will not be backfilled after certification and will be maintained as ponds that are fed by precipitation and perched water).

In addition, some contaminated, perched water zones present an unacceptable threat to the underlying aquifer. Remediation activities will involve excavation of soil in these zones. All perched water,

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including surface water and rainfall that is mixed with perched water, will be treated at the Advanced Wastewater Treatment (AWWT) facility.

The need for pretreatment of remediation-generated wastewater (i.e., storm water, perched water, and decontamination water), and the appropriate main treatment loop of the AWWT (i.e., Phase I and Phase II), will be evaluated during the design process using the AWWT's wastewater acceptance guidelines based on NPDES permit requirements, and coordinated with the AWWT facility.

Anticipated FEMP remediation wastewaters containing RCRA F-listed spent solvent constituents (e.g., perched water from the Sludge Drying Beds and Fire Training Facility areas, Hazardous Waste Management Unit decontamination water, and containerized wastewaters presently in inventory) meet the conditions in the Hazardous Waste Mixture Rule Exclusion [OAC 3745-51-03(a)(2)(e) and 40 CFR 261.3(a)(2)(iv)]. These wastewaters are not principal wastewater streams, are small in nature relative to the primary wastewater flow (i.e., storm water and groundwater), and generally contain concentrations of spent solvents far below the "after mixing" thresholds discussed in the rule. Therefore, these wastewaters can be appropriately managed as a wastewater exempted from RCRA listing through the on-site wastewater treatment system. More specifically, wastewaters that contain organic contaminants at concentrations below the thresholds discussed in the Hazardous Waste Mixture Rule Exclusion will be treated directly through the Phase II AWWT without pretreatment. Phase II AWWT includes carbon filtration capable of treating volatile organic compounds in these wastewaters.

For the purposes of demonstrating compliance with the Hazardous Waste Mixture Rule Exclusion thresholds, any unanticipated waste streams identified during future predesign investigations that contain significant concentrations of F-listed spent solvents will be held in the Surge Lagoon. The FEMP has identified the Surge Lagoon as the head works of the Phase II AWWT and the flow-through capacity of the Phase II AWWT system for those waste streams discharged on a more continuous basis. These identifications are necessary as they will be the basis for evaluating mixing of individual waste streams, some of which may contain concentrations of F-listed spent solvents above the stated thresholds.

The IRDPs will describe expected locations, depth, quantity, quality, and treatment requirements (if any) for perched water, as well as procedures to minimize potential impacts to the underlying Great Miami Aquifer during excavation activities, for each project.

### 2.5.5 Deep Pile Foundations

Several buildings in Remediation areas 3 and 4 have pile foundations that extend to a considerable depth below grade and below any known soil contamination. In Area 3, Building 1A (Preparation Plant) and the Plant 1 Conveyor Pit have sheet piles potentially extending to 33 feet below grade. Similarly, in Area 3, Building 10A (Boiler House) has pile foundations extending approximately 40 feet below the surface, as well as a multi-level basement at least 30 feet below grade. In Area 4, the former Plant 8A Thorium Silos (silos removed) have pile foundations that potentially extend 22 feet below grade.

Because of their depth, none of these pile foundations are expected to be readily removable. If the piles can be removed, it will not be feasible to obtain measurements or collect samples to the full depth of excavation, because the sands of the Great Miami Aquifer will collapse as the piles are removed. In addition, removal of the pile foundations could provide an enhanced pathway for contaminant transport. Finally, any groundwater contamination in the Great Miami Aquifer associated with the piles will be remediated by the aquifer restoration project.

If, for technical reasons, some deep pilings cannot be removed, each piling will be addressed on a case-by-case basis. Factors to be considered when deciding to leave in place or remove a piling include:

- The technical difficulties in removing the piling
- Process knowledge about the mobility and quantity of potential contaminants
- Analytical results from soil borings surrounding the piling
- The final grade of the excavation.

Potential impacts associated with this approach will be reviewed during the remedial design phase, and any necessary modifications will be made at that time and described in the appropriate IRDP.

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2.5.6 Subsurface Utility Lines

Subsurface utility lines include storm, sanitary, water, electric, gas, and sump lines. Excavation of utilities will include the utility lines themselves and backfill material, which typically consists of sand or gravel and extends below the lines. As described in Appendix F, active utilities within excavation areas will be either permanently shut off and/or rerouted prior to any excavation activities.

2.5.7 Cross-Contamination/Recontamination

Cross-contamination is defined as elevated levels of contamination from one location being transported to another area where the contamination did not previously exist or was not previously present at the elevated concentration. Recontamination is the cross-contamination of remediated locations. The transport of this contamination can occur through wind erosion, wind-blown dust generated by excavation-related activities, vehicular traffic, and/or storm water run-on. As described in Section 2.3.3.1, a major consideration in the sequencing of remediation activities is to minimize cross-contamination and recontamination. A comprehensive material inventory and tracking system has been developed to provide assurance that cross-contamination and recontamination will be minimized.

The basic elements of the material inventory and tracking system are as follows:

- All remediation, construction, and maintenance projects are required to generate a project waste identification document (PWID) during project planning activities.
- PWID development includes a review of the SED and a determination of the character of the waste streams to be encountered. The source location, profile number, estimated volume, and planned disposition for each anticipated waste stream are identified on the PWID.
- Unique Material Tracking Location (MTL) numbers are used in conjunction with gridded project drawings to designate each source location and any stockpiles where excavated material will be staged.
- PWIDs are reviewed and approved by the SCEP Project Manager.
- Administrative controls will ensure routine application of the PWID planning process to projects not directly associated with SCEP by linking generation of a PWID to the

issuance of the FEMP's well-recognized internal penetration permit. This will extend control to the occasional maintenance-type actions that occur outside of the soil remediation project.

The actual movement of waste material is preceded by the preparation of a Field Tracking Log (FTL) which identifies the source and destination MTL as well as the volume of material moved. These FTL are completed by WAO field representatives who monitor ongoing work activities.

Data from the PWID, the MTL locations, and the FTL are all recorded into an electronic database (the IIMS) which ties the SED data to the stockpile placement via the FTL. IIMS reports can list the volume in each stockpile, the source of the material in a stockpile, and the SED data associated with the material in the stockpile. Other reports can also track where excavated soils were staged during project activities.

The stockpile control system requires perimeter fencing and color-coded placards. The placard identifies the MTL number, status of the staged material relevant to the OSDF WAC, a contact name and phone number, and the statement "No unauthorized use". These requirements apply to stockpiles sitewide. However, the requirements do not apply to "working stockpiles" (e.g., excavated soils staged for backfill upon completion of the activity) unless they remain inactive for 45 days or more. The stockpile management approach will:

- Define clear project responsibilities regarding stockpile management through clear site procedures
- Establish a full inventory of all the existing stockpiles and track future movement of materials in and out of the stockpiles through the IIMS
- Provide color-coded designations and physical access controls for all non-working stockpiles to prevent mixing of materials
- Provide sufficient dust and runoff controls of all stockpiles
- Use underlying geotextile or infiltration barrier when necessary

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- Conduct sufficient WAC attainment characterization, including multi-phase physical sampling, potential TCLP tests, and statistical analysis before the final excavation and disposal of the Removal Action 17 stockpiles

- After removal of a stockpile, remediate and certify underlying soil with COCs identified in the pile if an infiltration barrier was not installed under the pile

- Establish unloading, loading, and/or decontamination procedures for the centralized above-WAC pile and the OSDF staging area.

Other controls directed at wind and water erosion include application of cover (e.g., crusting agent, vegetation or tarp) to stockpiles that are inactive for 45 days or more. Appendix F contains additional details on seeding requirements to minimize erosion and cross contamination. The above-listed requirements for excavated materials under this SEP supersede the documentation and data management methods for those materials under the Removal Action 17 Work Plan.

### 2.5.8 Special Materials

The following materials, if encountered during excavation activities, will require special handling because of operational or health and safety concerns:

| | |
|---|---|
| Asbestos | Transformers |
| Lead acid batteries | Medical/infectious waste |
| Miscellaneous debris | Pressurized containers |
| Piping | Tires |
| Nonpressurized containers | Uranium metal |
| Non-soil residues | Brick, including acid brick |

Some special materials will be eligible for disposition in the OSDF but may first require physical processing, sampling and analysis, or interim containerization. The remainder will be dispositioned off site. Protocols for handling special materials are described in the conceptual waste disposition process described in Section F.5 of Appendix F.

2.5.9 Capacity

The capacity of the OSDF is limited. Therefore, care must be taken during excavation activities to minimize the amount of soil and debris being dispositioned to the OSDF, while attaining FRLs in a cost-effective manner. These goals will be accomplished by:

- Supplementing, as necessary, RI/FS characterization data with predesign investigation data to allow, as much as practical, the extent of excavation to be sufficiently defined during remedial design
- Excavating to the levels defined by the remedial design, then using field measurement methods, as much as practical, to control additional excavation
- Precertifying the attainment of FRLs to identify areas of elevated levels of contaminants that may require further attention (i.e., additional localized excavation) before certification sampling (Section 3.4).

Remediation activities are discussed further in Section 3.0. The area-specific conceptual models of excavation presented in Section 4.0 are designed to attain FRLs in as cost-effective and timely manner as possible. This will be accomplished by minimizing the amount of below-FRL material that is dispositioned to the OSDF and by minimizing the amount of costly re-excavation and certification activities that would be required by initial failure to attain FRLs.

2.5.10 Off-Site Shipments

It is expected that a certain amount of material will be transported to one or more off-site facilities for final disposition and/or treatment and final disposition. This is material that exceeds the WAC for the OSDF (Tables 2-4 and 2-5) and has one or more of the following characteristics:

- Is prohibited from disposal in the OSDF
- Does not meet the physical criteria of the OSDF
- Is toxicity-characteristic waste from one of the six Operable Unit 5 areas shown on Figure 1-5 that cannot be cost-effectively treated for disposal in the OSDF
- Exceeds one or more of the other OSDF chemical or radiological WAC.

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The primary issues regarding off-site shipments are:

- Obtaining in advance of initiating transportation off site, and optimally prior to making off-site treatment/storage/disposal contract arrangements, a determination of acceptability under the CERCLA Off-Site Rule (40 CFR §300.400) for a potential receiving facility.

- Obtaining in advance an exemption from DOE Order 5820.2A for disposal of low-level waste at other than a DOE facility; no such exemption is needed for mixed waste.

- Meeting the LDR requirements for any hazardous waste, or the hazardous components of mixed waste.

- Meeting the waste acceptance criteria of the receiving facility, and attendant information and documentation to demonstrate such [e.g., sampling in conformance with off-site facility requirements, completion of the off-site facility's waste profile form(s) and other coordination with the off-site facility for waste stream acceptance in advance of preparing the waste for transport.

- Properly manifesting, packaging, labeling, marking, and placarding waste, in accordance with EPA and/or U.S. Department of Transportation requirements, before transporting low-level, mixed, or hazardous waste off site for either treatment or disposal.

- Contracting with a transportation firm(s) with the proper license(s) and/or permit(s).

### 2.5.11 Weather

The wide range of potential weather conditions at the FEMP can pose operational concerns during remediation activities. Such conditions include heat, cold, heavy rain, drought, snow and ice, high winds, and tornadoes. In general, construction operations during or pursuant to these conditions will be addressed in the FEMP subcontractor's Safe Work Plan, which is required by the contract documents. Health and safety issues regarding these conditions will be addressed in the PSHSRM and PSHASP prepared for each project (Section 6.0).

In addition to these conditions, some winterization activities may be required. Winterization encompasses those activities necessary to ensure that an excavation area can be re-entered with minimal time needed for construction to restart. Winterization requirements are described in Appendix F.

### 2.5.12 Access to Off-Property Areas

Permission to access off-property areas will be required prior to obtaining samples during the predesign investigations, and may also be required during remedial action. Such areas include, but are not limited to:

- Area 9 Phase II adjacent to the STP, where samples will be collected, excavation might be required in support of deep excavation requirements at the STP, and remediation of contamination might be required.
- The area east of the STP to the Great Miami River, where samples will be collected, excavation will be required to remove the abandoned outfall line, and additional excavation might be required to remediate contamination.
- The area adjacent to the northeast corner of the site (Area 9, Phase I), where samples will be collected and remediation of contamination might be required (Figures 1-3 and 1-4).

A procedure for access to off-property areas requiring certification will be developed by DOE and EPA in cooperation with the affected property owner. In general, this procedure should require that:

1) Proper permits be obtained through the FEMP Real Estate Department

2) NEPA requirements are reviewed by the FEMP Natural and Cultural Resource Program to ensure all areas designated for ground disturbing activities met the intent of the NEPA

3) The Advisory Council on Historic Preservation be notified if there will be adverse effects on historic properties

4) FEMP Construction, Engineering, Planning, and Bidding review all necessary documentation relevant to remedial actions

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5) Permission is obtained from the off-property owner prior to performing any remedial action.

The DOE is committed to the development of a good relationship with the nearby property owners during the planning, design, and implementation of any remedial action. Therefore, the DOE will work with the EPA and the property owners to schedule information meetings during the design process that will keep the property owner cognizant of proposed remedial actions. The information meetings should discuss a quick decision making process for the off-site certification issues, ways to reduce off-site impacts from on-site activities, and regular updates of site activities by FEMP public relations personnel.

The applicable IRDP will, as appropriate, describe the need for access to off-property areas and account for necessary permitting and approval times in the schedule. Off-property areas will be handled as part of the remediation of the adjacent, on-property area, to the extent possible. As necessary, separate IRDP(s) for off-property areas will be prepared.

### 2.5.13 Grading and Restoration

The DOE has made the commitment to accelerate the restoration of natural resources into the remediation process whenever possible. Areas that have been accelerated to the certification process are listed in Table 1-5 and discussed in Appendix B. The development of restoration guidelines is generally a three-phase process that will end with establishing vegetation to develop the proposed habitat for the final land use. The three major phases include:

- Rough or interim grading, to be performed after certification
- Final grading, to include the use of borrow material, additional excavation, placement of topsoil, and construction of required drainage features
- Habitat development, to include planting vegetation for the proposed land use.

The last two steps will be guided by the area-specific NRRDP. Each of these phases is detailed in Appendix F.

# TABLE 2-1

## HWMUs TO BE CLOSED UNDER CERCLA

| | HWMU IDENTIFICATION AND DESCRIPTION[1, 2] | | SCEP REMEDIATION AREAS | SCEP REMEDIATION ACTION | HWMU COCs OR RCRA CHARACTERISTICS[1, 6] | FINAL REMEDIATION LEVEL COCs[3] | OSDF WAC[4] OR RCRA TC COCs |
|---|---|---|---|---|---|---|---|
| **HWMUs TO BE CLOSED BY SCEP** | | | | | | | |
| 41 | Sludge Drying Beds | Inactive land-based surface impoundments that are part of the sanitary wastewater treatment system; managed wastewater treatment sludges which contained listed spent solvent. No spills are recorded. | 1 Phase II | SCEP to demonstrate soil FRL attainment and certify closure | Tetrachloroethene | Tetrachloroethene[6] | N/A[6] |
| 11 | Tank Farm Sump | Inactive land-based surface impoundment unit. Sump was used to collect and neutralize waste acid. No soil was identified to indicate pH <2. Spills (from leaking drums stored in area) are recorded. | 3 | SCEP to demonstrate soil FRL attainment and certify closure | Corrosive (low pH) | N/A | N/A |
| 20 | Plant 1 Storage Pad | Active outdoor and indoor container storage area. Paved outdoor portion with partial secondary containment berm system presently only manages containers without free liquids; indoor portion with secondary containment system manages containers with free liquids. Spills are recorded. | 3, 4b | SCEP to demonstrate soil FRL attainment and certify closure | Methylene Chloride | Methylene Chloride[6] | N/A[6] |
| | | | | | Tetrachloroethene | Tetrachloroethene[6] | N/A[6] |
| | | | | | 1,1,1-Trichloroethane | 1,1,1-Trichloroethane[6] | N/A[6] |
| | | | | | Xylene | Xylene[6] | N/A[6] |
| | | | | | Barium | Barium[6] | N/A[6] |
| | | | | | Lead | Lead[6] | N/A[6] |
| | | | | | Additional constituents TBD dependent on documented waste codes stored[6] | TBD[5] | TBD[5] |
| 36 | Storage Pad North of Plant 6 | Inactive outdoor paved container storage area without secondary containment berm system. Managed containers with free | 4a | SCEP to demonstrate soil FRL attainment and | 1,1,1-Trichloroethane | 1,1,1-Trichloroethane[6] | N/A[6] |
| | | | | | Lead | Lead[6] | N/A[6] |

# TABLE 2-1
# (Continued)

| | HWMU IDENTIFICATION AND DESCRIPTION[1, 2] | | SCEP REMEDIATION AREAS | SCEP REMEDIATION ACTION | HWMU COCs OR RCRA CHARACTERISTICS[1, 6] | FINAL REMEDIATION LEVEL COCs[3] | OSDF WAC[4] OR RCRA TC COCs |
|---|---|---|---|---|---|---|---|
| 4 | Drum Storage Area Near Lab Bldg. Loading Dock | Inactive outdoor unpaved (during active life) container storage area without secondary containment system. Managed containers with free liquids. No spills are recorded. Unit has documented soil contamination from roofing tar. Area is presently overlain by concrete due to loading dock expansion. | 4b | SCEP to demonstrate soil FRL attainment and certify closure | Corrosive (low pH) | N/A[6] | N/A[6] |
| | | | | | Benzene | Benzene[6] | N/A[6] |
| | | | | | Tetrachloroethene | Tetrachloroethene[6] | N/A[6] |
| | | | | | Toluene | Toluene[6] | N/A[6] |
| 10 | Nitric Acid Recovery (NAR) System Components | Inactive tank system, primarily indoor with single outdoor tank; indoor and outdoor components have secondary containment system. Stored waste nitric acid. Spills are recorded. | 4b | SCEP to demonstrate soil FRL attainment and certify closure | Corrosive (low pH) | N/A[6] | N/A[6] |
| | | | | | Chromium | Chromium IV[6] | N/A[6] |
| 14 | Box Furnace | Inactive outdoor furnace/ incinerator unit; has structurally sound flooring pad, but no secondary containment berm system. Managed only solid materials; burned rags and gloves contaminated by spent solvents. No spills are recorded. | 4b | SCEP to demonstrate soil FRL attainment and certify closure | Tetrachloroethene | Tetrachloroethene[6] | N/A[6] |
| | | | | | 1,1,1-Trichloroethane | 1,1,1-Trichloroethane[6] | N/A[6] |
| | | | | | Trichloroethene | Trichloroethene[6] | N/A[6] |
| | | | | | Barium | Barium[6] | N/A[6] |
| | | | | | Chromium | Chromium IV[6] | N/A[6] |
| | | | | | Lead | Lead[6] | N/A[6] |
| | | | | | Silver | Silver[6] | N/A[6] |
| 17 | Plant 8 East Pad | Inactive outdoor paved container storage area with secondary containment system. Managed containers with free liquids. Spills are recorded. | 4b | SCEP to demonstrate soil FRL attainment and certify closure | Ignitable (Xylene) | Xylene[6] | N/A[6] |
| | | | | | Methyl Ethyl Ketone | N/A[6] | N/A[6] |
| | | | | | Lead | Lead[6] | N/A[6] |
| 18 | Plant 8 West Pad | Inactive outdoor paved container storage area with secondary containment system. Managed containers with free liquids. Spills are recorded. | 4b | SCEP to demonstrate soil FRL attainment and certify closure | Ignitable (Xylene) | Xylene[6] | N/A[6] |
| | | | | | Methyl Ethyl Ketone | N/A[6] | N/A[6] |
| | | | | | Lead | Lead[6] | N/A[6] |



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# TABLE 2-1
## (Continued)

| HWMU IDENTIFICATION AND DESCRIPTION[1, 2] | | | SCEP REMEDIATION AREAS | SCEP REMEDIATION ACTION | HWMU COCs OR RCRA CHARACTERISTICS[1, 6] | FINAL REMEDIATION LEVEL COCs[3] | OSDF WAC[4] OR RCRA TC COCs |
|---|---|---|---|---|---|---|---|
| 22 | Abandoned Sump West of Pilot Plant | Inactive tank system. Sump contents failed TCLP for metals. Spills (leakage from the sump) are recorded.<br><br>NOTE: Also identified as an area where the soils might be RCRA toxicity characteristic hazardous for barium and lead. | 4b | SCEP to demonstrate soil FRL attainment and certify closure | Benzene<br>Tetrachloroethene<br>Barium<br>Chromium<br>Lead<br>Mercury | Benzene<br>Tetrachloroethene<br>Barium<br>Chromium IV<br>Lead<br>Mercury | N/A<br>Tetrachloroethene<br>Barium (by TCLP)<br>N/A<br>Lead (by TCLP)<br>Mercury |
| 5 | Drum Storage Area South of W-26 | Inactive outdoor unpaved container storage area without secondary containment system. Managed containers with free liquids. No spills are recorded. Unit has documented soil contamination from roofing tar. | 4b, 5 | SCEP to demonstrate soil FRL attainment and certify closure | Lead<br>Mercury | Lead[6]<br>Mercury[6] | N/A[6]<br>N/A[6] |
| 1 | Fire Training Facility | Inactive land-based miscellaneous unit; fire training exercise area, used oil and listed spent solvents were spread on ground and ignited. Spills are recorded. Soil contamination previously excavated under Removal Action 28. | 6 | SCEP to demonstrate soil FRL attainment and certify closure | 1,1,1-Trichloroethane<br>Toluene | 1,1,1-Trichloroethane[6]<br>Toluene[6] | N/A[6]<br>N/A[6] |
| 27 | Waste Pit 4 | Inactive land-based land disposal unit. No spills are recorded. | 6 | SCEP to demonstrate soil FRL attainment and certify closure | Barium | Barium | N/A |
| 42 | Waste Pit 5 | Inactive land-based land disposal unit. No spills are recorded. | 6 | SCEP to demonstrate soil FRL attainment and certify closure | 1,1,1-Trichloroethane<br>Other possible characteristic constituents TBD during removal of waste pit contents[6] | 1,1,1-Trichloroethane<br>TBD[5] | N/A<br>TBD[5] |

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# TABLE 2-1
## (Continued)

| | HWMU IDENTIFICATION AND DESCRIPTION[1, 2] | | SCEP REMEDIATION AREAS | SCEP REMEDIATION ACTION | HWMU COCs OR RCRA CHARACTERISTICS[1, 6] | FINAL REMEDIATION LEVEL COCs[3] | OSDF WAC[4] OR RCRA TC COCs |
|---|---|---|---|---|---|---|---|
| **HWMUs TO BE CLOSED BY FC&DP** | | | | | | | |
| 19 | CP Storage Warehouse (Butler Building) | Active indoor container storage area with secondary containment system. Manages containers with and without free liquids. Spills are recorded. | Not Applicable (3) | None; clean closure by FC&DP; D&D report to certify closure | Constituents TBD dependent on documented waste codes stored[6] | N/A [6] | N/A [6] |
| 34 | KC-2 Warehouse | Active indoor container storage area with secondary containment system. Manages containers with and without free liquids. Spills are recorded. | Not Applicable (3) | None; clean closure by FC&DP; D&D report to certify closure | Constituents TBD dependent on documented waste codes stored[6] | N/A [6] | N/A [6] |
| 35 | Plant 9 Warehouse | Active indoor container storage area with secondary containment system. Sealant applied prior to initiating strorage of hazardous waste in 1990. Manages containers with and without free liquids, equipped for storage of ignitible liquids. Spills are recorded. | Not Applicable (3) | None; clean closure by FC&DP; D&D report to certify closure | Constituents TBD dependent on documented waste codes stored[6] | N/A[6] | N/A[6] |
| 37 | Plant 6 Warehouse | Active indoor container storage area with secondary containment system. Sealant applied prior to initiating strorage of hazardous waste in 1989. Manages containers with and without free liquids, equipped for storage of ignitible liquids. Spills are recorded. | Not Applicable (4a) | None; clean closure by FC&DP; D&D report to certify closure | Constituents TBD dependent on documented waste codes stored[6] | N/A[6] | N/A[6] |
| 15 | Oxidation Furnace #1 | Inactive indoor furnace/ miscellaneous unit with cracked, pitted and heavily stained flooring pad but only a partial secondary containment diking system (where two ancillary scrubber liquid pumps were located). Managed materials with free liquids. No spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | 1,1,1-Trichloroethane | N/A [6] | N/A[6] |

# TABLE 2-1
## (Continued)

| | HWMU IDENTIFICATION AND DESCRIPTION[1, 2] | | SCEP REMEDIATION AREAS | SCEP REMEDIATION ACTION | HWMU COCs OR RCRA CHARACTERISTICS[1, 6] | FINAL REMEDIATION LEVEL COCs[3] | OSDF WAC[4] OR RCRA TC COCs |
|---|---|---|---|---|---|---|---|
| 25 | Plant 1 Storage Building | Inactive indoor paved container storage area without secondary containment system. Managed containers with free liquids. No spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Ignitability | N/A[6] | N/A[6] |
| 28 | Trane Thermal Liquid Incinerator | Inactive indoor incinerator unit, with outdoor ancillary above-ground one-tank tank system and two outdoor paved container storage areas. Indoor components with structurally sound flooring pad; outdoor tank system and one container storage area with secondary containment system, other without. Stored then burned oil containing lead and listed spent solvents. No spills are recorded; however, potential yellow cake in immediate area. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | 1,1,1-Trichloroethane | N/A[6] | N/A[6] |
| | | | | | Lead | N/A[6] | N/A[6] |
| 29 | Plant 8 Warehouse | Active indoor container storage area with secondary containment system. Sealant applied prior to initiating strorage of hazardous waste liquids in 1996. Manages containers with and without free liquids. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Constituents TBD dependent on documented waste codes stored[6] | N/A[6] | N/A[6] |
| 33 | Pilot Plant Warehouse | Active indoor container storage area with secondary containment system. Herculite diking constructed prior to initiating storage on liquids in 1992. Manages containers with and without free liquids. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Constituents TBD dependent on documented waste codes stored[6] | N/A[6] | N/A[6] |



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# TABLE 2-1
# (Continued)

| | HWMU IDENTIFICATION AND DESCRIPTION[1, 2] | | SCEP REMEDIATION AREAS | SCEP REMEDIATION ACTION | HWMU COCs OR RCRA CHARACTERISTICS[1, 6] | FINAL REMEDIATION LEVEL COCs[3] | OSDF WAC[4] OR RCRA TC COCs |
|---|---|---|---|---|---|---|---|
| 46 | UNH Tanks - NFS Storage Area | Inactive outdoor five-tank above-ground tank system with secondary containment system. Stored corrosive UNH. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Corrosive (low pH) | N/A [6] | N/A [6] |
| | | | | | Barium | N/A [6] | N/A [6] |
| | | | | | Chromium | N/A [6] | N/A [6] |
| | | | | | Lead | N/A [6] | N/A [6] |
| | | | | | Mercury | N/A [6] | N/A [6] |
| 47 | UNH Tanks - North of Plant 2A | Inactive outdoor three-tank above-ground tank system with secondary containment system. Stored corrosive UNH. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Corrosive (low pH) | N/A [6] | N/A [6] |
| | | | | | Barium | N/A [6] | N/A [6] |
| | | | | | Chromium | N/A [6] | N/A [6] |
| | | | | | Lead | N/A [6] | N/A [6] |
| | | | | | Mercury | N/A [6] | N/A [6] |
| 48 | UNH Tanks - Southeast of Plant 2A | Inactive outdoor one-tank above-ground tank system with secondary containment system. Stored corrosive UNH. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Corrosive (low pH) | N/A [6] | N/A [6] |
| | | | | | Barium | N/A [6] | N/A [6] |
| | | | | | Chromium | N/A [6] | N/A [6] |
| | | | | | Lead | N/A [6] | N/A [6] |
| | | | | | Mercury | N/A [6] | N/A [6] |
| 49 | UNH Tanks - Digestion Area (2 locations) | Inactive indoor eight-tank above-ground tank system with secondary containment system. Stored corrosive UNH. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Corrosive (low pH) | N/A [6] | N/A [6] |
| | | | | | Barium | N/A [6] | N/A [6] |
| | | | | | Chromium | N/A [6] | N/A [6] |
| | | | | | Lead | N/A [6] | N/A [6] |
| | | | | | Mercury | N/A [6] | N/A [6] |

# TABLE 2-1
## (Continued)

| | HWMU IDENTIFICATION AND DESCRIPTION[1, 2] | | SCEP REMEDIATION AREAS | SCEP REMEDIATION ACTION | HWMU COCs OR RCRA CHARACTERISTICS[1, 6] | FINAL REMEDIATION LEVEL COCs[3] | OSDF WAC[4] OR RCRA TC COCs |
|---|---|---|---|---|---|---|---|
| 50 | UNH Tanks - Raffinate Building (2 locations) | Inactive indoor four-tank above-ground tank system with secondary containment system. Stored corrosive UNH. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Corrosive (low pH) | N/A [6] | N/A [6] |
| | | | | | Barium | N/A [6] | N/A [6] |
| | | | | | Chromium | N/A [6] | N/A [6] |
| | | | | | Lead | N/A [6] | N/A [6] |
| | | | | | Mercury | N/A [6] | N/A [6] |
| 54 | Thorium Nitrate Tank (T2) | Inactive outdoor one-tank above-ground tank system with secondary containment system. Stored corrosive thorium nitrate. Spills are recorded. | Not Applicable (4b) | None; clean closure by FC&DP; D&D report to certify closure | Corrosive (low pH) | N/A [6] | N/A [6] |
| | | | | | Cadmium | N/A [6] | N/A [6] |
| | | | | | Chromium | N/A [6] | N/A [6] |

**NOTES:**

(1) Sources: Table 1-1, HWMU Identification, OU5 FS (DOE 1995b); and Terry Hagen, October 30, 1995 memo, M:EC:95-0071, titled "Hazardous Waste Management Unit/CERCLA Constituents of Concern" and its attached table entitled "RCRA COCs for Active and Inactive Units to be Closed Under CERCLA/RCRA Integrated Process" (October 17, 1995).
(2) Source: HWMU Release History, T. Spradlin to M. Strimbu Memorandum, June 24, 1997; based upon retrieval from Release History file.
(3) Source: Table 9-3, Final Remediation Levels for Soil, OU5 ROD (1996e).
(4) Source: Table 4-1, On-Site Disposal Facility Waste Acceptance Criteria (WAC), FEMP OSDF Impacted Materials Placement Plan (DOE 1998a); else, "(by TCLP)" means by concern for RCRA Toxicity Characteristic (TC), where TCLP is the Toxicity Characteristic Leaching Procedure.
(5) Specific RCRA waste COCs are yet to be determined dependent on documented waste codes managed/stored in these HWMUs.
(6) Potential for RCRA waste COC to be present in soil is low. Source: Table 4-68, Hazardous Constituents in Hazardous Waste Management Units (HWMUs) and Soil, OU5 RI (DOE 1995e).

CERCLA Comprehensive Environmental Response, Compensation and Liability Act
COCs Constituents of Concern
D&D report individual project completion report for the above-grade decontamination & dismantlement project
FC&DP Facility Closure and Demolition Project
FRL Final Remediation Level
HWMU Hazardous Waste Management Unit(s)
N/A Not applicable
OSDF On-Site Disposal Facility
RCRA Resource Conservation and Recovery Act
SCEP Soil Characterization and Excavation Project
TBD To be determined
TC Toxicity Characteristic
TCLP Toxicity Characteristic Leaching Procedure
UNH Uranyl nitrate hexahydrate
WAC Waste Acceptance Criteria

000123

# TABLE 2-2

## USTs TO BE CLOSED UNDER CERCLA

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| **TANKS CLOSED BY REMOVAL — DEMONSTRATION OF SOIL FRLs ATTAINMENT NEEDED** | | | |
| **RAILROAD ENGINE HOUSE - BUILDING 24B** | | | |
| **UST-3** | **Remediation Area: 3**<br><br>**Former Location:**<br>25 feet NE of Railroad Engine House (Bldg. 24B)<br><br>**Fomer Volume: 12,500 gallons**<br><br>**Former Size:**<br>10 foot diameter x 21 foot length; steel<br><br>**Former Accessories:**<br>Pump located immediately S of tank | **Material: Diesel Fuel**<br><br>**COCs:**<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br>Mercury . . . . . (FRL; OSDF WAC)<br><br>**Reference MEFs: 203, 584** | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRLs Attainment Needed.**<br><br>Tank removed. Soil samples taken during tank removal had elevated concentrations of BETX, TPH and Lead. An additional 530 cubic yards of soil was removed from the UST-3 pit based on visual staining, petroleum odors and headspace analysis vs. background. Hydrocarbon contamination also found under train tracks in upper 3 feet of soil (tracks ran to W side of pit to engine house and E side pit) and soil was excavated to headspace criteria. Excavation was backfilled with clean gravel.<br><br>Results from post-excavation soil sampling conducted at 20-foot intervals. Results for Lead (<4.7-12 mg/kg) were below the established FRL; BETX constituents were not detected; TPH was 28-112 mg/kg (no FRL established). [Source: UST-3 Tank Closeout Report (DOE 1992a)]. |

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| **MAINTENANCE SHOP - BUILDING 12** | | | |
| **UST-6** | **Remediation Area: 3**<br><br>**Former Location:**<br>1 foot N of Maintenance Shop (Bldg. 12)<br><br>**Former Volume:** 1,000 gallons<br><br>**Former Size:**<br>4 foot diameter x 12 foot length; steel<br><br>**Former Accessories:** N/A | **Material:** Gasoline<br><br>**COCs:**<br>Acetone . . . . . (FRL; no OSDF WAC)<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Carbon Tetrachloride . . . . . (FRL; no OSDF WAC)<br>1,2-Dichloroethane . . . . . (FRL; no OSDF WAC)<br>1,1-Dichloroethene . . . . . (FRL; OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Methyl Chloride . . . . . (no FRL; no OSDF WAC)<br>Methyl Ethyl Ketone . . . . . (no FRL; no OSDF WAC)<br>Tetrachloroethene . . . . . (FRL; OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>1,1,1-Trichloroethane . . . . (no FRL; no OSDF WAC)<br>Trichloroethene . . . . . (FRL; OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Arsenic . . . . . (FRL; no OSDF WAC)<br>Cadmium . . . . . (FRL; no OSDF WAC)<br>Chromium . . . . . (FRL as VI; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br>Mercury . . . . . (FRL; OSDF WAC)<br>Selenium . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 501, 1616, 1618, 1672, 2746, 10026 | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRLs Attainment Needed.**<br><br>Tank removed. Analytical results from 3 soil samples collected (selected based on highest PID levels) from the excavation indicated Lead (5.98-8.85 mg/kg), Toluene (5.4 $\mu$g/kg) and Xylene (11.8 $\mu$g/kg) are below established FRLs; Benzene (< 5.0 $\mu$g/kg) and Ethylbenzene (<5.0 $\mu$g/kg) were below detection limits, and below established FRLs; TPH was <10.0 mg/kg (no FRL established). [Source: Closure Assessment Report for Petroleum USTs (DOE 1991a)]. |

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| **PLANT 1 TRUCK DOCK** | | | |
| **UST-11** | **Remediation Area:** 4b<br><br>**Former Location:**<br>Buried under gravel approximately 6 feet E of Plant 1 Truck Dock and S of Bldg. 1. Also 2 feet N of UST-12 and 2 feet S of Plant 1 cyclone fence.<br><br>**Former Volume:** 3,000 gallons<br><br>**Former Size:**<br>5½ foot diameter x 18 foot length; steel<br><br>**Former Accessories:**<br>Tank piping ran N under cyclone fence, then approximately 10 feet to gas pump. | **Material:** Kerosene, Gasoline<br><br>**COCs:**<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Methyl Isobutyl Ketone . . . (no FRL; no OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>1,1,1-Trichloroethane . . . . (no FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Arsenic . . . . . (FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Chromium . . . . . (FRL as VI; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br>Mercury . . . . . (FRL; OSDF WAC)<br>Selenium . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 345, 492, 1408 | **REMOVED — Demonstration of Soil FRLs Attainment Needed.**<br><br>USTs-11, -12, and -13 were in poor condition upon removal. Soils surrounding USTs -11, -12, and -13 were sampled in 1990 upon completion of tank removal. Results for Benzene (342 μg/kg), Toluene (519 μg/kg), Ethylbenzene (2,920 μg/kg), Xylene (11,400 μg/kg), and Lead (19.7 mg/kg) are below established FRLs; maximum TPH was 1,810 mg/kg (no FRL established). [Source: Underground Storage Tanks Removal Site Evaluation (DOE 1991b)].<br><br>In 1991, additional soil excavation extended to approximately 11 feet deep and horizontally until structural constraints or non-petroleum hydrocarbon contamination discovered - 5,000 square feet with estimated volume of 2,000 cubic yards of soil. *No soil sampling conducted following 1991 excavation.* [Source: USTs-11, -12 and -13 Closure Report (DOE 1993c)].<br><br>The following is from R.E. Tiller 2/11/1992 letter to USEPA & OEPA: *During 1991 excavation, pocket of fly ash and rubble found approximately 50 feet E of tank cluster at 9 foot depth. Inconsistent organic vapor reading led to soil sampling. Results indicated presence of acetone and methanol* (could not find results in file) [NOTE: Acetone—FRL; no OSDF WAC; Methanol—no FRL; no OSDF WAC]. Also evidence of petroleum-contaminated soils underneath Plant 1 Truck Dock. |



000125

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| UST-12 | **Remediation Area:** 4b<br><br>**Former Location:**<br>Approximately 6 feet E of Plant 1 Truck Dock and S of Bldg. 1. Also 2 feet S of UST-11.<br><br>**Former Volume:** 3,000 gallons<br><br>**Former Size:**<br>5½ foot diameter x 18 foot length; steel<br><br>**Former Accessories:**<br>Tank piping ran across UST-11, under cyclone fence, then approximately 10 feet to gas pump. | **Material:** Gasoline<br><br>**COCs:**<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 492, 6055 | **REMOVED — Demonstration of Soil FRLs Attainment Needed.**<br><br>See entry for UST-11. |
| UST-13 | **Remediation Area:** 4b<br><br>**Former Location:**<br>Approximately 25 feet E of Plant 1 Truck Dock and 40 feet S of Bldg. 1 cyclone fence.<br><br>**Former Volume:** 3,000 gallons<br><br>**Former Size:**<br>5½ foot diameter x 18 foot length; steel<br><br>**Former Accessories:**<br>Pump and remote fill at N end of paved road S of tank | **Material:** Kerosene, Gasoline<br><br>**COCs:**<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Methyl Isobutyl Ketone . . . (no FRL; no OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>1,1,1-Trichloroethane . . . . . (FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Arsenic . . . . . (FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Chromium . . . . . (FRL; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br>Mercury . . . . . (FRL; OSDF WAC)<br>Selenium . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 345, 492, 1408 | **REMOVED — Demonstration of Soil FRLs Attainment Needed.**<br><br>See entry for UST-11. |

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| **GARAGE - BUILDING 31** | | | |
| **UST-1** | **Remediation Area: 5**<br><br>**Former Location:**<br>Centerline approximately 51 feet E of Garage (Bldg. 31).<br><br>Tank was buried approximately 1½ feet beneath a ½ foot concrete slab.<br><br>**Former Volume:** 1,500 gallons<br><br>**Former Size:**<br>8 foot diameter spherical tank; fiberglass<br><br>**Former Accessories:**<br>Piping from top of UST-1 to aboveground gasoline pumps and a 2 inch vent line from UST-1 to UST-2 and to Bldg. 31. | **Material:** Unleaded Gasoline<br><br>**COCs:**<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br>Mercury . . . . . (FRL; OSDF WAC)<br><br>**Reference MEFs:** 181, 60053 | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRLs Attainment Needed.**<br><br>USTs -1, -2, -8, -9, -10 removed in concert. Soil excavated to maximum depth of 11 feet within footprint of the 5 tank cluster. Horizontal excavation continued until a physical constraint was encountered. Final excavation covered approximately 6,000 square feet of surface area. Excavated volume estimated at 2,500 cubic yards of soil.<br><br>9 soil samples (based on highest PID levels) were collected in 1990 when the tanks were removed but prior to final soil excavation. Results for Benzene (1,210 $\mu$g/kg), Toluene (382 $\mu$g/kg), Ethylbenzene (1,190 $\mu$g/kg), Xylene (1,1300 $\mu$g/kg), and Lead (35.6 mg/kg) are below established FRLs; TPH was 656 mg/kg (no FRL established). *No samples were collected during excavation; no post-excavation samples were collected.*<br><br>USTs-1, -2, -8, -9 and -10 Closure Report (DOE 1993d) concluded that only minor residual petroleum contamination remained after excavation. Since USTs were located in an area with significant uranium contamination and further excavation was impractical, any additional remediation would be conducted under CERCLA. |

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| UST-2 | **Remediation Area:** 5<br><br>**Former Location:**<br>Centerline approximately 51 feet E of Garage (Bldg. 31).<br><br>Tank was buried approximately 1½ feet beneath a ½ foot concrete slab.<br><br>**Former Volume:** 1,500 gallons<br><br>**Former Size:**<br>8 foot diameter spherical tank; fiberglass<br><br>**Former Accessories:**<br>Piping from top of tank to aboveground gasoline pumps and 2 inch vent line from UST-2 to UST-1 | **Material:** Unleaded Gasoline<br><br>**COCs:**<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br>Mercury . . . . . (FRL; OSDF WAC)<br><br>**Reference MEFs:** 181, 60053 | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRL Attainment Needed.**<br><br>See entry for UST-1. |
| UST-8 | **Remediation Area:** 5<br><br>**Former Location:**<br>12 feet NE of Garage (Bldg. 31).<br><br>Tank was buried under 8 inch concrete slab with 2 foot x 2 foot 8 inch concrete dispensing pump foundation extending above pavement at N end of tank.<br><br>**Former Volume:** 1,000 gallons<br><br>**Former Size:**<br>4 foot diameter x 12 foot length; steel<br><br>**Former Accessories:**<br>Remote fill line ran from tank to 10 feet W of tank | **Material:** Leaded Gasoline<br><br>**COCs:**<br>Acetone . . . . . (FRL; no OSDF WAC)<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Methyl Ethyl Ketone . . . . . (no FRL; no OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Arsenic . . . . . (FRL; no OSDF WAC)<br>Selenium . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 183, 487 | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRLs Attainment Needed.**<br><br>See entry for UST-1. |

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| UST-9 | **Remediation Area: 5**<br><br>**Former Location:**<br>8½ feet from NE corner of Garage (Bldg. 31).<br><br>¾ of tank was buried under an 8 inch concrete pad.<br><br>**Former Volume:** 1,000 gallons<br><br>**Former Size:**<br>4 foot diameter x 12 foot length; steel<br><br>**Former Accessories:**<br>Remote fill line - tank to E wall of garage | **Material:** Diesel Fuel<br><br>**COCs:**<br>Acetone . . . . . (FRL; no OSDF WAC)<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Methyl Ethyl Ketone . . . . . (no FRL; no OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Arsenic . . . . . (FRL; no OSDF WAC)<br>Selenium . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 131, 487, 60331 | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRL Attainment Needed.**<br><br>See entry for UST-1. |
| UST-10 | **Remediation Area: 5**<br><br>**Former Location:**<br>Centerline approx. 43½ feet E of Garage (Bldg. 31).<br><br>Tank was buried beneath 2 gas pumps on concrete pad.<br><br>**Former Volume:** 3,000 gallons<br><br>**Former Size:**<br>5½ foot diameter x 18 foot length; steel<br><br>**Former Accessories:**<br>Concrete pump island with 2 pumps directly over tank | **Material:** Leaded Gasoline<br><br>**COCs:**<br>Acetone . . . . . (FRL; no OSDF WAC)<br>Methylene Chloride . . . . . (FRL; no OSDF WAC)<br>Trichlorofluoromethane . . . (no FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** N/A; See MSDS | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRLs Attainment Needed.**<br><br>See entry for UST-1. |

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| UST-5 | **Remediation Area:** 5<br><br>**Former Location:**<br>Approximately 10 feet E of Garage (Bldg. 31).<br><br>**Former Volume:** 200 gallons<br><br>**Former Size:**<br>2½ foot diameter x 6 foot length; steel | **Material:** Wastewater from Oil/Water Separator - contained hydraulic oil, motor oil, gasoline, diesel fuel and cleaning solvents (such as 1,1,1-Trichloroethane @ 6.3-6.9 mg/kg)<br><br>**COCs:**<br>Acetone . . . . . (FRL; no OSDF WAC)<br>Aroclors/PCBs . . . . . (FRL; no OSDF WAC)<br>Benzene . . . . . (FRL; no OSDF WAC)<br>Carbon Tetrachloride . . . . . (FRL; no OSDF WAC)<br>Cyclohexanone . . . . . (no FRL; no OSDF WAC)<br>1,2-Dichloroethane . . . . . (FRL; no OSDF WAC)<br>1,1-Dichloroethene . . . . . (FRL; OSDF WAC)<br>Ethylbenzene . . . . . (FRL; no OSDF WAC)<br>Ethyl Ether . . . . . (no FRL; no OSDF WAC)<br>Methylene Chloride . . . . . (FRL; no OSDF WAC)<br>Methyl Ethyl Ketone . . . . . (FRL; no OSDF WAC)<br>Methyl Isobutyl Ketone . . . (no FRL; no OSDF WAC)<br>Tetrachloroethene . . . . . (FRL; OSDF WAC)<br>Toluene . . . . . (FRL; no OSDF WAC)<br>1,1,1-Trichloroethane . . . . (no FRL; no OSDF WAC)<br>Trichloroethene . . . . . (FRL; OSDF WAC)<br>Trifluorochloromethane . . . (no FRL; no OSDF WAC)<br>Xylene . . . . . (FRL; no OSDF WAC)<br>Arsenic . . . . . (FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Cadmium . . . . . (FRL; no OSDF WAC)<br>Chromium . . . . . (FRL as VI; no OSDF WAC)<br>Lead . . . . . (FRL; no OSDF WAC)<br>Mercury . . . . . (FRL; OSDF WAC)<br>Selenium . . . . . (FRL; no OSDF WAC)<br>Silver . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 386, 1616, 1618, 1672, 1832, 10026, 10031, 30046, 60115, 60329, 60342 | **REMOVED — UST Removal Action appears to meet FRL criteria; Demonstration of Soil FRLs Attainment Needed.**<br><br>Tank reclassified from HWMU to SWMU (based on Waste Water Treatment Unit exemption); tank removed; soil removed during tank excavation was placed back into hole because no visibly contaminated soils were present [Source: USTs-5, -7, -14 and -17 Closeout Report (DOE 1995h)].<br><br>Soil samples were collected in 3/1990 after rainwater flowed into the tank after it had been uncovered. These sampling results were erroneously summarized in the UST-5 Removal Site Evaluation (RSE) (DOE 1993e) and USTs-5, -7, -14 and -17 Closeout Report (DOE 1995h). Review of analytical data indicates that results for rain water in tank and soil were switched in Table 1 of the RSE (and carried over into Closeout Report). As a result, these reports state that 1,1,1-Trichloroethane was detected in soils when the analytical data from the laboratory reports (included as Attachment 1 of the RSE) indicates that it was not detected. Results for Xylene (32 $\mu$g/kg), Barium (100 mg/kg), Arsenic (5.50 mg/kg), Cadmium (0.285 mg/kg), Chromium (20.7 mg/kg), Lead (11.1 mg/kg), and Silver (0.119 mg/kg) are below established FRLs; Benzene, Ethylbenzene and Toluene were not detected; Methanol (195 $\mu$g/kg) was detected but has no established FRL. No other semi-volatile or volatile organic compounds were detected in the soil. |



1621
000130

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| **HEAVY EQUIPMENT BUILDING - BUILDING 46** | | | |
| UST-17 | **Remediation Area:** 5<br><br>**Former Location:**<br>Approximately 10 feet N of Heavy Equipment Building (Bldg. 46).<br><br>**Former Volume:** 200 gallons<br><br>**Former Size:**<br>2½ foot diameter x 6 foot length; steel | **Material:** Waste Oil from Oil/Water Separator<br><br>**COCs:**<br>Acetone . . . . . (FRL; no OSDF WAC)<br>1,1,1-Trichloroethane . . . . . (FRL; no OSDF WAC)<br>Barium . . . . . (FRL; no OSDF WAC)<br>Selenium . . . . . (FRL; no OSDF WAC)<br><br>**Reference MEFs:** 123, 124, 60035<br><br>**SWMU - Not regulated by BUSTR** | **REMOVED — Demonstration of Soil FRsL Attainment Needed.**<br><br>Tank and concrete slab above tank was removed (slab was at 8 foot depth) - tank was in very poor condition and, upon removal, water inside tank emptied into the excavation (water accumulated after tank was emptied of its contents). Water in excavation was immediately removed and drummed. Soils that came into contact with water or that were discolored were excavated — 3 drums with Lot code W050-741-P011-0395. [Source: USTs-5, -7, -14 and -17 Closeout Report (DOE 1995h)].<br><br>Soil samples were collected prior to excavation. Results for Xylene (27 $\mu$g/kg) and Lead (29.7 mg/kg) were below established FRLs; Benzene, Toluene and Ethylbenzene were not detected; maximum TPH was 3,300 mg/kg (no FRL established); no other volatile or semi-volatile organic compounds were detected in the soil samples. Note that one soil sample collected prior to excavation did contain 12.9 mg/L Chromium (EP Tox); but Chromium (10.9 mg/kg) is below the 300 mg/kg FRL established for Chromium VI; other metals analyzed (Arsenic, Barium, Cadmium, Mercury, Selenium and Silver) were below establsihed FRLs. 1,1,1-Trichloroethane was detected in the oil-separator (1,050 $\mu$g/kg) but was not detected in the soil (no FRL established). *No post-excavation soil samples were collected.* [Sources: USTs-5, -7, -14 and -17 Closeout Report (DOE 1995h); UST-17 Removal Site Evaluation (DOE 1993f)]. |



000131

# TABLE 2-2
## (Continued)

| TANK ID | DESCRIPTION | FORMER CONTENTS | STATUS & DESCRIPTION OF CLOSURE ACTIVITIES |
|---|---|---|---|
| **TANK CLOSED IN PLACE — TO BE REMOVED FROM THE GROUND UNDER CERCLA** | | | |
| **PLANT 6** | | | |
| **UST-14** | **Remediation Area:** 4a<br><br>**Location:**<br>Buried under concrete floor in former scrap melting area (S end) of Plant 6.<br><br>**Volume:** 3,000 gallons<br><br>**Size:**<br>5½ foot diameter x 18 foot length; steel | **Material:** Waste Soluble Machining Oil - a heavy napthenic petroleum oil.<br><br>**COCs:**<br>Methanol . . . . . (no FRL; no OSDF WAC)<br><br>**Reference MEFs:** N/A; see MSDS<br><br>Analysis of tank residues: Methanol, 40 mg/kg; no other volatile or semi-volatile compounds or metals were detected. [Source: UST-14 Closure Report (DOE 1992b)]. | **CLOSED IN PLACE — UST to be removed from the ground; Demonstration of Soil FRLs Attainment Needed.**<br><br>Removed perched water from tank, disconnected process piping and filled tank with grout. To sample the soil beneath the UST, a hole was cut in the bottom of the tank. Perched water began flowing into the tank. *The presence of water precluded the sampling of underlying soils.* [Source: UST-14 Closeout Report (DOE 1995i).] Two soil samples were collected at a total depth of 2 feet below the base of the oil supply line. Results for Lead (17.8 mg/kg) were below the established FRL; BETX constituents (Benzene, Ethylbenzene, Toluene and Xylene) were not detected; TPH was 139-174 mg/kg (no FRL established). [Source: 6/1992 UST-14 Closure Report (DOE 1992b).] An inspector from the State Fire Marshal's office inspected and approved tank abandonment in place on 03/16/1995 [Source: UST-14 Closeout Report (DOE 1995i)]. |

| | |
|---|---|
| BETX | Benzene, Ethylbenzene, Toluene and Xylenes |
| BUSTR | Ohio Bureau of Underground Storage Tank Regulations |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| COCs | Constituents of Concern |
| FRL | Final Remediation Level |
| HWMU | Hazardous Waste Management Unit |
| MEF | Material Evaluation Form |
| mg/kg | milligrams per kilogram |
| MSDS | Material Safety Data Sheet |
| N/A | Not applicable |
| OSDF | On-Site Disposal Facility |
| PID | Photoionization Detector |
| RSE | Removal Site Evaluation |
| SWMU | Solid Waste Management Unit |
| TPH | Total Petroleum Hydrocarbons |
| μg/kg | micrograms per kilogram |
| UST | Underground Storage Tank |
| WAC | Waste Acceptance Criteria |

## TABLE 2-3

## AREAS POTENTIALLY CONTAINING RCRA CHARACTERISTIC WASTE IN SOIL

| Description of Area | Remediation Area | Potentially Hazardous Constituent(s) |
|---|---|---|
| Area between the KC-2 Warehouse and adjacent to railroad tracks | 3 | Lead |
| Trap Range | 1 | Lead |
| Paddys Run streambank fill materials west of the Silos | 7 | Chromium<br>Lead |
| Scrap Metal Pile | 3 | Lead |
| Area north of the Maintenance Building | 3 | Lead<br>TCE |
| Abandoned Sump west of the Pilot Plant [a] | 4b | Barium |
| South Field Firing Range[b] | 2 | Lead |

Note: [a] Also designated as HWMU No. 22.

[b] RCRA characteristic material from the South Field Firing Range will be disposed of off site as required by the Operable Unit 2 ROD.

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## TABLE 2-4

## RADIOLOGICAL AND CHEMICAL WASTE ACCEPTANCE CRITERIA (WAC) FOR ON-SITE DISPOSAL FACILITY (1)

| | Constituent | Concentration/Activity | Units |
|---|---|---|---|
| 1. | Neptunium-237 | $3.12 \times 10^{9}$ | pCi/g |
| 2. | Strontium-90 | $5.67 \times 10^{10}$ | pCi/g |
| 3. | Technetium-99 | $2.91 \times 10^{1}$ | pCi/g |
| 4. | Uranium-238 or | $3.46 \times 10^{2}$ | pCi/g |
| | Total Uranium | $1.030 \times 10^{3}$ | mg/kg |
| 5. | Carbazole | $7.27 \times 10^{4}$ | mg/kg |
| 6. | Bis(2-chlorisopropyl)ether (2)(3) | $2.44 \times 10^{-2}$ | mg/kg |
| 7. | Alpha-chlordane | $2.89 \times 10^{0}$ | mg/kg |
| 8. | Bromodichloromethane(3) | $9.03 \times 10^{-1}$ | mg/kg |
| 9. | 4-Nitroaniline(2)(3) | $4.42 \times 10^{-2}$ | mg/kg |
| 10. | Chloroethane | $3.92 \times 10^{5}$ | mg/kg |
| 11. | Vinyl chloride | $1.51 \times 10^{0}$ | mg/kg |
| 12. | Tetrachloroethene | $1.28 \times 10^{2}$ | mg/kg |
| 13. | Trichloroethene | $1.28 \times 10^{2}$ | mg/kg |
| 14. | 1,1-Dichloroethene | $1.14 \times 10^{1}$ | mg/kg |
| 15. | 1,2-Dichloroethene | $1.14 \times 10^{1}$ | mg/kg |
| 16. | Toxaphene | $1.06 \times 10^{5}$ | mg/kg |
| 17. | Boron(3) | $1.04 \times 10^{3}$ | mg/kg |
| 18. | Mercury | $5.66 \times 10^{4}$ | mg/kg |

(1) This table is based on information contained in the Operable Unit 2 and Operable Unit 5 Records of Decision.

(2) The WAC for these constituents are below their practical quantitation limit (PQL). Analytical limitations will be addressed in Project Specific Plans developed for each remediation area.

(3) The WAC for these constituents are below their corresponding final remediation level.

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## TABLE 2-5

## PHYSICAL WASTE ACCEPTANCE CRITERIA (WAC) AND PROHIBITED ITEMS FOR THE ON-SITE DISPOSAL FACILITY (OSDF)

| PHYSICAL WASTE ACCEPTANCE CRITERIA |
|---|
| The maximum length of irregularly shaped metals or other components of a building superstructure or finish components shall be 10 feet. |
| The maximum thickness of irregularly shaped metals or other components of a building superstructure or finish components shall be 18 inches. |
| The maximum thickness of an individual concrete member or other component of a building slab or substructure shall be 4 feet, when the item is handled individually and is a regular shape having no concrete protrusions greater than 18 inches. |
| Concrete reinforcement bars shall be cut within a nominal 12 inches of the concrete mass. The additional length added by these bars is not considered in determining the total length of the concrete mass. |
| The maximum thickness of uniform pallets of building cladding (e.g., transite panels), properly banded into rectangular shapes, shall be 4 feet. |
| Regulated asbestos-containing material (ACM) shall be double-bagged. |
| ACM brick and commingled debris shall be double contained. |
| Piping having ACM insulation shall be segregated. |
| Equipment shall be drained of all oils and liquids. |
| Piping with a nominal diameter of 12 inches or greater shall be split in half. |
| OSDF Category 3 items having voids greater than 1 cubic foot shall be filled with a quick-set grout, or flowable cohesionless material approved by the OSDF Construction Manager. If a grout is used in this manner, it shall be allowed to set for a minimum of four hours prior to the commencement of placement of that item. |

**TABLE 2-5**
**(Continued)**

| PROHIBITED ITEMS | |
|---|---|
| Prohibited Item | Comments/Examples |
| Materials not accompanied by the required manifest | Integrated Information Management System will provide the manifest |
| Material received from off-site that was not generated as a direct result of FEMP remediation | OSDF is designated for Fernald material only |
| RCRA characteristic waste[a] | Treat to below characteristic level (except material from South Field Firing Range which must be disposed off-site) |
| Pressurizable gas cylinders | Cylinders must be emptied and sized/filled to meet OSDF Category 2 or 3 |
| Process-related metals | Examples include uranium derbies, ingots, billets, and uranium scrap |
| Product, residues, other special material | Examples include green salt, black oxide, and sump sludges from process facilities |
| Material containing free liquids[b] | |
| Intact drums | Drums must be emptied and crushed |
| Acid brick[c] | |
| Transformers | Transformers must be crushed or filled with grout |
| Whole or shredded scrap tires | The specific prohibited tires are defined by OEPA |
| Used oils | |

[a]Sampling for characteristic waste will be performed in the seven areas presented in Sections 1.3.2.7 and 2.1.1.3 of this plan in accordance with the Operable Unit 2 and Operable Unit 5 Records of Decision and the Waste Acceptance Criteria Attainment Plan for the On-Site Disposal Facility.
[b]The intent of the exclusion of free liquids is to prevent contaminated liquid waste from being directly disposed of in the OSDF (e.g., a drum of solvent). Materials that contain rainwater or, like sludges, that have an inherent moisture content are not excluded from disposal in the OSDF. If a material that arrives at the OSDF for disposal is too wet to meet moisture content or compaction requirements, the material will be air dried or blended with a drier WAC-acceptable material at the OSDF, in accordance with construction quality control requirements.
[c]As a best management approach, actual and/or suspected acid brick from the FEMP's soil excavation activitiesm including the excavation of the Operable Unit 2 waste units, will be segregated from other debris during excavation and sent off site for disposal. The objective is to remove the vast majority of the brick (i.e., that brick which can be readily identified and safely removed during soil excavation and OSDF placement activities) to further minimize the chance that brick containing process residuals is placed in the OSDF.

## TABLE 2-6

## SUMMARY OF SITEWIDE CONSTITUENTS OF CONCERN (COCs)

| Constituent of Concern | Driver [a] | Constituent of Concern | Driver [a] |
|---|---|---|---|
| **Primary COCs** | | | |
| Uranium, total | WAC, FRL | Thorium-228 | FRL |
| Radium-226 | FRL | Thorium-232 | FRL |
| Radium-228 | FRL | | |
| **Secondary COCs** | | | |
| Aroclor-1254 | FRL | Heptachlorodibenzo-p-dioxin | FRL |
| Aroclor-1260 | FRL | Indeno(1,2,3-cd)pyrene | FRL |
| Arsenic | FRL | Lead | FRL |
| Benzo(a)anthracene | FRL | Lead-210 | FRL |
| Benzo(a)pyrene | FRL | Manganese | FRL |
| Benzo(b)fluoranthene | FRL | Neptunium-237 | FRL |
| Beryllium | FRL | 4-Nitroaniline | WAC |
| Bis(2-chloroisopropyl)ether | WAC | Octachlorodibenzo-p-dioxin | FRL |
| Bromodichloromethane | FRL | Plutonium-238 | FRL |
| Cesium-137 | FRL | Strontium-90 | FRL |
| Dibenzo(a,h)anthracene | FRL | Technetium-99 | WAC, FRL |
| 1,1-Dichloroethene | FRL | Tetrachloroethene | FRL |
| Dieldrin | FRL | Thorium-230 | FRL |
| Fluoride | FRL | Trichloroethene | WAC, FRL |
| **Ecological COCs** | | | |
| Antimony | BTV | Molybdenum | BTV |
| Cadmium | BTV | Lead | BTV |
| Silver | BTV | PAHs | BTV |

Notes:

[a] WAC and FRLs will drive remediation, but BTVs will be evaluated in the certification process.

WAC = Waste Acceptance Criteria
FRL = Final Remediation Level
BTV = Benchmark Toxicity Value
PAHs = polyaromatic hydrocarbons (see list in footnote of Table 2-7)

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## TABLE 2-7

## PRELIMINARY IDENTIFICATION OF PRIMARY, SECONDARY AND ECOLOGICAL COCS ASSIGNED TO REMEDIATION AREAS

| RA 1 | RA 2 | RA 3 | RA 4 | RA 5 | RA 6 | RA 7 | RA 8 |
|---|---|---|---|---|---|---|---|
| PRIMARY COCs | PRIMARY COCs | PRIMARY COCs | PRIMARY COCs | PRIMARY COCs | PRIMARY COCs | PRIMARY COCs | PRIMARY COCs |
| radium-226 | radium-226 | radium-226 | radium-226 | radium-226 | radium-226 | radium-226 | radium-226 |
| radium-228 | radium-228 | radium-228 | radium-228 | radium-228 | radium-228 | radium-228 | radium-228 |
| thorium-228 | thorium-228 | thorium-228 | thorium-228 | thorium-228 | thorium-228 | thorium-228 | thorium-228 |
| thorium-232 | thorium-232 | thorium-232 | thorium-232 | thorium-232 | thorium-232 | thorium-232 | thorium-232 |
| uranium-total | uranium-total | uranium-total | uranium-total | uranium-total | uranium-total | uranium-total | uranium-total |
| SECONDARY COCs | SECONDARY COCs | SECONDARY COCs | SECONDARY COCs | SECONDARY COCs | SECONDARY COCs | SECONDARY COCs | SECONDARY COCs |
| aroclor-1254 | aroclor-1254 | aroclor-1254 | aroclor-1254 | aroclor-1254 | aroclor-1254 | aroclor-1254 | to be determined |
| aroclor-1260 | aroclor-1260 [a] | aroclor-1260 | aroclor-1260 | aroclor-1260 [a] | aroclor-1260 | aroclor-1260 [a] | |
| arsenic | arsenic | arsenic | arsenic | arsenic | arsenic | arsenic | |
| beryllium | benzo(a)pyrene | benzo(a)anthracene | benzo(a)pyrene | beryllium | benzo(a)pyrene | beryllium | |
| cesium-137 | beryllium | benzo(a)pyrene | beryllium | dieldrin [a] | benzo(b)fluoranthene | cesium-137 | |
| dieldrin [a] | bromodichloromethane [a] | benzo(b)fluoranthene | bromodichloromethane [a] | | beryllium | dieldrin [a] | |
| heptachloradibenzo-p-dioxins | cesium-137 | beryllium | cesium-137 | | bromodichloromethane [a] | lead | |
| lead | dibenzo(a,h)anthracene | bromodichloromethane [a] | dieldrin | | cesium-137 | lead-210 | |
| manganese [a] | 1,1-dichloroethene [a] | cesium-137 | fluoride | | dibenzo(a,h)anthracene | manganese | |
| neptunium-237 | dieldrin | dibenzo(a,h)anthracene | lead | | 1,1-dichloroethene | technetium-99 | |
| technetium-99 | lead | 1,1-dichloroethene | plutonium-238 | | dieldrin | thorium-230 | |
| thorium-230 | neptunium-237 | dieldrin [a] | strontium-90 | | fluoride | | |
| | technetium-99 | fluoride | technetium-99 | | heptachloradibenzo-p-dioxins | ECOLOGICAL COCs | |
| ECOLOGICAL COCs | thorium-230 | indeno(1,2,3-cd)pyrene | tetrachloroethene | | indeno(1,2,3-cd)pyrene | antimony | |
| | | lead | thorium-230 | | octachlorodibenzo-p-dioxin | cadmium | |
| antimony | ECOLOGICAL COCs | technetium-99 | | | technetium-99 | molybdenum | |
| lead | antimony | tetrachloroethene | ECOLOGICAL COCs | | tetrachloroethene | silver | |
| molybdenum | silver | thorium-230 | antimony | | thorium-230 | PAHs* | |
| | cadmium | trichloroethene | | | | | |
| | lead | | | | ECOLOGICAL COCs | | |
| | molybdenum | ECOLOGICAL COCs | | | silver | | |
| | | cadmium | | | antimony | | |
| | | silver | | | cadmium | | |
| | | antimony | | | PAHs* | | |
| | | molybdenum | | | | | |
| | | PAHs* | | | | | |

Notes: [a] Not detected above the FRL in the RA, but the non-detect value is greater than the FRL
COCs = constituents of concern
RA = remediation area
FRL = final remediation area
* PAHs include: Benco(A)anthracene, Benco(A)pyrene, Benco(B)fluoranthene, Benco(G,H,I)perlene, Benco(K)fluoreanthene, Fluorenathene, chrysene, Dibenco(A,H)anthracene, Indeno(1,2,3-Co)pyrene, Phenantrene, pyrene

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# TABLE 2-8

## MEASUREMENTS AND ANALYSIS

| Function or Application | Field Measurements | | | On-Site and Off-Site Lab | | |
|---|---|---|---|---|---|---|
| | ASL A or ASL B | | | ASL B or ASL D | | |
| | Radiation | Metals | Organics | Radiological | Metals | Organics |
| 1. Pre-excavation | | | | | | |
| Footprint | | | | | | |
| Primary COCs[a] | NaI or HPGe | | | alpha spectroscopy<br>gamma spectroscopy<br>ICP/MS | | |
| Secondary COCs[a] | NaI or HPGe | XRF | PID | alpha spectroscopy<br>gamma spectroscopy<br>ICP/MS<br>gas proportionality counting<br>liquid scintillation counting | ICP<br>XRF | GC/MS |
| Depth Profile | | | | | | |
| Primary COCs[a] | NaI | XRF | PID | alpha spectroscopy<br>gamma spectroscopy<br>ICP/MS<br>liquid scintillation counting | | |
| Secondary COCs[a] | NaI | XRF | PID | alpha spectroscopy<br>ICP/MS<br>gas proportionality counting<br>liquid scintillation counting | ICP<br>XRF | GC/MS |
| 2. Excavation Control | | | | | | |
| Primary COCs[a] | NaI or HPGe | | | | | |
| Secondary COCs[a] | NaI or HPGe | XRF | PID | | | |
| 3. Pre-Certification | | | | | | |
| Primary COCs[a] | NaI or HPGe | | | | | |
| Secondary COCs[a] | NaI or HPGe | XRF | | | | |
| 4. Certification | | | | | | |
| Primary COCs[a] | | | | alpha spectroscopy<br>gamma spectroscopy<br>ICP/MS | | |
| Secondary COCs[a] | | | | alpha spectroscopy<br>gamma spectroscopy<br>gas proportionality counting<br>liquid scintillation counting | ICP<br>XRF | GC/MS |

[a]Primary and secondary COCs defined in Table 2-7

NaI = sodium iodide frisker or RTRAK
XRF = x-ray fluorescence
PID = photoionization detector

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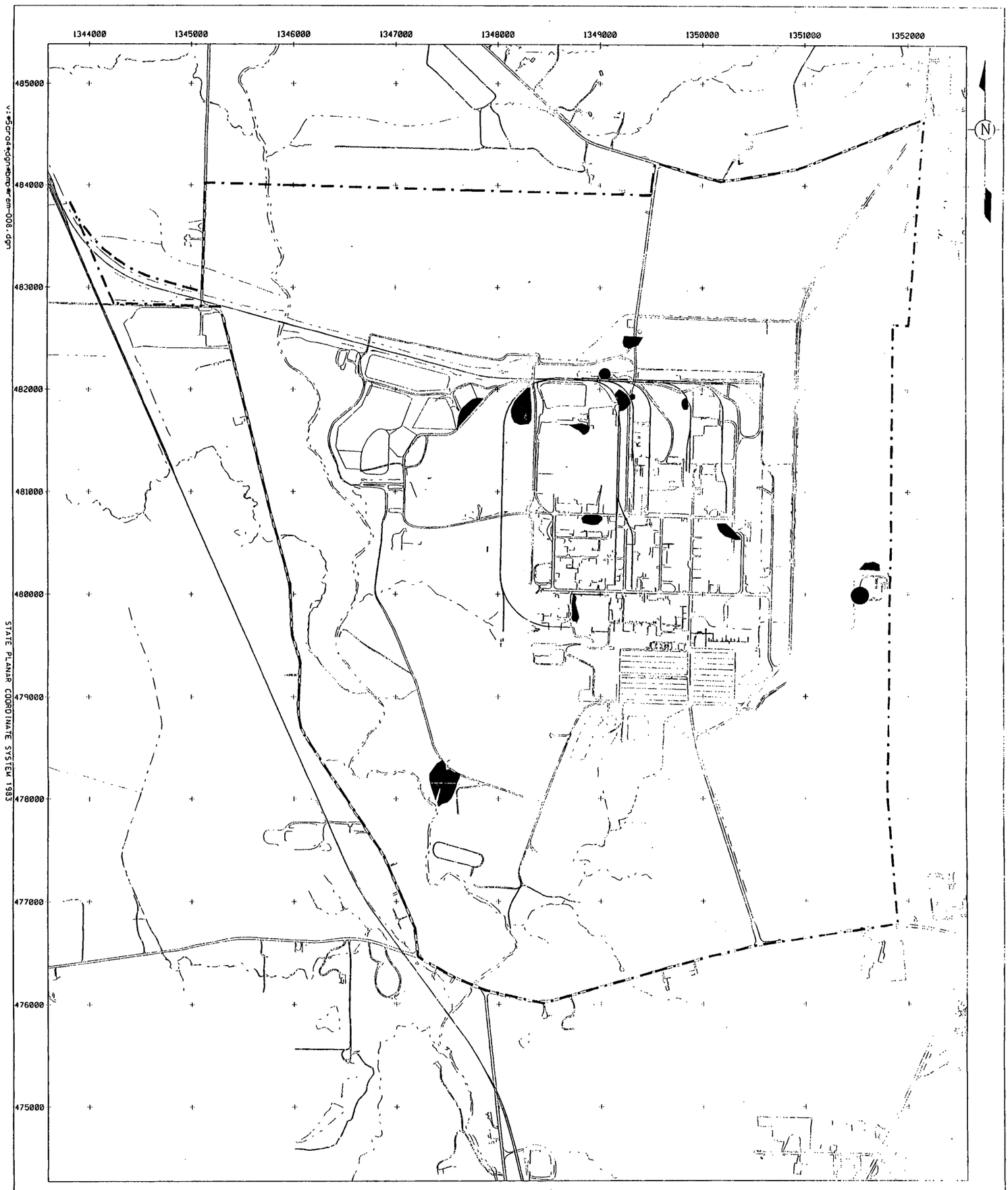


LEGEND:

FEMP BOUNDARY

WAC AREA

SCALE

1000 500 0 1000 FEET

FINAL

FIGURE 2-1. FEMP AREAS WITH TOTAL URANIUM CONCENTRATIONS GREATER THAN WAC

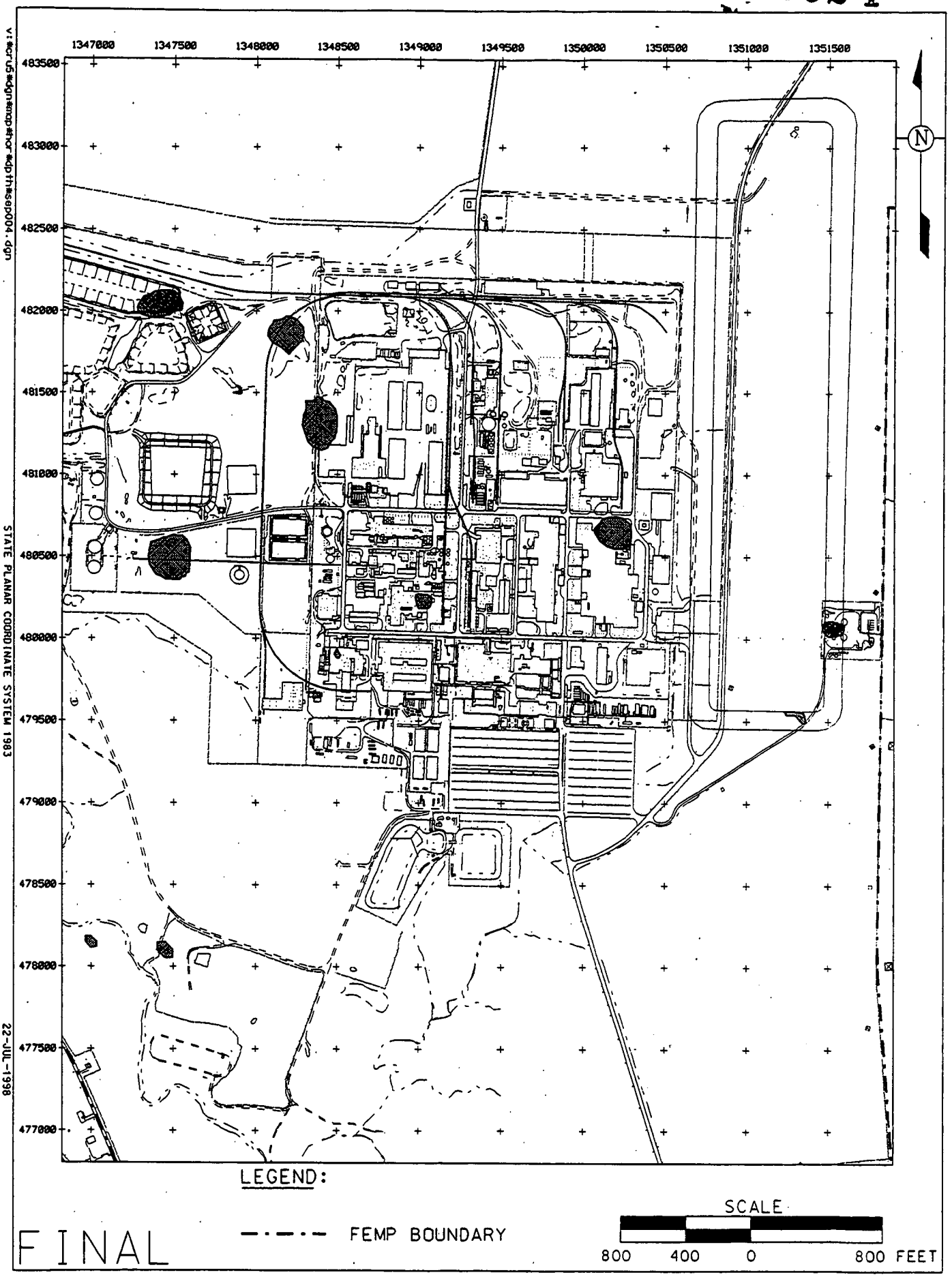


FIGURE 2-2. FEMP AREAS WITH TC-99 LEVELS POTENTIALLY GREATER THAN WAC/FRL (FOR INFORMATION PURPOSES ONLY)

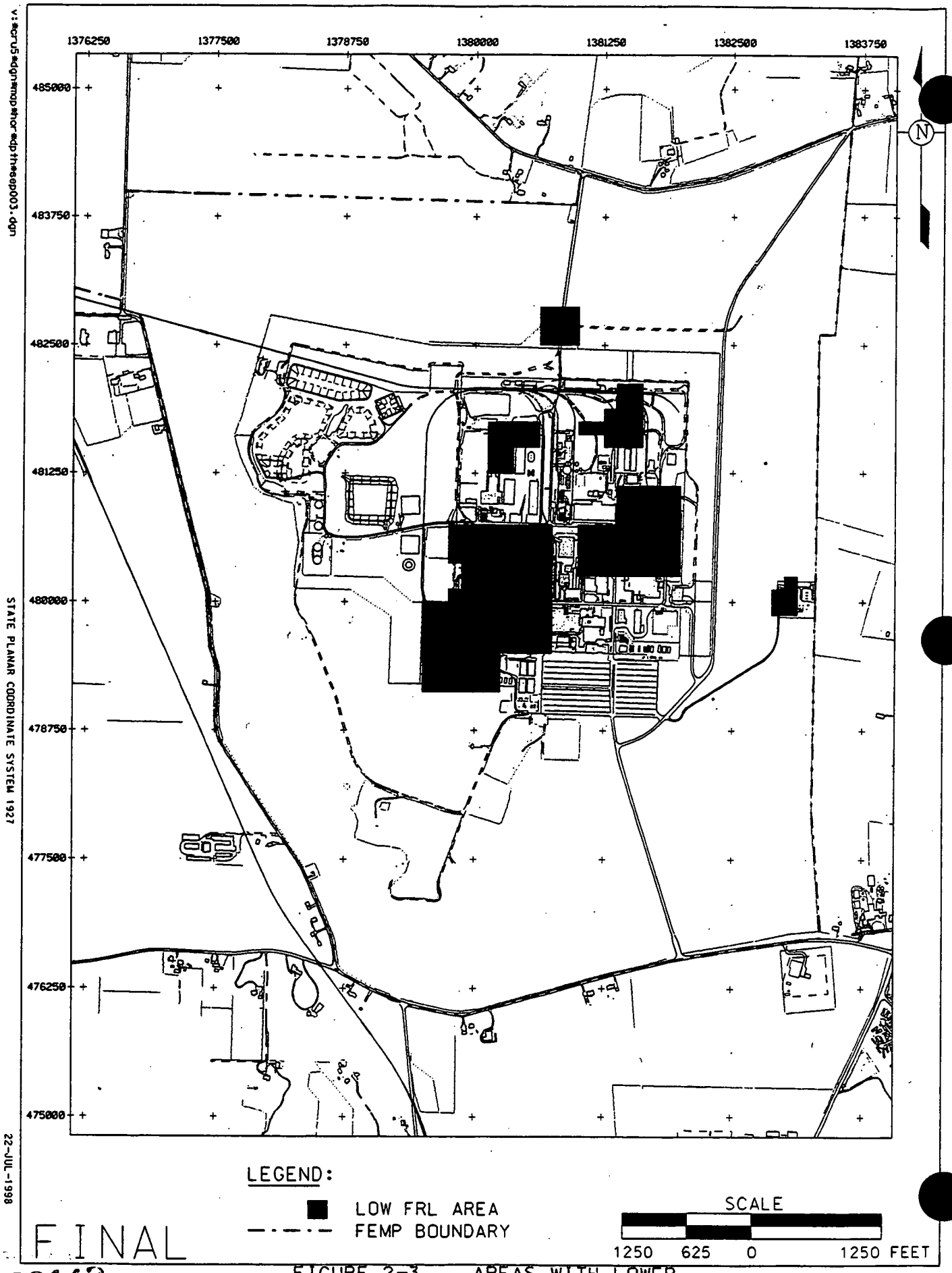


FIGURE 2-3. AREAS WITH LOWER URANIUM FRL DUE TO HIGH LEACHABILITY

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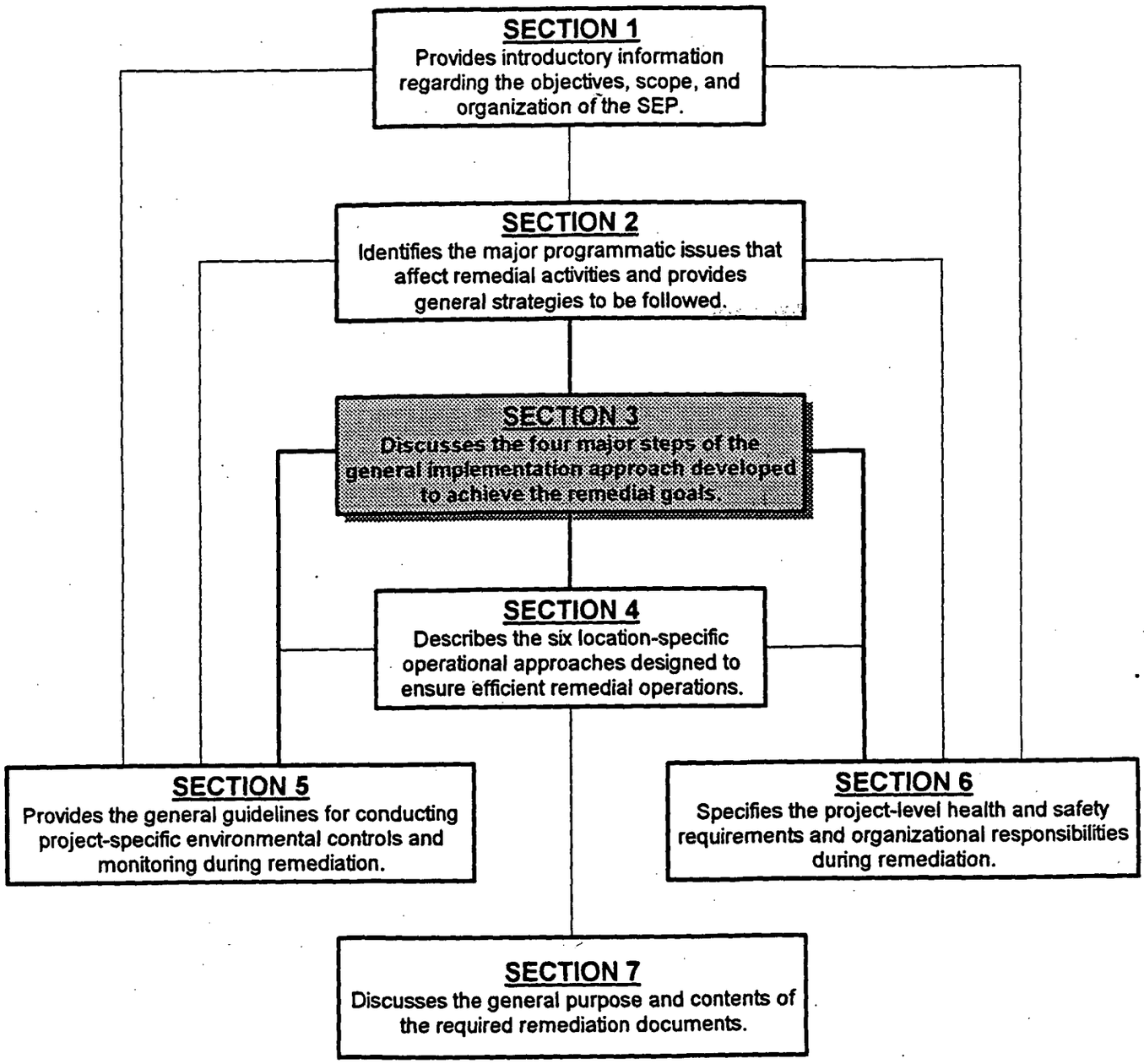
# SITEWIDE EXCAVATION PLAN




**APPENDIX A** - Soil Remediation ARARs and TBCs
**APPENDIX B** - Sitewide Sequencing Plan
**APPENDIX C** - Constituent of Ecological Concern Selection
**APPENDIX D** - Wood Sampling Program
**APPENDIX E** - SEP Quality Assurance Project Plan (QAPP)
**APPENDIX F** - Implementation of Construction and Waste Management Practices
**APPENDIX G** - Certification Design Rationale
**APPENDIX H** - Summary of Field Measurement and Laboratory Analytical Technologies
**APPENDIX I** - Sitewide Extent Of Contamination By Constituent

# 3.0 GENERAL IMPLEMENTATION APPROACH

This section provides details on the general implementation approach in a remediation area for performing excavations during remedial activities at the Fernald Environmental Management Project (FEMP) and for completing postremedial actions, as well as record keeping and data management. The discussions provided in this section address many of the issues identified in Section 2.0 and also form the basis for presentation of the detailed area-specific excavation approaches discussed in Section 4.0. Section 3.0 also identifies the important remediation documents that will be delivered during the soil remediation process. All contingency plans pertinent to the activities discussed in this section are noted and detailed in Appendix F.4.

Figure 3-1 summarizes the steps in the general soil remediation process in a remediation area and identifies their integration with three remediation documents that will be delivered to the U.S. Environmental Protection Agency (EPA) as part of the remediation process. The remediation process begins with the preparation of Project-Specific Plans (PSPs) for field activities carried out during the predesign investigation. The PSPs will provide additional characterization data, as needed, to establish the type and extent of the excavation. Field activities implemented by the PSP may consist of radiological surveys, geophysical surveys, and collection and analysis of discrete samples, as needed. A data summary will be issued for each executed PSP to provide the needed information to the predesign investigation.

Results from the predesign investigation are forwarded to the remedial design step to prepare the first deliverable document, the Integrated Remedial Design Package (IRDP), which will guide the actual excavation of the soil. After the IRDP has been approved, soil excavation will begin and materials designated as above waste acceptance criteria (WAC) will be segregated from those destined for the On-Site Disposal Facility (OSDF). Upon completion of the excavation, a PSP will be developed for the precertification survey prior to commencement of the final certification activities. If the precertification survey identifies soil that contains constituents of concern (COCs) above their respective final remediation level (FRL) or applicable hot-spot criteria, additional localized excavation will take place to remove the affected soil.

Prior to final certification, the second deliverable document, a Certification Design Letter (CDL), will be issued to the EPA. This letter will establish the boundaries of each certification unit (CU) that subdivides the remediation area, sampling locations within each CU, and a list of CU-specific COCs that require laboratory analysis (ASL D) to determine whether the certification criteria have been met.

After the CDL has been issued to the EPA and approval is obtained, a PSP will be developed for certification sampling and analysis according to the CDL. Analytical results obtained on the certification samples will be evaluated against the certification criteria to demonstrate that the CUs and the remediation area can be released. Interim data will be maintained on a website for EPA access and review during the certification process. Upon successful certification of all CUs in the area, a third deliverable document, the Certification Report, will be released for the remediation area. This report will contain summary information on sampling locations, analytical results, statistical methods, certification criteria, and notification of successful certification. During the review process, necessary access control and protective maintenance in the remediated area will be sufficiently maintained. After EPA approval of the Certification Report is obtained, interim grading and restoration of the area can begin.

The remediation activities have been grouped chronologically into steps to facilitate discussion in this document. These steps are: 1) predesign investigation (Section 3.1); 2) remedial design (Section 3.2), 3) remedial actions (Section 3.3); 4) certification (Section 3.4); and 5) postremedial actions (Section 3.5). Record keeping and information management issues associated with these five steps are presented in Section 3.6.

## 3.1 PREDESIGN INVESTIGATION

The flow of the predesign investigation process is shown on Figure 3-2. This process consists of PSP development that is tied to:

- Data review and initial delineation of excavation areas
- Selection of area specific COCs

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- Identification of potential technetium-99, toxicity characteristic, hazardous waste management units (HWMUs), underground storage tanks (USTs), above-WAC, and above-FRL areas
- Identification of geotechnical and potential perched water management issues
- Surveying, sampling, and analysis to support the investigations
- Final delineation of excavation areas and depth and contaminated perched water boundaries, if applicable.

It is expected that the sequence of events will follow this flow, but unusual or unexpected events can occur to change the order in which the steps are implemented. Nonroutine events that may occur and the contingency plans developed to deal with them are provided in Appendix F.4.

### 3.1.1 Types of Potential Excavation Areas

The remedial excavations at the FEMP will be conducted using a phased approach. Soil containing constituents that require special handling (e.g., technetium-99) will be excavated first. When these soils have been removed, the remainder of the soils identified for remediation (if any) will be excavated. To follow this approach, the location, spatial extent, and concentrations of constituents of interest in the soil must be delineated. This will be done through PSP implementation as part of the predesign investigation performed in each remediation area requiring excavation.

#### 3.1.1.1 Overall Excavation Extent

An area-specific predesign investigation will open with a review of remedial investigation/feasibility study (RI/FS) data to identify the COCs present in the area (Figure 3-2). This will be followed by an estimate of the total excavation soil volume in the remediation area. In most cases, the areal extent of the uranium footprint is expected to encompass all other COCs. If this is true, an estimate of the excavation's extent will be determined by analyzing the uranium RI/FS characterization data collected on surface and subsurface soil samples. In some areas, the spatial distribution of other COCs, such as radium and/or thorium, will not be correlated with the uranium distribution. When this happens, the excavation footprint will be based on the combined extent of all COCs. PSPs will be developed if the need arises to obtain additional characterization data to delineate the appropriate excavation volume.

3.1.1.2 Excavation/Segregation Phases

Surface and subsurface soil characterization data (e.g., RI/FS and predesign data) at or immediately below a COC's FRL will be used to generate an excavation profile through kriging or other appropriate 3-D interpolation techniques. Once the overall excavation footprint has been delineated, RI/FS and predesign characterization data will be used to identify soil within the footprint that may require special handling and disposal. For example, soil containing technetium-99 concentrations that exceed the WAC of 29.1 picoCuries per gram (pCi/g) will require segregation and off-site disposal. When such areas are identified, their extent will be delineated during the predesign investigation by implementing a PSP.

COCs selected to drive each phase of the excavation will depend on the distribution and concentration/activity of the COC in the area, the type of excavation area, applicable treatment options, and final disposition of soil for disposal (i.e., off site versus OSDF). In most remediation areas, uranium, radium, and/or thorium concentrations will drive the remediation. Remediation of areas with technetium-99, RCRA toxicity characteristic soil, or HWMUs/USTs may be driven by technetium-99 activity or the concentrations of toxicity characteristic metals or F-listed spent solvent organic compounds.

Based on the FEMP site history, process knowledge, and RI/FS data, potential technetium-99, RCRA, HWMU, UST, and above-WAC areas have been identified that may require excavation under this plan. There are seven potential locations where technetium-99 excavation may take place (Figure 2-2), seven locations where toxicity characteristic soil may be present (Figure 1-5), up to 14 HWMUs that may require excavation (Table 2-1), 13 UST locations (Table 2-2), and eight locations where uranium is potentially above the soil WAC (Figure 2-1).

Soil containing technetium-99 above the FRL/WAC limit of 29.1 pCi/g will be excavated and staged for off-site disposal in the Operable Unit 1 waste pits or Soil Pile 7 area (formerly the location of Soil Pile 5). This above-WAC soil will be disposed of with the material in the waste pits as part of the Operable Unit 1 remediation. If soil in a RCRA area exhibits the toxicity characteristic and overlaps with the area delineated for technetium-99 excavation, this material will be staged separately in the Soil Pile 7 area to await a decision by Waste Programs Management (WPM) on treatment and final off-site disposal options.

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The seven identified RCRA areas may be excavated to remove characteristic waste, if the toxicity characteristic is demonstrated by the toxicity characteristic leaching procedure (TCLP) test. Identified toxicity characteristic material from the six areas defined in the Operable Unit 5 Record of Decision (ROD) can be placed in the OSDF if the material is treated to remove the toxicity characteristic and if radiological COCs are below their WAC before treatment. Lead bullets from the South Field Firing Range, and the associated soil that is identified as toxicity characteristic, is categorically excluded from the OSDF by the Operable Unit 2 ROD and will be shipped off site for disposal. In the six areas covered by the Operable Unit 5 ROD, excavation of the footprint will be driven by the FRLs of all applicable area-specific COCs (ASCOCs), and TCLP tests will be conducted to determine whether treatment is required prior to disposal in the OSDF. Any above-WAC soil possessing the toxicity characteristic that is excavated from an identified RCRA area will be sent to the Soil Pile 7 area and segregated from other distinct above-WAC material (e.g., above-WAC material containing technetium-99). Decisions regarding off-site treatment and final off-site disposal will be made by WPM.

Excavation of other above-WAC soil (i.e., excluding soil in the identified six RCRA areas and areas where technetium-99 is above its WAC value) will be driven by concentrations of uranium-238 (or total uranium), neptunium-237, strontium-90 or boron, if they are shown to exceed the WAC. Soil containing these COCs at values above the WAC will be excavated and sent to the Operable Unit 1 waste pits or Soil Pile 7 area where they will receive further handling prior to disposal. Operable Unit 1 will be responsible for decisions regarding final off-site disposal of this soil.

For remaining excavation areas and HWMUs or UST footprints, excavation of the soil will be driven by the FRLs of all COCs present within the unit. Any above-WAC material excavated from a HWMU footprint will be will be evaluated (sampled) to determine if it contains a RCRA F-listed waste constituent or exhibits a RCRA hazardous characteristic. If so, it will be sent to the Soil Pile 7 area, where it will be segregated from other distinct above-WAC material. WPM will be responsible for decisions on treatment and final off-site disposal of above-WAC material.

### 3.1.2 Predesign Sampling and Analysis

The objective of the predesign (or pre-excavation) sampling effort is to fill in RI/FS data gaps by collecting supplemental data using sodium iodide (NaI) surveys, in situ high purity germanium (HPGe)

detectors, and/or sampling and analysis. Prior to initiating sampling activities, a PSP (or several PSPs) will be prepared to establish the list of COCs, summarize existing data, and provide the sampling design and approach. Prior to executing the PSP, the current level of access control will be determined for each area affected by sampling activities. Entry and access procedures for sampling activities will comply with the most current level of access control. Appendix F.2 contains a more complete discussion of access controls, and Section 2.4 and Appendix H discusses field and laboratory measurements suitable for a variety of sampling approaches.

#### 3.1.2.1 Material Contaminated by Technetium-99

Where RI/FS data indicate technetium-99 is present in soil above its FRL/WAC of 29.1 pCi/g, the RI/FS data will be reviewed to determine whether enough data exist to establish a reasonable excavation footprint to guide removal of the technetium-99. If additional information is needed, a PSP will be developed to initiate the sampling and analysis required to define the extent of excavation for technetium-99. This task will consist of collecting discrete surface and subsurface soil samples and submitting them to a laboratory for analysis of characteristic beta radiation. Sample collection, handling procedures, sample preparation, analytical methods, and detection limits are presented in Section 2.4, Appendix H, and the Quality Assurance Job-Specific Plan (QAjSP) (Appendix E).

#### 3.1.2.2 RCRA Waste

In the six RCRA areas identified in the operable Unit 5 ROD where the potential exists to excavate and treat toxicity characteristic soil, a sampling and analysis task will be initiated to establish whether toxicity characteristic soil is present. Where appropriate, this task will be integrated with the technetium-99 sampling and analysis program. Discrete surface and subsurface soil samples will be collected and subjected to the TCLP test to determine whether the soil exhibits the toxicity characteristic. Sample collection, handling procedures, sample preparation, analytical methods, and quantitation limits are presented in Section 2.4, Appendix H, and Appendix E.

#### 3.1.2.3 Material Containing COCs Above WAC

Material containing COCs above the WAC will be demonstrated to fulfill the data requirements specified in the sitewide WAC Attainment Plan (DOE 1998b). Potential above-WAC excavation areas will undergo radiological surveys and/or sampling and analysis to establish the extent of excavation for material containing COCs at levels above their corresponding WAC. In deep excavations containing

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mild side slopes, the shallow side slopes will be scanned using the RTRAK and HPGe instruments to monitor the activity of gamma-emitting radionuclides. The RTRAK has been used to conduct a WAC scan of the surface of some soil stockpiles that have slopes similar to the shallow slopes anticipated for some excavations. HPGe measurements carried out at and/or above the toe of these shallow slopes can also provide meaningful results for above-WAC decisions. With a conservative design on the excavation extent and the use of near real-time scanning, time consuming physical sampling and analysis of soil and the side slope can be eliminated. However, when vertical barriers are needed in deep excavations, a sufficient number of soil borings will be collected and analyzed to better define the contamination profile in the vertical face during the predesign investigation. Where appropriate, this task will be integrated with the technetium-99 and/or RCRA sampling and analysis activities.

RI/FS data and predesign sampling and analysis will be used to determine the excavation extent for the area-specific radiological, metal, and organic COCs. If the RI/FS data are not sufficient to determine the extent of the excavation, a PSP (or several PSPs) will be developed to execute the needed predesign sampling and analysis that will collect the additional information. The areal extent of soil containing uranium in concentrations that exceed the WAC can be determined by using the large-volume NaI detector or HPGe gamma spectrometry systems discussed in the User's Manual (DOE 1998c). Discrete soil samples will be collected and sent to a laboratory for analysis to generate information on the areal extent of non-uranium COCs. Information on the vertical extent of COCs will be obtained using a geoprobe or similar method to collect distinct subsurface samples for laboratory analysis. In all cases, sufficient field measurements and laboratory analyses will be available to demonstrate that material placed in the OSDF meets the WAC. Survey methodology, instrument sensitivity, sample collection, handling procedures, sample preparation, analytical methods, and detection limits are presented in Appendices E and H.

3.1.2.4 Other Considerations

Surface NaI surveys, HPGe measurements, and/or sampling and analysis will be carried out to define all above-WAC or above-FRL COCs and to identify a representative COC that can serve to bound the overall excavation extent of all COCs. In most cases, this COC will be uranium and the excavation extent will be the applicable area-specific uranium FRL, with consideration given to obtaining final uranium levels as low as reasonably achievable (ALARA).

HWMU and UST excavations will require no characterization outside of that carried out to identify above-WAC and above-FRL boundaries, as all listed waste may be placed in the OSDF under the corrective action management rule (CAMU) rule if it meets WAC. However, the closure requirements discussed in Sections 2.2.5 and 2.2.6 will apply to HWMU and UST footprints.

After the analytical results for all ASCOCs have been used to determine the extent of excavation, an assessment may be conducted to determine if additional geotechnical samples are needed to design the construction aspects of the excavation.

### 3.1.3 Establish Extent of Excavation

Radiological surveys, HPGe measurements, and sampling and analysis will be executed as needed to establish the extent of excavation for technetium-99, RCRA toxicity characteristic, above-WAC and/or above-FRL areas. The specific number of samples needed to establish the excavation extent will depend on the nature and extent of ASCOCs and the balancing of cost between laboratory analysis and soil excavation. A large number of samples will result in very accurate delineation of excavation volumes, which may be too precise to follow during excavation. Conversely, too few samples will result in delineation of excavation volumes that overestimate the soil volume above the FRL, and unneeded excavation will take place. Therefore, this section is restricted to presenting a conceptual model that can be used to assist in the development of PSPs to acquire the appropriate area-specific number of predesign samples.

The PSP approach used to establish the extent of a given excavation type will be similar to the conceptual model outlined on Figure 3-3. This approach sets the excavation type (e.g., technetium-99, RCRA, etc), selects COCs and appropriate analytical methods, and uses data from the Sitewide Environmental Database (SED) in a three-dimensional (3-D) interpolation model to determine the initial excavation volume. A unit volume not to exceed one-fourth of the total estimated volume is then selected to determine the cell size of the overlying grid. Using the above-FRL excavation type as an example, the grid is surveyed to locate any potentially elevated activity areas to ensure the grid nodes lie on these areas. HPGe measurements and/or samples are collected from the grid nodes and the analytical results evaluated to determine whether all nodes lie below the FRLs of applicable COCs. If the perimeter nodes are greater than the FRL criteria, the sampling grid is extended until all soil above the FRL is captured. When the lateral extent of COCs is determined, geoprobe borings are

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placed at the nodes exhibiting the most elevated levels of COCs, and a core soil boring sample is obtained to a depth of 3 feet to determine the vertical distribution of the COCs. At least one subsurface sample is collected in every 1-foot interval, and if the deepest sample contains ASCOCs above their respective FRL, the geoprobe boring is extended an additional 3 feet to obtain at least three additional samples. Additionally, if the subsurface interval at the perimeter of the excavation exceeds the criteria, the lateral extent will be extended and additional subsurface cores will be collected. Sampling will continue until the depth and lateral extent of excavation is established at the location of the deepest sample with ASCOCs less than their respective FRL. The excavation volume is then refined based on the depth of excavation established at each geoprobe boring location. Additional excavation types (e.g., technetium-99, RCRA, above-WAC, etc.) are established in a similar manner concurrently with the FRL volume. After the excavation volumes have been established for all excavation types, the collected data will be used to finalize the excavation profiles that will be presented in the IRDP.

The data collected from the PSP predesign characterization will be used to generate an excavation profile through kriging or other appropriate 3-D interpolation techniques. The kriged profile will be forwarded to remedial design so that a final volume and slope of excavation can be determined from the kriged profile of each excavation type (e.g., technetium-99, above WAC, etc.). In all cases, the final engineered slope of excavation will be located outside the profile estimated from the kriging data, owing to standard construction practices for slope stability. This approach will provide added assurance that the WAC will be attained for soil placed in the OSDF and that soil left in place is below the FRL established for each COC. The final engineered design will appear in the IRDP.

Steep sidewalls will be avoided during deeper excavations (i.e., over 6 feet), such as those to be encountered in the Former Production Area. The preferred approach is to construct multiple benches in the side slope and to allow progressively decreasing lateral excavation extent with depth (Figure 3-4). The footprint of the excavation will be determined in the conservative fashion noted above to encompass all the expected subsurface soil and debris that need to be excavated. Although subsurface contamination cannot be fully characterized before excavation, any unexpected contamination that is found by the continuous excavation control scanning process on lower sections of the side slope will be removed during excavation. The benched side slope design can allow easier

extension of the lower lateral excavation boundary, relative to a single-step sidewall when the need arises to remove additional contamination.

Although the above described multi-step side slope approach is preferred for deep excavations, and area boundaries will be delineated to facilitate implementation of such design, it may not always be possible to slope all sides of an excavation due to limited area access. When necessary, driven vertical barriers (e.g., sheet pilings) or other means of maintaining excavation integrity may be used.

Regardless of the configuration of the side slope, deep excavations will generally be conducted in lifts to facilitate real-time scanning and to allow visual inspection of excavated materials to identify potential above-WAC conditions.

## 3.2 REMEDIAL DESIGN AND THE IRDP

After completion of predesign investigation activities and prior to the start of excavation activities, a remedial design will be developed and documented in the IRDP (Figure 3-1), following the technical guidelines and requirements provided in the SEP. The remedial design details have been assigned to the IRDP so that flexibility can be maintained to integrate upgraded methods and lessons learned on preceding excavation activities to the next scheduled excavation. Area-specific interim and/or final grading and restoration requirements will also be provided in the IRDP. The IRDP will be reviewed and approved by the Ohio Environmental Protection Agency (OEPA) and EPA before excavation activities begin.

An IRDP will be developed for each remediation area or a combination of remediation areas when similar ASCOCs and excavation approaches are used. All area-specific information (e.g., RI/FS and additional pre-design investigation data) required to delineate excavation areas and conduct soil remediation, as outlined by the SEP general technical guidelines and appropriate area-specific excavation approaches (Section 4.0), will be presented in each IRDP. Each IRDP will also include an area-specific implementation plan that incorporates area-specific elements of a remediation work plan, such as ASCOCs, anticipated excavation depths, excavation controls, coordination of soil excavation with decontamination and dismantlement (D&D) activities in the Former Production Area, waste disposition, environmental controls and monitoring, health and safety, interim/final grading, and

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restoration design. All design drawings and specifications for the remediation elements will be provided in the IRDP.

The need for soil treatment (either on-site or off-site) and/or remediation-generated wastewater treatment will be specified. Remediation-generated wastewater is the stormwater, perched water, and other waters (e.g., excavation and other heavy equipment wash-down water) generated during the remediation process. The IRDP will include protocols for design change control and updating the contingency plans presented in Appendix F. Additional details on the content of the IRDP are provided in Section 7.2.

## 3.3 REMEDIAL ACTION

Upon approval of the IRDP by the EPA and completion of other applicable FEMP administrative actions, remedial activities can begin. This remedial action discussion is divided into three elements: 1) implementation of construction, excavation, and material-handling activities; 2) precertification activities; and 3) demonstration of attainment of remediation goals. Excavation activities are the principal actions executed during the remedial action, with precertification activities providing the verification that the actions were executed properly. An important closing aspect of the remediation is demonstrating that attainment of remediation goals and disposal constraints have been met.

### 3.3.1 Implementation of Construction, Excavation, and Material-Handling Activities

Figure 3-5 summarizes the soil excavation, segregation, and disposal process. After the site is prepared and surface water controls have been established, an excavation hierarchy is implemented to segregate soil types for the appropriate disposal option. Excavation begins with removal of soil containing technetium-99 above its FRL, then proceeds through the various combinations of TCLP/WAC excavations to FRL/ALARA excavations. Finally, each excavation type is traced to the appropriate treatment and disposal options.

#### 3.3.1.1 Site Preparation

Following submission and approval of the IRDP, site-preparation activities will commence. Site boundaries, access controls, support areas, and excavation staging areas will be established. Wheel wash and decontamination facilities will be installed and isolated from stormwater. Stormwater

controls will conform to applicable rainwater and land-development guidelines. Appendix F.2 provides a comprehensive discussion of site preparation procedures, with a summary of pertinent information given below.

A surface water management system will be installed to control runoff/runon and soil erosion. Runoff/runon controls will consider the layout of support areas within the remediation area and the natural drainage pattern when integrating the drainage of local areas with sitewide drainage channels. Conditions in the FEMP National Pollutant Discharge Elimination System (NPDES) Permit (EPA Permit No. 1IO00004*ED) lead to the development of the FEMP Stormwater Pollution Prevention Plan (SWPPP) (DOE 1996c). The SWPPP identifies potential pollution sources, practices that will be employed to reduce pollutant discharges, and provisions of the inspection program that will be implemented to ensure compliance with the requirements of the NPDES Permit. Section 5.1.3 provides additional details on implementation of these controls.

If excavation activities involve removal of soil from perched water zones, an appropriate area will be established for the pumping equipment and holding tanks required to remove and store (as needed) the perched water prior to treatment at the AWWT facility.

Following the establishment of support areas and surface water control, final surveying will be conducted to determine the excavation layout and monitoring design. In general the layout will delineate the excavation types in the hierarchy illustrated on Figure 3-5. However, if applicable, this survey will also consider removal of at- and below-grade structures, special material areas, and excavation of impacted material. The survey will also identify the appropriate areas for project-specific environmental monitoring stations to ensure that excavation activities will not destroy monitoring equipment.

3.3.1.2 Excavation Hierarchy

The conceptual excavation hierarchy shown on Figure 3-5 follows a step-by-step approach to illustrate the need to segregate soil piles based on the type and concentration of ASCOCs. Figure 3-5 is for illustrative purposes only and is not intended to imply that all technetium-99 soil must be removed before non-technetium, above-WAC soil is excavated. In large excavation areas, specialized crews

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may be used in a sequential manner; where a technetium-99 crew begins excavation and as it proceeds through the excavation area, it is followed by a non-technetium above-WAC crew. In this fashion, various excavation types will be performed simultaneously, when possible.

Excavation begins with the removal and segregation of any identified soil containing technetium-99 above its FRL/WAC (29.1 pCi/g). If the excavation of soil containing technetium-99 above its FRL/WAC includes soil that has failed the TCLP test, the excavated technetium-99 soil will be segregated into non-treatment and treatment containers, as needed, and stored at an approved RCRA storage facility. If on-site treatment of toxicity characteristic waste is selected, the treatment will be performed and the soil will be given to WPM for off-site disposal. RCRA-regulated soil designated for off-site treatment and disposal will be given to WPM for proper packaging and shipment to the designated facility.

After technetium-99 excavations are completed, excavation areas delineated as above WAC and failing TCLP will be excavated and segregated in containers for storage at an approved RCRA storage facility. Stabilization of this material will be required prior to disposal. Removal of above-WAC soil that fails the TCLP test is followed by removal of soil that is below the WAC but fails the TCLP test. If on-site treatment of toxicity characteristic waste is selected, the treatment will be performed and the soil will be given to WPM for decisions on final off-site disposal, based on the pretreatment concentrations of radiological COCs. Soil designated for off-site treatment will be given to WPM for proper packaging and decisions on locations for treatment and final disposal. A final, above-WAC excavation will then be performed on all soil not exhibiting the toxicity characteristic.

Following removal of all above-WAC and toxicity-characteristic soil, soil delineated as above the FRLs of ASCOCs driving the excavation will be removed and passed to Waste Acceptance Operations (WAO) for disposal in the OSDF. For excavations driven by uranium FRLs, excavation will take place to within the area-specific uranium FRL, with consideration given to the ALARA concept (Section 3.3.1.4).

All large debris (i.e., larger than 12 inches), USTs, and special materials encountered during excavation activities will be removed and segregated from the staged soil piles. Debris will be handled as Category 2, 3, 4, or 5 materials (Section 3.6.4.1), whereas tanks, pipes and associated pumping are

considered special materials (Section 3.3.2.2). All special materials encountered during excavation activities will be handled, tracked, treated (as needed), and disposed in accordance with the WAO procedures described in Section 3.6 and Appendix F.

3.3.1.3 Treatment, Special Handling, and Disposal Options

Treatment will be required for all soil from the seven identified RCRA areas that fails the TCLP test and becomes classified as RCRA toxicity characteristic waste (Figure 3-6). Soil failing the TCLP test and containing technetium-99 or other radiological COCs above their WAC will be given to WPM for decisions on treatment and final off-site disposal. For soil below the radiological WAC that fails the TCLP test, a decision will be made by WAO and WPM to treat and dispose of the soil on site or off site. An example of the decision process is provided in Figure 3-7 for the proposed remediation strategy at the former Trap Range. Regardless of where the material is treated, the lead bullets and associated toxic soil from the South Field Firing Range and treated material with pretreatment radionuclide concentrations above WAC will not be placed in the OSDF.

Above-WAC material designated for off-site treatment will be segregated and treated based on its classification as a listed waste (i.e., from within a HWMU) or a RCRA toxicity characteristic waste (i.e., soil from one of the seven areas that fails the TCLP) (Figure 3-6). RCRA F-listed wastes mixed with above-WAC radionuclides will be treated for organic COCs and then evaluated and treated, as needed, for RCRA organic and inorganic COCs prior to mixed waste disposal. If the above-WAC waste is not listed, it will be evaluated and treated, as needed, for RCRA organic and inorganic COCs prior to low-level waste disposal (i.e., the hazardous component has been removed through treatment).

Any RCRA toxicity characteristic waste excavated from six of the seven identified RCRA areas (the South Field Firing Range is excluded, as noted above) may undergo low-temperature thermal desorption treatment if organic COCs are present and/or cement stabilization if inorganic COCs are present (Figure 3-6). The treated material will than be placed in the OSDF. In all cases, decisions regarding soil disposition at the OSDF will follow the WAO procedures summarized in Appendix F.5, or future revisions to the program as approved by the EPA.

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3.3.1.4 ALARA Implementation

Implementing the ALARA philosophy requires executing a reasonable excavation approach that will strive to achieve the release criteria in each remediation area as set forth during the CERCLA process. In addition to this goal, ALARA advocates removal of any additional contaminated material present that is easily discernible and reasonably accessible during the excavation. This application of ALARA only serves to modify the extent of excavations that are scheduled to occur because COC soil concentrations in an area exceed the appropriate FRL. ALARA will not serve as a generic justification to initiate remediation of an area that does not require excavation or to conduct further excavation in areas that meet FRL attainment criteria (Section 2.1.5.3).

3.3.1.5 Reuse of Soil During Remedial Actions

Remedial actions may include the use of FEMP soil as borrow material for OSDF construction and/or the building of roadbeds. If nonimpacted soil is needed as borrow material for construction, the identified area will first be certified according to the normal process. When a temporary roadbed needs to be constructed through a contaminated area (e.g., the OSDF Haul Road in Area 3), impacted soil may be used from the area traversed by the road as long as COCs do not exceed the chemical WAC and the soil does not come from any of the six areas potentially containing RCRA hazardous constituents. The impacted soil will be excavated before final certification of the area. If a designated borrow area is intended to serve as a sediment basin for contaminated runoff, it will be certified at a later date after the fill is removed and the basin is no longer needed. This process is defined as "characterization for reuse," which is different from certification. Reuse areas will be delineated and separated as special CUs during certification.

3.3.2 Impacted Materials Handling and Tracking

Impacted materials are defined as all soil and debris that can be dispositioned to the OSDF (i.e., meeting all applicable radiological, chemical, and physical WAC). These materials will be handled and tracked by WAO and their program will be implemented and integrated with the SCEP excavation operations, as defined in the WAC Attainment Plan (DOE 1998b). Protocols for disposition of excavated soil and waste materials currently in place are summarized in Appendix F.5. Programmatic controls begin with waste planning during the predesign investigation, at which time volume estimates per matrix and source location will be prepared, characterization protocols are specified, treatment options noted, and tentative interim and final disposition identified.

3.3.2.1 Disposition Categories

During excavation, waste streams are segregated by disposition categories and managed in the context of the following characterization, storage, and disposal options:

- Bulk Waste Streams: On-Site Disposition
  - Physical matrix allows bulk management
  - Meets the OSDF chemical, radiological, and physical WAC
- Bulk Waste Streams: Off-Site Disposition
  - Physical matrix allows bulk management
  - Exceeds the OSDF radionuclide WAC (rail transport)
  - Exceeds the OSDF chemical WAC (truck transport)
- Containerized Waste Streams: Off-Site Disposition
  - Exceeds OSDF chemical, radiological, or physical WAC
  - Cannot be processed to meet OSDF WACs
- Containerized Waste Streams: On-site Disposition
  - Physical matrix or nature of waste does not allow bulk management
  - Requires processing in a controlled area, to meet OSDF WAC
  - Requires confirmatory sampling for OSDF WAC
  - Special Material that meets the OSDF WAC, but requires special handling for health and safety concerns.

Chemical and radiological requirements for the OSDF WAC are summarized in Table 2-4. Note that some of the RCRA constituents identified in Table 2-4 apply only to the six areas identified in the Operable Unit 5 ROD (DOE 1996e) as suspect RCRA toxicity characteristic areas with cost-effective treatment opportunities. The OSDF physical WAC are presented in Table 2-5. The WAC Attainment Plan (DOE 1998b) provides additional detail on the chemical, radiological, and physical requirements for the OSDF WAC.

Protocols specific to containerized special materials are provided in Appendix F.5. Containers will be managed in an interim storage area pending completion of characterization, treatment, WAC confirmation, and other activities specific to the selected on- or off-site facility. If on-site treatment options are developed, off-site designated waste streams will be reevaluated to allow on-site treatment of selected off-site designated materials. The waste disposition program will also be updated accordingly.

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3.3.2.2 Special Materials

When excavation activities encounter special materials or unexpected high levels of contamination, contingency plans may be implemented to address pertinent health and safety concerns. Special materials are defined as:

- Asbestos
- Nonpressurized containers (e.g., drums)
- Pressurized containers
- Piping and pumps
- Non-soil residues
- Transformers
- Lead acid batteries
- Uranium metal
- Medical/infectious waste
- Miscellaneous debris
- Tires
- Brick, including acid brick.

Portions of these waste streams will be eligible for OSDF disposition after physical processing, sampling and analysis, or interim containerization. Materials that do not meet OSDF WAC will be evaluated for off-site disposition. Protocols currently in place for identifying, managing, and tracking special materials are provided in Section 3.6 and Appendix F.

3.3.3 Precertification Activities

The general activities to be followed during precertification of a remediation area are outlined on Figure 3-8. Large-volume NaI detectors and portable HPGe instruments will be used to survey as much of the remediation area as possible. This area survey will be used to estimate the residual pattern of uranium, radium, and thorium distribution. Survey results will be used with historical knowledge, RI/FS data, and an understanding of the physical conditions of the area to determine the location of CU boundaries and the appropriate size of the CUs that will subdivide the remediation area.

After the CU grid has been established for the remediation area, CU-specific ASCOCs will be identified and HPGe measurements will be taken above areas designated as elevated by the NaI survey. If HPGe measurements indicate any single location to be above the hot spot criterion or the average concentration of individual ASCOCs is likely to exceed their FRL, additional excavation, scanning, and measurements will be conducted until each CU in the remediation area is considered to be ready

for certification (i.e., a high possibility for success is indicated). A CDL will be issued prior to conducting final certification sampling and analysis to present the EPA with the rationale used for final selection of the boundaries of each CU, the list of CU-specific COCs to be evaluated, and the certification sampling approach.

3.3.3.1 Field Survey to Evaluate Residual Radionuclide Distributions

Following excavation of all areas to established FRL depths, a scanning survey will be conducted on the excavated surfaces to establish the distribution pattern of residual uranium, thorium, and radium. This survey will be conducted with a large-volume NaI detector. Vehicle-mounted detectors like the RTRAK may be used in areas where excavations are not deep and the excavation depth is uniform over a large area. A large-volume NaI detector mounted on a cart (i.e., the RSS) may be used when the excavation depth is not uniform over a large area and surveying is required for each excavation layer. Regardless of the configuration used, the selected equipment configuration should have the sensitivity to provide a threshold response to radioactivity from soil containing uranium, thorium, or radium at concentrations exceeding three times the FRL.

The scanning survey will cover as much of the excavated and unexcavated areas as possible, with the understanding that some densely-wooded areas and steep slopes may not be suitable for surveying with the instruments. Areas will be marked with paint, chalk, flags, or other appropriate method when instrument readings indicate uranium thorium, or radium is present above a value corresponding to three times its FRL. Where possible, a rough estimate of the areal extent of the residual affected area will be delineated in the field to facilitate follow-up measurements with the HPGe instrument, to meet applicable health and safety protocol, and to identify potential access control areas. The presence and location of these areas will be recorded in precertification field notebooks and reported to appropriate management and oversight personnel. The area-wide radiological activity pattern will be contoured using scanning results and the GIS.

3.3.3.2 Determination of CU Size, Area-Wide CU Delineation, and CU-Specific COCs

FEMP remediation areas are classified as either impacted or nonimpacted areas using historical knowledge and RI/FS data. Impacted areas (i.e., areas that contain known and/or expected hot spots) primarily include the former production area, waste storage/management areas (e.g.,Waste Pits, Silos, Flyash Piles, etc.), and other localized areas with known or potential significant contamination (e.g.,

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Sewage Treatment Plant, Fire Training Facility, other HWMUs, and USTs). Nonimpacted areas (i.e., areas where hot spots are believed to be absent) are outside the impacted areas and include the area west of Paddys Run (Remediation Area 8), the wooded area north of the production area (Remediation Area 1, Phase III), and much of the area south of the Former Production Area (Remediation Area 1, Phase II and Remediation Area 2, Phase III). However, some of the nonimpacted areas may require local excavation in order to satisfy the certification requirements.

The size of the CU will be determined by the type of area in which it is located. Impacted areas are expected to have a greater diversity of COCs, a higher reported residual concentration or activity, and/or a greater variability in reported concentrations than nonimpacted areas. Experience has shown that these areas have a higher potential to exhibit a complex distribution of contamination. This, in turn, requires CUs located in impacted areas to have a greater number of sample locations per unit area than areas with a more homogeneous distribution of contamination. To reflect the need for a more detailed characterization of these areas, the initial CU size in impacted areas will be smaller than those in nonimpacted areas. The nominal CU size for impacted areas will be no greater than 250' by 250' (62,500 $ft^2$) and referred to as a Group 1 CU. For nonimpacted areas, a maximum CU size of 500' by 500' (250,000 $ft^2$) will be defined as a Group 2 CU.

In general, the CU boundary in a remediated area will be delineated considering both the preremediation and postremediation conditions (i.e., physical and chemical conditions). To ensure that residual contamination within a CU is reasonably homogenous, the CU boundaries will be delineated using the pattern of total radioactivity that is generated during the precertification scan. Within each CU, the range of residual total radioactivity is expected to be within one order of magnitude. To the extent practical, a CU will cover an area with similar physical and chemical conditions to ensure valid statistical assumptions apply to the sampling and data reduction calculations used to make the certification decision. The CU delineations will also need to consider efficient access control and prevention of cross- and re-contamination during the certification process. Also, the number of CUs and physical samples must be manageable in order to facilitate an efficient remediation and certification process. The initial CU delineation, sampling locations, and rationale (e.g., RI/FS and precertification data) will be presented in an area-specific CDL for regulatory review and approval before certification sampling is initiated.

Group 1 CUs will be defined in areas that, generally, have COC concentrations above their respective FRL before remediation, with the nominal CU size up to 250' by 250'. Local area-specific conditions and COC distributions will determine the individual Group 1 CU size. Factors to be considered for reducing the Group 1 CU size from the nominal 250' by 250' dimension include: previous hot spot and above-WAC boundaries, HWMU boundaries, boundaries of areas containing toxicity characteristic soil, storage pile foot prints, previous building foundations, drainage features (e.g., ditch or basin), road ways, former production area fence line, property lines, and previous major site pipe lines.

Group 2 CUs will be defined in areas that, generally, have COC concentrations below their respective FRL prior to remediation, with the nominal size up to 500' by 500'. Factors to be considered for reducing the Group 2 CU size from the nominal 500' by 500' dimension include: storage pile foot prints, drainage features (e.g., ditch or basin), road ways, property lines, farm land boundaries, and previous major site pipe lines.

HWMUs will be defined as special CUs to isolate their footprint for closure activities discussed in Section 2.2.5. Each HWMU will be designated as a special CU, the exception being multiple HWMUs within a single building footprint can be grouped into a single special CU.

CU boundaries are delineated after the precertification survey and/or sampling activities and any additional excavations so that the landscape physiography and the most updated information about the distribution of residual COCs are used in delineation. CU design should take into account drainage patterns, with boundaries established to follow the drainage rather than strict northings and eastings. Based on the most current data on COC distribution, CU boundaries will be delineated in a manner that minimizes the number of COCs that must be certified in each area. For example, if the residual distribution of arsenic is limited to 50,000 $ft^2$ in a remediation area, this area will be contained within a single CU to minimize the number of CUs that must be certified for arsenic. In this way, each CU may have a subset of the entire set of ASCOCs distributed throughout the remediation area. Additionally, an area that has been designated as a reuse area (Section 3.3.1.5) will be delineated as a separate CU or multiple CUs. Reuse areas will not be mixed with areas designated for certification.

The delineated CU boundaries, list of CU-specific COCs, and certification sampling approach will be stated in the Certification Design Letter. CU boundaries will be field checked to ensure that fixed

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boundaries can be established for the duration of the certification process (e.g., no road surfaces, surface-water impoundments). Following EPA review and approval of the CDL, CU boundaries will not be reconfigured without concurrence from the EPA.

3.3.3.3 Final Field Measurements and Excavation, As Needed

After establishing the CU boundaries and specifying the CU-specific COCs, HPGe measurements will be made over areas designated as elevated by the NaI scan. If the HPGe measurements indicate that uranium, radium, and thorium concentrations in soil exceed three times the FRL or the average concentration of a COC in the CU is above its FRL, additional excavation will take place to remove the elevated material. The contamination can be removed by re-excavating the entire CU or by excavating the elevated areas (i.e., hot spots). If the entire CU is excavated, the CU will be resurveyed with NaI detectors. If the excavation is selective in nature, excavation will continue until the HPGe measurements indicate that the certification criteria have been met.

If nonradiological COCs are driving the excavation in a CU, field screening will be conducted and the decision may be made to collect discrete samples for laboratory analysis of metal or organic COCs. Field screening for inorganic and organic COCs will be carried out as described in Section 2.4 and Appendix H. Should discrete sampling and analysis be conducted, the samples will be collected in a manner that will allow them to be used for final certification in the event that the laboratory analysis confirms the COCs are below CU release criteria.

Upon completion of all HPGe measurements, additional excavations, and optional sampling activities, a CDL will be issued prior to conducting final sampling and analysis activities for certification. The CDL will contain figures depicting the boundaries of the CU proposed for certification, the basis for delineating the boundaries shown on the figures, the list of CU-specific COCs that will be analyzed to demonstrate certification, and the certification sampling approach. CU boundaries are delineated in the CDL rather than in the IRDP to allow use of precertification data to optimize the location of boundary lines. Submittal of the CDL will indicate that the CU is ready for final sampling and analysis activities to commence. Upon EPA review and approval of the CDL, certification sampling activities will be initiated.

### 3.3.4 Attainment of Remediation Goals

The remediation goals established for soil excavation activities at the FEMP include: 1) WAC attainment, 2) FRL attainment, 3) hot spot attainment, 4) RCRA-characteristic-waste compliance, 5) HWMU closure, and 6) UST closure. These goals are discussed in detail in Section 2.2 and are expected to be met when the CDL is submitted and will be shown to be met when the Certification Report is issued.

## 3.4 CERTIFICATION

The general sampling strategy and procedures proposed for certification of remediation areas are illustrated on Figures 3-9 and 3-10. Figure 3-9 summarizes the classification and delineation of CUs and the range in the number of samples to be collected and submitted for analysis. The general certification process is outlined on Figure 3-10, and this process will begin after the CDL has been approved by EPA and OEPA. Discrete physical samples will be collected for laboratory analysis (ASL D) of all CU-specific COCs[1]. During certification sampling, the sidewalls, side slope, benches and bottom of deep excavation areas will all be included in the CDL and subject to random sampling.

Analytical results will be reviewed and validated prior to conducting the statistical test used to make the pass/fail decision for each CU. If there is an analytical problem identified during data review or validation, it will be corrected with additional sample analysis or other appropriate action. Validated data are placed in the SED and used to perform the appropriate statistical test needed to make the pass/fail decision for each CU. When all CUs within a remediation area pass certification, a Certification Report is issued to EPA for concurrence. In the event a CU fails, one of three conditions must be evaluated: 1) high variability in the data set (fail a *posteriori* test); 2) widespread contamination (fail UCL-on-the-mean test); or 3) localized contamination (fail hot spot criterion). These conditions are discussed in Section 3.4.5.

Elements of the certification process (Figures 3-9 and 3-10) that warrant further discussion in this section include: 1) classification and delineation of CUs; 2) sampling design; 3) statistical analysis; 4)

[1]At some future date, EPA may approve the use of HPGe measurements for certifying uranium, thorium, and/or radium.

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criteria for attainment of certification; 5) procedures for nonattainment scenarios; and 6) submittal of the Certification Report. Additional certification design rationale is provided in Appendix G.

### 3.4.1 Classification and Delineation of CUs

The CUs will be classified and delineated after the precertification survey has been completed. To simplify data management and decision making processes, only two nominal CU sizes and a HWMU specific, special CU size will be used in the certification process (Section 3.3.3.2). No COC-specific CU delineation will be performed.

### 3.4.2 Sampling Design

The soil sampling design requires subdividing the remediated area into Group 1 or Group 2 CUs, with each CU containing 16 cells. Sixteen random soil sampling locations will be selected for each CU (one random location within each cell), regardless of its group classification (Figure 3-9). Depending on the CU-specific COCs and the group classification, 8 to 16 samples will be submitted for laboratory analysis (ASL D) of all CU-specific COCs. QA/QC samples will be collected per the guidelines in the Sitewide CERCLA Quality Assurance Plan (SCQ) and Appendix E. In Group 1 and Group 2 CUs, all 16 sample locations will be measured with the HPGe to collect comparability data for future decisions on the use of HPGe measurements for certification of uranium, thorium, and radium.

As Group 1 CUs lie in impacted areas known to or suspected to contain hot spots, 12 to 16 of the samples will be selected for analysis of primary COCs (i.e., uranium, thorium, and radium), and 8 to 12 samples will be analyzed for secondary COCs. In Group 2 CUs there are no known and/or suspected hot spots (i.e., no radiological risk drivers); therefore, 8 to 12 samples will be selected for analysis of all CU-specific COCs. Appendix G provides additional justification for the range of 8 to 16 analyses per CU. The justification is based on results obtained from conducting statistical tests with data representative of expected sitewide residual COC conditions, with a 20 percent increase in the statistical result to account for possible problems associated with sample preparation and analysis.

#### 3.4.2.1 Soil Sampling Locations

Sampling locations in Group 1 and Group 2 CUs will be determined randomly within each of the 16 cells of the CU. To prevent clumping of the sampling locations in one small area of the CU, two criteria must be met before the sampling locations are used. The first criterion requires that four

points must be located in each quadrant of the CU. The second criterion requires that the distance between any two adjacent points will be limited to some maximum distance determined by the CU size and shape. If the first randomly generated sampling grid fails to meet these criteria it will be discarded and a new one generated. Once a grid that satisfies these criteria is generated, the sample locations must be verified by a field check to ensure that samples can be obtained (e.g., a sample location does not correspond with a large tree trunk). Once sample locations have been confirmed as accessible for soil collection they may not be moved without prior consent of the EPA and OEPA. The sample locations will be tied into the global positioning system (GPS) or appropriate site survey system.

Minimum Distance Criterion

After sample locations have been randomly selected, each location must pass a minimum distance criterion. Occasionally, during the process of sample point generation two or more random sample locations may be very close, or clustered. When sample locations are clustered in one or more area(s), that area becomes overemphasized in the overall average and UCL calculations. Conversely, when sample locations are clustered in one or more area(s) this will almost necessitate that other areas are underemphasized. In order to avoid clustering of data locations, the following minimum distance criterion will be applied to all randomly selected sample locations within the CU.

The equation used as a Minimum Distance Criterion is as follows:

$$\frac{\sqrt{Area_{CU}}}{\left(\sqrt{16} \times 2\right)} = \frac{\sqrt{Area_{CU}}}{8}$$

The equation used to determine the distance between two sample locations is

$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

where

$x_1$ = easting coordinate for the first sample location,

$x_2$ = easting coordinate for the second sample location,

$y_1$ = northing coordinate for the first sample location, and

$y_2$ = northing coordinate for the second sample location.

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If any two or more sample locations fail the Minimum Distance Criterion these locations are rejected and alternate random sample locations are generated. This process is repeated until all sample locations within a CU meet the criterion.

3.4.2.2 In Situ Soil Measurements for Gamma Emitters

In situ HPGe is the preferred method of certification for gamma-emitting radionuclides because of its rapid response time and relatively large field of view. However, the measurements will only be used for comparability purposes until EPA and OEPA approval of the method is received. A recent comparability study (DOE 1997f) has demonstrated that HPGe measurements meet ASL B requirements for total uranium and thorium-232. Currently, radium-226 measurements do not meet these requirements, but ongoing research is focusing on method modifications that may allow radium-226 measurement to meet ASL B criteria. This capability will be documented in a follow-up submittal to the EPA and OEPA.

For both Group 1 and Group 2 CUs, HPGe measurements will be made at all sampling locations defined in the CU. The measurements will be taken in accordance with the established protocol in the User's Manual (DOE 1998c). As ongoing work with the comparability of in situ HPGe measurements to laboratory measurements is completed, an addendum will be developed and provided to EPA for review. When EPA and OEPA approval is obtained, HPGe measurements will be incorporated into the certification process.

3.4.2.3 Laboratory Analysis

For Group 1 CUs (Figure 3-9), three of the four samples in each quadrant of the CU (i.e., 12 per CU) will be selected randomly and submitted to a laboratory for an ASL D analysis of all primary CU-specific COCs. If conditions warrant additional analysis of samples, all 16 collected samples may be submitted for analysis. For all secondary CU-specific COCs, two or three of the four samples in each quadrant of the CU (i.e., eight or twelve samples per CU) will be selected randomly and submitted to a laboratory for the appropriate analysis (e.g., metals, volatile organic compounds, technetium-99, etc). The remaining samples will be archived until the holding times have been exceeded for their CU-specific COCs, or until the unit is certified as released. Duplicates will be collected and submitted in accordance with established protocol in the SCQ.

For Group 2 CUs (Figure 3-9), two or three of the four samples in each quadrant of the CU (i.e., 8 or 12 samples per CU) will be selected randomly and submitted for an ASL D analysis of all CU-specific COCs. The remaining samples will be archived until the holding times have been exceeded for their COCs, or until the unit is certified as released. Duplicates will be collected and submitted in accordance with established protocol in the SCQ.

Samples collected from the CUs and submitted for laboratory analysis will meet the quality assurance/quality control requirements listed in the SCQ and Appendix E. All analytical results will be reported and verified as ASL D, with 90 percent of the results validated to ASL B, and 10 percent validated to ASL D.

3.4.2.4 Special Considerations for Off-property Certification

The soil located outside of the eastern FEMP boundary (off-property) is identified as Remediation Area 9. Based on existing data, soil contamination has only been demonstrated in isolated portions of Area 9 that are adjacent to the east FEMP fence line. Therefore, DOE proposes to conduct soil certification off-property along portions of the eastern FEMP boundary, along portions of the eastern FEMP boundary, along the length of the outfall pipe between the FEMP and the Great Miami River and in the vicinity of the old outfall along the Great Miami River to certify this soil as attaining all off-property FRLs. The off-property soil north, west and south of the FEMP will be certified if adjacent on-property contamination is found during remediation and/or certification of those areas.

For certification purposes, Area 9 has been divided into three phases. Area 9, Phase I is the area adjacent to and east of Area 1, Phase I (Figure 1-3), and this area will be certified in its entirety. Area 9, Phase II is adjacent to and east of Area 1, Phase II, and the portion of Area 9, Phase II north of the FEMP outfall line that borders excavated areas in Area I, Phase II will be targeted for certification. The remaining portions of Area 9, Phase II that border Area 1, Phase II do not require excavation and will not be targeted for certification. Area 9, Phase III is defined as the soil along the length of the outfall pipeline between the FEMP and the Great Miami River and the soil along the Great Miami River in the vicinity of the old outfall, and this area will be certified in its entirety. The extent of soil to be certified within each phased area and the depth of soil for certification will be determined based on existing data, precertification data and the current land use scenario.

For example, the property owner's consent will need to be obtained and consideration must be given to farming activities, structures, trees, and other obstacles. Cultivated areas imply the soil is disturbed to deeper levels, which will limit the usefulness of real-time instruments in precertifying the area. Therefore, some physical sampling may be required and the depth of sampling in during precertification and certification activities will be greater than the standard 6-inch depth proposed for certification samples. The depth of the samples collected in cultivated areas will be determined in the area-specific PSPs.

Due to the identification and removal of a total uranium hot spot in CU O-20 of Area 1, Phase I, a Group 1 CU will be located off-property immediately north of this CU to determine if contamination extends beyond the FEMP boundary. This CU will be included in the scope of work carried out for Area 9, Phase I. A similar strategy will be implemented to certify other localized off-property areas north, west and south of the FEMP when above-FRL contamination is identified at an adjacent on-site location.

The schedule for off-property certification has been outlined in the proposed addendum to the Operable Unit 5 Remedial Design Work Plan. The schedule has been developed so that precertification and certification activities can be carried out in consecutive winters in cultivated lands to minimize the disruption of agricultural use of the land. Efforts will be made, however, to accomplish precertification and certification in the same winter, if arrangements can be made with the landowner. Performing this work in the winter will ensure that field activities do not disturb the planting schedules of the landowners.

In the event that above-FRL contamination is discovered during precertification or certification activities, an IRDP will be submitted for regulatory review and approval. The schedule would then be modified, if necessary, to allow time for excavation before submittal of the CDL.

### 3.4.3 Statistical Analysis

A statistical analysis will be conducted with the validated analytical data to determine the distribution of the data set (e.g., normal or lognormal) and to establish whether the CU passes the certification criteria at the specified confidence level. If the data set, or a log transformation of the data set, exhibits a normal distribution, the Student's t-Test will be used to establish the pass or fail decision for

the CU. A distribution that is not normal will result in using a nonparametric approach to determine the pass or fail decision for the CU. Regardless of the distribution and test used, the Type I error probability ($\alpha$) will be set at 0.05 for primary COCs and 0.1 for secondary COCs. This states that there is less than a 5 percent chance that the CU will pass certification for primary COCs when it should have failed; the chance increases to less than 10 percent for secondary COCs. Details on the statistical approach and proposed tests are provided in Appendix G.

### 3.4.4 Criteria for Attainment of Certification

A statistical analysis will be performed on the validated analytical results obtained from the certification samples to establish whether the CU passes the certification criteria at the specified confidence level. Two criteria must be met for the CU to be certified as passing. The first criterion is that each individual sample within a CU must show each of the three primary radiological COCs (i.e., uranium, thorium, and radium) to be below a value of two times its FRL. If the data distribution is normal or lognormal, the second criterion compares the 95 percent upper confidence level (UCL) of the mean of each primary COC to its FRL and the 90 percent UCL of each secondary COC to its FRL to make a pass/fail decision. When the UCL of the mean (normal or lognormal distribution) of each COC is less than its FRL, the CU is certified as passing the second criterion. For the special case when a HWMU is the CU or part of the CU, all COCs pertinent to the HWMU are considered secondary COCs, and the 95 percent UCL of the mean will be compared to the respective FRL to make the closure decision. If the data distribution is not normal or lognormal, the appropriate nonparametric approach will be used to evaluate the second criterion. Both criteria must be met for the CU to be certified. Appendix G provides additional details on the statistical analysis and tests applied to certification.

### 3.4.5 Procedures for Nonattainment Scenarios

Both certification criteria defined in Section 3.4.4 must be met for a CU to pass certification. In the event a CU fails certification, one of three conditions must be evaluated: 1) high variability in the data set; 2) widespread contamination; or 3) localized contamination.

Condition 1 (High Variability). High variability in the data set is evaluated with the a *posteriori* test to determine the pass/fail decision for the data set (Figure 3-10). If this test fails due to high variability of a single sample, the decision may be made to rerun the sample to check for laboratory

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inconsistency. Alternatively, if the confidence in the laboratory results is high, the high variability resulting from a single sample may be traced to localized contamination that is identified as a hot spot (Condition 3). For high variability arising from a wide range in CU-specific COC concentrations, widespread contamination may be indicated (Condition 2).

Condition 2 (Widespread Contamination). Widespread contamination indicates the UCL mean test has failed (Figure 3-10). When this condition occurs for Group 1 CUs, further excavation is needed and the CU requires another complete round of sampling and analysis (i.e., 16 random samples are collected and 12 of the 16 are selected randomly for laboratory analysis). For Group 2 CUs, the CU is repartitioned into four Group 1 CUs and each of the newly-formed Group 1 CUs is evaluated to determine if sampling and analysis will result in a pass decision. If it appears unlikely that sampling and analysis will provide the data needed for a pass decision on the CU, each of the CUs will be excavated and undergo a new round of sampling and analysis. In contrast, if the newly formed Group 1 CUs are likely to pass certification by repeating the sampling and analysis without excavation, samples are collected and analyzed to perform the statistical evaluation and to reassess the certification of each Group 1 CU (Figure 3-10).

Condition 3 (Localized Contamination). Localized contamination indicates the CU has failed the hot spot criterion, and the sample location that has failed is re-excavated until the anomaly is removed. The footprint is than sampled and the soil submitted for analysis to demonstrate removal of the hot spot. Hot spot criteria and implementation strategies are depicted in Figure 3-11.

When the CU fails certification under Condition 1, archived samples may be analyzed. Archived samples may be used to supplement the original submission to the lab for two reasons. First, if transportation, holding times, and/or events at the laboratory invalidate the sample, the archived sample from the relevant CU quadrant can be sent as a replacement. Second, if the statistical analysis of the data indicates the mean of the COC concentration is below its FRL, but the UCL of the mean is above the FRL, then the option to analyze the available archived samples will be exercised to better estimate the average contaminant levels within the CU. In the case of a Group 2 CU, archived samples exist for all CU-specific COCs, whereas a Group 1 CU may have archived samples for only secondary CU-specific COCs. In all cases, the holding times of archived samples must be assessed prior to analysis to determine if they meet quality assurance protocols.

### 3.4.6 Implementation Strategy for the Hot Spot Criteria

Figure 3-11 summarized the hot spot criteria to be evaluated during precertification and certification activities. The hot spot criteria will be implemented during these activities using real-time measurements, field instruments, and laboratory analysis of physical samples for each CU-specific primary and secondary COCs and analysis of physical samples for the primary radiological COCs (i.e., uranium, thorium, and radium).

During precertification scanning, two-point averages will be calculated from RTRAK measurements for the primary COCs and the averages will be compared to values corresponding to 3 times the FRL to make the hot spot decision. When the uranium FRL is less than 82 mg/kg, the RTRAK scan will acquire data as total gross activity and the areas of highest total gross activity will be measured with the HPGe to establish the total gross activity measurement that corresponds to three times the uranium FRL. If the RTRAK MDA is less than three times the FRL, a total activity contour map will be produced and activity areas that exceed three times the FRL or areas that are contoured based on total gross activity will be surveyed with the HPGe. Areas that exceed three times the FRL will be scanned again with the HPGe instrument to confirm and delineate the hot spot area. For either case, if the HPGe measurements confirm the existence of a hot spot (i.e., three times the FRL), the hot spot will be excavated and the scanning will be repeated until the area is precertified as free of hot spots.

During the certification activities, several hot-spot criteria are evaluated when any individual laboratory sample result indicates a COC is greater than two times its FRL, after the other statistical criteria are met (i.e., Conditions 1 and 2 in Figures 3-10 and 3-11). First, HPGe measurements are taken above the sample location and surrounding area to delineate the hot spot area. If these measurements indicate any primary COC has exceeded 30 times its FRL, the hot spot is excavated. When this initial evaluation is passed, the hot spot is evaluated with respect to the area represented by the HPGe measurement. If the area is less than $10m^2$ and any primary COC exceeds a value of three times the FRL, the delineated hot-spot area will be excavated. When the area is greater than $10\ m^2$, the hot-spot criterion is defined as greater than two times the FRL. Failure of any of the above criteria will result in excavation of the hot spot followed by an additional round of sampling and analysis to demonstrate all certification criteria have been met.

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Secondary COC hot spots will be evaluated based on physical samples collected during the certification process. When a secondary COC concentration exceeds two times its FRL (Condition 3 on Figure 3-11) the hot spot associated with the secondary COC will be further delineated using a combination of field techniques, sampling, and laboratory analysis. In agreement with the hot spot criteria for primary COCs, if the area of the secondary hot spot is less than 10 $m^2$, measurements of the COC corresponding to the hot spot must exceed a value of three times its FRL before excavation will take place. In general, a decision on the need for further excavation of secondary COCs will be made with regulatory concurrence on a case-by-case basis.

### 3.4.7 Certification Report

Certification reports will be used to demonstrate progression of the remedial action, although the report is not required in accordance with EPA guidance or the Amended Consent Agreement (EPA 1991). The intent behind submitting a Certification Report for each phase of a remediation area is to receive acknowledgment that the pertinent operable unit remedial actions were achieved. This report will allow natural resource restoration to proceed as rapidly as possible. Upon completion of all certification activities within a remediation area, a formal certification report will be issued for the entire remediation area. Interim grading activities will commence after EPA and OEPA approval of the Certification Report.

A Certification Report will be prepared for individual or several remediation areas, and this report is the final area-specific remediation deliverable. The primary objectives of this report are to 1) document the remedial actions that occurred; 2) describe the certification process; 3) present all data supporting the certification that area-specific COCs do not exceed FRLs specified in the relevant RODs; 4) demonstrate that Federal and State of Ohio closure regulations have been met for HWMUs and/or USTs; 5) summarize data necessary to demonstrate WAC attainment; and 6) describe access controls implemented to prevent recontamination. Section 7.4 presents additional information on the content and preparation of Certification Reports.

## 3.5 POSTREMEDIATION ACTION

Once excavation at the FEMP is complete and the results of the certification activities have been documented, the area will be developed into the final land use specified by the Natural Resource Restoration Plan (NRRP). For many areas, this can be done immediately after certification. However, for some areas, final development must wait until other remediation projects at the site are complete. Therefore, postremedial activities can be divided into two categories: 1) interim actions taken to maintain the area and 2) actions taken to develop the area into its final land use. A general discussion follows with details provided in Appendix F.7.

### 3.5.1 Interim Actions

Interim actions are taken to stabilize the unit after certification, to prevent recontamination, and to maintain it until the unit can be developed into its final land use. Stabilization activities should be initiated upon the completion of construction activities or upon a decision to suspend construction for more than 45 days. The three stabilization categories are defined and described in Appendix F.7. Additional interim actions are discussed below.

#### 3.5.1.1 Access Controls

Physical hazards from traffic and construction work will exist during interim actions. In addition, the certification unit will have to be secured from trespass. For these reasons, the certification unit will be treated as a Category II controlled area (Appendix F.2) during the interim between certification and conversion to final land use. For such an area, access is restricted to authorized personnel, and no personnel or material monitoring is required to exit the area. A certification unit's access controls will be maintained at the same level as surrounding certification units until the entire area has been converted to its final land use.

#### 3.5.1.2 Surface Stabilization After Certification

Interim grading activities will be performed after each certification unit is certified. Interim grading will be performed to flatten slopes (for stability), control water drainage, and begin the process of grading the certification unit in accordance with the restoration concept. Where possible, the certification unit will be graded to the final grade level according to the sitewide restoration strategy. Regardless of the level of interim grading, all temporary ground cover will be stabilized to hold the soil in place until the final grading and development begins (Appendix F.7.1).

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3.5.1.3 Interim Monitoring

Interim monitoring of a certified unit will be limited to verifying that contamination for unremediated areas is not spreading back to the certified unit through uncontrolled runoff. Section 5.2 discusses the monitoring that will be implemented to demonstrate the needed control.

3.5.1.4 Runoff Control

Runoff controls will be implemented as described in Appendix F.2. Regular inspections of the certification unit will be made to verify that it is properly drained and that runoff does not adversely affect surrounding areas and stream quality. If it is determined that either of these conditions is not the case, remedial action will be taken to correct the drainage problem.

3.5.2 Final Land Use Development

The current commitment for final land use is an undeveloped park. Deep excavations will be allowed to develop into ponds and will be backfilled only to the extent necessary to hold water or provide adequate surface drainage. Vegetation will be established on barren excavation surfaces. Final land use for all excavation areas will be described in the NRRP; designs will be developed for each area individually.

3.5.2.1 Final Grading

Final grading will include construction of drainage features, placement of topsoil, seeding, and other steps necessary to properly grade the area. This may include bringing in additional soil from other areas to restore the site (Appendix F.7).

3.5.2.2 Access Controls

During the final phase of site restoration, physical hazards from traffic and construction work will exist. For this reason, the entire remediation area unit will be treated as a Category II controlled area (Appendix F.2) until the unit is released to its final land use. Consequently, access is restricted to authorized personnel, and no personnel or material monitoring is required to exit the area.

3.5.3 Final Land Use

The NRRP will dictate the final land use and future habitats for the remediation area. Specific design criteria for the design and development of these habitats will be identified in relevant IRDPs. After

final grading is complete, vegetation will be established for the specific habitat desired using seeding, tree planting, and other methods as appropriate for the habitat. The following general guidelines were developed for wetlands, open water areas, woodlands, riparian, and grasslands. These habitats have been identified as the feasible natural environments at the FEMP.

3.5.3.1 Wetlands

Wetlands require very specific environmental conditions that are affected by saturation, slopes, water depth, and other mitigating factors. Gradual shoreline slopes of 6:1 or flatter to a depth of 1 to 3 feet will encourage plant species diversity and feeding areas. Poorly drained soil types are essential to supply an impermeable substrate for holding water. For a wetland to be functional, it must have adequate amounts of water during appropriate times of the year. Subsurface tile drains must be broken or removed if they are identified in a proposed wetlands location.

3.5.3.2 Open Water Areas

Requirements for open water areas will be provided in the NRRP and subsequent design documents (i.e., area-specific NRRDPs).

3.5.3.3 Woodlands

A woodlands habitat can be located in any area on the FEMP that is well drained.

3.5.3.4 Riparian Areas

Soil conditions that would support a riparian habitat would have to be located along a linear, topographically low area that receives surface water runoff from the surrounding area. Paddys Run currently supports the only naturally occurring riparian environment at the FEMP.

3.5.3.5 Grasslands

Grassland habitat would require poorly drained soil conditions and could be located in a wide range of areas on the FEMP property.

3.5.3.6 Postremediation/Postclosure Care and Inspection

Postclosure maintenance of remediation areas (other than the footprint of the OSDF) will be addressed within the NRRP as part of the site's restoration activities. Postclosure maintenance of the OSDF is

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specifically addressed within the Post-Closure Care and Inspection Plan, On-Site Disposal Facility (DOE 1997b).

## 3.6 RECORD KEEPING AND INFORMATION MANAGEMENT

Management of existing and newly-generated information is essential to economically completing a successful remediation of the FEMP. This information will be used by remediation projects for a variety of applications and consequently must be available sitewide, retrievable in diverse formats, and require minimal turn-around time to access.

The guidelines provided in this section are intended to promote consistent record keeping and information management associated with all excavation activities, regardless of the on-site or off-site disposition of the material. The electronic Integrated Information Management System (IIMS) described below will facilitate information records management and reporting, including compliance-based record keeping and reporting requirements. Information management objectives identified in Section 3.6.1 must be met throughout remediation. These objectives will ensure the integrity of the information used for completion of remediation under the SCEP.

### 3.6.1 Information Management Objectives

Information management and retrieval systems at the FEMP function as a central information repository that can be used in all facets of the remediation. So that this information can be readily available to all potential users, a uniform system of record keeping and information management has been adopted. The primary information management objective of the SEP is to ensure that the people planning, performing, surveying, and documenting remediation will have access to this centralized repository of information about the site in a timely and efficient manner.

Table 3-1 summarizes the types of analytical information that will be generated by following the general remediation process. Other excavation information needs can be grouped into four major types:

1. Planning information
2. Excavation control, status, and general management information
3. Material control and handling information
4. Documentation of cleanup.

To meet these needs, the information management system employed will:

- Maintain a central repository for geological, topographical, engineering, and analytical data from all available sources in a format that promotes multiple uses
- Receive and store new information and relate it to existing information
- Provide current information simultaneously to all ongoing excavation projects at the FEMP
- Allow tracking of interim and final disposition of excavated materials
- Comply with record keeping requirements that safeguard the analytical data used to demonstrate certification and remedial action completion.

As remediation progresses, additional needs will be assessed and methodologies refined accordingly.

### 3.6.2 Integrated Information Management System

Bulk waste stream information for the FEMP will be managed in the IIMS database. Relationships between IIMS and other site databases are depicted on Figure 3-12. The IIMS is designed to accommodate fast-track, bulk waste stream characterization, OSDF WAC attainment demonstration, and OSDF manifesting by using site characterization data. The system interfaces with the SED through a grid system to retain connections to RI/FS, historical, and newly generated data when excavated material is moved from the source location. The system also interfaces with the Sitewide Waste Information Forecasting and Tracking System (SWIFTS) to allow electronic transfer of bulk waste inventory to the container management system, when containerization is required.

### 3.6.3 Operational Documents

Operational documents for the FEMP will be generated during remediation activities. Such documents include construction drawings, field logs, analytical data, manifests, and specialized waste handling documents. Figure 3-13 summarizes these documents as the communication links between the functional organizations of the SCEP. Management of each category of documents is presented in the following subsection. Quality assurance controls for these documents are discussed in the (Appendix E).

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3.6.3.1 Construction Drawings and Associated Field Logs

Construction drawings and associated field logs will be maintained by Engineering/Construction Document Control. These items will be used on an evolving basis in the Geographic Information System (GIS) and, at site closeout, will reflect final as-built drawings.

3.6.3.2 Analytical Data and Associated Field Logs

Analytical data will be entered into the SED as it is generated. Hard-copy analytical reports and field scan/measurement print-out records, as well as associated field logs, will be maintained in active project files until completion of each phase of field work. At that time, these items will be turned over to Engineering / Construction Document Control. The required format and content of the field logs will be specified in the IRDP and CDL.

3.6.3.3 Miscellaneous Field Logs

Other types of field logs will be maintained in active project files until completion of each phase of field work. At that time, they will be turned over to Engineering / Construction Document Control.

3.6.3.4 Manifest-Type Documents

Field tracking logs (FTLs) used by WAO to document the movement of materials from the initial excavation to interim and final locations will be stored in the site operating record. Information from the FTL will be entered into the IIMS database, which allows retrieval of analytical data to support WAC determinations, provides an up to date record of the types and volumes of bulk material in interim staging locations, and provides a cumulative record of types and volumes of material placed in the OSDF.

3.6.3.5 Specialized Waste Handling Documents

FTLs used by WAO to document transfer of materials to interim storage for off site disposition will be managed as described in Section 3.6.3.4. Subsequent documentation used for waste streams dispositioned off site will be maintained as part of the site operating record. Key information from these documents will be stored in SWIFTs.

### 3.6.4 Field Documentation and Information Management Activities

Records and information will be generated in various forms based on the nature of the technical task, as previously discussed in this section. Field information will be collected using GPS, field logs, sampling programs, as-built construction drawings, and a tracking system. In addition to becoming part of the operation documents produced during the course of excavation planning and implementation, this information will be used to prepare the deliverable documents described in Section 7.0. Appendix E provides additional information on QA protocols related to information management activities.

#### 3.6.4.1 Tracking System for Waste Stream Categories

Field information for input to IIMS will be collected on the FTLs, with information subsequently entered to IIMS. Key information elements that are recorded on the FTLs are listed below:

- Project number and name
- Source Material Tracking Location (MTL)
- Interim or final disposition MTL
- Estimated volume of material
- Material matrix (interim movements) or profile number (final disposition movements)
- Generation date
- WAO signature.

Figure 3-14 shows the FTLs which will be generated between material destinations and organizational hand-off points.

MTLs are defined on the FTLs and tracked electronically in the IIMS using the grid system. During the development of the excavation design, analytical data in the SED (newly generated and RI/FS) are reviewed and contiguous areas with similar COCs are identified as unique MTLs. Each MTL comprises an in situ waste stream that is identified on project drawings. When the FTL is entered into the IIMS, SED data for the specified MTL are tied to excavated soil volumes that have been moved to either an interim location (above-WAC or below-WAC stockpiles and/or containers) or final disposition at the OSDF. IIMS maintains transaction histories to provide cumulative analytical data for soil that is moved more than one time. The main types of MTLs include WAC attainment areas (i.e., controlled areas for storing above-WAC material) and stockpiles.

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The following profiles are assigned to each of the five primary waste streams designated for OSDF disposal:

| | | |
|---|---|---|
| Profile # 91,000 | OSDF Category 1 | Soil and soil-like material |
| Profile # 92,000 | OSDF Category 2 | Debris for en masse placement |
| Profile # 93,000 | OSDF Category 3 | Debris for individual placement |
| Profile # 94,000 | OSDF Category 4 | High organic content (humus and vegetation) |
| Profile # 95,000 | OSDF Category 5 | Double-bagged asbestos, sludge, and special case-by-case approval. |

Numeric extensions (e.g., 91,001...95,999) are used to facilitate further delineation of waste streams on an as-needed basis. The numeric extension profiles include information in common with the FTLs to facilitate electronic information retrieval, as well as material descriptions and data group identifiers for newly generated data.

All wastes dispositioned to the OSDF will be covered under a waste stream profile. OSDF manifests are prepared in IIMS by accessing information entered from the tracking logs and profiles. The manifest number facilitates retrieval of electronic characterization information from IIMS, if required, to support a determination of "meets WAC." Information recorded on the hard-copy manifest will comply with requirements of the OSDF Impacted Materials Placement Plan (DOE 1998a).

3.6.4.2 Other Field Data

Other field data will include information on sample collection, attainment of excavation design, maps, and surveys in either electronic or hard-copy format. Field-generated analytical data will include precertification, certification, and WAC attainment; additional analyses may be generated in conjunction with special material activities described in Appendix F. Anticipated field instruments include, but are not limited to, the RTRAK and the HPGe. Field activity documentation requirements of the SCQ will be met. Field logs will be submitted daily to the Project Manager with approval signatures from the Construction Manager, the Project Manager, and Subcontractor. As-built drawings will be completed in accordance with applicable site procedures.

**TABLE 3-1**

**SUMMARY OF SAMPLING TASKS AND ANALYTES**

| Stage | Drivers | Analytes[a] |
|---|---|---|
| Predesign Investigation | Extent of excavation for: technetium-99, RCRA characteristic waste, above WAC, and above FRL | Area-specific COCs, technetium-99, and TCLP |
| Excavation | Non-technetium-99 WAC attainment | Uranium and organic vapor |
| Precertification | CU delineation, FRL attainment, and hot-spot screening | Area specific gamma-emitting radionuclides |
| Certification | FRL attainment, HWMU closure, and UST closure | Area specific COCs, HWMU and UST COCs |

Note: [a] See Table 2-8 for the applicable analytical methods.

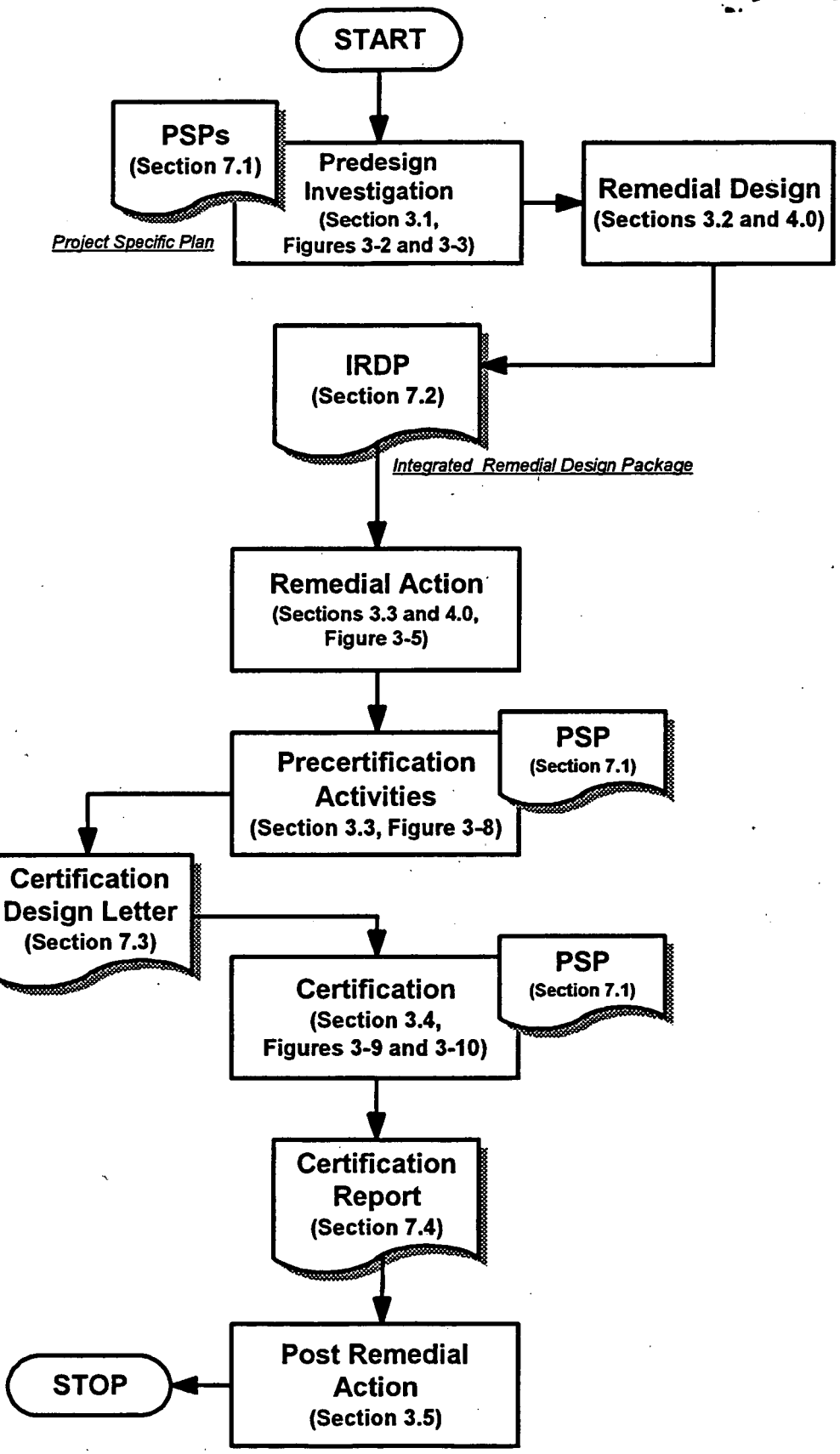


FIGURE 3-1 GENERAL SOIL REMEDIATION PROCESS

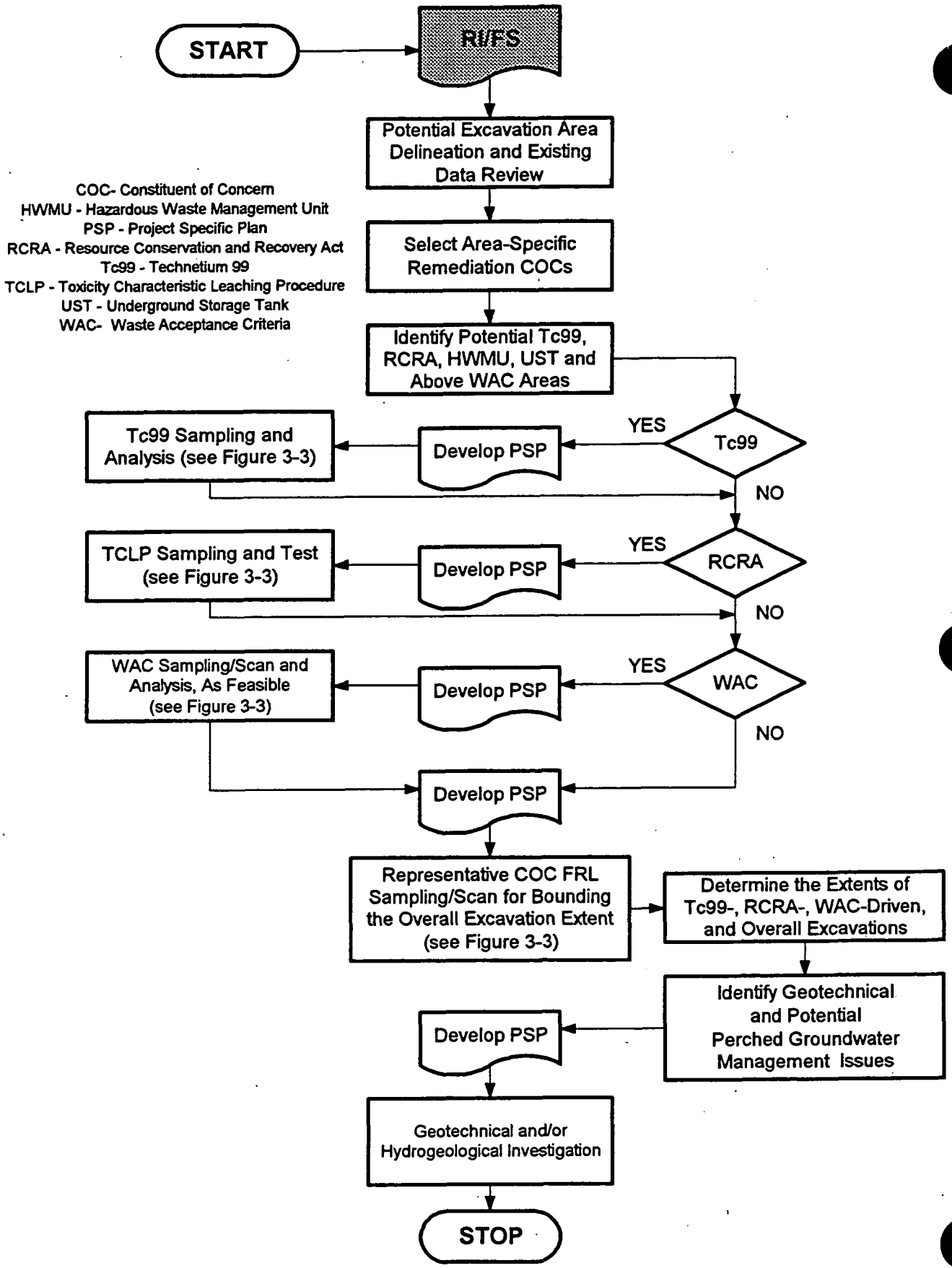


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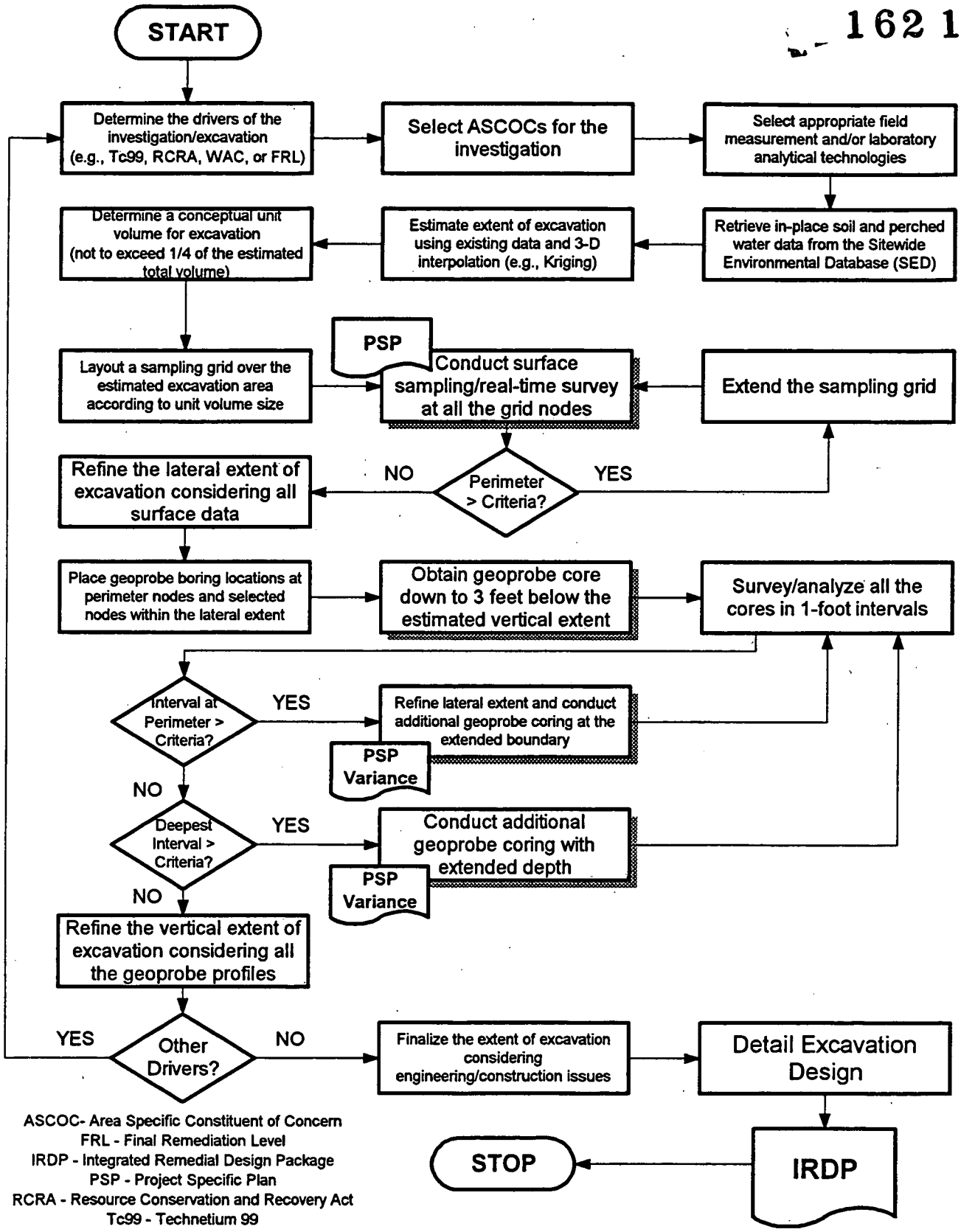
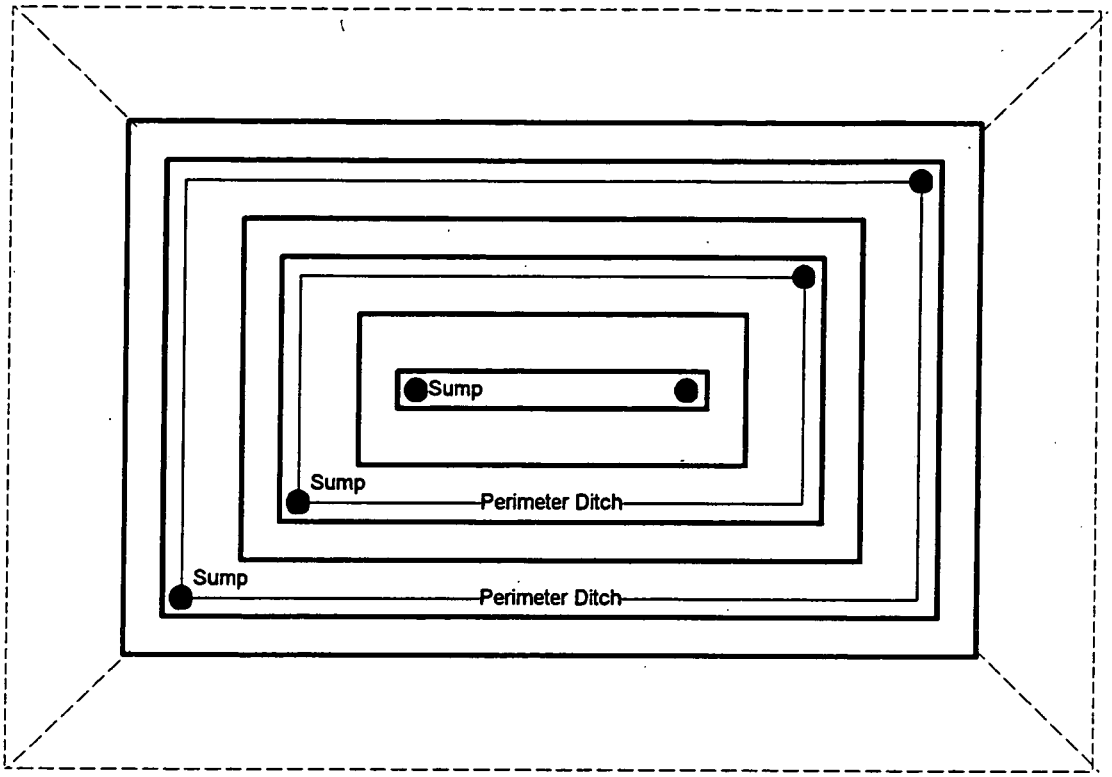
**FIGURE 3-2 GENERAL PREDESIGN INVESTIGATION PROCESS**




ASCOC- Area Specific Constituent of Concern
FRL - Final Remediation Level
IRDP - Integrated Remedial Design Package
PSP - Project Specific Plan
RCRA - Resource Conservation and Recovery Act
Tc99 - Technetium 99
WAC- Waste Acceptance Criteria

**FIGURE 3-3 ESTABLISH EXTENT OF EXCAVATION**



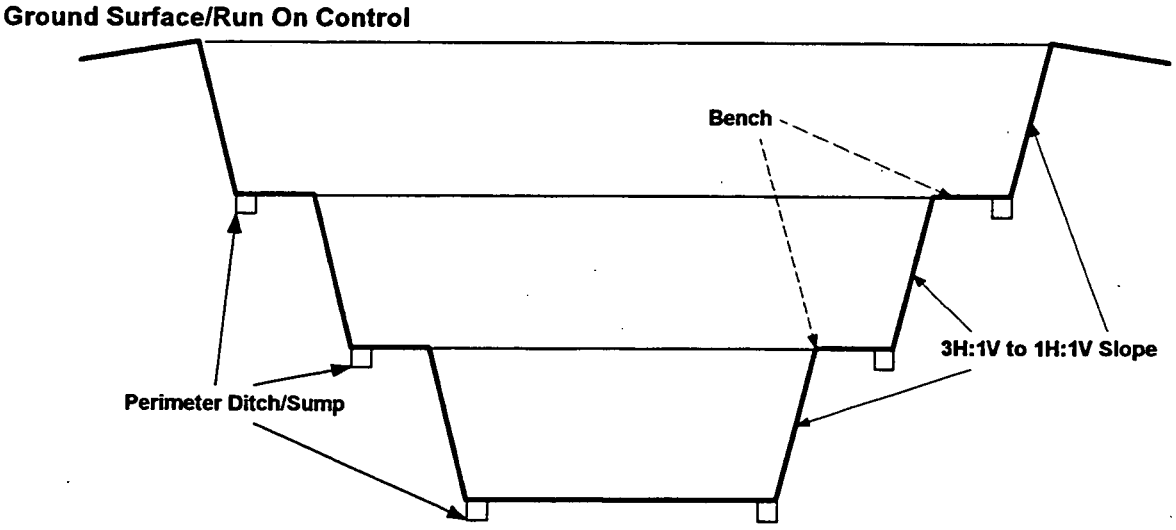




FIGURE 3-4 CONCEPTUAL SIDE SLOPE CONFIGURATION FOR DEEP EXCAVATION

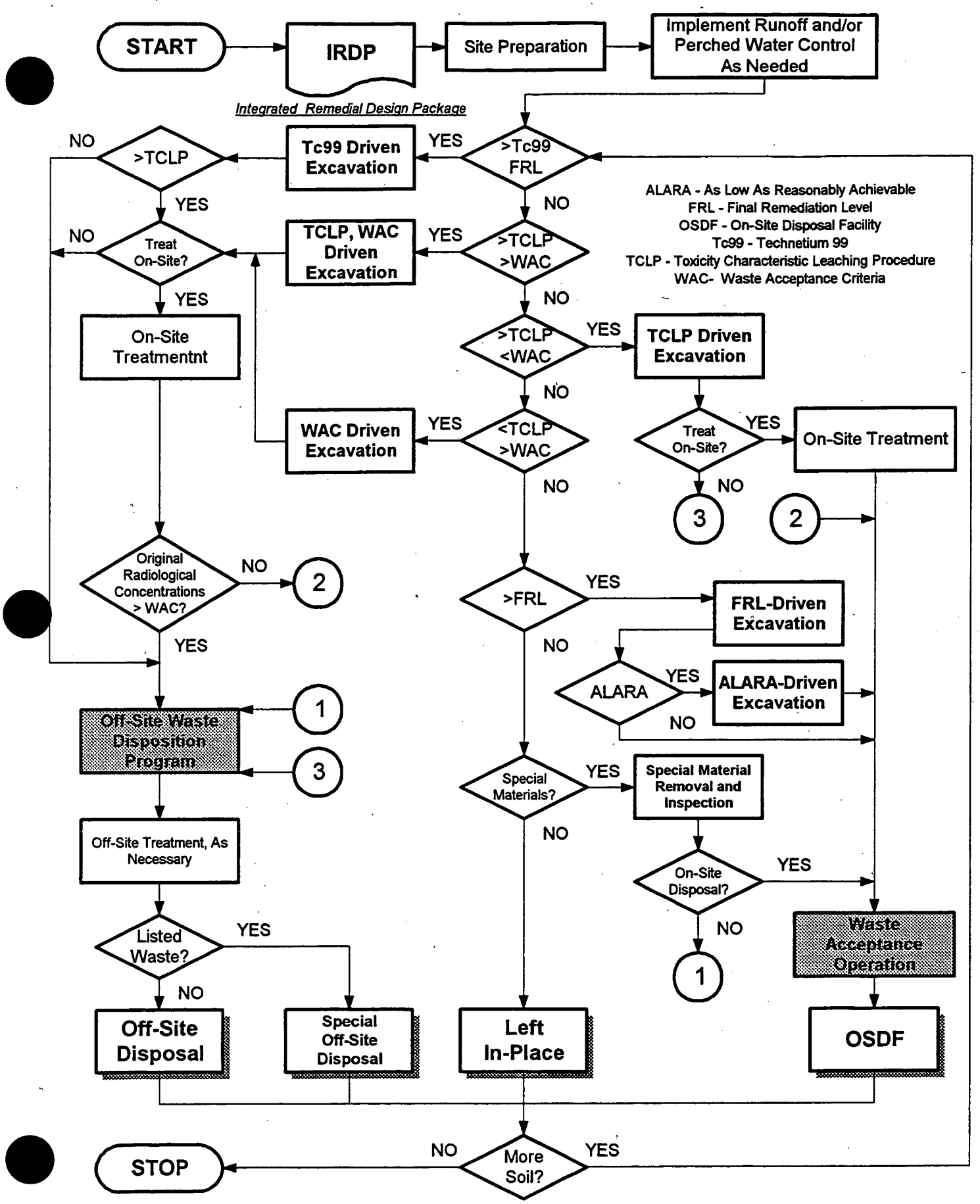



FIGURE 3-5 GENERAL SOIL SEGREGATION/DISPOSAL PROCESS

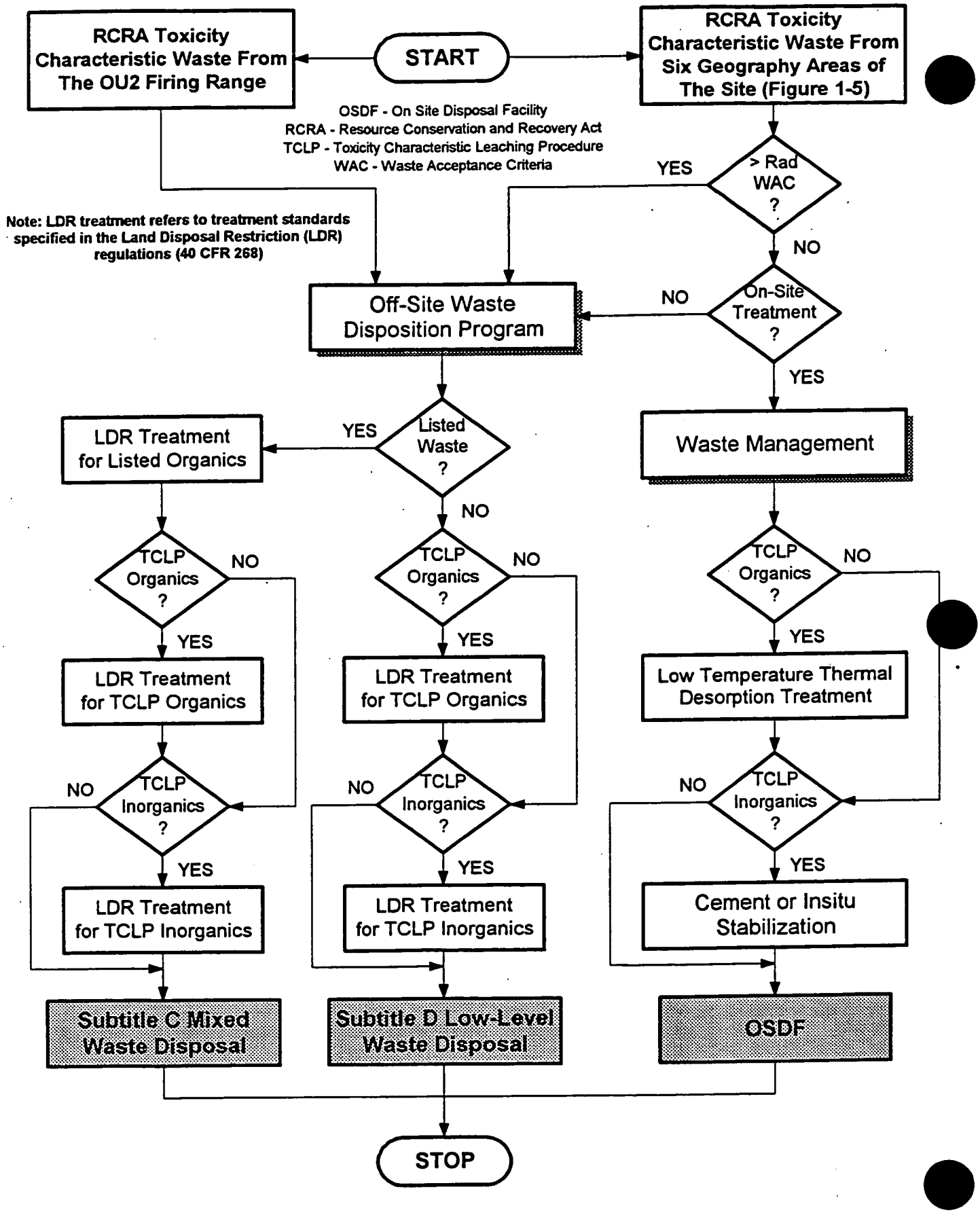



FIGURE 3-6 RCRA-REGULATED SOIL TREATMENT AND DISPOSAL REQUIREMENTS

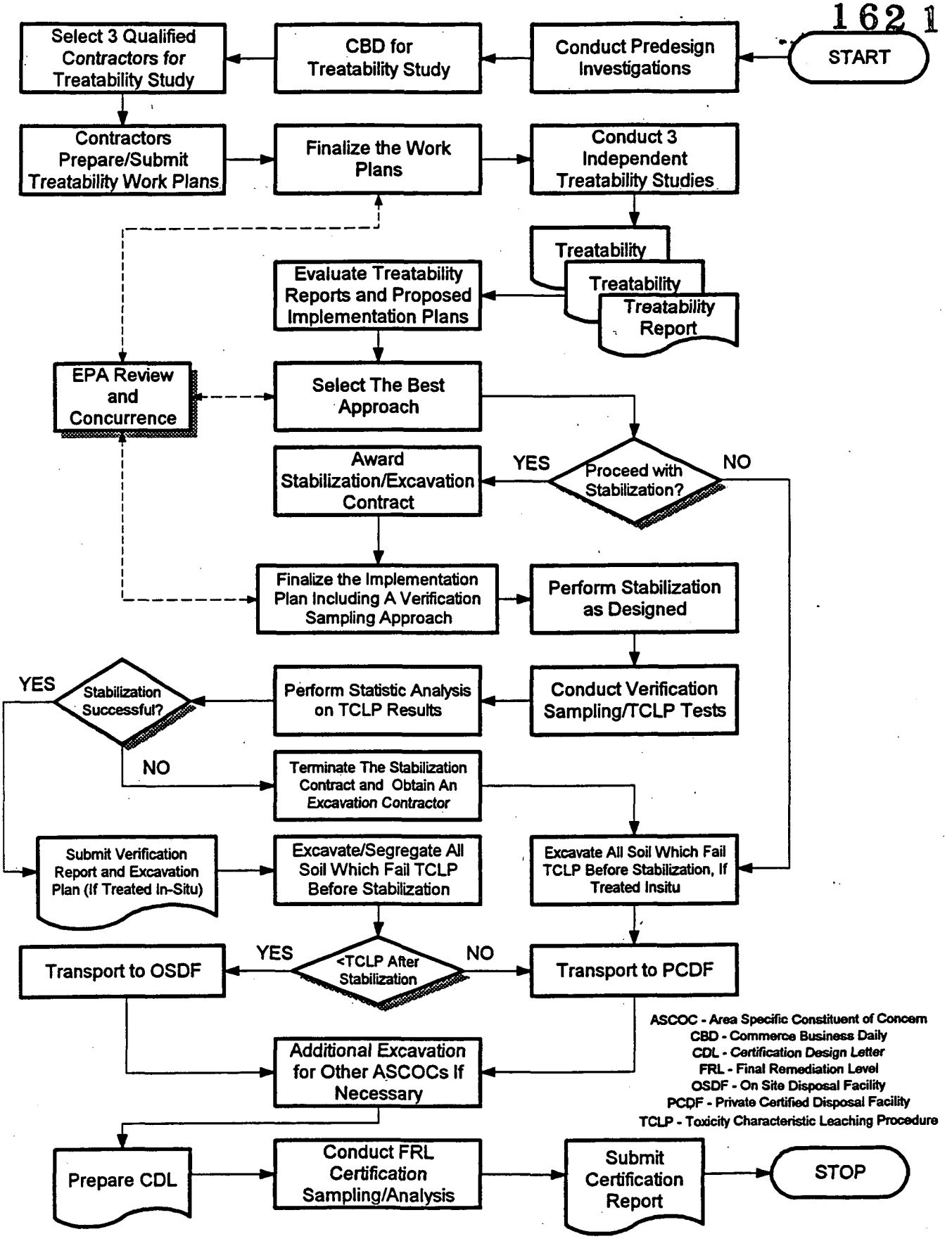



**FIGURE 3-7 PROPOSED TRAP RANGE REMEDIATION STRATEGY**

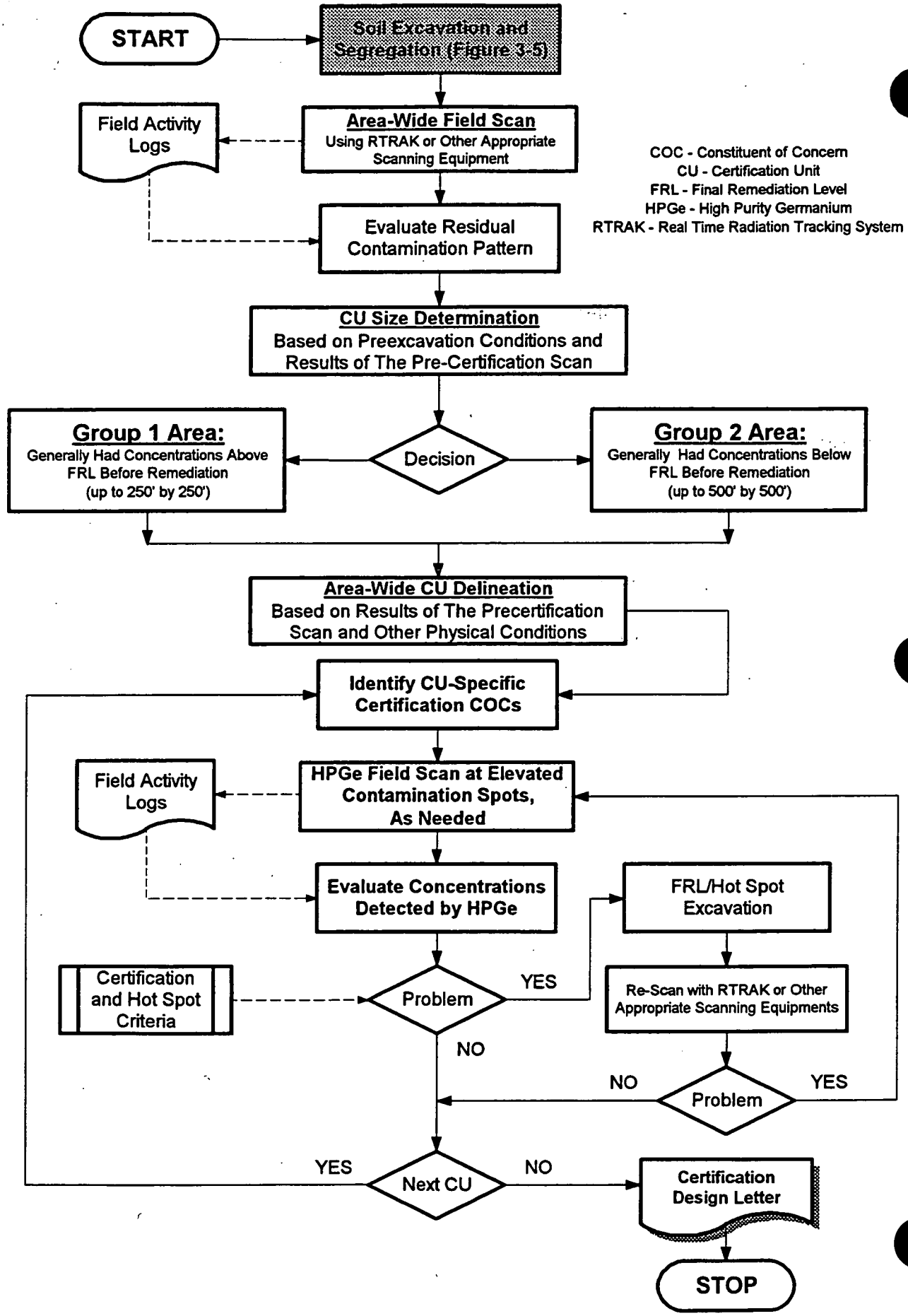



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FIGURE 3-8 GENERAL PRECERTIFICATION ACTIVITIES

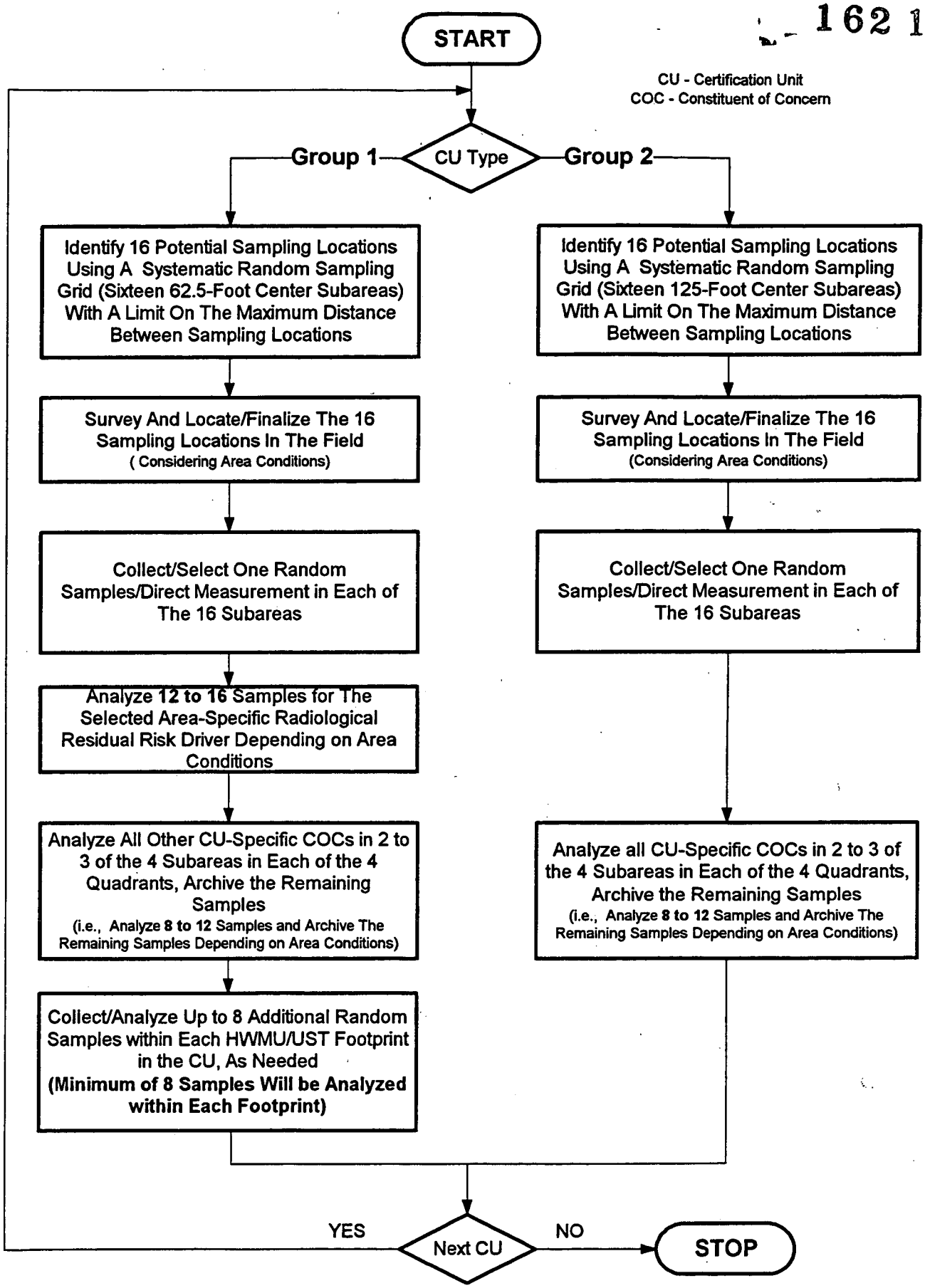


**FIGURE 3-9 GENERAL CERTIFICATION SAMPLING STRATEGY**

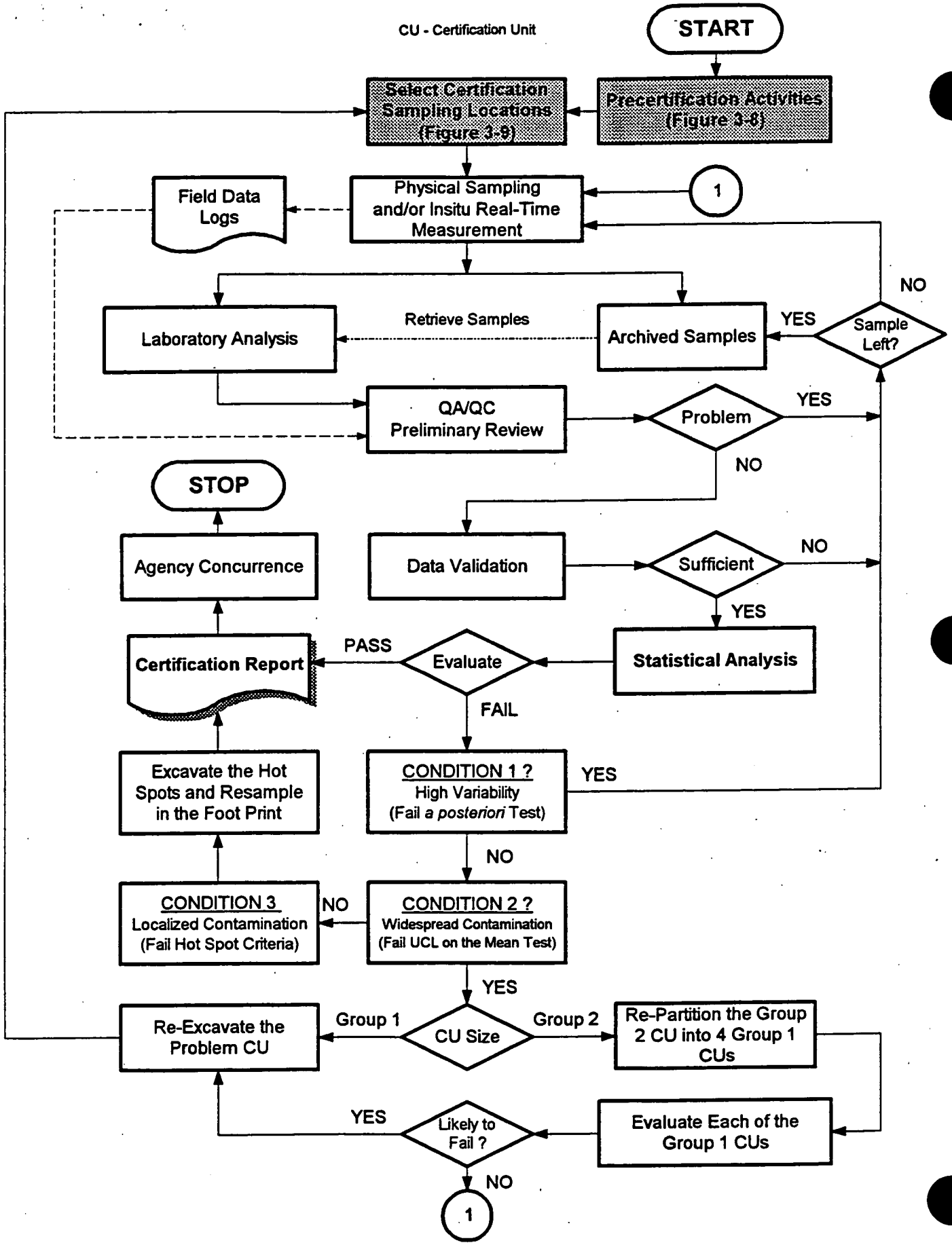


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FIGURE 3-10 GENERAL CERTIFICATION PROCEDURE

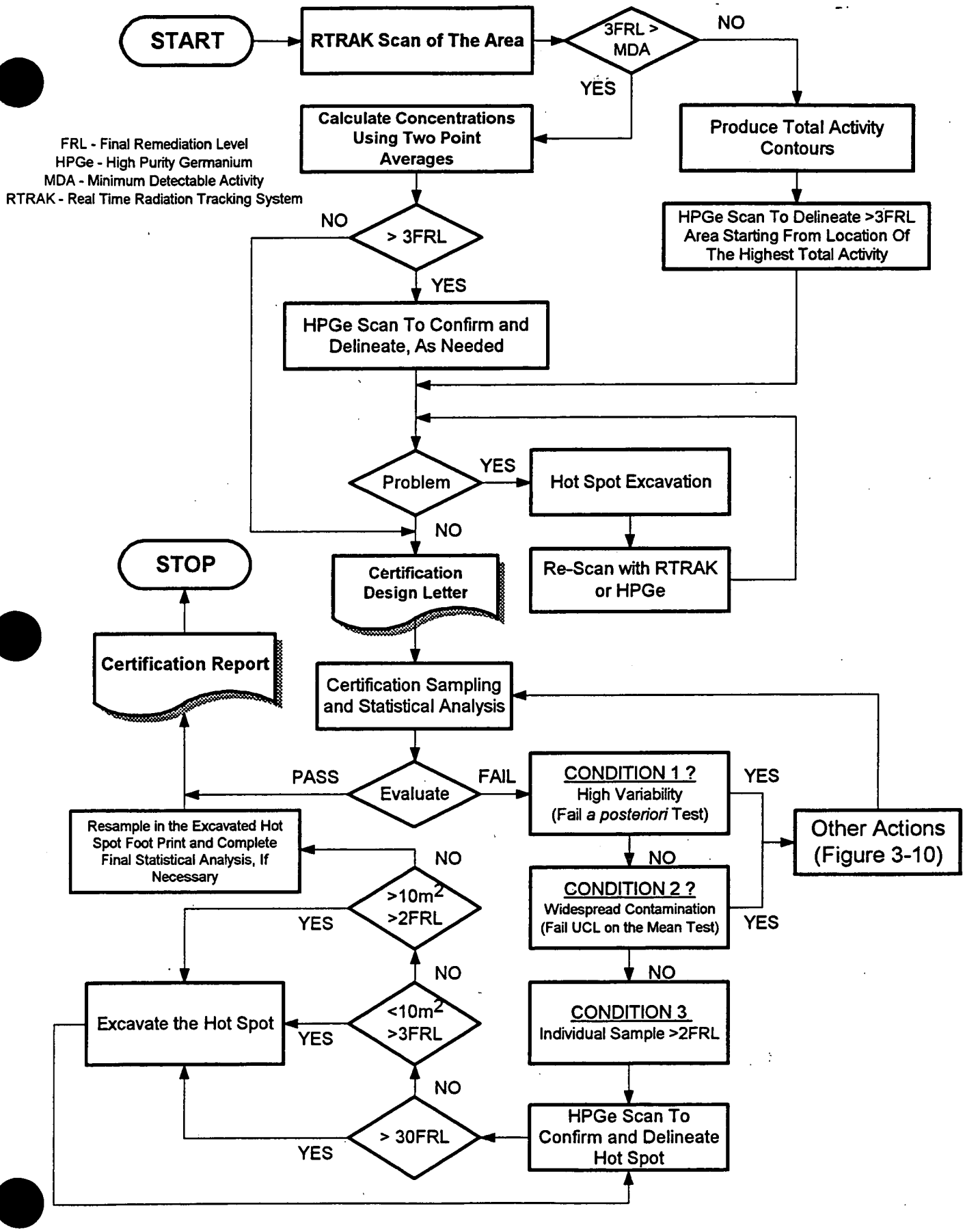
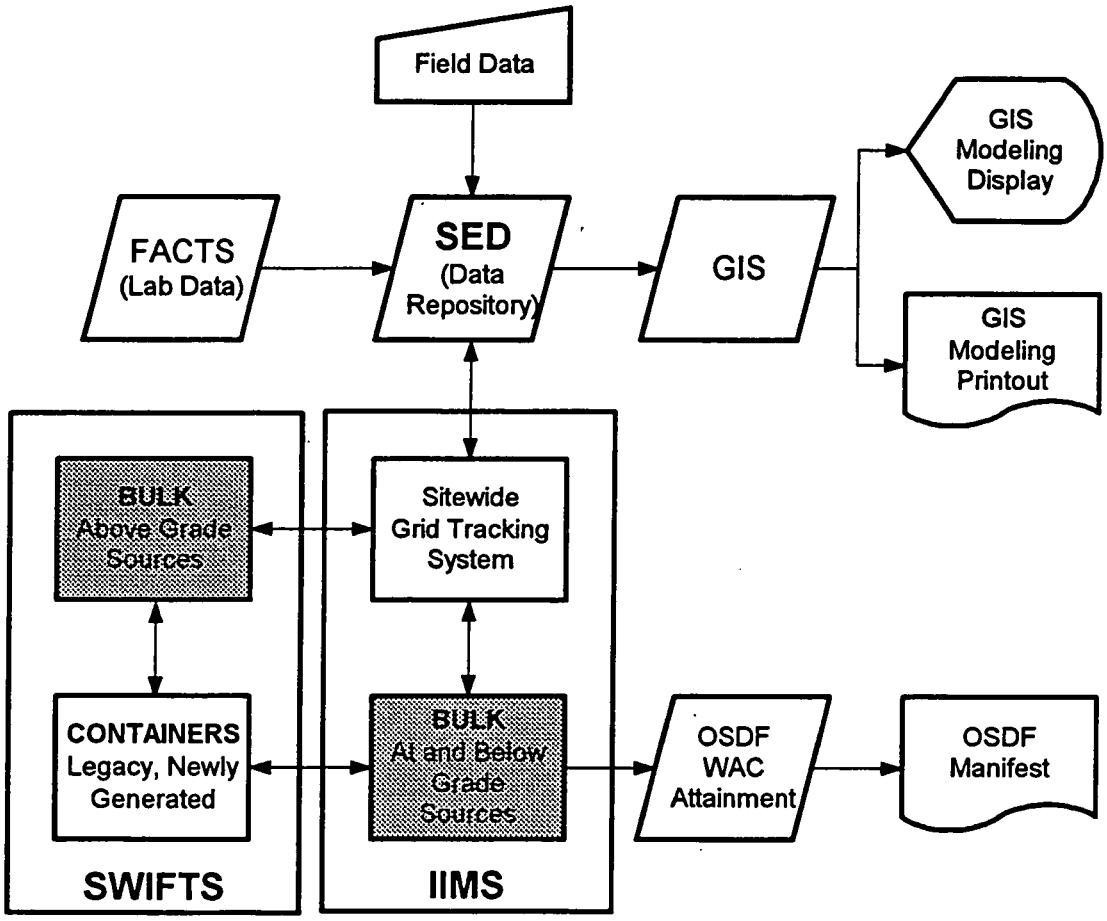



FIGURE 3-11 HOT SPOT CRITERIA AND IMPLEMENTATION STRATEGY




FACTS: Fernald Analytical Computerized Tracking System
GIS: Geographical Information System
IIMS: Integrated Information Management System
OSDF: On-Site Disposal Facility
SED: Sitewide Environmental Database
SWIFTS: Sitewide Waste Information Forecasting and Tracking System

**FIGURE 3-12 SITE DATABASE RELATIONSHIPS**

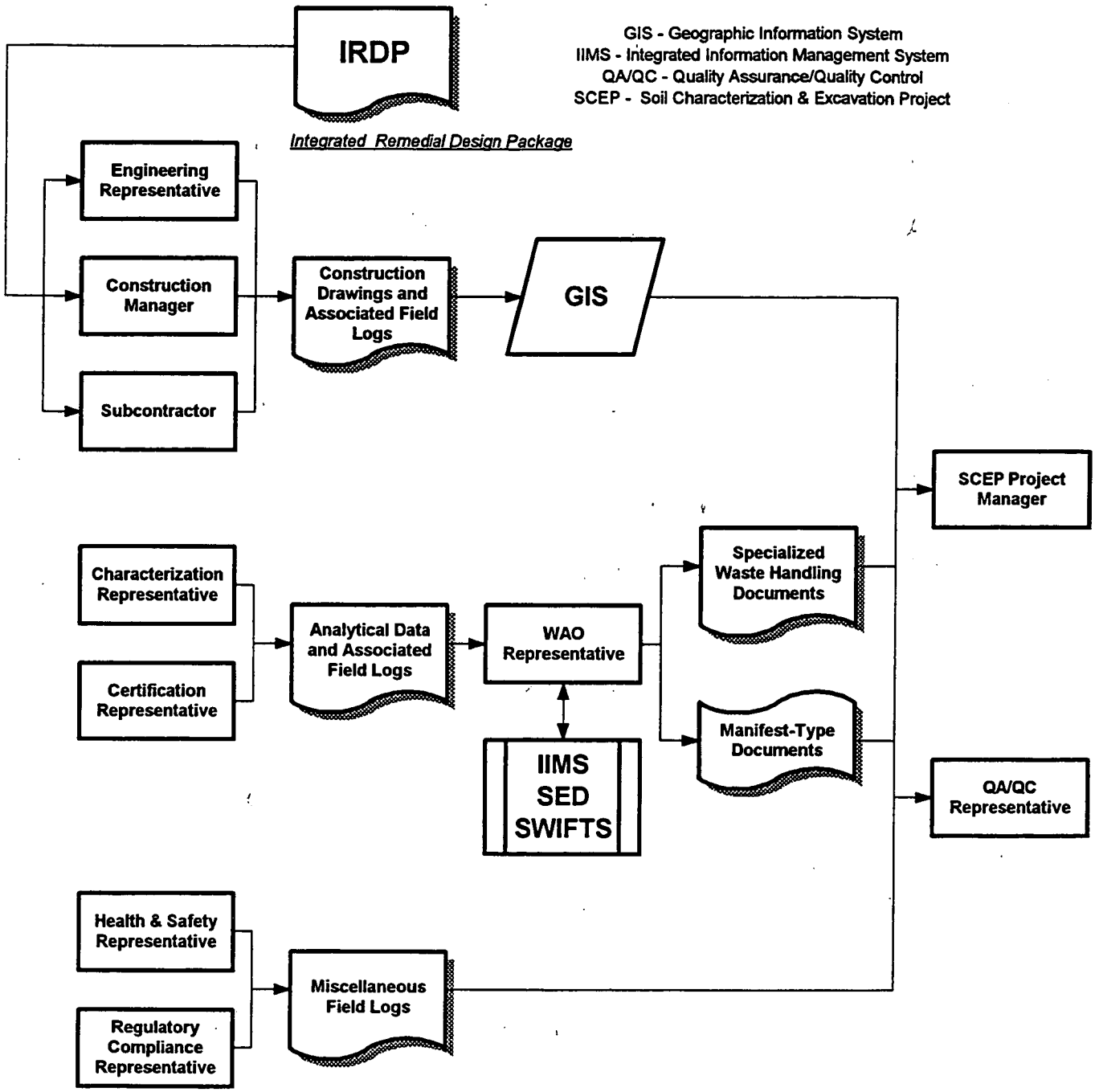
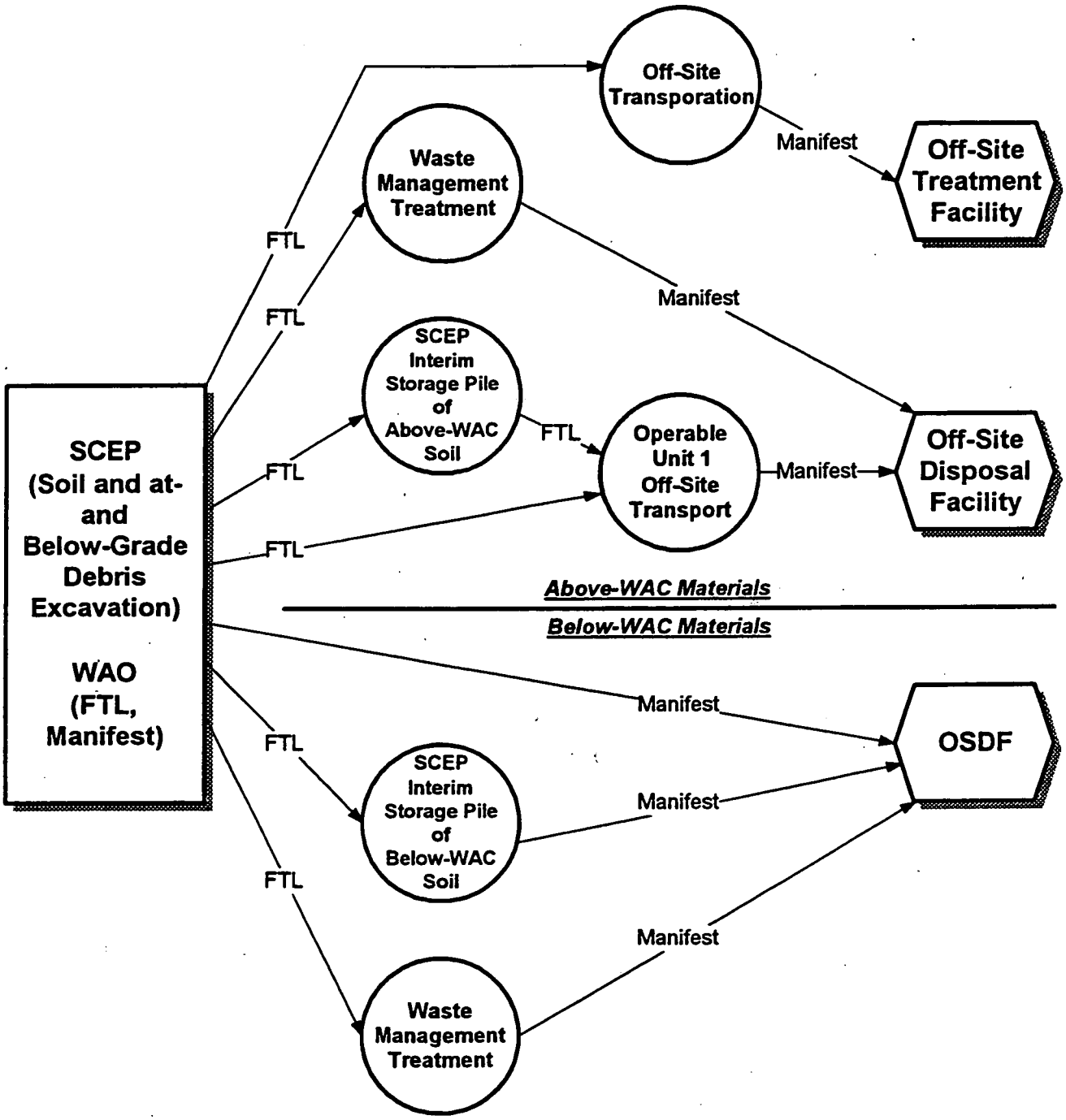


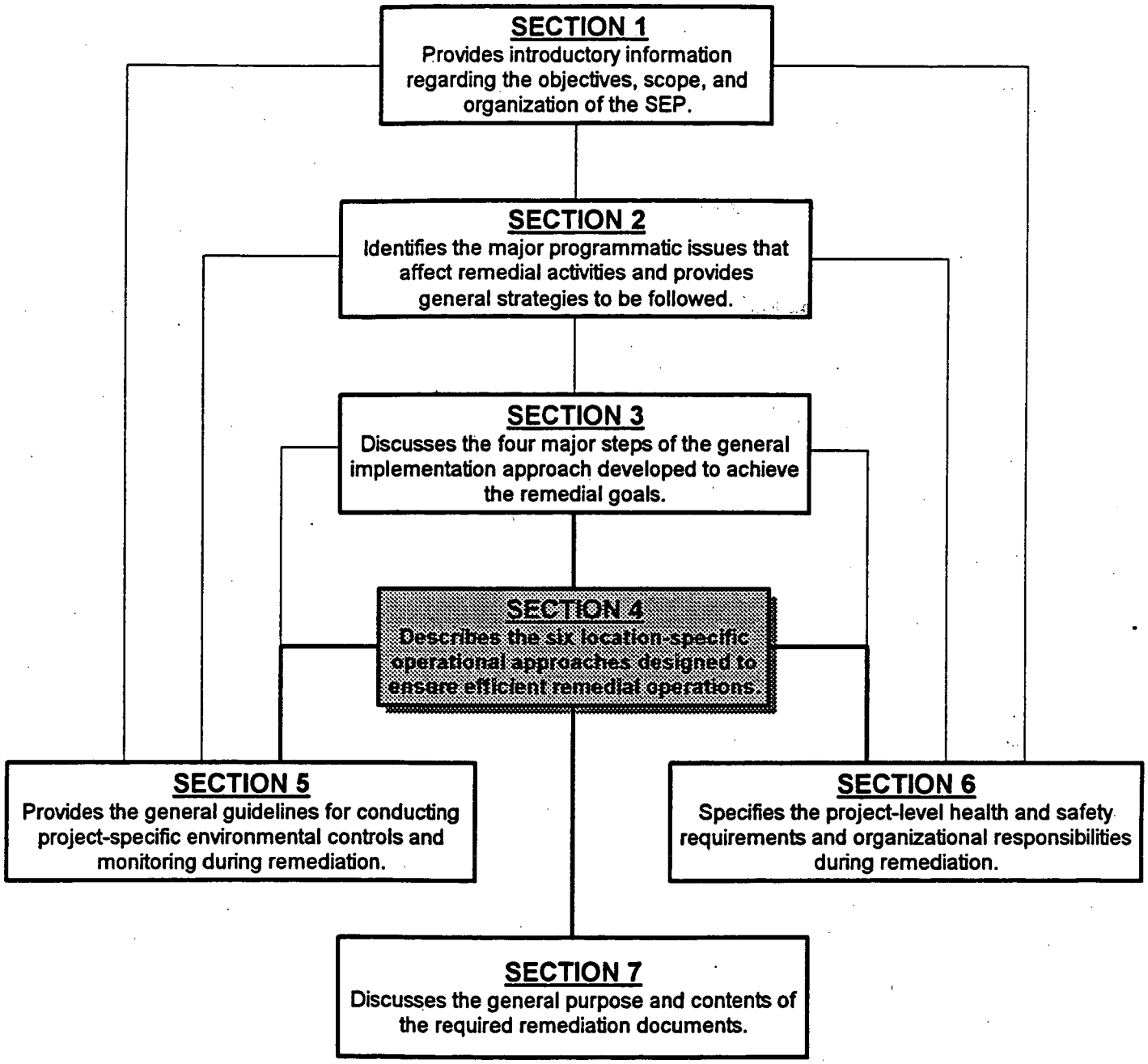

FIGURE 3-13 OPERATIONAL DOCUMENTS AND SCEP FUNCTIONAL ORGANIZATIONS




FTL: Field Transfer Logs
OSDF: On-Site Disposal Facility
SCEP: Soil Characterization and Excavation
WAO: Waste Acceptance Operation

**FIGURE 3-14 MATERIAL DESTINATION DECISIONS AND ORGANIZATIONAL HAND-OFF**

# SITEWIDE EXCAVATION PLAN




**APPENDIX A** - Soil Remediation ARARs and TBCs
**APPENDIX B** - Sitewide Sequencing Plan
**APPENDIX C** - Constituent of Ecological Concern Selection
**APPENDIX D** - Wood Sampling Program
**APPENDIX E** - SEP Quality Assurance Project Plan (QAPP)
**APPENDIX F** - Implementation of Construction and Waste Management Practices
**APPENDIX G** - Certification Design Rationale
**APPENDIX H** - Summary of Field Measurement and Laboratory Analytical Technologies
**APPENDIX I** - Sitewide Extent Of Contamination By Constituent

# 4.0 LOCATION-SPECIFIC EXCAVATION APPROACHES

Because of the wide range of physical conditions at the Fernald Environmental Management Project (FEMP), location-specific conceptual excavation approaches are needed to meet the various remediation challenges described in Sections 2.0 and 3.0. The conceptual area-specific approaches outlined in this section will incorporate the general guidelines discussed in Section 3.0 (Figure 3-1). Soil excavation conducted in impacted areas surrounding the FEMP will be relatively simple when compared to the logistics of soil excavation in the Former Production Area. Perimeter areas of the FEMP may have localized surface contamination that can be removed using shallow excavation procedures. However, within the Former Production Area, deep excavations of soil must be coordinated with decontamination and dismantlement (D&D) activities, removal of at- and below-grade structures, (e.g., building foundations and pipelines), and removal and closure of hazardous waste management units (HWMUs), underground storage tanks (USTs), and non-homogenous stockpiles. This section will present and discuss six location-specific soil excavation approaches to deal with the diverse nature of the soil remediation scenarios.

The six location-specific excavation approaches that will be discussed are: A) shallow excavation of impacted on-property area outside the Former Production Area and other waste storage/management areas; B) Excavation in waste storage/management areas outside the Former Production Area; C) Excavation of existing stockpiles in the Former Production Area; D) Excavation following D&D in the Former Production Area and Sewage Treatment Plant; E) Off-property and nonimpacted on-property area certification; and F) Non-high density polyethylene pipeline excavation outside the Former Production Area. Major differences among the six approaches include: extent of the predesign investigation, excavation sequence, excavation control monitoring, perched water controls, and Waste Acceptance Criteria (WAC) attainment requirements. Environmental controls and monitoring for individual soil remediation projects are developed as an integral part of the planning and design of the project (Section 5.0). Table 4-1 summarizes the six location-specific approaches tied to nine sitewide remediation areas and one off-site area.

The nine sitewide remediation areas are numbered 1 through 8 and 10, with Remediation Area 10 representing the long term corridors. Remediation Area 1 contains the Sewage Treatment Plant, Remediation Area 3 includes the Lime Sludge Ponds, and Remediation Area 6 contains the Fire

Training Facility and Solid Waste Landfill. Remediation Area 9 is the off-site property adjacent to the eastern boundary of the FEMP site. Figure 4-1 shows the location of nine remediation areas, their associated phases, and the proposed division into subareas that correspond to the various excavation approaches (i.e., A, B, C, etc). Remediation Area 10, the long term corridors, is shown on Figure B-18 in Appendix B of the Sitewide Sequencing Plan for remediation areas. It has not been depicted on figures in Section 4.0 in the interest of maintaining a clear picture of the principal remediation areas.

Table 4-2 summarizes the proposed excavation approaches in each remediation area. For example, Remediation Area 5 is in the Former Production Area and contains an existing soil stockpile; therefore, Excavation Approaches C and D apply to Remediation Area 5. This example is important to keep in mind because remediation will be implemented within a remediation area or subarea rather than within a single excavation-approach area (i.e., remediation of all areas designated as Excavation Approach A will not take place simultaneously).

The Sitewide Sequencing Plan for remediation areas (Appendix B) and the general remediation process presented on Figure 3-1 is followed in each of the location-specific excavation approaches, with individual variances noted in the subsections below. Principal steps in each excavation approach are 1) development and implementation of project specific plans (PSPs) to support the predesign investigation and remedial integrated design package; 2) soil excavation and segregation; 3) precertification activities; 4) certification and preparation of certification report; and 5) interim grading and restoration. Within each remediation step, distinct tasks are performed that are specific to each excavation approach. These tasks are tied to each excavation approach in Table 4-3 to provide a cross-comparison among the area-specific approaches. For example, 11 tasks comprise Remediation Step 1, 4 of which are common to all excavation approaches.

The remainder of Section 4.0 covers each of the six conceptual excavation approaches and provides a detailed discussion comparing the similarities and differences of the approaches in each remediation area (Table 4-3). Each excavation approach is discussed with respect to the rationale for its approach, a general description of the approach, special considerations for implementing the approach, and the implementation details of the tasks. Area-specific PSPs (Section 7.1) and IRDPs (Section 7.2) will reflect the conceptual approaches described in this section.

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## 4.1 EXCAVATION APPROACH A-SHALLOW EXCAVATION OF IMPACTED ON-PROPERTY AREA OUTSIDE THE FORMER PRODUCTION AREA AND OTHER WASTE STORAGE/MANAGEMENT AREAS

Excavation Approach A is designed to handle shallow soil excavation that takes place in impacted areas (i.e., hot spots potentially present) which surround the Former Production Area. The nature and extent of Constituents of Concern (COCs) in areas proposed for Excavation Approach A is generally limited to a few COCs in localized areas of contamination restricted to the top few feet of soil. Most of the excavation area within the boundary of the FEMP is expected to follow Excavation Approach A.

Excavation Approach A will be applied to Remediation Areas 1, 2, 6, and 7 (Tables 4-1 and 4-2; Figures 4-1 and 4-2). Remediation Areas 1 and 2 encompass most of the perimeter of the FEMP, where soil exceeding final remediation levels (FRLs) has been documented through the collection of Remedial Investigation/Feasibility Study (RI/FS) characterization data. In Remediation Areas 6 and 7, Excavation Approach A will be applied to the areas between waste storage units and the Former Production Area. The list of potential area-specific COCs for these remediation areas is provided in Table 2-7.

### 4.1.1 General Description

Excavation Approach A follows the general soil remediation process discussed in Section 3.0. The soil remediation process begins by identifying area-specific constituents of concern (ASCOCs), preparing PSPs for the predesign investigation, estimating the extent of the excavation, and performing pre-excavation surveys and sampling activities. Radiological survey results and laboratory analytical data will be forwarded to the remedial design to delineate the extent of soil excavation for all applicable technetium-99, Resource Conservation and Recovery Act (RCRA) characteristic waste (within the seven locations shown on Figure 1-5), above-WAC, and above-FRL areas. This information will be incorporated into an IRDP and submitted to the U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (OEPA) for approval. After the IRDP has been approved, soil excavation will begin and materials delineated as technetium-99, RCRA toxicity characteristic, and above WAC will be segregated for treatment, if required, and disposal.

Upon completion of all excavation types, a precertification survey and/or sampling activities will commence, and the Certification Unit (CU) boundaries will be delineated to subdivide the remediated area for final certification. This information will be given to the EPA and OEPA as a Certification

Design Letter (CDL), which will establish the boundaries of the CUs, the list of CU-specific COCs requiring certification sampling, and the certification sampling approach. Certification sampling and analysis will follow and the results will be evaluated against the certification criteria to demonstrate that the CU can be released. Sampling locations, analytical results, statistical methods, and certification criteria used to pass the CUs in the remediated area will be summarized in the Certification Report. Following approval of the Certification Report of EPA and OEPA, interim or final grading and restoration activities will take place.

#### 4.1.2 Special Considerations

Special considerations for implementing Excavation Approach A are summarized under the following discussions of the nature and extent of contamination, radiological scanning and field measurements, and attainment of WAC.

##### 4.1.2.1 Nature and Extent of Contamination

Excavation Approach A will be implemented in Remediation Area 1 (Figures 4-1 & 4-2) in areas that have not been remediated under the Area 1, Phase I project, which was completed prior to release of the final Soil Excavation Plan (SEP). Soil in Remediation Area 1 has been affected primarily by air deposition of uranium particles. This mode of deposition results in a relatively homogenous distribution of material over the land surface, and shallow excavations are expected to remove the contamination. Exceptions to this approach may be encountered in Remediation Area 1 along the north central boundary of the FEMP, where topographic data indicate thicknesses of fill in excess of 20 feet. RI/FS data collected on surface soil samples indicate the top 6 inches of the fill are not contaminated. However, if excavation activities are conducted in this portion of Remediation Area 1, additional radiological scans will be conducted on exposed excavation surfaces to assess the presence or absence of primary radiological COCs in the fill material.

In Remediation Area 2, Phase II operations will use Excavation Approach A to remove identified surface contamination. The Phase II operations will be implemented after Phase I work has removed the Flyash Piles and associated debris (Excavation Approach B, Section 4.2). In a similar fashion, Excavation Approach A will be applied to portions of Remediation Areas 6 and 7 after excavation of their respective waste storage units is complete (Section 4.2). Local excavation sequencing will be

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developed in the IRDP to minimize the potential of recontamination and/or cross-contamination of remediated or nonimpacted areas.

4.1.2.2 Radiological Scanning and Field Measurements

Much of the area designated for remediation under Excavation Approach A is open field terrain that is amendable to radiological scanning using a large volume sodium iodide (NaI) detector mounted to a tractor (i.e., the RTRAK equipment). However, the northeast corner of Remediation Area 1 contains a stand of conifers that prevents use of the RTRAK for radiological scans. Therefore, in the forested portion of Remediation Area 1 and other locations that preclude the use of the RTRAK, radiological surveys may be conducted with a single, large-volume NaI detector mounted on a tri-wheel stroller (i.e., the RSS) that is pushed by personnel conducting the traverses. Alternatively, the in situ high purity germanium (HPGe) detector may be used to obtain information on the activity of gamma-emitting nuclides in the remediation area. Additional details on these instruments are provided in the Users Manual (DOE 1998c).

The time required to remediate areas designated as Excavation Approach A will be dependent on the number and types of COCs detected within the remediation areas and the type of radiological scanning equipment that can access the terrain. In Remediation Areas 2, 6, and 7, the presence of metal and organic COCs in waste storage areas dictates that volatile organic compound (VOC) monitoring with the photo-ionization detector (PID) and additional sampling and analysis may be required during the implementation of Excavation Approach A. These activities will be conducted independent of radiological scanning, resulting in an increase in the time required to excavate the soil. Additionally, radiological scanning of a unit soil area is likely to take longer in Remediation Areas 6 and 7 because access problems may limit the scanning to the RSS equipment rather than the RTRAK.

4.1.2.3 Attainment of Waste Acceptance Criteria

To assure that a high level of confidence is achieved in the ability to screen and segregate above-WAC material from material that can be placed in the OSDF, several independent methods will be used to demonstrate WAC attainment. RI/FS data will be used to focus PSPs and pre-excavation investigations on areas known to contain above-WAC materials. Above-WAC areas will be delineated for excavation by establishing the areal extent using real-time, large-volume NaI detectors. Radiological boundaries established by NaI detectors will be verified for uranium by obtaining field measurements with the

HPGe instrument and/or by the collection of physical samples. The WAC boundaries established by uranium will be used as a starting point for field and sampling activities that will establish the extent of above-WAC secondary ASCOCs (e.g., technetium-99 and metals). Discrete surface and subsurface soil samples will be collected to establish the extent of above-WAC secondary ASCOCs, as described in Section 3.1.3. The samples will be submitted for laboratory analysis (ASL B) of secondary ASCOCs to determine the extent of above-WAC material. All available field and laboratory data will be used to support the demonstration of WAC attainment.

### 4.1.3 Excavation Details

Figure 4-3 presents the logic flow for conducting Excavation Approach A. Each of the 23 tasks identified for this type of excavation is discussed in detail and tied to material presented in Sections 3.0 and 7.0 and/or relevant appendices. A comparison of these tasks with other excavation approaches is provided in Table 4-3.

Task 1 - Potential Excavation Area Delineation and Data Review

This task is carried out as discussed in Section 3.1.1. The potential areas requiring Excavation Approach A have been defined using RI/FS data collected for uranium and are shown on Figure 4-2.

Task 2 - Select COCs and Identify Potential Technetium-99, RCRA, and Above-WAC Areas

The preliminary COC lists for Remediation Areas 1, 2, 6, and 7 are summarized in Table 2-7. These lists are derived from RI/FS characterization data and are divided into primary and secondary ASCOCs (Section 2.1.3.1). The ASCOCs will be finalized in the area-specific IRDPs.

Technetium-99 has been measured above the FRL in Remediation Area 6 near the eastern boundary with Remediation Area 3 (Figure 4-2).

The Trap Range is a potential RCRA area (i.e., the potential exists for soil to exhibit the toxicity characteristic) in the southern portion of Remediation Area 1, directly southeast of Remediation Area 5 (Figure 4-2). Soil removed from this potential RCRA area will be subjected to the Toxicity Characteristic Leaching Procedure (TCLP) tests to determine whether treatment is required prior to disposal.

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Based on the RI/FS characterization data for uranium, there are four known areas within the proposed Excavation Approach A boundaries with the potential to exceed established WAC levels for uranium (Figure 4-2). Above-WAC areas for uranium have been identified along the northern boundary of the Sewage Treatment Plant (Remediation Area 1), around the northwest perimeter of the Inactive Flyash Pile (Remediation Area 2), surrounding the south and east perimeter of the potential technetium-99 area in Remediation Area 6, and along the southern boundary of the Fire Training Facility in Remediation Area 6.

Task 3 - Pre-excavation Surveys and Sampling

Pre-excavation surveys and depth profile sampling discussed in area-specific PSPs (Section 7.1) will be implemented during the predesign investigation using the conceptual approach discussed in Section 3.1.2. Radiological field surveys will be carried out in accordance with the in situ gamma Users Manual (DOE 1998c) and the selection and use of laboratory analytical techniques are discussed in Appendix H. In general, the concentrations of uranium, thorium, and radium (i.e., primary constituents in Table 2-7) in surface and subsurface soil will drive the excavation. Initially, radionuclide activities will be established using RI/FS data, PSP data, surveys with NaI detectors, and/or by discrete measurements with HPGe field instruments. After the extent of radionuclide distribution is established with RI/FS, PSP, and survey data, additional discrete soil samples will be taken for laboratory analysis, as needed. In the event metal or organic ASCOC concentrations drive the soil excavation, field x-ray fluorescence (XRF), PID, or laboratory analysis may be used to characterize the discrete soil samples (Appendix H).

To establish the area extent of ASCOCs, RI/FS data will be used to minimize the number of samples collected during pre-excavation survey and sampling activities implemented via PSPs. In general, survey and sampling activities will be carried out by placing a grid with appropriate cell dimensions over the estimated excavation area and executing a systematic surface survey and/or sampling protocol. After establishing the area extent of excavation, applicable RI/FS and PSP data will be reviewed to determine the location and number of geoprobe borings. Geoprobe borings will be placed on the established perimeter of the excavation and within the delineated excavation area to determine the depth of excavation. Section 3.1.3 and Figure 3-3 provide details on the methods and protocols proposed for establishing the extent of excavation.

Task 4 - Delineate Excavation Extent Due to Technetium-99 Contamination

The extent of soil excavation needed to remove technetium-99 will be determined using RI/FS data and by implementing a PSP to obtain discrete samples from surface and subsurface locations, as needed. The number of additional sample locations will be determined by the adequacy of the RI/FS data, the cell dimensions of the surface grid, and the number of geoprobe borings needed to define the depth of excavation for soil containing technetium-99 above its FRL (Section 3.1.3). Samples will undergo laboratory analysis by liquid-scintillation or gas-proportional counting techniques to quantify the technetium-99 activity (Appendix H). Sample collection and handling procedures, laboratory protocols and methods, and instrument detection limits are presented in Appendices E and H.

Task 5 - TCLP Test and Delineate Characteristic Waste Extent

The extent of soil excavation needed to remove potential toxicity characteristic ASCOCs in the potential RCRA area identified as the former Trap Range in Remediation Area 1 (Figure 4-2) will be determined by obtaining discrete samples from the surface and subsurface locations. The number of sample locations will be established by the adequacy of RI/FS data, the cell dimensions of the surface grid, and the number of geoprobe borings needed to define the depth where COCs are below their FRLs (Section 3.1.3). Samples will undergo TCLP testing to determine what portions, if any, of the potential RCRA area exhibits the toxicity characteristic. If soil is identified as exhibiting the toxicity characteristic, it will be delineated as such to indicate that treatment is required prior to disposal.

Task 6 - Determine Remaining Excavation Extent

After excavation volumes for technetium-99 and identified toxicity characteristic COCs have been delineated, the excavation volumes for non-technetium-99, above-WAC soil, and soil above the FRLs for primary ASCOCs will be determined. If above-WAC soil is present in the four above-WAC areas identified on Figure 4-2, the excavation extent will be determined as described in Section 3.1.3. The entire footprint for the delineated above-WAC soil area will be excavated to the depth corresponding to WAC attainment. After the delineation of all above-WAC areas, soil remaining above the FRLs of the ASCOCs will be delineated for excavation.

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Task 7 - Prepare Area-Specific IRDP

An area-specific IRDP (i.e., a remedial design) will be prepared as presented and discussed in Sections 3.2 and 7.2. The IRDP must be approved by the EPA and OEPA prior to beginning excavation activities.

Task 8 - Prepare Excavation Site

Prior to and during excavation, a number of institutional and constructional measures will be implemented to control access to the area, prepare staging areas, prevent the spread of contaminated soil, and dispose of cleared shrubs and trees, as needed. Section 3.3.1.1 and Appendix F.2 further discuss site preparation activities.

Task 9 - Implement Run-off Control, As Needed

Based on the levels of contamination and the extent of excavation, an appropriate surface water management system will be implemented to ensure that water and sediment run-off/run-on is maintained and erosion is controlled to prevent cross-contamination of remediation areas during excavation. This system will conform to the FEMP National Pollution Discharge Elimination System (NPDES) Permit requirements through implementation of the FEMP Storm Water Pollution Prevention Plan (SWPPP) (DOE 1996c). Sections 3.3.1.1 and 5.1.3 discuss additional details of the run-off control measures.

Task 10 - Technetium-99 - Driven Excavation

Soil delineated as at or above the FRL for technetium-99 in Remediation Area 6 (Figure 4-2) will be excavated and staged prior to packaging and shipment to an off-site disposal facility. This excavation may be coordinated with removal of soil having non-technetium-99 ASCOCs above the WAC if the excavation volumes overlap. That is, if ASCOCs other than technetium-99 are above the WAC and present in the soil volume designated for technetium-99 excavation, they will be removed and segregated with the technetium-99 soil rather than with the non-technetium-99, above-WAC soil. Additionally, if the technetium-99 excavation overlaps with the excavation of soil that has failed the TCLP test, the excavated technetium-99 and toxicity characteristic soil will be treated prior to disposal. Additional information on excavation and disposal protocols is provided in Sections 3.3.1.2 and 3.3.1.3, and procedures to be followed for excavated material management are covered in Appendix F.5.

Task 11 - Characteristic Waste-Driven Excavation and Treatment

RCRA areas containing soil that exhibits the toxicity characteristic will be treated in situ then excavated or will be excavated and staged until Waste Management Programs (WMP) establishes the treatment and disposal options. If the toxicity characteristic soil contains radiological COCs above the WAC (e.g., uranium), the above-WAC soil will be excavated and staged for treatment prior to removing the above-FRL soil. Additional excavation and disposal information is provided in Sections 3.3.1.2 and 3.3.1.3, and procedures to be followed for excavated material management are covered in Appendix F.5.

Task 12 - Non-Technetium-99, WAC-Driven Excavation/Confirmation

There are 4 known soil areas in Remediation Areas 1, 2, and 6 that have the potential to exceed the established WAC levels (Figure 4-2). If RI/FS data and surveying and sample analysis carried out to define the excavation volumes indicates ASCOC concentrations above the WAC, the extent will be delineated with respect to non-technetium-99, above-WAC soil. The above-WAC soil will be excavated and segregated to isolate the above-WAC material prior to off-site disposal. Additional excavation and disposal information is provided in Sections 3.3.1.2 and 3.3.1.3.

Task 13 - FRL-Driven Excavation

After completing the excavations to remove soil containing technetium-99 above its FRL/WAC, soil exhibiting the toxicity characteristic (i.e., potential RCRA area), and soil exceeding the WAC, any remaining soil with uranium, thorium, radium, metal ASCOCs, and/or organic ASCOCs above their respective FRL will be excavated and staged (if needed) prior to placement in the OSDF. WAC attainment will be demonstrated for the excavated material placed in the OSDF using the field and analytical methods discussed in Section 4.1.2 and Appendix H. Additional excavation and disposal information is provided in Section 3.3.1 and Appendix F.

Task 14 - Precertification Scan

Upon completion of excavation activities within the remediation area, the area will be prepared for a precertification survey. The radiation survey will be conducted with NaI detectors and/or by discrete measurements with field instruments containing an HPGe detector. Precertification will be based on the residual activity of primary radioactive ASCOCs in the soil, except in areas where technetium-99, metal ASCOCs, and/or organic ASCOCs drive the excavations. For these exceptions, discrete samples

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may be collected to supplement the pre-excavation data, as needed. Additional details, on precertification activities are presented in Section 3.3.3.

Task 15 - CU Delineation/Classification

As part of the precertification survey, the excavated remediation area will be divided into certification units (CUs) and CU footprints will be defined. CUs will be up to 500 ft by 500 ft (Group 2 CU) in Remediation Areas 1 and 2 and up to 250 ft by 250 ft (Group 1 CU) in Remediation Areas 6 and 7. A Group 1 classification in Remediation Areas 6 and 7 has been selected to provide denser sample coverage in areas containing waste storage units. Section 3.4.1 contains additional details on the delineation and classification of CUs.

Task 16 - Evaluate Precertification Scan Results

RI/FS data and results from the precertification scan and/or supplemental sampling and analysis will be reviewed to assess the residual pattern of primary ASCOCs across the excavated area. FRL attainment for radiological, metal, and organic ASCOCs will be evaluated with RI/FS data and samples collected via PSPs during pre-excavation characterization and/or supplemental sampling and analysis, as needed. Additional assurance will be provided for the radiological ASCOCs by conducting HPGe measurements above designated certification sample locations prior to obtaining certification samples. Section 3.3.4 provides additional details on the attainment of remediation goals prior to conducting certification activities.

Task 17 - Hot-Spot/FRL Excavation/Confirmation

Hot spots delineated by the precertification scan in Task 14 (i.e., any of the primary radiological COCs in Table 2.6 that is greater than three times its FRL) will be reexcavated, and the precertification scan will be repeated on the re-excavated areas to confirm removal of radiological ASCOCs. This step will be reiterated as needed until the CU is determined to be ready for formal certification.

Task 18 - Prepare Certification Design Letter

When the CU is determined to be ready for certification, a CDL will be prepared to detail the CU delineation and the certification sampling approach and locations (Section 7.3). The CDL will be submitted to EPA and OEPA for review and approval. Upon approval of the CDL by EPA and

OEPA, the sample locations will be considered fixed and they may not be moved without review and concurrence by EPA and OEPA.

Task 19 - CU-Specific Certification Sampling

Based on the Data Quality Objectives (DQOs) and CU-specific sampling needs, a sufficient number of samples (generally 12 to 16) will be collected from each CU to certify all CU COCs. HPGe measurements may be collected for uranium, thorium, and radium for data comparison with physical sampling results. Section 3.4.2 provides additional details on the certification sampling design.

Task 20 - Certification/Recertification

A statistical analysis will be performed on the validated analytical results obtained from the certification samples to establish whether the CU passes the certification criteria at the specified level of uncertainty. Two criteria must be met for the CU to be certified as passing. The first criterion is that each individual sample within a CU must show each primary, CU-specific COC to be below a value of two times its FRL. When the data distribution is normal or lognormal, the second criterion compares the 95 percent upper confidence level (UCL) of the mean of each primary CU-specific COC and the 90 percent UCL of the mean of each secondary CU-specific COC to the appropriate FRL to make a pass/fail decision. In the event the data distribution is nonparametric, the pass/fail decision for the second criterion will follow the statistical protocol given in Appendix G. When the UCL of the mean (normal or lognormal distribution) of each CU-specific COC is less than its FRL or the appropriate nonparametric test is passed (Appendix G), the CU is certified as passing the second criterion. Both criteria must be met for the CU to be certified.

Task 21 - Additional Hot Spot/FRL Excavation/Confirmation

In the event either one of the two criteria fails in Task 19, additional excavation, field screening and surveying, sampling, and analysis will be conducted until the CU passes certification. The nonattainment scenarios that pertain to additional excavation and sampling activities are discussed in Section 3.4.5.

Task 22 - Prepare Certification Report

After both certification criteria are shown to pass the evaluation, individual CUs will be considered certified. As each CU is demonstrated to pass certification, analytical data will be communicated to

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the EPA through the posting of data results and information via a web site. A Certification Report will be issued for each remediation area after all CUs within the remediation area have been shown to pass the certification criteria. Further discussion on the content of this report is provided in Section 7.4.

Task 23 - Area-Wide Interim Grading and Restoration

After the Certification Report has been approved by the EPA, interim grading and restoration will be implemented to stabilize the excavation slopes prior to final sitewide grading and restoration. Interim grading and restoration activities are described in Appendix F.6.

## 4.2 EXCAVATION APPROACH B - EXCAVATION IN WASTE STORAGE/MANAGEMENT AREAS OUTSIDE THE FORMER PRODUCTION AREA

Excavation Approach B is designed to handle moderate to deep excavation of Operable Unit 2 waste units and of soil that underlies current waste storage/management area in Operable Units 1, 2, and 4. Soil underlying the waste storage/management areas is expected to be adversely affected by contaminants. The list of potential ASCOCs in the soil areas proposed for Excavation Approach B (Table 2-7) is expected to reflect RI/FS data on the waste presently stored in the remediation areas. However, the distribution of COCs in soil under the waste storage/management areas cannot be fully established until waste has been removed from the remediation areas.

Excavation Approach B will be applied to the Operable Unit 2 waste units and soil underlying waste storage areas in Remediation Areas 2, 3, 6, and 7 (Tables 4-1 and 4-2; Figures 4-1 and 4-4). Remediation Areas 2, 3, 6, and 7 encompass the waste storage areas of Operable Units 1, 2, and 4. The waste storage areas include the Southern Waste Units (a.k.a. the Inactive and Active Flyash Piles and South Field area) in Remediation Area 2, the Lime Sludge Ponds in Remediation Area 3, the Operable Unit 1 waste pits and Solid Waste Landfill in Remediation Area 6, and Operable Unit 4 silos housing the K-65 and metal-oxide material (Remediation Area 7).

### 4.2.1 General Description

Excavation Approach B follows the general soil remediation process discussed in Section 3.0. The soil remediation process in Remediation Areas 2, 3, and 6 is coupled with the removal of materials in the Southern Waste Units, Lime Sludge Ponds, and Solid Waste Landfill because all these materials will go to the OSDF if the WAC are met. In Remediation Areas 6 and 7, the soil remediation process

begins after waste materials have been removed because the Operable Units 1 and 4 waste materials will be shipped off site for disposal.

A predesign investigation will be conducted to estimate the extent of the excavation and above-WAC material using RI/FS data, pre-excavation surveys, and additional sampling activities, as dictated by PSPs. Radiological survey results and laboratory analytical data are forwarded to the remedial design to delineate the extent of soil excavation for technetium-99, RCRA (within the seven locations shown on Figure 1-5), HWMUs, and above-WAC and above-FRL areas. This information will be incorporated into an IRDP and submitted to the EPA and OEPA for approval.

After the IRDP has been approved, waste and soil excavation will begin and materials delineated as technetium-99, RCRA toxicity characteristic, and above WAC will be segregated for treatment, if required, and disposal. Because moderate to deep soil excavations are expected within the waste storage footprints, excavation will proceed in layers or lifts, with each layer being surveyed with a large-volume NaI detector and/or an HPGe instrument to demonstrate WAC attainment for primary radiological COCs. The specification of lift thickness for radiological scanning under Excavation Approach B will be defined for EPA and OEPA approval as part of the detailed design documentation. If special materials (Section 3.3.2.2) are encountered during the excavations, the materials will be handled, treated (as needed), and disposed of in accordance with the procedures outlined in Appendix F.5.

Upon completion of all excavation activities, the precertification survey, sampling activities, delineation of CU boundaries, and final certification effort follow the general approach discussed in Section 4.1.1.

### 4.2.2 Special Considerations

Special considerations for implementing Excavation Approach B are summarized under the following discussions of the nature and extent of contamination, radiological scanning and field measurements, attainment of WAC, and logistics.

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4.2.2.1 Nature and Extent of Contamination

Contamination associated with Excavation Approach B areas is tied to waste storage/management areas in Operable Units 1, 2, and 4. The nature of contamination at the Southern Waste Units, Lime Sludge Pond, and Solid Waste Landfill (placed in Remediation Areas 2, 3, and 6) includes radiological, metal, and organic ASCOCs (Table 2-7), with contamination expected to extend to moderate to deep levels below the surface. RI/FS data indicate the potential for technetium-99 and uranium to be above the WAC in the Southern Waste Units. Characterization of the waste materials will be limited to delineation and removal of above WAC material for off-site disposal, with all remaining material sent to the OSDF. RI/FS data will be used to determine whether additional characterization data are needed to delineate above-WAC waste material.

Waste materials will be removed from the waste units associated with Operable Units 1 and 4 prior to completing ASCOC characterization of underlying soil. In general, the nature of soil contamination below the waste units is expected to follow the COCs associated with the waste materials, with the extent of soil contamination established by PSPs during the pre-excavation investigation. The potential above-WAC technetium-99 zones associated with Waste Pit 5 in Remediation Area 6 and the western part of the slurry line near Silos 1 and 2 in Remediation Area 7 indicate the potential for soil underlying these waste units to be contaminated with technetium-99.

4.2.2.2 Radiological Scanning and Field Measurements

In Remediation Areas 2, 3, and 6, the Southern Waste Units, Lime Sludge Ponds, and Solid Waste Landfill will be characterized, as needed, and excavated as part of Excavation Approach B. The nature of contamination in these waste units will require radiological scanning of the waste materials, field measurements with the HPGe to detect gamma-emitting radionuclides, and VOC monitoring using PID meters.

A layer-by-layer radiological scan with a large-volume NaI detector will be conducted on the waste material and if above-WAC material is identified, HPGe measurements may be taken to identify gamma-emitting radionuclides and/or a geoprobe sample may be taken for characterization of pertinent ASCOCs. In the Solid Waste Landfill, field measurements or scanning for organic vapors will be conducted in addition to the radiological scans. However, the following special circumstances may limit the field activities.

The rheology of Lime Sludge Ponds material may not allow loading of the surface, which would eliminate walk-over radiation surveys and systematic sampling efforts. Under these conditions, materials will be screened and sampled after excavation. Similar consideration must be given to the heterogeneity of materials expected to be found in the Solid Waste Landfill when conducting radiation surveys and sampling activities. Excavation of the Solid Waste Landfill is not anticipated to result in the smooth surfaces expected for soil excavations. Therefore, the geometry of the surface must be considered when radiation scans and/or HPGe measurements are performed. The heterogeneity of materials expected to be found in the Solid Waste Landfill also creates unique problems with sampling efforts designed to identify metals above-WAC, as no real-time scanning instrument similar to NaI detectors and PID meters is available for metal COCs.

#### 4.2.2.3 Attainment of Waste Acceptance Criteria

WAC attainment will be carried out using the general approach discussed in Section 4.1.2, with the following exceptions. The Southern Waste Units, Lime Sludge Ponds, and Southern Waste Landfill will undergo a layer-by-layer NaI scan on each lift surface during excavation, if possible, to identify material containing uranium above its WAC. Details on the execution of such scans and the level of radioactive that indicates potential WAC material are presented in the User's Manual (DOE 1998c). If an in situ scan is not possible, excavated material will be stockpiled and scanned to determine whether the uranium WAC is met. Secondary ASCOCs will be shown to comply with the WAC by sampling and analysis of in situ or stockpiled material, with the exception of the Southern Waste Landfill.

For the heterogeneous materials expected to be found in the Southern Waste Landfill, radiation surveys can demonstrate WAC attainment for uranium when scanning of the exposed surfaces in the Southern Waste Landfill is possible, but it is not feasible to sample 100 percent of the waste to demonstrate WAC attainment for other ASCOCs. Therefore, biased sampling, based on radiation and organic-vapor surveys during excavation will be coupled with random sampling during the predesign investigation to demonstrate WAC attainment.

#### 4.2.2.4 Logistics

Soil characterization and excavation activities conducted in waste storage footprints associated with Remediation Areas 6 and 7 will proceed after the waste materials are removed. Removal of waste material and structures associated with the Operable Unit 1 Waste Pits (Remediation Area 6) will be

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carried out under the Waste Pits Remedial Action Project. Waste materials and structures associated with the Operable Unit 4 Silos (Remediation Area 7) will be removed under the Silos Project. Therefore, the source of radon in the Operable Unit 4 silos will be removed from the area prior to remediation of soils and there is no source present to emit radon-222 in sufficient concentration to exceed the 40 CFR 61 Subpart Q limit of 20 pCi/m2/sec. Required radon monitoring at the FEMP is addressed in the Integrated Environmental Monitoring Plan (IEMP) (DOE 1997a).

The potential for deep excavations (i.e., greater than 20 ft) in the waste storage areas poses logistical problems as well as health and safety concerns. Excavation of soil, layer by layer, will be slow because of continual radiation scanning of the excavation surfaces for primary ASCOCs, the dewatering of perched water zones, and the need to construct soil ramps or retaining walls to achieve the target depth of excavation. Additionally, radiological scanning of successively deeper layers is likely to take longer than initial surface scans because access problems may limit the scanning to hand-held instruments rather than the RTRAK.

In addition to the challenges posed by deep excavations, the presence of metal and organic COCs in the waste storage areas dictates that VOC monitoring and additional sampling and analysis may be required during the implementation of Excavation Approach B. These activities will be conducted independently of radiological scanning, resulting in an increase in the time required to excavate the soil.

### 4.2.3 Excavation Details

Figure 4-5 presents the logic flow for conducting Excavation Approach B. Each of the 25 tasks identified for this type of excavation is discussed in detail and tied to material presented in Sections 3.0, 4.0, and 7.0 and/or relevant appendices. A comparison of these tasks with other excavation approaches is provided in Table 4-3.

#### Task 1 - Potential Excavation Area Delineation and Data Review

This task is carried out in the general manner outlined in Section 3.1.1. The potential areas requiring Excavation Approach B are shown on Figure 4-4 and have been defined where RI/FS data for uranium are available. However, much of the potential excavation area will not be defined rigorously until

waste is removed from the waste storage units and the extent of ASCOCs in the underlying soil is determined.

Task 2 - Select COCs and Identify Potential Technetium-99, RCRA, HWMU, and Above-WAC Areas

The preliminary COC lists for Remediation Areas 2, 3, 6, and 7 are summarized in Table 2-7. These lists are derived from RI characterization data and divided into primary and secondary ASCOCs (Section 2.1.3.1). The ASCOCs will be finalized in the area-specific IRDPs.

Technetium-99 has been measured above the FRL in three of the four remediation areas designated for Excavation Approach B: near the northwest corner of the Southern Waste Units in Remediation Area 2, in the northeast corner of Waste Pit 5 (Remediation Area 6), and surrounding the west portion of the slurry line in Remediation Area 7 (Figure 4-4). Most of the technetium-99 material in Remediation Areas 6 and 7 is likely to be removed with the waste materials prior to conducting soil excavation activities. However, the material in the Southern Waste Units and soil underlying the waste storage areas will be investigated for potential technetium-99 removal under this excavation approach.

There are two potential RCRA areas (i.e., potential for soil to exhibit the toxicity characteristic) in areas covered by Excavation Approach B: Remediation Area 7, directly west of the waste storage units that comprise Silos 1 and 2, and the South Field Firing Range in Remediation Area 2 (Figure 4-4). Soil and material from the South Field Firing Range that exhibits the toxicity characteristic will be shipped off site for disposal.

Two HWMUs are located in Remediation Area 6: HWMU #27 - Waste Pit 4 and HWMU #42 - Waste Pit 5 (Table 2-1; Figure 4-4). The characterization and excavation of soil underlying waste materials in these HWMUs and the closure of the HWMUs will be covered under this excavation approach.

Based on the RI/FS characterization data for uranium, there are two known areas within the proposed Excavation Approach B boundaries with the potential to exceed established WAC levels (Figure 4-4). Above-WAC areas for uranium have been identified along the eastern margin of the waste pit area in Remediation Area 6 and along the northwest margin of the Southern Waste Units in Remediation Area 2. It is likely that much of the above-WAC material in Remediation Area 6 will be removed

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when the waste materials are removed. However, underlying soil will be sampled and analyzed to determine whether above-WAC soil exists. All above-WAC material in Operable Unit 2 waste units and above-WAC soil underlying all waste units will be excavated and handled under this approach.

Task 3 - Pre-excavation Surveys and Sampling

Pre-excavation surveys and sampling will be carried out as described under Task 3 in Section 4.1.3, with the exception of the following scenarios. The rheology of material in the Lime Sludge Ponds may not permit loading of the surface, and walk-over radiation surveys and systematic in situ sampling may not be possible. Under these conditions, radiological scanning and sampling will take place on excavated material that has been stockpiled. A second potential scenario that varies from standard protocol is the sampling of heterogenous material in the Solid Waste Landfill. Although radiation surveys can demonstrate WAC attainment for primary radiological COCs by scanning of accessible exposed surfaces in the Solid Waste Landfill, it is not feasible to sample 100 percent of the waste to demonstrate WAC attainment for other COCs. Therefore, biased sampling, based on radiation and organic-vapor surveys, will be coupled with random sampling to demonstrate WAC attainment.

Task 4 - Delineate Excavation Extent Due to Technetium-99 Contamination

Delineation of the extent of technetium-99 will be carried out as described under Task 4 in Section 4.1.3, with the exception of the following scenario. Waste material in the northwest corner of the Southern Waste Units that contains technetium-99 above its FRL (i.e., the Inactive Flyash Pile) will be delineated for excavation in addition to potential technetium-99 soil areas.

Task 5 - TCLP Test and Delineate Characteristic Waste Extent

The extent of soil excavation needed to remove potential toxicity characteristic ASCOCs in the RCRA area west of Silos 1 and 2 will be determined by obtaining discrete samples from surface and subsurface locations. The sampling and analysis protocol to delineate potential toxicity characteristic soil will be carried out as described under Task 5 in Section 4.1.3.

Task 6 - Determine Remaining Excavation Extent

After excavation volumes for technetium-99 and identified toxicity characteristic ASCOCs have been delineated, the excavation volumes for non-technetium-99, above-WAC soil and soil above the FRLs for ASCOCs will be determined. If above-WAC soil is present in the two above-WAC areas identified

on Figure 4-4, the area will be delineated and excavated as described under Task 6 in Section 4.1.3. The general approach for determining the excavation extent of soil containing ASCOCs above the FRL is described in Section 3.1.3.

Task 7 - Prepare Area-Specific IRDP

The area-specific IRDP will be prepared as discussed under Task 7 in Section 4.1.3.

Task 8 - Prepare Excavation Site

The excavation site will be prepared as discussed under Task 8 in Section 4.1.3.

Task 9 - Implement Run-off Control As Needed

Run-off control will be implemented as discussed under Task 9 in Section 4.1.3.

Task 10 - Technetium-99-Driven Excavation

Soil delineated as at or above the FRL for technetium-99 (Figure 4-4) will be excavated and staged prior to packaging and shipment to an off-site disposal facility. This excavation will be carried out as discussed under Task 10 in Section 4.1.3.

Task 11 - Characteristic Waste-Driven Excavation and Treatment

Excavation and treatment of identified RCRA toxicity characteristic soil will be carried out as discussed under Task 11 in Section 4.1.3.

Task 12 - Implement Perched Water Control, As Needed

If excavation activities encounter uncontaminated perched water, controls will be implemented to pump and contain the perched water prior to discharge. In the event perched water is recovered from a zone identified to contain RCRA characteristic waste, sampling and analysis will be carried out to determine whether toxicity characteristic COCs are present in sufficient concentration to warrant sending the water to the AWWT facility for treatment. The perched water control actions are presented in Section 2.5.4.

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Task 13 - Layer-Specific, Pre-excavation, Non-Technetium-99 WAC Scan

During moderate to deep excavations, soil will be removed in layers. As each layer is stripped away, a gamma scan will be conducted on the exposed soil to determine whether uranium is present above the WAC level. This survey will be conducted with the radiation scanning system (RSS) or hand-held NaI detectors and/or by discrete measurements with a field instrument containing a HPGe crystal. When a radiological scan indicates uranium is above the WAC, a geoprobe boring will be extended to collect samples and determine the vertical extent of above-WAC material for all pertinent ASCOCs.

In the event material cannot be surveyed in situ (e.g., Lime Sludge Ponds material), the radiological scan for WAC attainment will be conducted on excavated material staged for disposal. If ASCOCs associated with identified RCRA toxicity characteristic soil and HWMUs drive the soil excavation, field XRF, PID, or laboratory analysis may be used to delineate ASCOCs that are above the WAC levels when pre-excavation data are not sufficient to assess WAC attainment.

Task 14 - Non-Technetium-99, WAC-Driven Excavation/Confirmation

There are two known soil areas that have the potential to exceed the established uranium WAC level in Remediation Areas 2 and 6 (Figure 4-4). However, the potential also exists for soil to exceed the WAC under the waste storage units, HWMUs, and other areas within the remediation areas. If soil containing ASCOCs at or above the WAC is determined to exist through review of RI/FS data and pre-excavation characterization activities, the extent will be delineated with respect to non-technetium-99, above-WAC soil exhibiting toxicity characteristic ASCOCs (treatment required) and non-technetium-99, above-WAC soil. These above-WAC soil types will be excavated and segregated to isolate the above-WAC material requiring treatment. All above-WAC material will be shipped off site for disposal. Additional excavation and disposal information is provided in Sections 3.3.1.2 and 3.3.1.3.

Task 15 - FRL-Driven Excavation

The FRL-driven excavation will be carried out as described under Task 13 in Section 4.1.3. WAC attainment will be demonstrated for the excavated material placed in the OSDF using the field and laboratory analytical methods described in Section 4.2.2 and Appendix H.

Task 16 - Precertification Scan

The precertification scan will be carried out as discussed under Task 14 in Section 4.1.3.

Task 17 - CU and HWMU Footprint Delineation/Classification

As part of the precertification survey, the excavated remediation areas will be divided into CUs, and CU footprints will be defined. Group 1 CUs (up to 250 ft by 250 ft) will be established after Excavation Approach B has been executed. Each HWMU footprint in Remediation Area 6 (i.e., Waste Pits 4 and 5) will be delineated as a specific, special CU and will be certified for closure independent of the nominal CUs that surround them. Section 3.3.3.2 contains additional details on the delineation and classification of CUs and HWMUs.

Task 18 - Evaluated Precertification Scan Results

Evaluation of the precertification scan results will be carried out as described under Task 16 in Section 4.1.3.

Task 19 - Hot-Spot/FRL Excavation/Confirmation

Hot-spot evaluation will be carried out as discussed under Task 17 in Section 4.1.3.

Task 20 - Prepare Certification Design Letter

When the CU is determined to be ready for certification, a CDL will be prepared to detail the sampling approach and locations (Section 7.3). The CDL will be submitted to EPA and OEPA for review and approval. Upon approval of the CDL by EPA and OEPA, the sample locations will be considered fixed and they may not be moved without review and concurrence by EPA and OEPA.

Task 21 - CU-Specific Certification Sampling

Certification sampling will be conducted as presented under Task 19 in Section 4.1.3, with the exception of evaluating HWMU closure.

Task 22 - Certification/Recertification

Certification will be evaluated as discussed under Task 20 in Section 4.1.3, with the exception of evaluating HWMU closure.

For closure of the HWMUs, analytical results will be reviewed and closure will be complete if the average concentration of each COC is below its respective FRL. Additionally, the HWMU closure will meet all substantive requirements of the RCRA and Ohio hazardous waste closure regulations (Section 2.2.5).

Task 23 - Additional Hot-Spot/FRL Excavation/Confirmation

Additional hot-spot evaluation will be carried out as discussed under Task 21 in Section 4.1.3, with the exception of HWMU closures.

If the HWMU fails the closure test, the HWMU will be reexcavated to remove the anomalies, and sampling, analysis, and statistical tests will be repeated until closure meets all substantive requirements of the RCRA and Ohio hazardous waste closure regulations.

Task 24 - Prepare Certification Report

The Certification Report will be prepared after the completion of excavation in the remediation area, as presented under Task 22 in Section 4.1.3. HWMU closure will be reported as part of the Certification Report. Additionally, in accordance with the OEPA Director's Final Findings and Orders (OEPA 1996), HWMU closures will be documented in the Remedial Action Reports submitted for the former operable units and the SCEP.

Task 25 - Area-Wide Interim Grading and Restoration

Interim grading and restoration activities will be carried out as described under Task 23 in Section 4.1.3.

## 4.3 EXCAVATION APPROACH C - EXCAVATION OF EXISTING SOIL STOCKPILES AND MANAGEMENT OF CONTAINERIZED SOIL IN THE FORMER PRODUCTION AREA AND REMEDIATION AREA 1, PHASE I

Excavation Approach C is designed to remove existing soil stockpiles in the Former Production Area (a.k.a. Removal Action 17) and in Remediation Area 1, Phase I. Most of these stockpiles are distinct from intermittent, characterized stockpiles created during remedial actions because little to no characterization data are available to trace the soil to a source. For soil stockpiles in the Former Production Area, this approach will apply only to delineation and removal of the soil stockpile, with the underlying soil evaluated for removal by Excavation Approach D (Section 4.4). The purpose for

handing the underlying soil to Excavation Approach D is to allow the soil in the entire Former Production Area to be remediated at one time; following removal of all buildings, structures, and stockpiles. The soil stockpiles in Remediation Area 1, Phase I will be removed to the former, initial grade surface with the former footprint of the piles to be addressed as part of Area 1, Phase II under Excavation Approach A. When necessary, this approach will also be applied to other soil stockpiles which may require characterization before being excavated. A list of potential primary and secondary ASCOCs for Excavation Approach C (Table 2-7) areas will be based on the COC list for the remediation areas that contain the piles (i.e., Remediation Areas 1, 3, and 5).

Excavation Approach C will be applied to the six existing soil stockpiles in Remediation Areas 1, 3, and 5 (Tables 4-1 and 4-2; Figures 4-1 and 4-6). Two of the stockpiles are located northwest of the Sewage Treatment Plant in the eastern corridor of Remediation Area 1 and four of the soil stockpiles are located in the northwest portion of Remediation Area 3. This approach is not likely to be applied to future, temporary stockpiles that may be generated during remediation activities because the material in such piles will be characterized before the temporary stockpile is formed.

Containerized soil will also be addressed under this excavation approach. DOE will prepare a PSP for EPA and OEPA review and approval that will present the required sampling and analysis and the disposition strategy for the containerized soil. No additional containerized soil will be bulked until this PSP is approved.

### 4.3.1 General Description

Excavation Approach C follows the first half of the general soil remediation process discussed in Section 3.0. This approach terminates when the soil stockpiles have been removed. For stockpiles in the Former Production Area, the stockpile footprint and the certification process are forwarded to Excavation Approach D (Section 4.4). The purpose for handing the underlying soil to Excavation Approach D is to allow the soil in the entire Former Production Area to be remediated at one time, after all buildings, structures, and stockpiles have been removed. After removal of the two stockpiles in Remediation Area 1, Phase I, to the former, initial grade surface, WAC attainment sampling will be conducted on the top six inches of soil prior to final sampling and analysis for certification.

Characterization of the soil stockpiles will begin by conducting a predesign investigation to delineate the soil stockpile to be removed, identify COCs, and perform pre-excavation surveys and sampling activities. Where the soil stockpile origin history is not known, the predesign characterization step will include an evaluation for RCRA toxicity characteristics using the "20 times rule" and/or TCLP sampling. This pile sampling will follow EPA SW-846 sampling strategies and OSWER Directive 9938.4-03 RCRA Waste Characterization Objectives. The remaining sampling activities will be carried out to achieve a density of surface and subsurface sampling points similar to the RI/FS sampling density in the Former Production Area or in the vicinity of the stockpile. For the eastern and western stockpile in Remediation Area 1, Phase I (Figure 4-6), sample density will be determined in the PSPs developed for the stockpiles. Radiological survey results and laboratory analytical data will be forwarded to the remedial design to delineate the extent of excavation for technetium-99, RCRA (within the seven locations shown on Figure 1-5), above-WAC, and above-FRL areas. This information will be incorporated into an excavation work plan and submitted to the EPA and OEPA for approval.

After the excavation work plan has been approved, removal of the soil stockpiles will begin and soil delineated as technetium-99, RCRA toxicity characteristic, and above WAC will be segregated for treatment, if required, and disposal. Because of the potential for heterogeneity within the stockpiles, excavation may proceed in layers, with each layer being surveyed by a large-volume NaI detector for attainment of uranium WAC. The excavation lift thickness will be specified in the follow up design documentation for the stockpile of interest. If special materials are encountered during the removal activities (Section 3.3.2.2), the materials will be handled, treated (as needed), and disposed of in accordance to the procedures outlined in Appendix F.5. Upon removal of the stockpiles in the Former Production Area, the soil footprint will be remediated and certified under Excavation Approach D.

### 4.3.2 Special Considerations

Special considerations for Excavation Approach C are summarized under the following discussions of the nature and extent of contamination, radiological scanning and field measurements, and attainment of WAC.

#### 4.3.2.1 Nature and Extent of Contamination

The origin of soil and material placed in the five stockpiles located in the Former Production Area (Figure 4-6) is largely unknown. Therefore, characterization and excavation activities will proceed in a systematic and controlled manner to ensure health and safety protocol is met and all materials are identified correctly. These activities will be coordinated with D&D operations in the Former Production Area to ensure access corridors and staging areas can be developed where they are needed. Characterization activities will be carried out according to the area-specific PSP, which will generally propose to generate a sample point density that is equivalent to RI/FS sample point density in the Former Production Area. Based on the characterization data, excavation may proceed layer by layer with real-time scanning of each layer for gamma activity and organic vapors.

#### 4.3.2.2 Radiological Scanning and Field Measurements

Radiological scanning and field measurements will be carried out using the instruments and approach summarized in Section 4.1.2, with the following exceptions. In situ HPGe measurements may not be possible if the pile geometry (e.g., a conical form) prevents acquisition of a representative spectra. Although RCRA listed or characteristic organic waste is not expected to be present in the stockpiles, monitoring for organic vapors will be conducted during excavation activities.

#### 4.3.2.3 Attainment of Waste Acceptance Criteria

WAC attainment will be demonstrated using a combination of data obtained from NaI surveys and HPGe measurements (if possible) as well as sampling and analysis carried out via area-specific PSPs. Scans with NaI detectors will be used on each excavation layer within the pile, if possible, or on the unit volume removed by the excavation equipment during remediation. If radiological scans indicate uranium exceeds the WAC in zones not characterized by PSP sampling and analysis, additional sampling and analysis will be performed to determine whether secondary ASCOCs exceed the WAC. When additional assurance is needed to confirm the WAC scans, discrete samples may be collected for laboratory gamma spectroscopy analysis. Use of the HPGe instrument to establish WAC attainment may not be possible because of the geometry of the stockpiles.

### 4.3.3 Excavation Details

Figure 4-7 presents the logic flow for conducting Excavation Approach C. Each of the 15 tasks identified with this type of excavation is discussed in detail and tied to material presented in

Sections 3.0, 4.0, and 7.0 and/or relevant appendices. A comparison of these tasks with other excavation approaches is provided in Table 4-3.

Task 1 - Stockpile Delineation and Data Review

The current estimated areas for the 6 soil stockpiles discussed under Excavation Approach C are shown on Figure 4-6. Additional data will be collected and reviewed, as necessary, to determine initial characterization aspects of the soil and final area boundaries prior to removal. If future remediation activities generate additional uncharacterized stockpiles that are to be remediated under Excavation Approach C, they will be delineated in a similar manner.

Task 2 - Select COCs and Identify Potential Technetium-99, RCRA, and Above-WAC Areas

The preliminary ASCOCs lists for Remediation Areas 1, 3, and 5 are summarized in Table 2-7. These lists are derived from RI/FS characterization data and are divided into primary and secondary ASCOCs (Section 2.1.3.1). The ASCOCs will be finalized in the area-specific IRDPs. In general, the full list of 18 numerical WAC constituents of concern will be utilized for existing stockpiles, where the original history of the stockpile does not support use of a defensible short list. The constituent of concern list will also include RCRA toxicity characteristic testing, for those situations where, as mentioned earlier, the origin history of the pile is not known. If an acceptable shortlist can be utilized for a particular stockpile based on pile history and/or followup supplemental sampling, it will be proposed for stockpile-specific EPA and OEPA acceptance through the PSP and design-level document review and approval process.

Technetium-99 has not been detected in past samples obtained from the current soil stockpiles. If PSP sampling and analysis initiated during the predesign investigation indicates technetium-99 is present above its FRL or if future stockpiles are generated which contain technetium-99, it will be excavated and segregated under this excavation approach.

The current soil stockpiles are not known to contain toxicity characteristic hazardous waste. However, sampling and analysis carried out under the area-specific PSP will address RCRA constituents that are known to be present in the remediation area. Additionally, organic-vapor monitoring will be conducted with a PID meter during excavation to screen for potential organic compounds that are regulated under RCRA.

Based on the RI characterization data for uranium, there are two known areas near the northwest corner of Soil Stockpiles 1 and 4 with the potential to exceed established uranium WAC levels (Figure 4-6). If pre-excavation characterization indicates the presence of soil with ASCOCs at or above the WAC here or in other stockpiles, it will be excavated and segregated under this approach.

Task 3 - Pre-excavation Surveys and Sampling

Pre-excavation surveys and depth profile sampling initiated by PSPs will follow the general protocol discussed under Task 3 in Section 4.1.3, with the addition of the specific details noted here.

In general, sample point density within the stockpiles will be similar to the sample point density of RI/FS data in the surrounding areas. The exact number of samples to be collected will be determined in the stockpile-specific PSP. Radiological scanning will be used to identify surface areas where primary ASCOCs are above the WAC. Any such identified areas will be investigated further using geoprobe borings. Geoprobe borings will also be placed near the established perimeter of the stockpile and within the stockpile at biased and/or random locations to determine whether technetium-99, RCRA toxicity characteristic, or above-WAC material is present. If available, RI/FS data will also be used to determine the extent of individual ASCOCs.

Task 4 - Delineate Excavation Extent Due to Technetium-99 Contamination

The presence or absence of technetium-99 has not been established for the soil stockpiles in the Former Production Area. Therefore, sampling and analysis will be conducted to determine whether technetium-99 is present in soil stockpiles in the Former Production Area. If present above its WAC/FRL, the extent of technetium-99 excavation will be delineated as discussed under Task 4 in Section 4.1.3. The PSP developed for sampling the western soil stockpile in Remediation Area 1, Phase I will indicate that a limited number of samples will be collected and characterized for technetium-99 to account for materials tied to Operable Unit 1 that may contain technetium-99.

Task 5 - TCLP Test and Delineate Characteristic Waste Extent

Based on current RI/FS data, toxicity characteristic hazardous waste is not present in the soil stockpiles. However, if the source(s) for the stockpile material can be identified, all RCRA COCs from the source area will be considered in the PSP characterization effort. Additionally, if the source is unknown, then all RCRA COCs on the WAC list will be considered in the sampling effort. If

RCRA COCs are found at values that exceed 20 times the TCLP limit, sampling and TCLP analysis will be performed to delineate the potential toxicity characteristic soil.

Task 6 - Determine Remaining Excavation Extent

Based on the RI/FS characterization data for uranium, the northwest corner of Soil Stockpiles 1 and 4 have the potential to exceed established uranium WAC levels (Figure 4-6). Pre-excavation characterization data will determine the extent of this and other potential above-WAC areas, and all soil above the WAC will be removed prior to excavation of the remaining soil. The remaining soil will be delineated as above or below the FRLs of applicable COCs.

Task 7 - Prepare Area-Specific IRDP

The area-specific IRDP will be prepared as discussed under Task 7 in Section 4.1.3.

Task 8 - Prepare Excavation Site

The excavation site will be prepared as discussed under Task 8 in Section 4.1.3.

Task 9 - Implement Run-off Control, As-Needed

Run-off control will be implemented as discussed under Task 9 in Section 4.1.3.

Task 10 - Technetium-99 Driven Excavation

If soil is delineated as being above the WAC/FRL for technetium-99, it will be excavated and staged prior to packaging and shipment to an off-site disposal facility. If needed, this excavation will be carried out as discussed under Task 10 in Section 4.1.3.

Task 11 - Characteristic Waste-Driven Excavation and Treatment

Based on the RI/FS data, neither TCLP tests nor excavations are planned for RCRA characteristic waste. However, if RCRA COCs are added to the analyte list at a future date (e.g., organic-vapor monitoring discovers materials suspected of being characteristic waste), a contingency plan will be implemented to assess and characterize the suspect materials. Based on the findings of the contingency actions, if soil should be delineated as exhibiting the toxicity characteristic, it will be excavated, staged, and given to the WMP to establish treatment and disposal options.

Task 12 - Layer-Specific, Pre-Excavation, Non-Technetium-99 WAC Scan

If the predesign characterization data indicate above-WAC material and heterogeneity in the size and types of materials in the stockpile, excavation will take place in layers. A gamma scan will be conducted on each layer or unit volume of material removed from the pile to determine whether the uranium WAC is exceeded before successive layers are removed. All identified above-WAC soil will be segregated for off-site disposal. Additional excavation and disposal information is provided in Sections 3.3.1.2 and 3.3.1.3.

Task 13 - Non-Technetium-99, WAC-Driven Excavation/Confirmation

If above-WAC soil is identified and removal can proceed as a bulk excavation rather than in layers, the above-WAC material will be delineated through pre-excavation surveys and/or sampling activities. All soil with ASCOCs above the WAC will be excavated and segregated to isolate the above-WAC material prior to shipment off site. Additional excavation and disposal information is provided in Sections 3.3.1.2 and 3.3.1.3.

Task 14 - FRL-Driven Excavation

After the excavations to remove any soil detected with ASCOCs above the WAC, remaining soil with uranium, thorium, radium, and other potential ASCOCs above their respective FRL will be excavated and staged prior to placement in the OSDF. WAC attainment will be demonstrated for materials to be placed in the OSDF using the field and laboratory analytical methods discussed in Section 4.3.2 and Appendix H. Additional excavation and disposal information is provided in Section 3.3.1 and Appendix F.

Task 15 - Remediate/Certify the Footprint as Part of the Former Production Area With Excavation Approach D

After the removal of soil stockpiles in the Former Production Area and Remediation Area I, Phase I, the stockpile footprints will be established and final remediation and certification will be carried out under Excavation Approach D (Section 4.4).

## 4.4 EXCAVATION APPROACH D - EXCAVATION FOLLOWING D&D IN THE FORMER PRODUCTION AREA, STP, AND FTF

Excavation Approach D is designed to handle shallow to deep soil excavations that take place after buildings, above-grade structures, and soil stockpiles (Excavation Approach C) have been removed

from the Former Production Area, the Sewage Treatment Plant, and the Fire Training Facility. Soil underlying buildings, structures, and stockpiles is anticipated to be affected by contaminants. The list of potential ASCOCs for proposed Excavation Approach D areas (Table 2-7) is expected to reflect the production history of process materials and RI/FS data on soil samples collected around the perimeter of buildings and structures. However, the distribution of ASCOCs under the buildings, structures, and stockpiles cannot be established completely until preliminary, above-grade D&D activities in the Former Production Area, Sewage Treatment Plant, and Fire Training Facility are completed.

Excavation Approach D will be applied in the following remediation areas: Remediation Area 1, Phase II - soil underlying the Sewage Treatment Plant on the eastern border of the FEMP; Remediation Areas 3, 4A, 4B, 5, and 7 - soil and at- and below-grade structures and debris associated with the Former Production Area; and Remediation Area 6 - soil underlying the Fire Training Facility. The preliminary extent of excavations requiring Approach D are shown on Figure 4-8. A comparison of Excavation Approach D with other excavation approaches is provided in Table 4-3.

### 4.4.1 General Description

Excavation Approach D follows most of the general soil remediation process discussed throughout Section 3.0. It deviates from the general approach in Section 3.0 with respect to coordinating pre-excavation characterization with above-grade D&D activities and in dealing with the disposition of at- and below-grade construction debris. The remediation process will begin by conducting a data review to estimate the potential extent of the excavation using RI/FS data and to identify ASCOCs. After initial, above-grade D&D activities have removed equipment, piping, and all other ancillary materials from the buildings and structures, pre-excavation surveys and sampling activities inside the remaining structure will commence to refine the list of ASCOCs, as needed. Similar to the other approaches, the supplementary surveying and sampling conducted as part of the pre-excavation activity will be conducted under the direction of a PSP prepared for the effort. Upon completion of the pre-excavation surveys and sampling activities, final, above-grade D&D activities will be initiated and completed. Existing data, radiological survey results and laboratory analytical data will be forwarded to the remedial design to delineate the extent of soil excavation for technetium-99, RCRA toxicity characteristic (within the seven locations shown on Figure 1-5), HWMUs, USTs, above-WAC, and above-FRL areas. This information will be incorporated into an IRDP and submitted to the EPA and OEPA for approval.

After the IRDP has been approved by the EPA and OEPA, at- and below-grade structures will be removed and staged for disposal assessment by the WAO. Soil excavation will begin after the structures are removed and materials delineated as technetium-99, RCRA toxicity characteristic, HWMU, UST, and above WAC will be segregated for treatment, if required, and disposal. Because deep soil excavations are expected below some of the buildings, excavations in these areas will proceed in layers with each layer being surveyed for WAC attainment of primary radiological ASCOCs prior to excavating the next. The specified lift thickness will be defined for EPA and OEPA approval as part of the follow up design documentation. Additionally, because of the expected heterogeneity of contamination within the Former Production Area, real-time monitoring of the active excavation will be conducted for WAC attainment purposes. If special materials (Section 3.3.2.2) are encountered during the excavations, the materials will be handled, treated (as needed), and disposed of in accordance with the procedures outlined in the Waste Disposition Program.

Upon completion of all excavation activities, precertification surveys, delineation of CU boundaries, and certification sampling activities will take place as described in Section 4.1.1. Additionally, soil samples will be collected and analyzed to obtain the necessary closure data for identified HWMUs and USTs within the CUs.

### 4.4.2 Special Considerations

Special considerations that apply to Excavation Approach D are summarized under the following discussions of the nature and extent of contamination, radiological scanning and field measurements, attainment of WAC, and logistics.

#### 4.4.2.1 Nature and Extent of Contamination

The diversity and concentration of ASCOCs within the Former Production Area dictates that remediation activities will progress slowly, because of additional monitoring, sampling, and analysis and the possibility of encountering special materials and perched water. Sampling and analysis conducted prior to above-grade demolition may not be sufficient to delineate completely the excavation zones for technetium-99, RCRA toxicity characteristic, above-WAC, and above-FRL soil or to identify all areas containing special materials. When excavation zones need to be delineated further, additional

sampling and analysis will need to be coordinated with removal of at- and below-grade structures or conducted during excavation. If special materials (Section 3.3.2.2) are encountered during excavation activities, additional monitoring, sampling, and analysis may be necessary to characterize the materials.

HWMUs and USTs will be excavated and closed during remediation activities carried out in the Former Production Area. Care must be taken to ensure that sampling and analysis plans will account for the HWMUs and USTs and that the needed analyte lists are submitted with samples collected for HWMU and UST COCs as well as certification of CUs. For example, HWMUs and USTs must have a minimum of eight samples collected and analyzed from within their footprint and sidewall (if applicable). The HWMU and UST analyte list may be different from the list of COCs in surrounding CUs.

4.4.2.2 Radiological Scanning and Field Measurements

Because of access controls and limited equipment maneuverability in the Former Production Area, real-time monitoring for WAC attainment with the large-volume NaI detector will be restricted to the BTRAK or hand-held instruments. When conducting real-time monitoring in deep excavations with the NaI detector, the geometry of the excavation and the presence of saturated conditions from perched water zones may affect the instrument reading. The real-time monitoring will be an integral part of the excavations in the Former Production Area, and the geometry of the excavations and implementation of perched-water controls will place additional time constraints on this monitoring, which must be considered when excavation plans and schedules are developed.

4.4.2.3 Attainment of WAC

A combination of radiological surveys and field and laboratory measurements will be used to demonstrate that soil placed in the OSDF meets the WAC. Initial radiological scans will identify above-WAC uranium zones, and additional sampling and analysis will be conducted to delineate these zones for all ASCOCs when RI/FS data are not sufficient to make the delineation. These surveys will be concentrated in zones identified by RI/FS data as highly contaminated with uranium and in areas where historical knowledge indicates process materials were spilled. However, because of the expected heterogeneous distribution of uranium in the soil, surveys with NaI detectors will also be conducted on each volume unit removed during active excavation and on the excavation layer prior to removing the next lift.

Where excavation takes place in zones of perched water, scanning techniques may need to be modified to obtain a reliable reading from saturated soil and/or delayed until the soil has been dried by placement in a stockpile. Above-WAC zones identified during these scans will be investigated for all ASCOCs, as needed or demonstrated by existing RI/FS and pre-excavation characterization data. The IRDPs will specify the details on how the real-time technologies will be applied for a given area, recognizing the heterogeneous conditions that may be encountered.

Debris associated with the removal of at- and below-grade structures will not undergo further characterization, other than the visual checks and response specified for debris in Section 5.0 of the OSDF WAC Attainment Plan, and the observations and/or scans necessary to address worker health and safety concerns for handling the materials.

4.4.2.4 Logistics

The coordination of D&D activities with soil characterization and remediation activities in the Former Production Area poses unique challenges in the way of logistics and health and safety requirements. Coordination of scanning, sampling, and analysis activities with D&D schedules, the removal of at- and below-grade structures in limited access areas, and the implementation of excavation activities in zones of perched water must be considered in the IRDPs prepared for remediation areas in the Former Production Area.

Initial sampling activities associated with soil underlying buildings will be scheduled after removal of production equipment and ancillary materials from the buildings, if possible. It is not desirable to conduct sampling activities coincident with the removal of equipment and ancillary materials because of the increased chance for cross-contamination of samples. When possible, the sampling will precede demolition of above-grade structures to allow proper selection and bias sampling locations and to allow sample analysis and evaluation to continue while building debris is removed.

The sequencing of building demolition will be considered from the perspective of achieving a continuous, large area where at- and below-grade remediation activities can commence without interfering with above-grade D&D activities. Access controls for personnel and vehicles will be designed to minimize traffic in areas of active excavation and demolition, where deep excavations (Section 3.1.3) and debris piles may pose health and safety concerns. Furthermore, access to at- and



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below-grade structures may be limited by debris piles produced from above-grade demolition activities. The debris piles may be present for extended periods of time as material is reduced in size and sorted and staged for disposal in the OSDF. Additional holding time for the debris piles may be incurred if the placement of the debris in the OSDF is dependent on soil to fill void space and sufficient soil is unavailable.

Perched water (Section 2.5.4) will be encountered during deep excavations within the Former Production Area. Access limitations constrained by rubble and soil piles from on-going D&D and remediation activities will be constrained further by the need to set up a staging area for tanks to hold the perched water prior to treatment at the AWWT facility. Alternatively, if perched water is to be pumped directly to the AWWT facility from the excavation, volumes will have to be coordinated with the treatment schedule at the AWWT facility to ensure that the system can handle the additional capacity.

### 4.4.3 Excavation Details

Figure 4-9 presents the logic flow for conducting Excavation Approach D. Each of the 26 tasks identified for this type of excavation is discussed in detail or tied to details presented in Sections 3.0, 4.0, and 7.0 and/or relevant appendices. A comparison of these tasks with other excavation approaches is provided in Table 4-3.

#### Task 1 - Potential Excavation Area Delineation and Data Review

This task is carried out as outlined in Section 3.1.1. Potential areas expected to follow Excavation Approach D are shown on Figure 4-8. However, the final excavation area will change after the soil underlying structures and buildings are characterized for ASCOCs.

#### Task 2 - Select COCs and Identify Potential Technetium-99, RCRA, HWMU, UST, and Above-WAC Areas

The preliminary ASCOC lists for Remediation Areas 1, 3, 4a, 4b, 5, and 7 are summarized in Table 2-7. These lists are derived from RI/FS characterization data and divided into primary and secondary ASCOCs (Section 2.1.3.1). The ASCOCs will be finalized in the area-specific IRDPs.

Technetium-99 has been measured above the FRL in soil below Tension Support Structures 4 and 5, located in the southwest corner of Remediation Area 3; in the northeast corner of the Metal Fabrication Building, located in the northeast section of Remediation Area 4a; in the Sewage Treatment Plant and surrounding area, and along the west end of the slurry pipeline in Remediation Area 7 (Figure 4.8).

There are three potential RCRA areas in Remediation Area 3 and one in Remediation Area 4b (Figure 4.8). The largest is associated with the decontamination pad and is located in the northeast corner of the Remediation Area 3. A second is located along the northern boundary of Remediation Area 3 and is associated with the KC-2 warehouse (Building 63) and west pad. The third is associated with the lumber storage area (Building 12C) and maintenance warehouse (Building 12D) in Remediation Area 3. A fourth is in Remediation Area 4b and is associated with HWMU #22 - the abandoned sump west of the Pilot Plant Excavation. All of these potential toxicity characteristic soil areas will be dealt with under Excavation Approach D.

There are 25 HWMUs in the Former Production Area (Remediation Areas 3, 4a, 4b, and 5), one HWMU in Remediation Area 6 outside the production area (i.e., Fire Training Facility), and one HWMU in Remediation Area 1 (Sewage Treatment Plant). A list of the HWMUs is presented in Table 2-1. All of these HWMUs will be closed under the CERCLA/RCRA process, with most of these closures anticipated to be completed during the initial D&D activities associated with preparing the buildings and structures for demolition. Footprints remaining from the 14 HWMUs assigned to the SCEP for final closure will be evaluated for HWMU COC distribution under this excavation approach.

There are five UST sites in the Former Production Area (Table 2-2): UST-11 and UST-13, east of Plant 1 truck dock (Remediation Area 4b); UST-12, east of Building 31A (Remediation Area 5); UST-14, buried under the south end of Plant 6 (Remediation Area 4a); and UST-17, north of Building 46 (Remediation Area 5). Footprints remaining from the removal of USTs will be evaluated for UST COC distribution under this excavation approach.

Based on the RI/FS characterization data for uranium, eight known areas within the proposed Excavation Approach D boundaries have the potential to exceed established WAC levels for uranium (Figure 4-8). These areas are as follows: northeast of Soil Stockpile 1; west of Soil Stockpile 4; northeast of Quonset Hut #1; under Tension Structure #6; north of the Ore Refinery Plant; the

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northeast corner of the Metals Fabrication Plant; the southwest and northwest corners of the analytical laboratory; and the southwest area associated with the Sewage Treatment Plant. Additional above-WAC areas may be delineated in soil underlying buildings and structures. All identified above-WAC soil in the Former Production Area will be excavated and segregated under this approach.

Task 3 - Initial D&D Activities

Initial D&D activities anticipated to be performed prior to pre-excavation surveying and sampling include removal of equipment and associated hardware, piping, and other materials from within buildings and structures. It is desirable to perform these D&D activities prior to sampling and analysis activities to eliminate cross-contamination of samples by concurrent D&D activities. Buildings and structures will be considered ready for pre-excavation sampling activities when their shells are ready for demolition, and such activities will be carried out prior to demolition when possible.

Task 4 - Pre-excavation Sampling and Refine COC List, As Needed

Above-grade D&D activities to be conducted by other FEMP projects will leave the at-grade slabs and underlying soil in place, but are likely to result in staging of resultant debris on the slab. Therefore, in order to access the soil contamination below the slabs in a timely fashion that will support the design process, some predesign sampling and analysis will be carried out prior to final D&D on above-grade buildings and structures, when possible.

Pre-excavation sampling will be executed to determine whether ASCOCs are present at above-WAC and above-FRL values in soil below building floors and foundations. Sampling holes may be drilled through concrete floors and foundations to access the presence of ASCOCs in underlying soil. In general, RI/FS data will be used to determine the number of additional samples to be collected near the perimeter and center of the building foundation and in areas where process knowledge and history indicate the potential for contamination to occur. When possible and as needed, geoprobe borings will be placed prior to demolition of the above-grade structures to determine the depth of ASCOCs above-WAC and above-FRL values.

In the event geoprobe borings cannot be placed prior to demolition of the above-grade structures (e.g., geoprobe equipment cannot fit into building or structure), the pre-excavation sampling event will investigate the presence of ASCOCs in the first 6 inches of soil underlying the concrete floors and

foundations. A comprehensive laboratory analysis of all ASCOCs applicable to the production area will be performed to establish the nature of contamination below the building structures. The initial ASCOC list will be modified, as needed, pending the results of the laboratory analyses. If ASCOCs are determined to be present above their respective FRL, the extent of the ASCOCs will be pursued after final D&D activities are completed (Task 8).

Task 5 - Delineate Excavation Extent Due to Technetium-99 Contamination

Delineation of the extent of soil containing technetium-99 will be carried out as described under Task 4 in Section 4.1.3.

Task 6 - TCLP Test and Delineate Characteristic Waste Extent

The extent of soil excavation needed to remove potential toxicity characteristic ASCOCs in the RCRA areas identified in Task 2 will be determined by obtaining discrete samples from surface and subsurface locations. The sampling and analysis protocol to delineate potential toxicity characteristic soil will be carried out as described under Task 5 in Section 4.1.3.

Task 7 - Determine Remaining Excavation Extent

After excavation volumes for technetium-99 and identified toxicity characteristic ASCOCs have been delineated, the excavation volumes for non-technetium-99, above-WAC soil and soil above the FRLs for ASCOCs will be determined. If above-WAC soil is present in the eight above-WAC areas identified on Figure 4-8, the excavation area will be delineated as described under Task 6 in Section 4.1.3.

Task 8 - Final, Above-Grade D&D Activities

Following the pre-excavation sampling event, demolition of the buildings and structures will take place and the above-grade debris will be removed and staged for sizing and proper disposition. Upon completion of these activities, additional surveys and sampling may be initiated, as needed, to determine the extent of soil excavation.

Task 9 - Prepare-Specific IRDP

The area-specific IRDP will be prepared as discussed under Task 7 in Section 4.1.3.

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Task 10 - Implement Run-off Control, As Needed

Run-off control will be implemented as discussed under Task 9 in Section 4.1.3.

Task 11 - Technetium-99-Driven Excavation

The technetium-99 excavations will be carried out as described under Task 10 in Section 4.1.3.

Task 12 - Characteristic Waste-Driven Excavation and Treatment

Any identified RCRA toxicity characteristic soil will be excavated as described under Task 11 in Section 4.1.3.

Task 13 - UST Excavation

The five UST sites in the Former Production Area (Table 2-2) will be excavated and removed to satisfy the relevant and appropriate regulatory requirements. If fluids and/or residue material are present in the UST, they will be sampled and analyzed prior to removal of the UST to determine appropriate handling and storage procedures as well as treatment options, if applicable.

After UST removal, underlying soil will be surveyed and/or sampled and analyzed to determine whether COCs (Table 2-2) have been released from the UST. If surface soil samples indicate COCs are present at or above their respective FRL, the depth of excavation will be determined by obtaining soil cores with geoprobe borings and performing surveys or sampling and analysis on the core material.

The level of effort placed in the soil survey and sample effort will be determined by the production history and knowledge of the contents of the UST, analytical information on the contents of the UST (if applicable and available), and the physical condition of the removed UST.

Task 14 - Implement Perched Water Control, As Needed

If excavation activities encounter perched water, controls will be implemented as discussed under Task 12 in Section 4.2.3.

Task 15 - Real-Time, Non-Technetium-99, WAC Monitoring and Excavation

Presently, there are eight known soil areas with the potential to exceed the established WAC levels in Remediation Areas 1, 3, 4a, 4b, and 5. If analytical characterization data indicate above-WAC soil is present, the delineated above-WAC areas will undergo real-time monitoring with NaI instruments during excavation to provide added assurance that above-WAC material does not enter the OSDF (Section 4.4.2). All above-WAC soil will be shipped off site for disposal. Additional details on the approach to real-time monitoring are provided in the in situ gamma Users Manual (DOE 1998c).

Task 16 - FRL-Driven Bulk Excavation of the Layer

Bulk excavation of soil exceeding FRLs will proceed as discussed under Task 13 in Section 4.1.3. WAC attainment will be demonstrated for all material placed in the OSDF in the manner presented in Section 4.4.2.

Task 17 - Precertification Scan

The precertification scan will be conducted as described under Task 14 in Section 4.1.3.

Task 18 - CU, HWMU, and UST Footprint Delineation/Classification

As part of the precertification survey, the excavated remediation areas will be divided into CUs, and CU footprints will be defined. Group 2 CUs will be established after Excavation Approach D has been executed. The footprint for HWMUs and USTs will be delineated and certified for closure independent of the CUs which contain them. Section 3.4.1 contains additional details on the delineation and classification of CUs, HWMUs, and USTs.

Task 19 - Evaluate Precertification Scan Results

Evaluation of precertification data will be carried out as described under Task 16 in Section 4.1.3.

Task 20 - Hot-Spot/FRL Excavation/Confirmation

Removal of hot spots will be evaluated as described under Task 17 in Section 4.1.3, with the exception of areas where the uranium FRL is 20 ppm. In these areas, hot-spot evaluation will be conducted with the HPGe instrument, as indicated under Task 17.

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Task 21 - Prepare Certification Design Letter

When the CU is determined to be ready for certification, a CDL will be prepared to detail the sampling approach and locations (Section 7.3). The CDL will be submitted to EPA and OEPA for review and approval. Upon approval of the CDL by EPA and OEPA, the sample locations will be considered fixed and they may not be moved without review and concurrence by EPA and OEPA.

Task 22 - CU/HWMU/UST-Specific Certification/Closure Sampling

The CU certification and HWMU closure will be demonstrated using the approach described under Task 21 in Section 4.2.3. UST closure will follow the protocol for HWMU closure, which is a minimum of eight random samples collected within the UST footprint. Sample locations will be established with the GPS or appropriate survey system, and the random samples will be submitted for laboratory analysis for all UST COCs which have an established soil FRL (Table 2-2).

Task 23 - Certification/Recertification

Certification and closure of the CUs and HWMUs will be established as outlined under Task 22 in Section 4.2.3. Closure of the UST sites will follow the HWMU closure protocol, which specifies that the average concentration of each UST COC must be below its respective FRL.

Task 24 - Additional Hot-Spot/FRL Excavation/Confirmation

Evaluation of the need to perform further excavation will be made as described under Task 23 in Section 4.2.3. UST closure will be evaluated in a manner analogous to HWMU closure.

Task 25 - Prepare Certification Report

Preparation of the Certification Report will follow the requirements summarized under Task 24 in Section 4.2.3.

Task 26 - Area-Wide Interim Grading and Restoration

Interim grading and restoration activities are described under Task 23 in Section 4.1.3.

## 4.5 EXCAVATION APPROACH E - OFF-PROPERTY AND NONIMPACTED ON-PROPERTY AREA CERTIFICATION

Excavation Approach E is designed to handle shallow soil excavations that take place in remediation areas which require a minimal amount of excavation prior to certification. In nonimpacted areas (i.e., no known hot spots), the need for excavation is unlikely, and radiological scans may be used to forward the area directly to certification. The nature and extent of COCs in areas proposed for Excavation Approach E is generally limited to a few COCs in the top 1 foot of soil. Soil excavations for technetium-99, RCRA characteristic waste, and above-WAC material are not expected. If these types of excavations are required, the area will be addressed by Excavation Approach A.

Excavation Approach E will be applied to Remediation Areas 1 (Phase III), 8, and 9 (off-property areas), where a potential for excavation may exist (Tables 4-1 and 4-2; Figures 4-1 and 4-10). Remediation Area 1, Phase III, encompasses most of the northern perimeter of the FEMP, where most areas along the perimeter have been shown by RI/FS characterization data to be nonimpacted. In Remediation Area 8, this approach will be applied throughout the area. In Remediation Area 9, the potential for remediation is limited to areas adjacent to the eastern fenceline and the corridor for the outfall pipeline.

### 4.5.1 General Description

Excavation Approach E follows a simplified version of the soil remediation process discussed throughout Section 3.0. The process will begin by screening existing data to identify whether excavation is needed. In most cases, excavation is not expected, and the area can be forwarded to the certification process. If excavation is needed, radiological survey results and laboratory analytical data may be collected and used in the remedial design to delineate the extent of soil excavation for above-FRL areas. The certification design is incorporated into a CDL and the pre-excavation investigation information is incorporated into an IRDP, if needed. These documents are submitted to the EPA and OEPA for review, and if an IRDP is submitted, it will be approved by the EPA and OEPA. After the necessary reviews and/or approvals have been obtained from EPA and OEPA, certification activities will begin along with any limited soil excavation which needs to take place. Soil delineated as above FRLs will be excavated and placed in the OSDF. Upon completion of excavation in above-FRL areas, a precertification survey and certification sampling activities will commence, as discussed in Section 4.1.1.

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4.5.2 Special Considerations

Special considerations for Excavation Approach E are summarized under the following discussions of the nature and extent of contamination, radiological scanning and field measurements, and attainment of WAC.

4.5.2.1 Nature and Extent of Contamination

Concentrations of ASCOCs in the northern corridor associated with Remediation Area 1. Phase III and Remediation Areas 8 and 9 are expected to below established FRLs, and these areas are expected to be moved into the certification process without the need for excavation. If RI/FS data indicate the potential for contamination above established FRLs, pre-excavation surveys, HPGe measurements, and/or limited sampling and analysis will be conducted to delineate potential above-FRL zones. If the pre-excavation survey indicates the potential for above-WAC soil, the area will be remediated under Excavation Approach A.

4.5.2.2 Radiological Scanning and Field Measurements

Radiological scanning and HPGe measurements will be performed as a precertification activity to prepare the area for certification. Scanning with NaI detectors will be performed with the RTRAK when possible. However, trees and riparian vegetation along Paddys Run in Remediation Area 8 pose some constraints on the implementation of radiological surveys and sampling activities if minimal impact to environmental habitat is desired. Radiological scanning will be conducted with the BTRAK or hand-held instruments to obtain the best coverage possible.

4.5.2.3 Attainment of WAC

WAC attainment will not be relevant to most areas remediated under Excavation Approach E, as remediation will move immediately to certification without excavation. When excavation is needed to remove soil above established FRLs, WAC attainment will be demonstrated for uranium, using scans conducted with NaI detectors and/or HPGe measurements. RI/FS data and pre-excavation data (if collected) will be used to demonstrate that excavated soil placed in the OSDF has met the WAC for secondary ASCOCs.

### 4.5.3 Excavation Details

Figure 4-11 presents the logic flow for conducting Excavation Approach E. Each of the 17 tasks is discussed in detail and tied to material presented in Sections 3.0, 4.0, and 7.0 and/or relevant appendices. A comparison of these tasks with other excavation approaches is provided in Table 4-3.

Task 1 - Potential Excavation Area Delineation and Data Review

This task is carried out as outlined in Section 3.1.1. Based on the RI/FS data, the only potential excavation areas are within the northern corridor of Remediation Area 1, Phase III, designated as Excavation Approach A/E on Figure 4-1. Excavation in Remediation Area 8 is not anticipated based on historic knowledge and RI/FS data. Radiological surveys and certification sampling activities will be conducted to confirm this preliminary decision.

Task 2 - Select COCs and Identify Potential Above-FRL Areas

The preliminary ASCOC lists for Remediation Areas 1 and 8 are summarized in Table 2-7. These lists are derived from RI/FS characterization data and divided into primary and secondary ASCOCs (Section 2.1.3.1). Note that there are no secondary ASCOCs established for Remediation Area 8. The ASCOCs will be finalized in the area-specific IRDPs.

Based on the RI/FS characterization data, the only known area within the proposed Excavation Approach E boundaries with the potential to exceed established FRL levels is Remediation Area 1, Phase III. Remediation Area 1, Phase III, could potentially contain soil above WAC levels in areas along the FEMP perimeter that are designated Excavation Approach A/E (Figure 4-1). If such areas are detected, they will be remediated under Excavation Approach A.

Task 3 - Pre-excavation Surveys and Sampling

Pre-excavation surveys and surface-soil sampling (a.k.a. predesign investigation) will be conducted, as needed, using field and laboratory analytical techniques identified in Appendix H. Activities will be carried out as indicated under Task 3 in Section 4.1.3.

Task 4 - Determine Excavation Extent

If excavation of above-FRL material is needed, excavation volumes will be defined by RI/FS data and pre-excavation survey and/or sampling results that indicate ASCOCs are present above their respective

FRL. Excavation Approach E will not deal with contamination present below the depth of 12 inches or with soil having ASCOCs above established WAC values. Therefore, the presence of ASCOCs above their respective FRL at depths greater than 12 inches or above their WAC will result in the area being remediated under Excavation Approach A. Soil with ASCOCs above their respective FRL but which meets the WAC will be excavated and disposed of in the OSDF.

Task 5 - Prepare Area-Specific IRDP

If needed, an area-specific IRDP (i.e., a remedial design) will be prepared as discussed under Task 7 in Section 4.1.3.

Task 6 - CU Delineation/Classification

For most of the area designated for remediation under Excavation Approach E, the remediation areas will be divided into CUs without prior excavation. The CUs established in areas designated as Excavation Approach E will be Group 2 CUs (up to 500 ft by 500 ft). Group 2 CUs are designated for Excavation Approach E because little to no contamination is expected in these areas. Section 3.4.1 contains additional details on the delineation and classification of CUs.

Task 7 - Implement Run-off Control, As Needed

Where excavation is required, run-off control will be implemented as discussed under Task 9 in Section 4.1.3.

Task 8 - FRL-Driven Excavation

In the limited areas where it is identified, soil with ASCOCs above their respective FRL will be excavated and staged prior to placement in the OSDF. RI/FS, pre-excavation characterization data, and HPGe measurements will be used to demonstrate that soil placed in the OSDF will meet the WAC. Section 2.2.1 provides additional details on demonstrating WAC attainment.

Task 9 - Precertification Scan

Most areas will progress to a precertification scan without requiring excavation. Areas that have been excavated will be precertified as discussed under Task 14 in Section 4.1.3.

Task 10 - Evaluate Precertification Scan Results

Evaluation of precertification results will follow the discussion under Task 16 in Section 4.1.3.

Task 11 - Hot-Spot/FRL Excavation/Confirmation

Hot-spots are not expected in areas remediated under Excavation Approach E, but a hot-spot evaluation will be carried out according to the protocol described under Task 17 in Section 4.1.3.

Task 12 - Prepare Certification Design Letter

When the CU is determined to be ready for certification, a CDL will be prepared to detail the sampling approach and locations (Section 7.3). The CDL will be submitted to EPA and OEPA for review and approval. Upon approval of the CDL by EPA and OEPA, the sample locations will be considered fixed and they may not be moved without review and concurrence by EPA and OEPA.

Task 13 - CU-Specific Certification Sampling

Certification sampling will be performed as discussed under Task 19 in Section 4.1.3.

Task 14 - Certification/Recertification

Certification will be evaluated as discussed under Task 20 in Section 4.1.3.

Task 15 - Additional Hot-Spot/FRL Excavation/Confirmation

Hot spots are not expected in areas remediated under Excavation Approach E. However, additional hot-spot evaluation will be carried out as discussed under Task 21 in Section 4.1.3.

Task 16 - Prepare Certification Report

A Certification Report will be prepared for each remediation area as described under Task 22 Section 4.1.3.

Task 17 - Area-Wide Interim Grading and Restoration

Interim grading and restoration activities will be carried out as described under Task 23 in Section 4.1.3.

## 4.6 EXCAVATION APPROACH F - NON-HDPE PIPELINE EXCAVATION OUTSIDE THE FORMER PRODUCTION AREA

Excavation Approach F is designed to handle non-high density polyethylene pipeline excavations outside the Former Production Area. High density polyethylene pipelines associated with the aquifer restoration activities and the AWWT will be left in place as part of the post-closure monitoring system in case that prolonged groundwater extraction is required. Excavation depths using this approach may be moderate to deep. The list of potential ASCOCs in areas proposed for Excavation Approach F is expected to reflect RI/FS data for the soils in the vicinity of the pipelines and process knowledge of materials handled by the pipelines. However, the distribution of ASCOCs under the pipelines will not be established until the pipelines are removed.

Excavation Approach F will be applied to the pipeline associated with the Sewage Treatment Plant and silo slurry line. The Sewage Treatment Plant pipeline extends from the Former Production Area to the Sewage Treatment Plant and offsite to the Great Miami River. Potentially contaminated soil and sediment along the Great Miami River that is associated with the Sewage Treatment Plant pipeline will also be remediated under this approach. The silo slurry line extends from the Former Production Area to the silos. Additional non-HDPE pipelines may be delineated upon completion of Excavation Approaches A through E.

### 4.6.1 General Description

Excavation Approach F will be implemented in Remediation Area 1, Phase II and Remediation Area 9 after Excavation Approaches A and E have been completed (Tables 4-1 and 4-2; Figures 4-1 and 4-12). The approach is modified slightly from the general soil remediation process discussed throughout Section 3.0. The process will begin by conducting a predesign investigation to delineate the extent of the Sewage Treatment Plant pipeline, identify potential ASCOCs, and perform pre-excavation surveys and sampling activities as needed. Radiological survey results and laboratory analytical data will be forwarded to the remedial design to delineate the extent of soil excavation and the removal sequencing of the pipeline sections. This information will be incorporated into an IRDP and submitted to the EPA and OEPA for approval. After the IRDP has been approved, soil excavation and removal of the pipe will begin. Upon completion of excavation and pipeline removal in sections, a precertification survey, CU delineation (as sections of the pipe), and certification sampling activities will commence as described in Section 4.1.1.

4.6.2 Special Considerations

Special considerations for Excavation Approach F are summarized under the following discussions of the nature and extent of contamination, radiological scanning and field measurements, attainment of WAC, and logistics.

4.6.2.1 Nature and Extent of Contamination

The nature of contamination associated with soil surrounding (primarily underlying) the Sewage Treatment Plant pipeline and silo slurry line is expected to be similar to Sewage Treatment Plant and silo COCs that have been established with RI/FS data. Pre-excavation and excavation characterization data will be needed to establish the extent of contamination surrounding the Sewage Treatment Plant pipeline and silo slurry line, as well as any other non-HDPE pipelines remediated under this approach.

4.6.2.2 Radiological Scanning and Field Measurements

Soil above the crown of the pipe to be excavated using this Approach F is not expected to be significantly contaminated. However, in certain sections of the pipe where the pipe was under pressure and/or previous leaks are suspected, radiological scanning with NaI detectors and in situ measurements with the HPGe instrument may be used, if physically possible, to confirm whether soil lying above the crown of the pipe can be staged and directly used to backfill the trench. No matter what soil will be used for backfill, backfill operation can only be conducted after completion of pipe removal and certification of residual impacted soil underlying the pipe.

Real-time radiological scanning is preferred to control excavation of the potentially impacted soil underlying the pipe. However, radiological scanning with NaI detectors and in situ measurements with the HPGe instrument at the bottom of a trench may not be feasible for some conditions encountered in the field. Open trenches may prove to be unsuitable for real-time scanning and/or HPGe measurements, because of the geometry of the excavation or because of risk to personnel entering the trench. If pre-excavation surveys indicate the potential for contamination under the pipe and if in situ HPGe measurements within the trench cannot be performed, excavated soil from under the pipe will be staged at an on-property location and the stockpile will be assigned to Excavation Approach C for later characterization and disposition decisions. Alternatively, if scanning and HPGe measurements can be performed in the trench and widespread contamination is indicated, excavation of the impacted soil under the pipe will be conducted similar to Excavation Approach D.

4.6.2.3 Attainment of WAC

WAC attainment for ASCOCs will be demonstrated using a combination of real-time scans, field measurements, and analytical data obtained on discrete samples. Real-time, gross-gamma scans and HPGe measurements will be performed on the excavation surfaces in the trench to demonstrate WAC attainment for uranium, if possible. When the trench geometry, perched water, and/or health and safety considerations prohibit the use of real-time scans and in situ HPGe measurements, the potentially contaminated soil underlying the pipe will be excavated and isolated in a stockpile on FEMP property. The stockpile will be remediated under Excavation Approach C to determine characterization and disposition decisions. WAC attainment for secondary ASCOCs, if applicable, will be determined by analytical data collected on discrete samples during pre-excavation sampling activities.

4.6.2.4 Logistics

Excavation of non-HDPE pipelines outside the Former Production Area will require consideration of off-property access, real-time monitoring limitations, perched-water controls, and handling and staging of pipeline and impacted soil. Right-of-way ownership and private property access will need to be obtained when the Sewage Treatment Plant pipeline between the FEMP and Great Miami River is removed, and construction permits for off-property excavation may be required. Adequate planning must be developed in the IRDP to ensure all necessary access routes and permits are obtained prior to initiating off-property excavation activities.

Real-time monitoring may be limited by the geometry of the trench and the presence of perched water and/or by health and safety considerations. Contingency plans will be developed in the IRDP that describe the actions needed when real-time monitoring cannot be conducted. These actions may include moving the characterization and disposal decisions to a different excavation approach similar to Approach D.

The handling and staging of pipeline and soil off-property may pose additional constraints on the remediation. Soil characterized as below established FRLs will be staged in proximal areas to use as backfill after the CU (i.e., a section of the trench) has been certified. However, if product material is in the pipeline or soil has been excavated without the ability to conduct an in situ scan or HPGe

measurement, different excavation and staging scenarios will apply. Contingency plans for these site-specific scenarios will be developed and addressed in the IRDP.

4.6.3 Excavation Details

Figure 4-13 presents the logic flow for conducting Excavation Approach F. Each of the 26 tasks is discussed in detail and tied to material presented in Sections 3.0, 4.0, and 7.0 and/or relevant appendices. A comparison of these tasks with other excavation approaches is given in Table 4-3.

Task 1 - Pipeline Section Delineation and Data Review

The potential pipeline excavation areas will be delineated using final construction plans with additional delineation provided where RI/FS data are available. However, additional pipeline excavation areas may be delineated upon completion of Excavation Approaches A through E.

Task 2 - Select COCs and Identify Potential Above-WAC Areas

The ASCOC list for Remediation Area 1, Phase II is summarized in Table 2-7. These lists are derived from RI characterization data and divided into primary and secondary ASCOCs (Section 2.1.3.1).

Based on the RI/FS characterization data, there are no known areas within the proposed Excavation Approach F boundaries with the potential to exceed established WAC levels. However, soil surrounding and underlying the pipelines could potentially contain ASCOCs above WAC levels. If such soil exists, it will be excavated and segregated under this approach.

Task 3 - Pre-Excavation Surveys and Sampling

The pre-excavation survey and sampling will be carried out as discussed under Task 3 in Section 4.1.3, with the following noted exceptions. Pipeline excavation in Area 1, Phase II property will take place after Excavation Approach A has been implemented in Area 1, Phase II. However, the surface above the pipeline in Area 1, Phase II will not be certified until the pipeline is removed and the trench has been backfilled.

Furthermore, surface surveys and/or sampling may need to be conducted for the pipeline extending from the Sewage Treatment Plant to the Great Miami River. If sampling is implemented, a nominal grid width of 50 ft will be centered along the length of the pipeline to develop an initial zone of

investigation that is 25 ft on each side of the pipeline. After establishing the grid, geoprobe borings may be placed on the established perimeter of the grid and within the estimated excavation area between the surface projection of the pipeline and grid perimeter to determine the depth of excavation. Section 3.1.3 provides additional details on establishing the excavation boundaries.

Task 4 - Determine Excavation Extent and Pipeline Section Sequence

Excavation volumes will be defined by using soil cores returned from geoprobe borings and surveying and/or sampling the cores to define the depth where ASCOCs are above their respective FRL. The presence of soil with ASCOCs at or above the WAC will result in delineation of a WAC excavation volume. Soil with ASCOCs at or above their respective FRL that meets the WAC will be delineated as a FRL excavation. Sample collection and handling procedures, laboratory protocols and methods, and instrument detection limits are presented in the QAPP (Appendix E).

In general, previous excavation completed in the Former Production Area is likely to have exposed the pipeline at the margin of the Former Production Area. Therefore, the pipeline section sequence for excavation is proposed to begin at the margin of the Former Production Area and proceed outward. The proposed excavation sequence for the pipeline associated with the Sewage Treatment Plant is to initially remove the on-property pipeline followed by removal of the off-property portion of the pipeline.

Task 5 - Prepare Area-Specific IRDP

An area-specific IRDP will be prepared as described under Task 7 in Section 4.1.3.

Task 6 - Prepare Excavation Site

Prior to excavation, a number of institutional and constructional measures will be implemented to control access to the area and to prevent the spread of contaminated soil. Because pipeline excavation within the boundary of the FEMP will be conducted after all other excavation is complete, grubbing and disposal of cleared shrubs and trees will not be an issue. However, these latter preparation activities may apply to excavation of the off-site pipeline that runs from the Sewage Treatment Plant to the Great Miami River. When off-site grubbing and clearing must be conducted, all needed permits and access controls must be obtained, and the action will be implemented in a manner that minimizes

the impact to the environment. Section 3.3.1.1 and Appendix F.2 further discuss site preparation activities.

Task 7 - Implement Run-Off Control, As Needed

Run-off control will be implemented on the FEMP site in the manner discussed under Task 9 in Section 4.1.3. Special considerations for run-off controls in off-site areas will be evaluated on a site-specific basis in the IRDP.

Task 8 - Implement Perched Water Control, As Needed

If excavation activities encounter perched water on the FEMP property, the protocol discussed under Task 12 in Section 4.2.3 will be executed. If perched water is encountered during off-site excavation activities, the water will be pumped and stored until a disposition decision can be reached. Sampling and analysis will be necessary to determine whether the water can be discharged to the surface or whether it needs to be treated prior to discharge. Specific sampling and analysis plans will be developed on a case-by-case basis in the IRDP.

Task 9 - Excavation to Crown of Pipeline and Set Soil Aside as Clean

Because pipeline excavation within the boundary of the FEMP property will take place after Excavation Approach A has been implemented, surface soil excavated to the crown of the pipeline will be below the FRL values established for the COCs. Similar conditions are expected to exist for the off-property pipeline leading from the Sewage Treatment Plant to the Great Miami River. Clean soil will be excavated and segregated prior to excavation of contaminated soil. In the event surface soil above the off-property pipeline has areas where ASCOCs are above their respective FRL, the contaminated soil will be excavated and segregated from clean soil.

Task 10 - Remove Section of Pipeline and Cap Ends

Pipeline sections outside the Former Production Area but within the FEMP boundary will be removed first. If holdup material is present in the pipeline, it will be drained and managed with the pipeline as summarized in Appendix F. The length of section to be removed will be tied to the nominal dimensions of the CU adjacent to the pipeline (i.e., 250 ft or 500 ft) or the length of the entire pipeline, whichever is shorter. After the pipeline is exposed by excavating the surrounding soil and

staging the soil into appropriate clean or contaminated piles, a section of the pipeline will be removed and the open end will be capped, if applicable.

If pre-excavation surveys and/or sampling indicate the potential for soil to exceed the WAC and if scanning instrumentation can enter the trench, a WAC scan of the soil under the removed section of pipeline will be conducted to delineate the excavation area (Task 11). However, if access to the trench is restricted and a WAC scan cannot be performed, bulk excavation will proceed without the WAC scan (Task 14) and the soil will be remediated under Excavation Approach C to determine the disposal option.

Task 11 - WAC Scan of Soil Below the Pipeline

When access to the trench is possible, soil below the pipeline will be surveyed to establish whether uranium is present above WAC. If above-WAC soil is detected, additional WAC scans will be conducted during excavation and/or geoprobe borings will be placed to determine the depth of above-WAC material, as needed. In the absence of finding any above-WAC soil, bulk excavation of the remaining impacted soil will proceed (Task 13).

Task 12 - WAC-Driven Excavation/Confirmation

After the extent of above-WAC soil has been delineated, excavation will resume to remove the identified volume of above-WAC material. Soil above the WAC will be excavated, segregated, and contained to prevent contamination of below-WAC areas.

Task 13 - Bulk Excavation of Remaining Impacted Soil

Following the removal of soil above the WAC, if applicable, any remaining soil containing ASCOCs above the FRLs will be excavated and staged prior to placement in the OSDF. RI/FS data and pre-excavation scans and characterization data will be used to demonstrate WAC attainment. Section 2.2.1 provides additional details on demonstrating WAC attainment.

Task 14 - Bulk Excavation of Potentially Impacted Soil and Placement into a Temporary Staging Area

When access of personnel and scanning instruments to the pipeline trench is not possible, bulk excavation of impacted soil will proceed, and the soil will be remediated under Excavation Approach C prior to determining the disposal option.

Task 15 - Precertification Scan to the Extent Possible

Upon completion of excavation, the site will be prepared for a precertification survey and/or sampling event. Based on the geometry of the excavation awaiting precertification, the survey and/or sampling equipment may be restricted by limited access and/or health and safety issues. The radiation survey will be conducted with NaI detectors and/or by discrete measurements with field instruments containing a HPGe, if possible. Precertification will be based on the residual activity of primary radioactive COCs in the soil, except in areas where primary COCs are metals or organic compounds. For these exceptions, discrete samples will be collected to supplement the pre-excavation data, as needed. Additional details on precertification activities are presented in Section 3.3.3.

Task 16 - CU Delineation/Classification

After the precertification scan, the pipeline trench will be divided into CUs. When possible, the CUs established on site will conform with surrounding CU dimensions (ideally 250 ft by 50 ft or 500 ft by 50 ft). For cases where the entire pipeline length is less than 250 ft, the CU dimensions will be adjusted accordingly. Additionally, in the event pre-excavation characterization has defined an excavation width greater than 50 ft (i.e., 25 ft on each side of the pipeline trace), the CU boundary will be extended to the designated width.

Task 17 - Evaluate Precertification Scan Results

Precertification results will be evaluated as discussed under Task 16 in Section 4.1.3.

Task 18 - Hot-Spot/FRL Excavation/Confirmation

Evaluation of hot spots will follow the protocol described under Task 17 in Section 4.1.3.

Task 19 - Prepare Certification Design Letter

When the CU is determined to be ready for certification, a CDL will be prepared to detail the sampling approach and locations (Section 7.3). The CDL will be submitted to EPA and OEPA for review and approval. Upon approval of the CDL by EPA and OEPA, the sample locations will be considered fixed and they may not be moved without review and concurrence by EPA.

Task 20 - CU-Specific Certification Sampling

The certification sampling will be conducted using the procedure described under Task 19 in Section 4.1.3.

Task 21 - Certification/Recertification

The criteria and statistical tests used to make the certification decision are described under Task 20 in Section 4.1.3.

Task 22 - Additional Hot-Spot/FRL Excavation/Confirmation

If certification fails and additional excavation is required, it will be carried out as indicated under Task 21 in Section 4.1.3.

Task 23 - Backfill Section with Excavated Soil Removed from Above Pipeline

After certification sample results have demonstrated that the CU is ready for certification, the trenches will be backfilled with below-FRL soil removed from above the pipeline. Interim grading and restoration will take place after the Certification Report is approved.

Task 24 - Segregated All Excavated Impacted Soil for Disposal

Soil that was staged because of the inability to conduct a WAC scan (Task 14) will be surveyed, sampled, and analyzed under Excavation Approach C prior to determining the disposal option.

Task 25 - Prepare Certification Report

The Certification Report will be prepared as described under Task 22 in Section 4.1.3.

Task 26 - Area-Wide Interim Grading and Restoration

Interim grading and restoration will be implemented as discussed under Task 23 in Section 4.1.3.

## TABLE 4-1

## EXCAVATION APPROACHES TIED TO REMEDIATION AREAS

| Excavation Approach | Remediation Areas |
|---|---|
| A: Shallow Excavation of Impacted, On-Property Area Outside the Former Production Area and Other Waste Storage/Management Areas (Figure 4-2; Section 4.1) | 1, 2, 6, and 7 (Figures 4-1 and 4-3) |
| B: Excavation in Waste Storage/Management Areas Outside the Former Production Area (Figure 4-4; Section 4.2) | 2, 3, 6, 7, LSP, and SWL (Figures 4-1 and 4-5) |
| C: Excavation of Existing Soil Stockpiles in the Former Production Area and Remediation Area 1, Phase I (Figure 4-6; Section 4.3) | 1, 3 and 5 (Figures 4-1 and 4-7) |
| D: Excavation Following D&D in the Former Production Area STP, and FTP (Figure 4-8; Section 4.4) | 3, 4a, 4b, 5, 7, FTF, and STP (Figures 4-1 and 4-9) |
| E: Off-Property and Nonimpacted, On-Property Area Certification (Figure 4-10; Section 4.5) | 1, 8, and off site areas (Figures 4-1 and 4-11) |
| F: Non-HDPE Pipeline Excavation Outside the Former Production Area (Figure 4-13; Section 4.6) | 1 (Figures 4-1 and 4-12) |

D&D = decontamination and dismantlement
FTF = Fire Training Facility
HDPE = high-density polyethylene
LSP = Lime Sludge Ponds
STP = Sewage Treatment Plant
SWL = Solid Waste Landfill

## TABLE 4-2

## REMEDIATION AREAS TIED TO EXCAVATION APPROACHES

| Remediation Area | Excavation Approach |
|---|---|
| 1 (includes STP) | A, D, E, and F |
| 2 | A and B |
| 3 (includes FTF and LSP) | B, C, and D |
| 4 | D |
| 5 | C and D |
| 6 (includes SWL) | A and B |
| 7 | A, B, and D |
| 8 | E |
| 9 (off-site) | TBD |

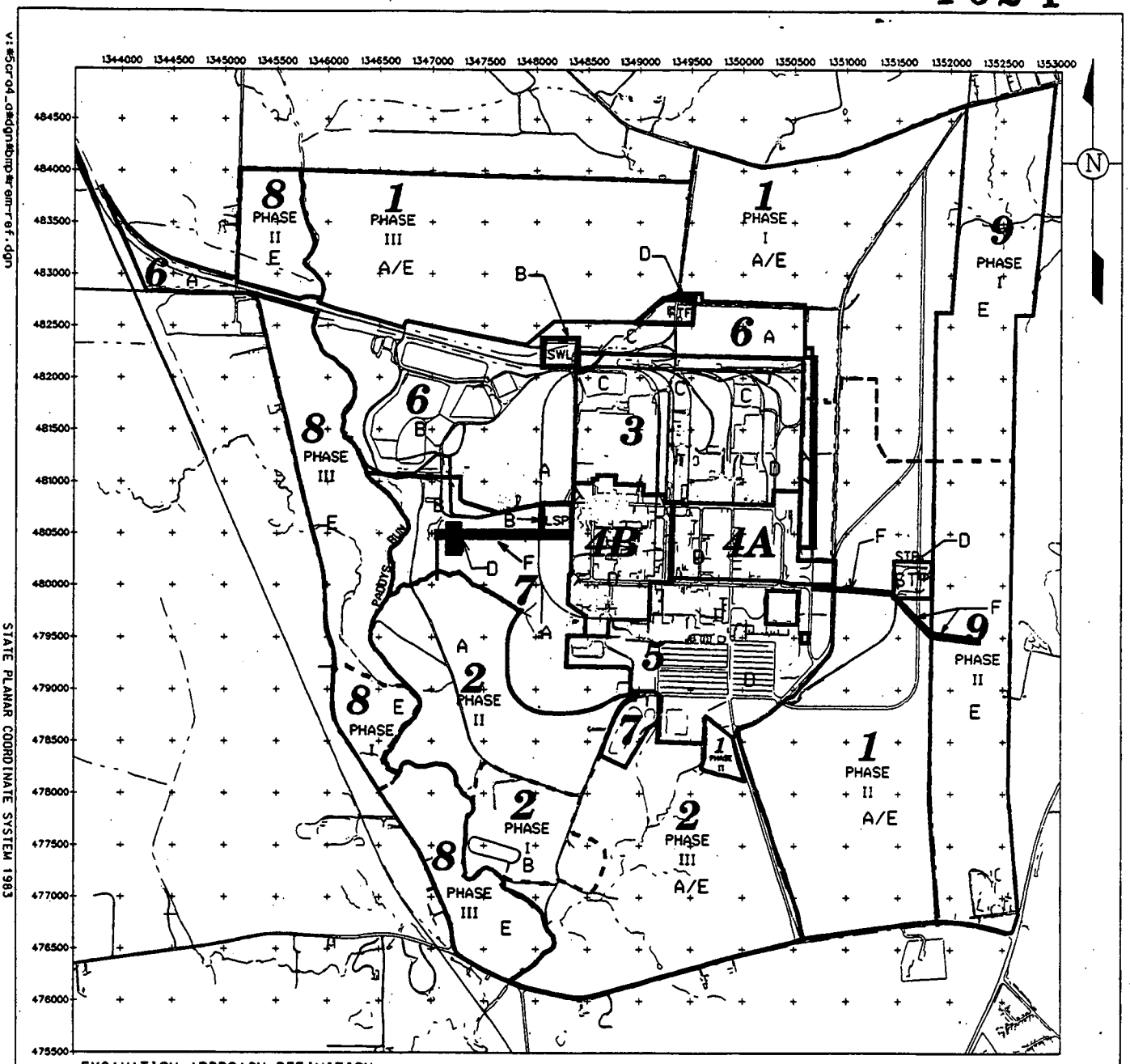
FTF = Fire Training Facility
LSP = Lime Sludge Ponds
STP = Sewage Treatment Plant
TBD = to be determined
SWL = Solid Waste Landfill

## TABLE 4-3

## CROSS-COMPARISON OF TASKS WITHIN THE EXCAVATION APPROACHES

| Step | TASK | Excavation Approach | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | F |
| | Potential Excavation Area Delineation and Data Review | x | x | x | x | x | x |
| | Select COCs, Identify Potential Technetium-99, RCRA, HWMU, and Above-WAC areas | x | x | x | x | x | x |
| | Coordination with D&D Activities | | | | x | | |
| | Pre-Excavation Surveys and Sampling | x | x | x | x | x | x |
| | Delineate Excavation Extent Due to Technetium-99 Contamination | x | x | x | x | | |
| | TCLP Test and Delineate Characteristic Waste Extent | x | x | x | x | | |
| | Delineate Remaining Excavation Types | x | | | | x | |
| | Determine Excavation Extent and Vertical Intervals or Unit Volume | | x | x | x | | |
| | Determine Excavation Extent and Pipeline Section Sequence | | | | | | x |
| | Prepare Area-Specific IRDP | x | x | x | x | x | x |
| 1 | Pre-Excavation CU Delineation/Classification | | | | | x | |
| | Prepare Excavation Site | x | x | x | | | x |
| | Implement Run-off Control, as Needed | x | x | x | x | x | x |
| | Technetium-99 Driven Excavation, as Necessary | x | x | x | x | | |
| | Characteristic Waste Excavation, as Necessary | x | x | x | x | | |
| | Implement Perched Water Control, as Needed | | x | | x | | x |
| | Layer/Volume-Specific, Non-Technetium-99, WAC Scan | | x | x | | | x |
| | Non-Technetium-99, WAC-Driven, Excavation/Confirmation (Search and Remove) | x | x | x | | | x |
| | Real-Time, Non-Technetium-99, WAC Monitoring/Excavation | | | | x | | |
| | FRL-Driven Excavation (after above-WAC material is removed) | x | | | | x | |
| | Bulk Excavation to OSDF | | x | x | x | | |
| 2 | Bulk Excavation to Temporary Staging Area for Segregation | | | | | | x |
| | Pre-Certification Scan | x | x | | x | x | x |
| | Post-Excavation CU Delineation/Classification | x | x | | x | | x |
| 3 | Pre-Certification Hot-Spot/FRL Excavation/Confirmation | x | x | | x | x | x |
| | CU-Specific Certification Sampling and Scan | x | x | | x | x | x |
| | FRL/HWMU/UST Certification/Recertification | x | x | | x | x | x |
| | Additional FRL/Hot-Spot Excavation/Confirmation, As Necessary | x | x | | x | x | x |
| 4 | Prepare Area-Wide-Certification Report | x | x | | x | x | x |
| 5 | Area-Wide Interim Grading and Restoration | x | x | | x | x | x |

CU = Certification Unit
FRL = Final Remediation Level
HWMU = Hazardous Waste Management Unit
OSDF = On=Site Disposal Facility
UST = Underground Storage Tank
WAC = Waste Acceptance Criteria




EXCAVATION APPROACH DEFINITION:

A: SHALLOW EXCAVATION OF IMPACTED ON-PROPERTY AREA OUTSIDE OF THE FORMER PRODUCTON AREA AND OTHER WASTE STORAGE/MANAGEMENT AREAS.

B: EXCAVATION IN WASTE STORAGE/MANAGEMENT AREAS OUTSIDE THE FORMER PRODUCTION AREA.

C: EXCAVATION OF EXISTING STOCKPILES IN THE FORMER PRODUCTION AREA.

D: EXCAVATION FOLLOWING D & D IN THE FORMER PRODUCTION AREA. SEWAGE TREATMENT PLANT AND THE FIRE TRAINING FACILITY.

E: OFF-PROPERTY AND NON-IMPACTED ON-PROPERTY AREA CERTIFICATION.

F: NON-HIGH DENSITY POLYETHYLENE PIPELINE EXCAVATION OUTSIDE THE FORMER PRODUCTION AREA.

LEGEND:

- - - - - - PHASE BOUNDARY

— · — · — FEMP BOUNDARY

——— EXCAVATION APPROACH BOUNDARY

**4b** REMEDIATION AREA

B EXCAVATION APPROACH

STP = SEWAGE TREATMENT PLANT
FTF = FIRE TRAINING FACILITY
SWL = SOLID WASTE LANDFILL
LSP = LIME SLUDGE POND

SCALE

1500 750 0 1500 FEET

000257

FINAL

FIGURE 4-1.
PROPOSED EXCAVATION APPROACHES WITHIN SITEWIDE REMEDIATION AREAS

v:\fcr04_design\bmp\fgm-ref.dgn
STATE PLANAR COORDINATE SYSTEM 1983
22-JUL-1998

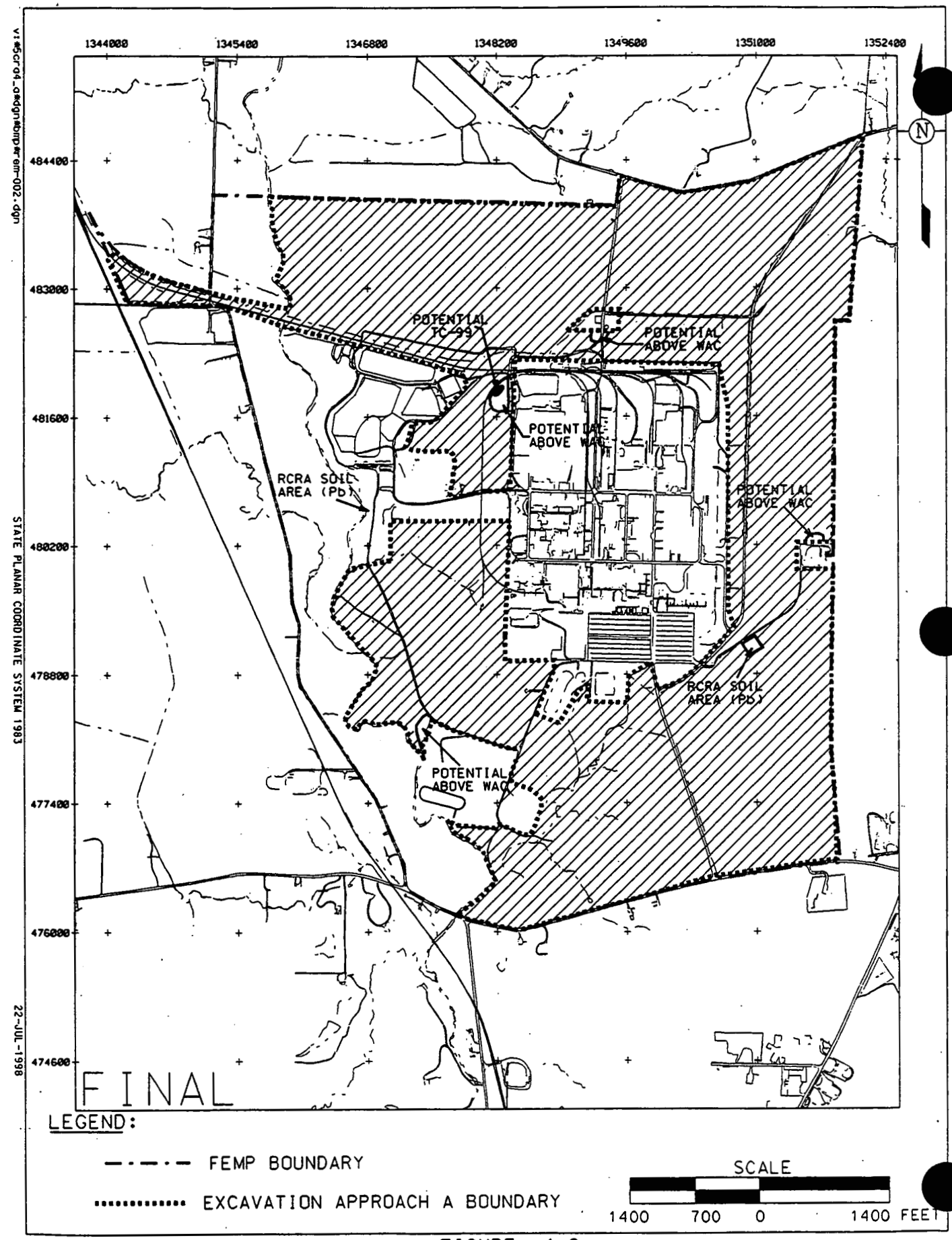



FIGURE 4-2.
ANTICIPATED EXCAVATION AREAS FOR EXCAVATION APPROACH A
(FOR INFORMATION PURPOSES ONLY)

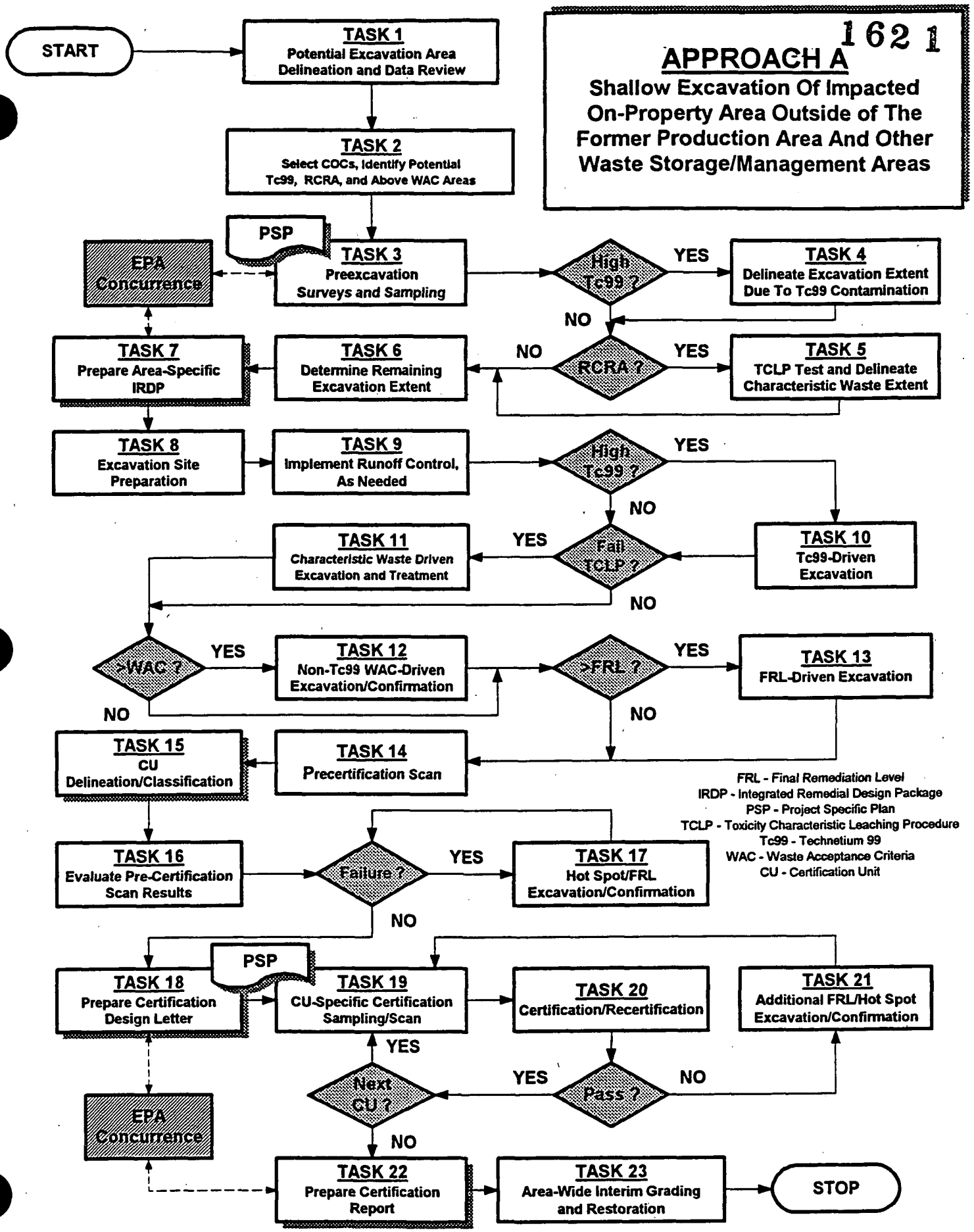



FIGURE 4-3 LOGICAL FLOW FOR EXCAVATION APPROACH A

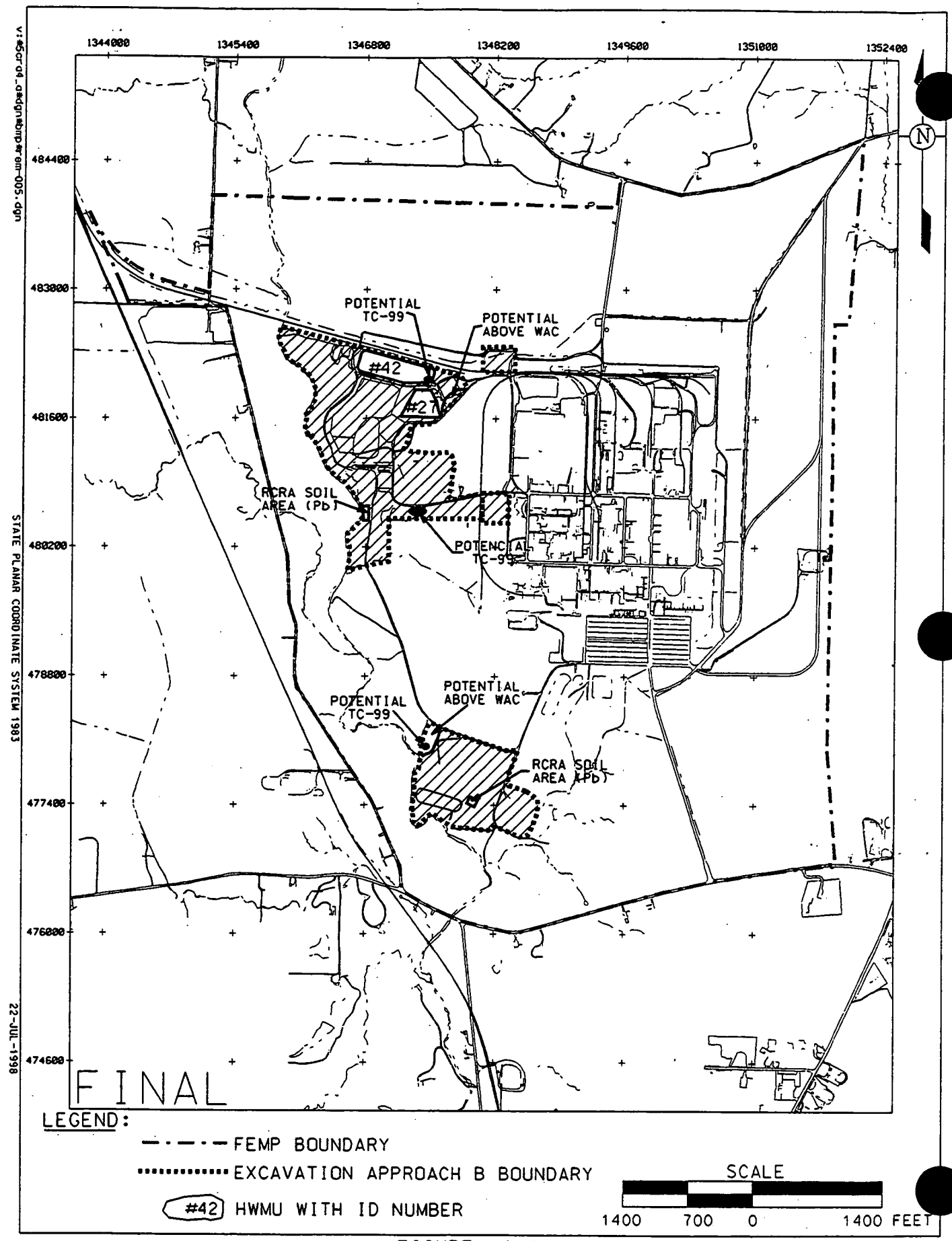



FIGURE 4-4.
ANTICIPATED EXCAVATION AREAS FOR EXCAVATION APPROACH B
(FOR INFORMATION PURPOSES ONLY)

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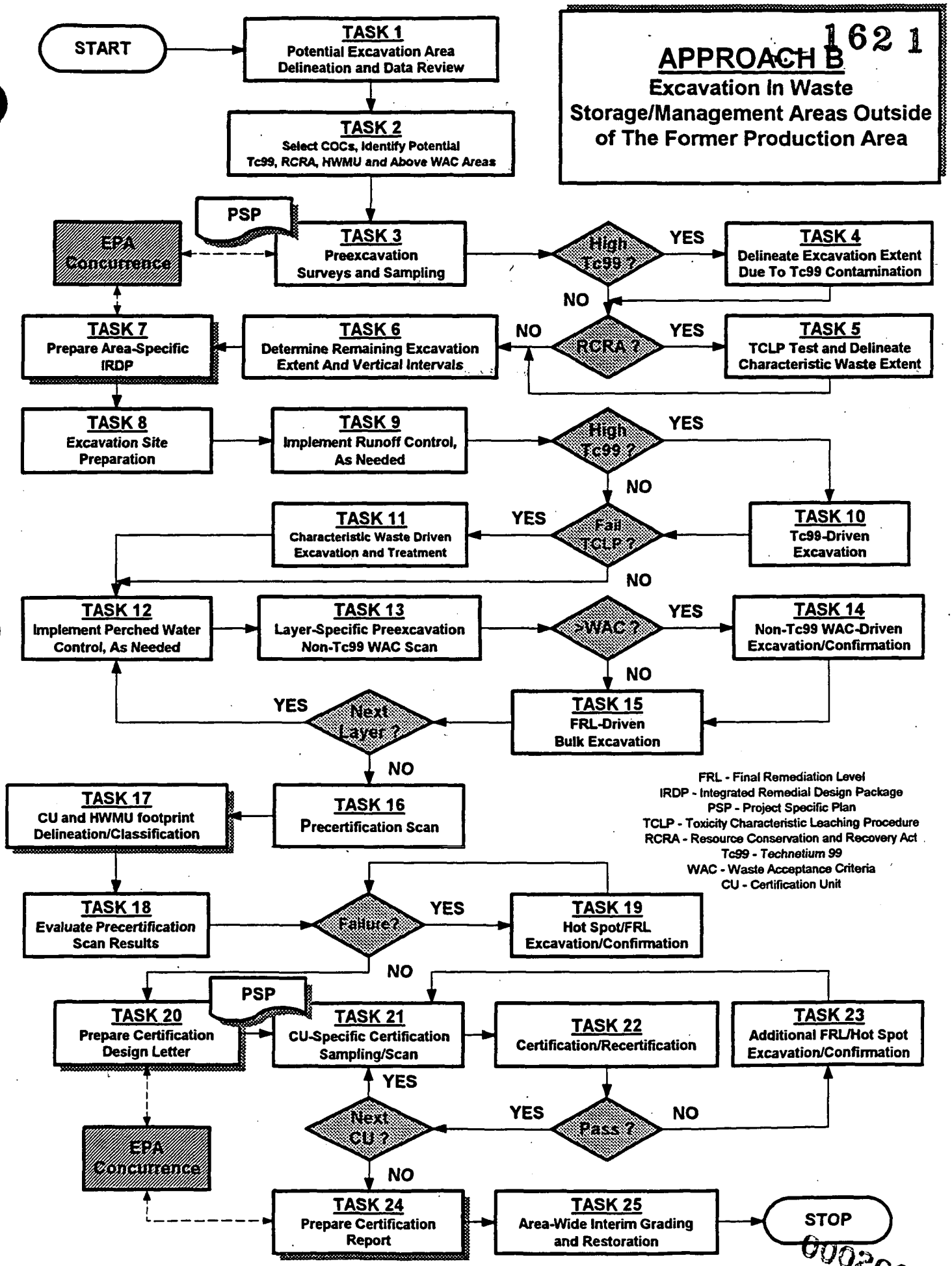


FIGURE 4-5 LOGICAL FLOW FOR EXCAVATION APPROACH B

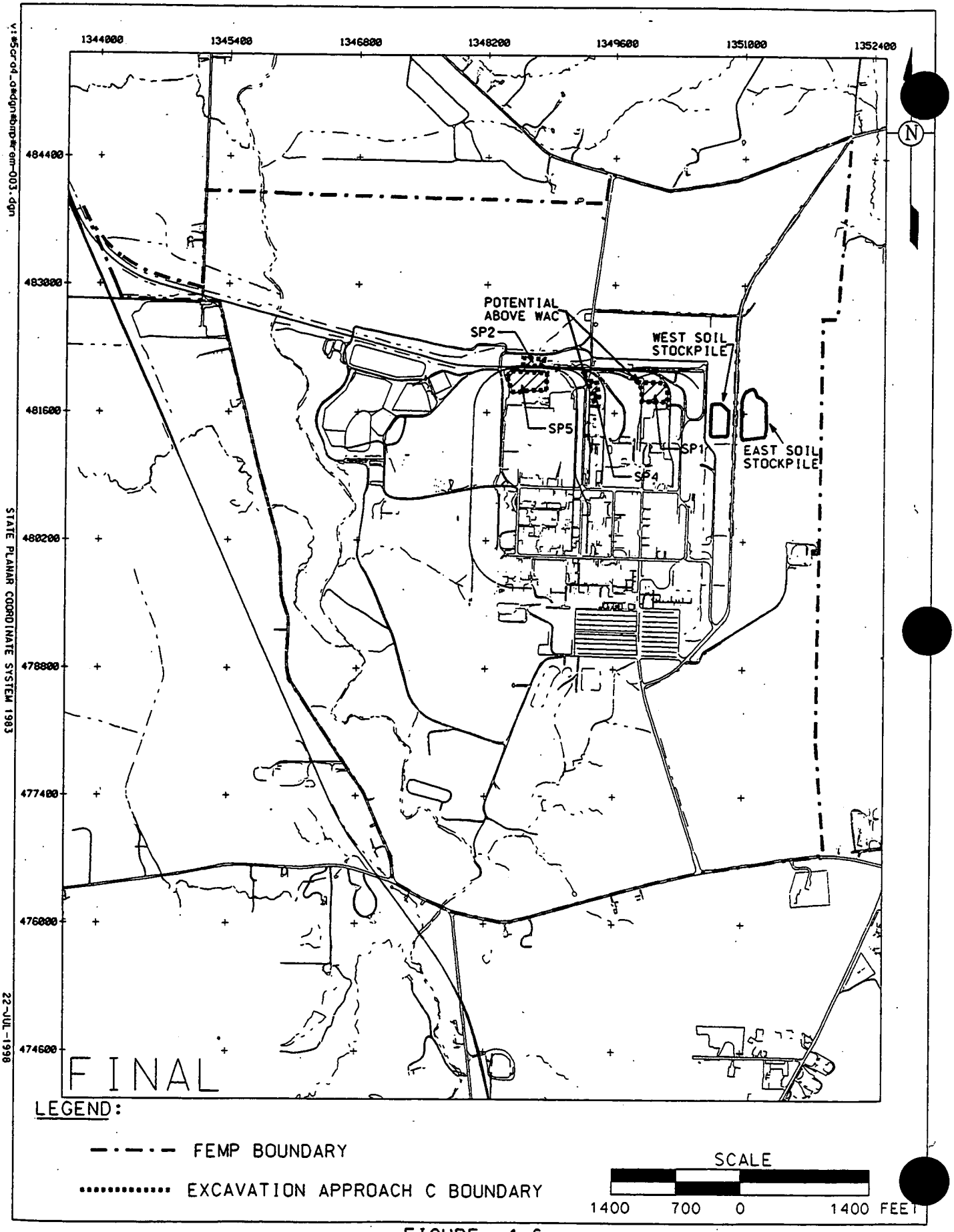


FIGURE 4-6.
ANTICIPATED EXCAVATION AREAS FOR EXCAVATION APPROACH C
(FOR INFORMATION PURPOSES ONLY)

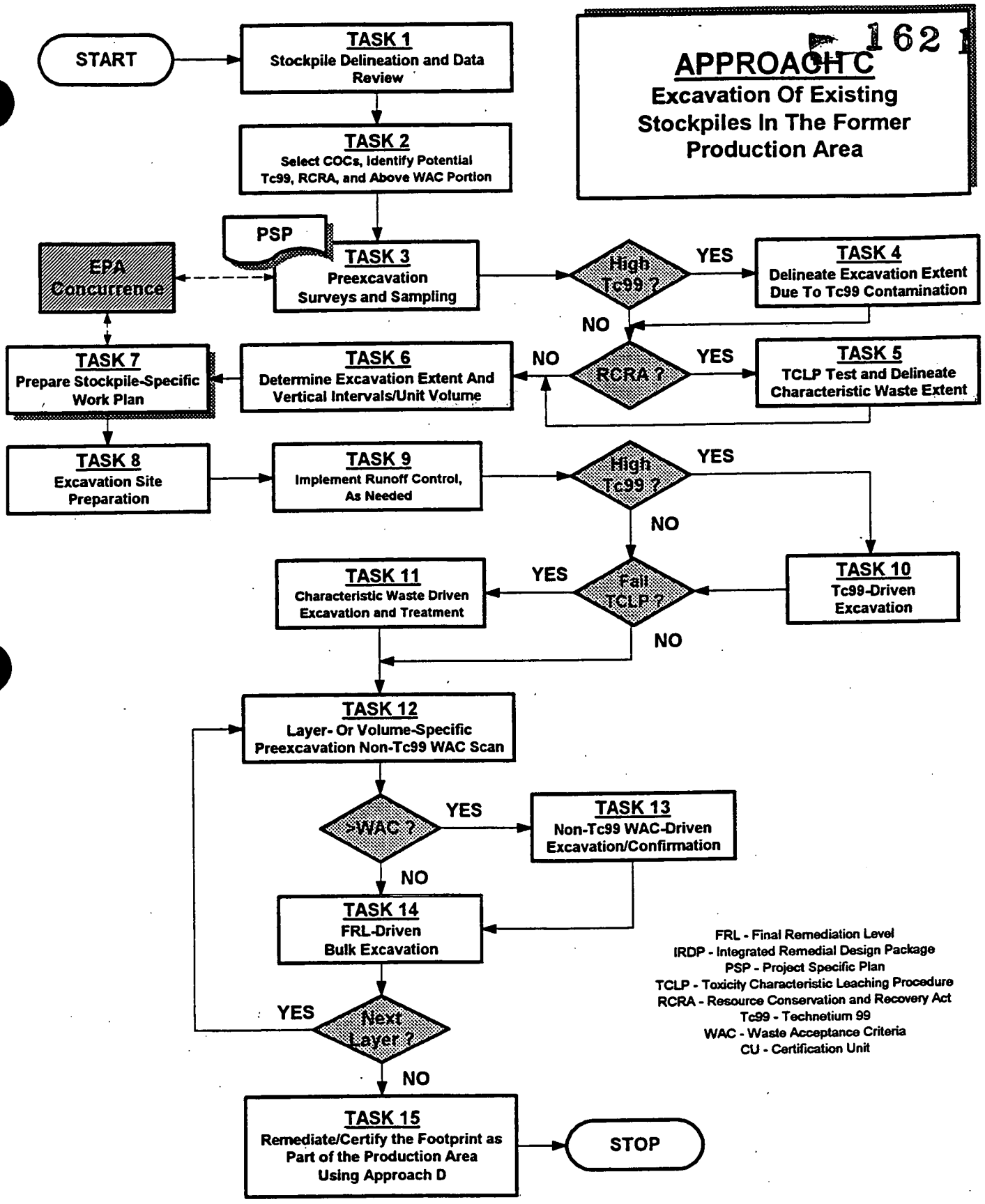


FIGURE 4-7 LOGICAL FLOW FOR EXCAVATION APPROACH C

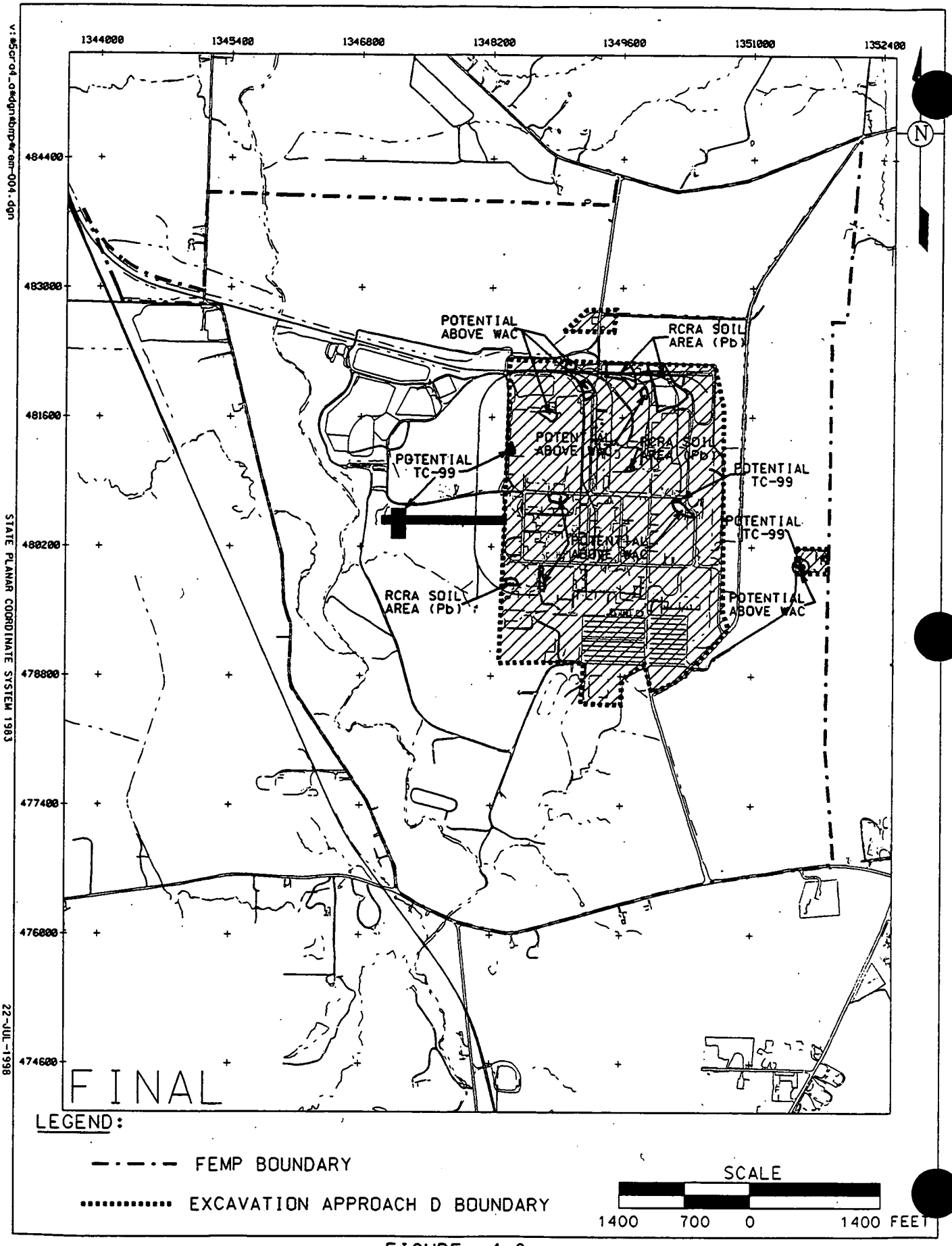


FIGURE 4-8.
ANTICIPATED EXCAVATION AREAS FOR EXCAVATION APPROACH D
(FOR INFORMATION PURPOSES ONLY)

# APPROACH D
## Excavation Following D&D In The Former Production Area, and STP

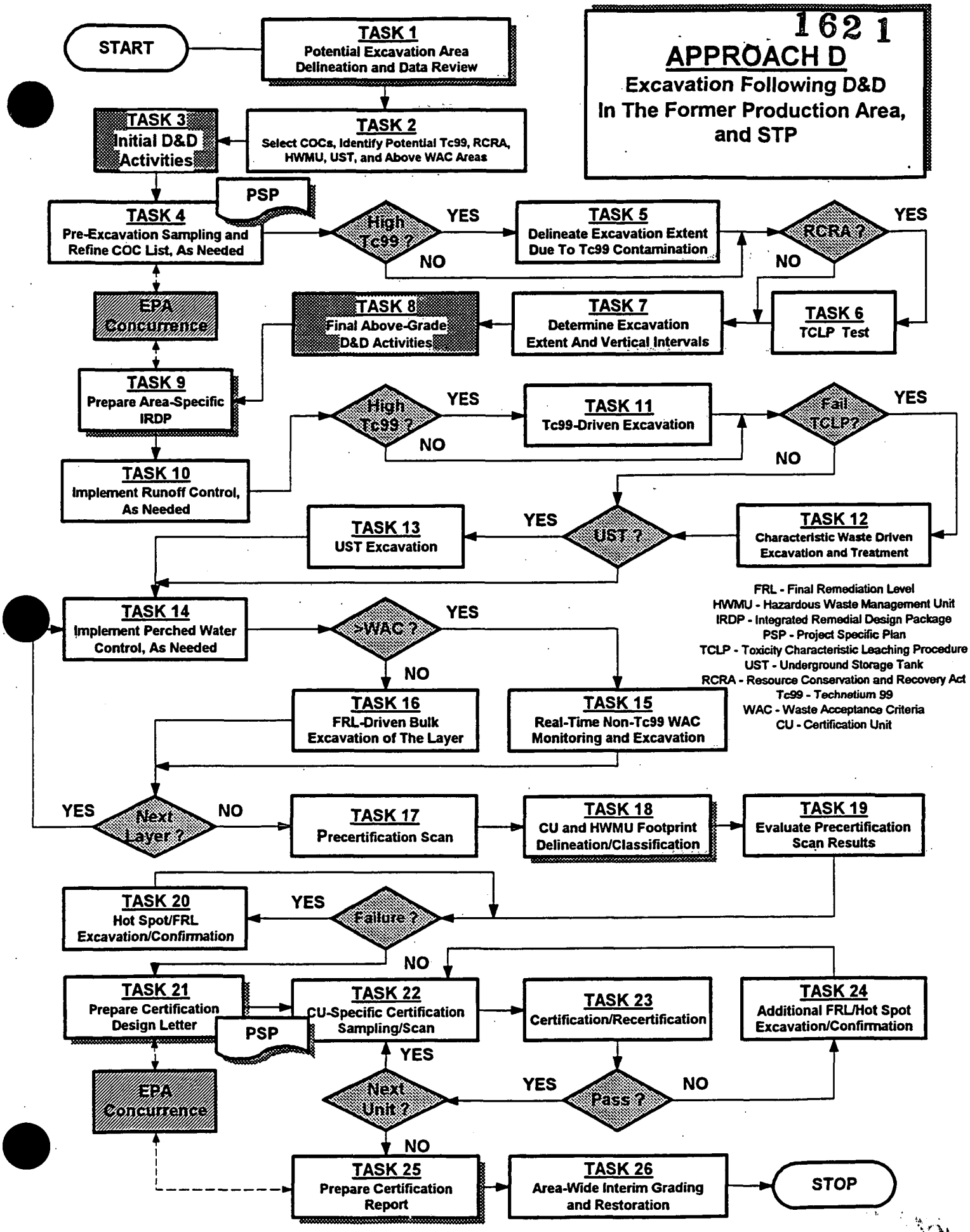


FIGURE 4-9 LOGICAL FLOW FOR EXCAVATION APPROACH D

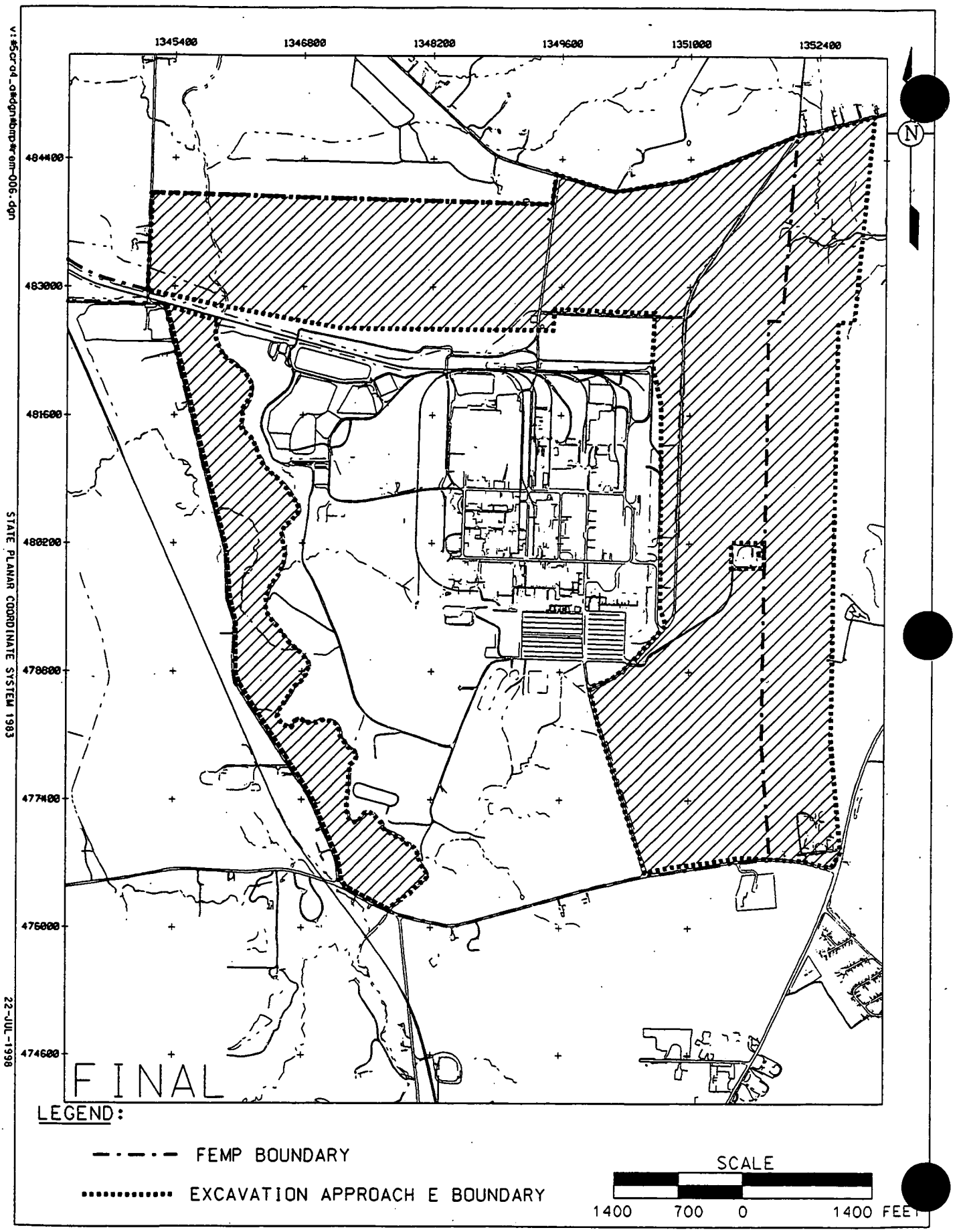


FIGURE 4-10.
ANTICIPATED EXCAVATION AREAS FOR EXCAVATION APPROACH E
(FOR INFORMATION PURPOSES ONLY)

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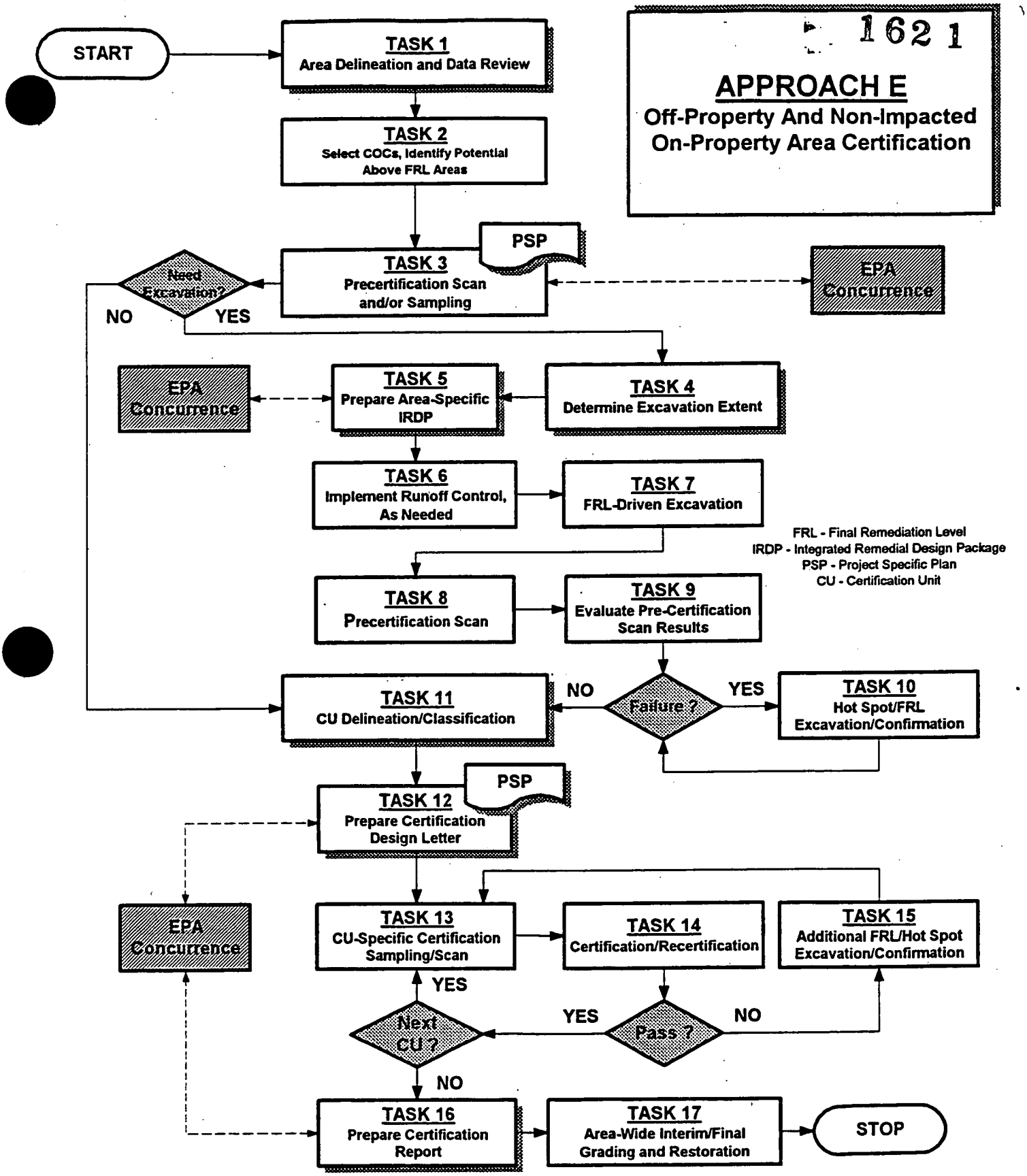


FIGURE 4-11 LOGICAL FLOW FOR EXCAVATION APPROACH E

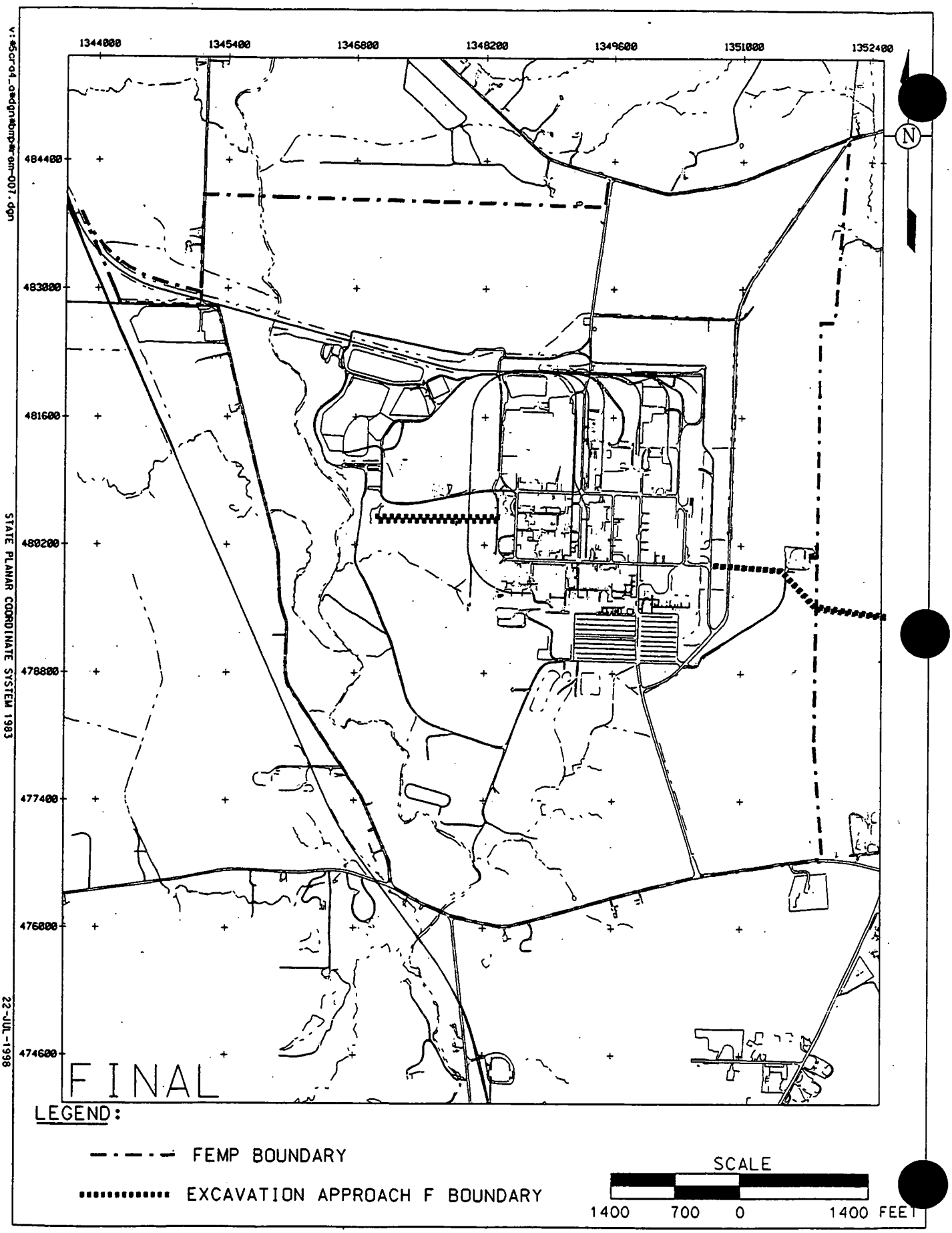


FIGURE 4-12.
ANTICIPATED EXCAVATION AREAS FOR EXCAVATION APPROACH F
(FOR INFORMATION PURPOSES ONLY)

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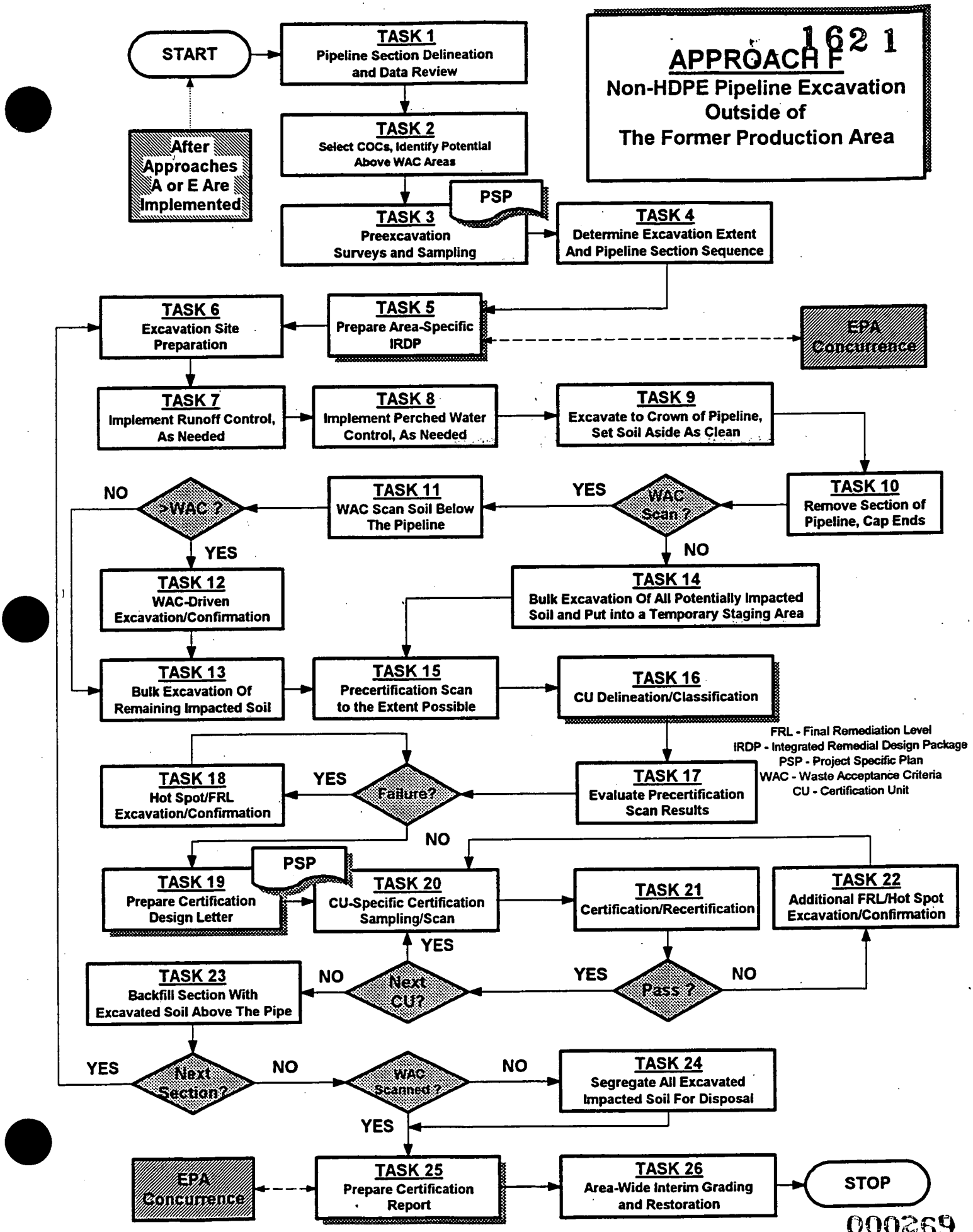
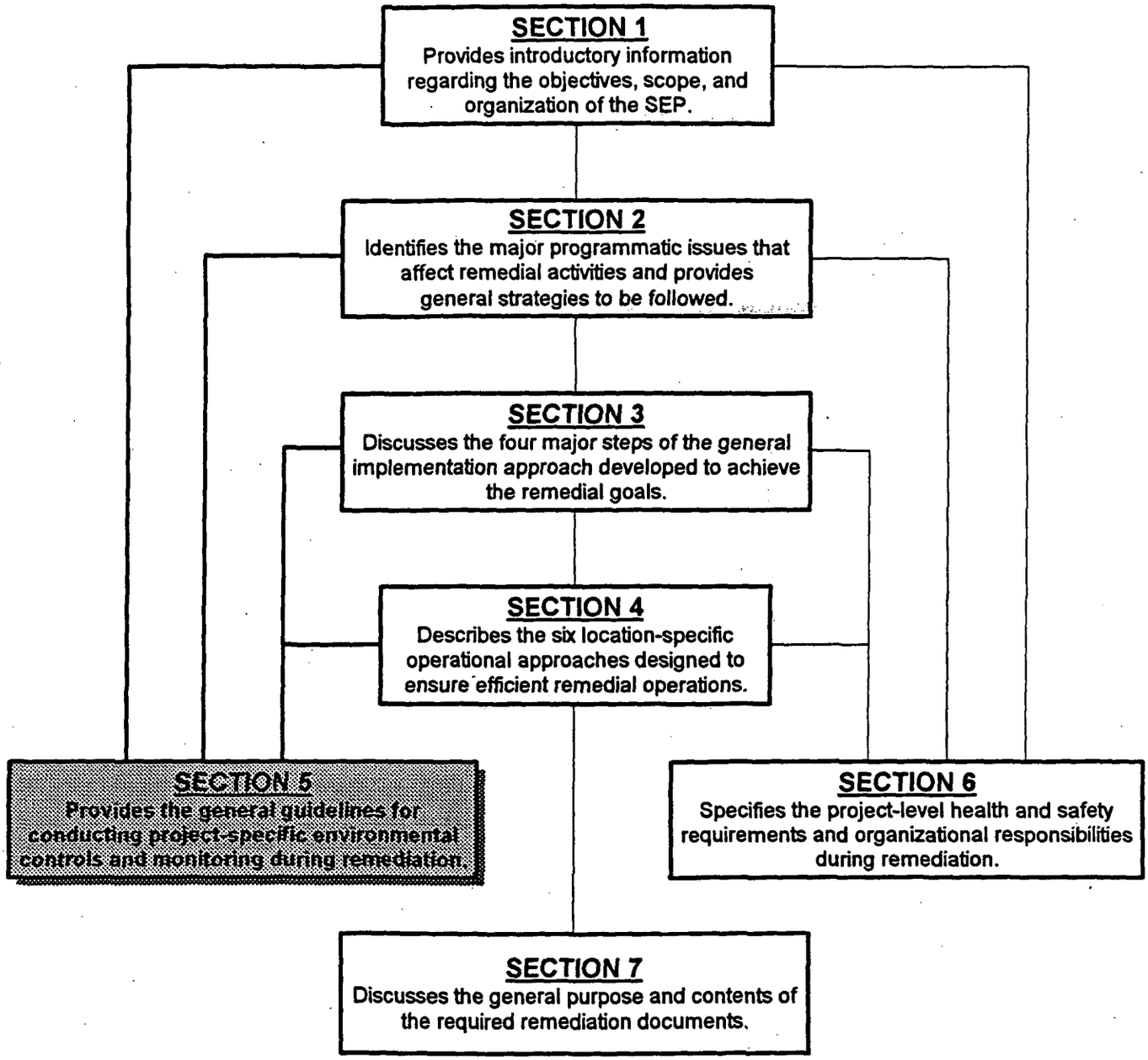



FIGURE 4-13 LOGICAL FLOW FOR EXCAVATION APPROACH F

# SITEWIDE EXCAVATION PLAN




**APPENDIX A** - Soil Remediation ARARs and TBCs
**APPENDIX B** - Sitewide Sequencing Plan
**APPENDIX C** - Constituent of Ecological Concern Selection
**APPENDIX D** - Wood Sampling Program
**APPENDIX E** - SEP Quality Assurance Project Plan (QAPP)
**APPENDIX F** - Implementation of Construction and Waste Management Practices
**APPENDIX G** - Certification Design Rationale
**APPENDIX H** - Summary of Field Measurement and Laboratory Analytical Technologies
**APPENDIX I** - Sitewide Extent Of Contamination By Constituent

# 5.0 ENVIRONMENTAL CONTROLS AND MONITORING

In accordance with the Integrated Environmental Monitoring Plan (IEMP) (DOE 1997a), each remediation project is responsible for the design and execution of its own monitoring activities (outside the IEMP) to demonstrate compliance with its respective project-specific environmental-emission-control applicable or relevant and appropriate requirements (ARARs) (Appendix A) and to obtain the timely feedback required to track the effectiveness of those controls and make necessary, routine "process adjustments." This section includes the management strategy for implementing project-specific environmental control mechanisms and for conducting project-specific environmental monitoring, during remediation of impacted soils at the Fernald site. Environmental control mechanisms, and monitoring and reporting requirements, are provided by pathway for natural resource impacts, air, surface water, and groundwater. This sequence follows that of Appendix A, where the pertinent environmental requirements are presented.

This section of the Sitewide Excavation Plan (SEP) will be used as the basis for defining the specific environmental control, monitoring, and data evaluation requirements in each project-specific Integrated Remedial Design Package (IRDP). The information provided in this section addresses the approach for project-specific environmental control and monitoring, how the resulting information will be used by the project organization for "process-adjustment" decisions, and how it will be integrated with sitewide monitoring and reporting requirements, based on the regulatory-driven (Appendix A) and IEMP-related monitoring and reporting programs at the site. To the extent practical (dependent on sampling frequency, analysis turnaround times, etc.), data collected under both the project-specific and sitewide monitoring programs will be reported in accordance with their associated regulatory drivers and the framework of the IEMP reporting schedule. The IEMP will provide a summary reporting link (to assist with sitewide interpretations) and a cumulative feedback function for the project-specific monitoring conducted by the individual remediation projects. It should be noted, however, that routine "process-adjustment" decisions, which will be made by the Soil Characterization and Excavation Project (as the FEMP's lead project organization) to react and respond to project-specific operating conditions and process-control objectives, will not be reported as part of the IEMP quarterly or annual reporting cycles. Rather, these types of routine decisions will be maintained as part of the project organization's daily operations logs and are considered to be a normal course of day-to-day practice to

achieve project-specific operating objectives (Section 3.6). Figure 5-1 summarizes the FEMP sitewide and project-specific environmental monitoring and control mechanisms.

The need to relocate sitewide environmental monitoring program's monitoring locations or stations will be evaluated during the development of project-specific IRDPs. Relocations will be coordinated with IEMP personnel to ensure that the integrity of the sitewide environmental monitoring program is maintained. To the extent practical, those relocations will be identified in the IEMP during its annual review or biennial revision cycles. Needed relocations not known in time for these cycles will be identified in the respective IRDP and reflected in the subsequent IEMP cycle.

## 5.1 PROJECT-SPECIFIC CONTROL MECHANISMS AND MONITORING

Project-specific control mechanisms, associated monitoring, and the use of the resulting information by the project organization for "process-adjustment" decisions are presented in the following subsections. Each project-specific IRDP will utilize the control mechanisms, monitoring programs, and data evaluation programs described in this section for development of their project-specific programs, but may revise and improve the programs described herein using the "keep, stop, start" concept to take advantage of "lessons learned" during the previous phases of the soil remediation process.

### 5.1.1 Natural Resource Impacts

For soil remediation projects to be initiated under the SEP, the strategic control mechanism for natural resource impacts is threefold:

1. Identify the unavoidable impacts to natural resources anticipated to result from remediation activities.

2. Plan and design the remediation activities to limit the anticipated natural resource impacts to those which practically cannot be avoided.

3. Conduct natural resource restoration.

The first component, unavoidable impacts to natural resources, has been addressed by the Records of Decision (RODs) for Operable Units 2 and 5 (DOE 1995f, 1996e). These RODs identified the

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unavoidable potential natural resource impacts anticipated to occur as a result of remediation activities to be initiated under the SEP. The second component, design, is discussed briefly in the following paragraph.

Avoidance of impacts to FEMP natural resources will be controlled through design as follows. Sensitive natural resource areas have been delineated at the FEMP through a variety of field activities and through regulator and stakeholder input. These areas, termed "Priority Natural Resource Areas," encompass the Paddys Run riparian corridor; the 26-acre forested wetlands; the northern woodlots of the site; and threatened and endangered species habitat on the FEMP. These areas are illustrated in Figure 5-2. All remedial activities will be designed to avoid impacts to Priority Natural Resource Areas to the extent practicable. Each IRDP will specify access points, laydown areas, etc., outside Priority Natural Resource Areas. Potential impacts to other FEMP natural resources will be minimized through the incorporation of appropriate environmental control mechanisms as well.

The third component, restoration, is addressed briefly in Section 3.5.3.

### 5.1.2 Air Pathway

The strategy for assessing impacts on the air pathway from remedial activities includes monitoring activities that will satisfy requirements for noise, fugitive emissions (visible dust), airborne radiological particulate, and radon and direct radiation monitoring during excavation of impacted soils. Air pathway monitoring activities initiated under the SEP to the maximum extent possible will make use of both the existing FEMP occupational air monitoring program and the sitewide environmental monitoring program (described in Section 6.0 of the IEMP). Using existing monitoring programs will help ensure that project-specific data are of comparable quality and are beneficial in evaluating and reporting project-specific air pathway releases under the various regulatory drivers (Appendix A) associated with these monitoring programs. Administrative and engineering control techniques, in accordance with the FEMP fugitive dust control "best available technology" (BAT) determination, will be implemented during excavation activities to mitigate potential emissions of fugitive dust and airborne radiological particulate emissions.

Project-specific monitoring requirements related to noise and fugitive emissions (visible dust) are presented in the following pages. Plans for integrating project-specific air pathway monitoring data into the IEMP reporting process are described in Section 5.2.2.

5.1.2.1 Noise

Federal law mandates that all federal agencies, including the Department of Energy (DOE), comply with federal, state, interstate, and local laws and regulations governing the control and abatement of environmental noise. As identified in the Operable Unit 5 ROD (DOE 1996e), the Noise Control Act (42 U.S.C. 4901 et seq.) and the Noise Pollution and Abatement Act (42 U.S.C. 7641 et seq.) are the two primary federal statutes regulating noise pollution and abatement. Executive Order 12088, entitled "Federal Compliance With Pollution Control Standards," also requires federal agencies to comply with the Noise Control Act. The implementing regulations associated with these statutes that are ARARs under the SEP (Appendix A) include the construction equipment noise standards promulgated in 40 CFR §204.1 and the transportation equipment noise standards promulgated in 40 CFR §205.1.

Control Mechanisms

Noise control and abatement will include noise control devices (mufflers) on vehicles and machinery, proper maintenance of vehicles and machinery, and also may include rescheduling time periods in which heavy equipment is used in the field. Currently, only minimal remediation activities are anticipated to be performed after sunset.

To ensure that Occupational Safety and Health Administration (OSHA) and American Conference of Governmental and Industrial Hygienists (ACGIH) noise limits are met, an administrative action level below these limits will be specified in the project-specific health and safety plans. This administrative action level will be used to assess the need for hearing protection for field personnel in the vicinity, the need for maintenance of vehicles and machinery, and the need for additional noise control and abatement.

Monitoring

Noise monitoring will be conducted to implement IRDP project-specific health and safety plans. Noise measurements will be made in the field by health and safety personnel, using health and safety

protocols for noise monitoring, to assess whether administrative action levels are exceeded; the need for hearing protection; the need for maintenance of vehicles and machinery; the need for additional noise control or abatement; and compliance with OSHA and ACGIH occupational noise limits.

Components of noise monitoring will include establishing remediation area-specific background levels prior to the start of excavation activities, and occasional monitoring during implementation of remedial activities. If background noise levels are within 10 dBA (decibels on the A-weighted scale) of a pre-contemplated administrative action level (e.g., from a preceding project), then a new administrative action level may be established for a given area before remediation of that area is initiated. If the environmental noise level falls within 5 dBA of the administrative action level, health and safety personnel will contact the project field manager to begin appropriate corrective actions.

Field managers will be responsible for documenting noise monitoring in the field in accordance with the record keeping guidelines presented in Section 3.6 and for initiating noise abatement measures.

5.1.2.2 Fugitive Emissions

Control Mechanisms

Project-specific IRDPs will be developed in accordance with the following, which has itself been developed from the "Fugitive Dust Control Requirements" (RM-0047), developed in turn from the FEMP-specific determination of BAT for dust control.

Water, commercially available dust suppression agents, or other appropriate methods and work practices, will be used proactively to reasonably minimize dust generation from remediation activities. Only the amount or method necessary for dust control will be applied; excessive amounts or methods will not be applied. The application rate of water or other dust suppression agents, and frequency of application, are anticipated to vary depending on existing moisture, surface type, and other environmental conditions. Water or other dust suppression agents will be applied in sufficient quantity to prevent dust generation but limited so that they do not result in migration of the agent beyond work area boundaries, ponding, or disruption of other portions of work.

For soil hauling activities, dust control shall be by progressive increments focused on making the material to be transported unlikely to become airborne. The base mechanism is anticipated to be reliance on inherent moisture in the soil or soil-like materials, coupled with a 15-mile-per-hour (mph) speed limit during hauling. If visible dust emissions from the hauled materials occur during hauling, one or a combination of the following dust control methods are anticipated to be used:

- Change configuration of material (e.g., place less in the trucks)
- Apply water mist
- Add surfactants or other agents to the water mist
- Apply resins, crusting agents, or foams in lieu of water mist (atypical truck load bed covers)
- Reduce hauling speed
- Cover truck load bed.

Wheel-washing stations will be used at the point of origin from the soil remediation project prior to entering any defined paved or unpaved roadways. Clods, clumps, or visible deposits of soil or other materials that could readily become visible fugitive emissions from paved or treated unpaved roadways/parking areas will be promptly removed. Appropriate dust control mechanisms will be applied to reasonably minimize the generation of visible dust that may result from the removal process.

Applicable definitions, and the criteria for determining visible dust or excessive visible dust, will be as follows:

1. Definitions

*Dust alert:* Whenever FDF gives notification to the Subcontractor that visible particulate emissions exceed the site-specific limit or Ohio standard during non-work periods.

*Paved roadway or paved parking area*: A predetermined and delineated area designed and improved specifically for vehicle traffic. Improvements to the predetermined area include the application of materials such as asphalt or cement that forms a level surface for travel. (RM-0047)

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*Unpaved roadway or unpaved parking area*: A predetermined and delineated area selected by OEPA and DOE for the specific purpose of vehicle traffic. Unpaved roads will appear in the IRDP on the design drawings. Improvements to the predetermined delineated area include the application of gravel, shredded shingles, cinders, compaction, etc. (RM-0047)

*Visible particulate emissions (visible dust):* Visible particulate that are generated during material handling, construction, or remediation activities, from equipment wheels or tracks, or from any tools or other equipment used. Visible particulate emissions are also those generated by wind. (RM-0047)

*Wind erosion*: Fugitive emissions strictly created by the wind and not by material handling, equipment, or vehicle traffic (RM-0047).

2. For dust control purposes, the relationship between categories, remediation activities, associated areas, dust control/work practices, and site-specific limits or Ohio standards are summarized in Table 5-1.

Remediation activities will be monitored for visible dust. Project personnel will tour the areas of remediation activities at the start of the day and periodically during the day. The number or type of dust suppression equipment in operation will not preclude stopping work if there is visible dust or excessive visible dust. Visible dust indicates the need to increase the level of dust control effort. Increasing levels of visible dust indicate a need to increase the dust control level of effort up to and including alteration of, possible slowdown of, or even temporary suspension of corresponding work activity(ies) observed to be generating the visible dust. Work activity(ies) observed to be generating the visible dust will be temporarily suspended if visible dust exceeds the corresponding site-specific limit or Ohio standard; an increase of dust controls and/or modification to work practices will be implemented to bring the fugitive emissions to, at a minimum, below the limit/standard during dust-generating activities.

Personnel will be on-call during non-work periods seven days per week (including holidays) to respond to an off-hours dust alert, as is defined above. Pre-designated site personnel will notify pre-designated Subcontractor personnel of a dust alert; dust suppression will begin no more than three hours after dust-alert notification given by the pre-designated site personnel.

As part of the Subcontractor's "Safe Work Plan," the Subcontractor will develop a "Dust Suppression Plan" to specify:

- A narrative description of how the Subcontractor field personnel will implement the "Dust Suppression Plan," how they will monitor for visible dust, how they will progressively implement increased dust control or alter work activities when required, and how they will maintain appropriate records of dust control activities.

- A listing of methods to be used to suppress dust, and the associated frequency that routine dust suppression is to take place.

- By method, the materials to be used to suppress dust — e.g., water, dust suppression agents, etc.

- By method, the specific types and quantities of equipment to be used to suppress dust.

- A description of the notification process, including designation of personnel, that the Subcontractor intends for site personnel to utilize during non-work periods to notify the Subcontractor of a "dust alert."

Monitoring

Real-time visual observation of visible dust, in accordance with the criteria described in the preceding control mechanisms discussion, will be used to assess the presence of visible fugitive dust emissions and progressively implement corrective changes.

Additionally, visual monitoring in accordance with 40 CFR Part 60, Appendix A, Method 22, Visual Determination of Fugitive Emissions from Material Sources and Smoke Emission from Flares, will be conducted.

Furthermore, in accordance with the Ohio Environmental Protection Agency's (OEPA's) fugitive dust control BAT determination for the FEMP, visual determination of opacity will be conducted on activities identified in Table 5-1 as project field activities and material handling/vehicle traffic on storage piles. That determination will be in accordance with 40 CFR Part 60, Appendix A, Method 9, Visual Determination of Opacity of Emissions from Stationary Sources (or an approved alternative method).

Field managers will be responsible for documenting visible emission monitoring records in the field in accordance with the recordkeeping guidelines defined in Section 3.6 and initiating fugitive dust

abatement measures. Records of the following information for each work day (including off-hours dust-alert response, except as noted below) will be maintained for each soil remediation project:

- The date, weather conditions, and scheduled work activities (e.g., excavation, trenching, hauling, placement, compaction, loading, etc.)
- Records of opacity readings (if any) conducted that day in accordance with 40 CFR Part 60, Appendix A, Method 9, Visual Determination of Opacity of Emissions from Stationary Sources (or an approved alternative method) [NOTE: not required for off-hours dust alert responses]
- Time of dust-alert notification given to the Subcontractor, names of the individuals (FDF notifier, Subcontractor employee notified, and Subcontractor dust-alert responders), and time of initiation of dust suppression activity [NOTE: required only for days when such notification occurs]
- Identification of areas (or segments) where dust control was performed
- The manner or type of dust control activity(ies) applied by area (or segment) to which applied
- Application rate of water or other dust suppression agents — at a minimum, tank truck load capacity and number of tankloads applied per area (or segment) to which applied
- Identification of the party(ies) responsible for the dust control activity by area (or segment) — at a minimum, name of the Subcontractor firm.

5.1.2.3 Airborne Radiological Particulates

Control Mechanisms

Airborne radiological particulate emissions associated with on-site excavation activities to be initiated under the SEP are anticipated to all be from fugitive emissions. Control mechanisms for fugitive emissions are presented in the preceding subsection. No additional airborne radiological particulate control mechanisms for environmental or public safety concerns are anticipated to be required as a result of remedial activities to be initiated under the SEP.

Monitoring

Airborne radiological particulate emissions associated with on-site excavation activities to be initiated under the SEP will be monitored via the sitewide airborne radiological particulate monitoring program presented in Section 6.0 of the IEMP. The IEMP airborne radiological particulate monitoring program

locations are based on the primary wind rose sectors and potential receptor locations. As discussed in Section 6.0 of the IEMP, that program is designed to collect data representative of ambient air quality at select locations at or near potential receptors and encompasses all the current and expected point and diffuse sources at the Fernald site, including the SEP soil remediation excavations. The IEMP air monitoring network as approved is designed to be representative of potential receptors in each sector. The IEMP's existing network of airborne radiological particulate monitor stations placed at the FEMP fenceline provide an adequate level of assurance that the cumulative dose from FEMP remediation activities can be managed to remain within the National Emissions Standards Hazardous Air Pollutants List (NESHAPs) standards. The data collected under the IEMP airborne radiological particulate monitoring program will be used to assess the collective effect of concurrent remediation activities at the site, including those to be initiated under the SEP, under various regulatory drivers described in Section 6.0 of the IEMP.

No supplement or modification to the sitewide airborne radiological particulate monitoring program (as briefly described above) is anticipated to be required as a result of remedial activities to be initiated under the SEP until SEP work begins in the former waste pits area. The need to supplement or modify the then-existent IEMP airborne radiological particulate monitoring program will be evaluated during the development of the project-specific IRDP for that area. Supplement to or modification of the then existent program might then be required if monitoring stations do not already exist downwind (under the prevailing wind) of the SEP remediation activities, or if the monitoring frequency and/or analyses addressed by the program at that time do not adequately address the COCs in that particular remediation area. However, since these same issues will arise as part of the Waste Pits remedial action project that will precede the soil remediation project under this SEP, the potential need for supplement or modification triggered by SEP-initiated soil remediation activities is anticipated as very minor. If needed, such a supplement or modification would be coordinated with IEMP personnel to ensure that the integrity of the sitewide airborne radiological particulate monitoring program was maintained. To the extent practical, such a supplement or modification would be identified in the IEMP during its annual review or biennial revision cycles; if it could not be accommodated within these cycles, it would be identified in the respective IRDP and reflected in the subsequent IEMP cycle.

Furthermore, some of the airborne radiological particulate monitoring stations might need relocation to

facilitate excavation activities to be initiated under the SEP. The need to relocate any of the airborne radiological particulate monitoring stations will be evaluated during the development of project-specific IRDPs; if relocation is required, it will be coordinated with IEMP personnel to ensure that the integrity of the sitewide monitoring network is maintained.

5.1.2.4 Radon

Control Mechanisms

Emission of radon from soils being remediated under the SEP is not anticipated to be an environmental or public safety concern. Hence, no control mechanisms are anticipated to be required as a result of remedial activities to be initiated under the SEP.

Monitoring

Radon emissions associated with on-site excavation activities to be initiated under the SEP will be monitored via the sitewide radon monitoring program presented in Section 6.0 of the IEMP. That program is designed to monitor environmental radon concentrations resulting from radon generating sources at the site, in addition to fulfilling the monitoring requirements imposed by the Federal Facility Agreement for Control and Abatement of Radon-222 Emissions. As remedial activities are undertaken at the Fernald site, the sitewide radon monitoring program may change to ensure proper monitoring as a result of changing work activities. No supplement to that sitewide radon monitoring program is anticipated to be required as a result of remedial activities to be initiated under the SEP.

However, some of the radon monitoring stations might need relocation to facilitate excavation activities to be initiated under the SEP. The need to relocate any of the radon monitoring stations will be evaluated during the development of project-specific IRDPs; if relocation is required, it will be coordinated with IEMP, Radiological Environmental Monitoring (REM), and Radiation Control personnel to ensure that the integrity of the sitewide monitoring network is maintained.

5.1.2.5 Direct Radiation

Control Mechanisms

No additional control mechanisms for environmental or public safety concerns are anticipated to be required as a result of remedial activities to be initiated under the SEP.

Monitoring

Environmental radiation levels associated with on-site excavation activities to be initiated under the SEP will be monitored via the sitewide environmental direct radiation monitoring program presented in Section 6.0 of the IEMP. That program is designed to collect measurements of environmental radiation levels resulting from radioactive materials stored on site. As remedial activities are undertaken at the Fernald site, the sitewide environmental direct radiation monitoring program may change to ensure proper monitoring as a result of changing work activities. No supplement to that sitewide environmental direct radiation monitoring program is anticipated to be required as a result of remedial activities to be initiated under the SEP.

However, some of the environmental direct radiation monitoring stations might need relocation to facilitate excavation activities to be initiated under the SEP. The need to relocate any of the environmental direct radiation monitoring stations will be evaluated during the development of project-specific IRDPs; if relocation is required, it will be coordinated with IEMP, REM, and Radiation Control personnel to ensure that the integrity of the sitewide monitoring network is maintained.

### 5.1.3 Surface Water Pathway

Control Mechanisms

As a condition of its National Pollutant Discharge Elimination System (NPDES) Permit (Ohio EPA Permit No. 1IO00004*ED), the FEMP was required to develop and implement a Storm Water Pollution Prevention Plan (SWPPP) by May 1, 1996 (DOE 1996e). The SWPPP identifies potential sources of pollution associated with industrial and construction activities that may affect storm water quality at the facility and describes the practices that will be employed to reduce pollutants within these types of discharges. The SWPPP also contains provisions on the inspection programs which are being implemented to ensure that discharges of storm water associated with industrial and construction activities comply with the requirements of the FEMP NPDES Permit and of the SWPPP.

Effective implementation of erosion control and storm water management strategies depends on addressing these issues during the design, early in the planning phase of a remediation project. The erosion control measures and storm water management strategies must be appropriate for the area of remediation activity, and must be clearly transferred from the conceptual basis to the detailed design

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while maintaining the constructability of the remediation activity. Inside the Former Production Area and waste pit area drainage basin (hereinafter referred to as the "Former Production Area drainage basin" as that term is used in the SWPPP), erosion and sediment control measures will be implemented, as appropriate, to mitigate sediment loading to the existing controlled storm sewer system. Outside the Former Production Area drainage basin, erosion and sediment control measures will be implemented to protect downgradient areas.

Inside the Former Production Area drainage basin (i.e., inside the Former Production Area and waste pit area drainage basin), storm water run-off will continue to be controlled by the existing controlled storm sewer system, gravity drained to the Storm Water Retention Basin (SWRB), and under normal conditions, treated through the Advanced Wastewater Treatment (AWWT) facility. Additional erosion and sediment controls may be specified under project-specific IRDPs, as appropriate, to ensure that sediment loading to the existing controlled storm sewer system is minimized to the greatest extent practicable during excavation activities. It is anticipated that surface water control and treatment devices currently in place within the Former Production Area drainage basin of the site will remain largely in place until remediation of the area has been completed; however, they will be dismantled in phases (area-by-area) during implementation of the SEP. To the extent practical, surface water discharges from the area being worked will be conveyed via pumping or other appropriate mechanism to the adjacent area where the conveyance system is still intact. Because of the finite treatment capacity available at the site, it is the intent of the FEMP to minimize storm water treatment requirements through prioritization, pollutant source isolation and excavation sequencing, and limiting duration of open excavations. Thus, in accordance with the SWPPP (DOE 1996e), once an area is certified clean, surface water run-off/storm water from that area will be diverted so that it is not routed to the SWRB or to the AWWT.

Outside the "storm water run-off controlled" Former Production Area drainage basin, storm water from construction activity is regulated as an industrial activity (if a certain magnitude of earth-moving activities is involved). Soil remediation activities to be initiated under the SEP are a subset of construction activities. In accordance with the SWPPP under the FEMP's NPDES permit, erosion and sediment controls (sediment basins/traps, silt fences, etc.) will be installed where appropriate to protect downgradient areas. These controls will be designed and installed as specified in individual,

project-specific IRDPs to manage surface water run-off and run-on, minimize erosion, and control sedimentation in on-site surface waters such as wetlands and Paddys Run.

The grubbing and grading of various areas of the site, particularly those associated with construction of the OSDF and excavation of the Southern Waste Units, will result in the generation of substantial quantities of downed trees and brush. Current management options include the following:

- Chip (or shred) and land apply these materials concurrently with their generation.
- Chip (or shred) and manage in on-site stockpiles for potential use as compost during future site restoration activities.
- Grind stumps and roots in place, excavate with the soil, and dispose of in the On-Site Disposal Facility (OSDF).

In the first case, chipped/shredded tree and brush material can be land applied in areas identified where soil excavation will not be required to achieve soil final remediation levels (FRLs), or in areas which have already undergone FRLs attainment certification. Small quantities may also be used in non-certified areas for landscaping and maintenance (mulching, unpaved walkways, etc.).
The specific strategy(ies) used to manage chipped/shredded tree and brush material from each remediation area will be identified in its corresponding IRDP; however, management of chipped/shredded material under either of the first two options (other than disposal in the OSDF) is supported by the following analysis:

- Soil FRLs. Sampling of on-site tree tissues supports the premise that land application of these materials will not adversely affect the site's ability to attain soil FRLs. Analytical data have demonstrated that the concentrations of constituents exhibited in on-site tree tissues are substantially lower than their respective soil FRLs (Appendix D). Therefore, the biodegradation and subsequent release of constituents contained in woody tree and brush tissues during land application will not lead to an exceedance of soil FRLs in any areas of the site. Grubbed stumps will be managed as debris for disposal into the OSDF to ensure the potentially contaminated soils clinging to their roots are not introduced into the chipped/shredded tree and brush material stream.
- Storm Water Quality. Because of the bio-degradation process, slight increases in loadings and observed values for conventional pollutants, such as biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), pH,

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color, and turbidity, are likely to be associated with storm water discharges from both woodchip stockpile areas and areas in which chipped/shredded tree and brush material has been land applied. In either case, discharges from these areas are not anticipated to contribute to the eutrophication of Paddys Run, since their small volume and intermittent nature will render them innocuous when mixed with the larger volume of run-off available within Paddys Run during a typical storm event. To further minimize potential impacts, drainage from woodchip stockpiles will be controlled by locating the stockpile in a location that does not drain directly into Paddys Run, or by employing runoff diversion methods such that the concentrated runoff from the pile does not drain directly to Paddys Run.

Storm water discharges from woodchip stockpile and land application areas are considered industrial in nature and therefore can be managed under the terms and conditions of the existing FEMP NPDES permit, provided they occur at one of four permitted industrial storm water outfalls along Paddys Run. The current permit specifies biannual monitoring for conventional pollutants at each outfall and, therefore, additional monitoring of run-off from woodchip stockpile and land application areas is deemed unnecessary at this time.

Also in accordance with the SWPPP under the FEMP's NPDES permit, during development of project-specific IRDPs, the need to provide treatment (beyond the erosion and sediment controls mentioned above) for storm water generated during remediation will be evaluated based upon two categories of activities:

- Shallow soil excavation or other earth-moving activities
- Deeper excavation.

The need to provide treatment (beyond erosion and sediment controls) is best determined through a comparison to existing conditions and whether storm water degradation is expected to occur during the period of excavation. For instance, areas with only surficial or shallow subsurface contamination may be removed in a manner such that storm water degradation would not be expected. For areas where there is considerable subsurface contamination (e.g., Operable Unit 2 Southern Waste Units), the removal of the surface soils would expose the subsurface contamination, such that storm water degradation could be expected. Thus, consistent with the SWPPP (DOE 1996e), project-specific IRDPs will designate whether treatment (beyond erosion and sediment control) of storm water run-off will be provided.

During the development of each project-specific IRDP, the FEMP Drainage Area Map (Figure 2-1 of the SWPPP) will be revised to show changes in the drainage areas flowing to NPDES-permitted storm water outfalls *4003 through *4006 that result from SEP-initiated remedial activities in these areas. A revised copy of the FEMP Drainage Area Map will be submitted with each project-specific IRDP and with the annual update of the SWPPP. Revisions to the descriptions of the watershed basins currently provided in Section 4.0 of the SWPPP will be provided with the annual SWPPP update.

Monitoring

Under the SWPPP (DOE 1996e) in accordance with the FEMP's NPDES permit, an industrial activity inspection program exists for the FEMP site. It covers both the Former Production Area drainage basin and areas outside that drainage basin. Under the FEMP's industrial activity inspection program, quarterly inspections are and will be conducted in areas draining to the site's controlled storm sewer system (Former Production Area drainage basin) and the uncontrolled watershed basins draining through NPDES permitted storm water outfalls *4003 through *4006 (Figure 5-3). These industrial activity inspections include evaluation of housekeeping issues, engineering controls and practices, and material handling and management activities associated with any industrial processes located within each of these watershed basins. Industrial activity inspections are not conducted within areas that are actively being inspected under the construction activity inspection program described below. Industrial activity inspections are documented and maintained as part of the NPDES and SWPPP files at the facility. See the SWPPP for further details.

Similarly, under the SWPPP (DOE 1996e) in accordance with the FEMP's NPDES permit, a construction activity inspection program exists for the FEMP site. Under the FEMP's construction activity inspection program, weekly inspections are and will be conducted within all construction areas at the site and after any rain events totaling 0.5 inch or more of precipitation within a 24-hour period. Construction activity inspections mandated by the SWPPP are and will be conducted in all remediation areas disturbed under the IRDPs. Inspections conducted in these areas will ensure that:

- Erosion and sediment controls required under the approved IRDPs are in place and are well maintained.

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- Work practices and housekeeping activities are conducted in a manner that reduces the potential discharge of pollutants in association with storm water discharges from disturbed areas.

- Corrective actions related to the establishment and/or maintenance of erosion and sediment control structures are documented and tracked to resolution.

- Excessive erosion and/or siltation to Paddys Run or other off-property waterways is not occurring as result of construction activities initiated under the IRDPs.

Construction activity inspections are documented and maintained as part of the NPDES and SWPPP files at the facility. See the SWPPP for further details.

Outside the Former Production Area drainage basin, a project-specific Storm Water Monitoring Program will be implemented under the SEP. Its primary objective is to monitor performance of erosion and sediment control structures (e.g., sediment traps and basins) against their anticipated design efficiencies; TSS is the appropriate indicator parameter for this objective. Note that the particle-bound fraction of a constituent of concern (COC) is anticipated to settle either in the sediment trap/basin or in the surface water course; both of these on-site surfaces will be addressed by follow-on soil remediation projects. Its secondary objective is to determine whether the run-off, or potential overflow, presents an unacceptable impact to surface water quality or presents an unacceptable cross-media impact to Great Miami Aquifer groundwater. Because uranium is the principal site contaminant and the predominant COC in the soils being remediated, total uranium is the appropriate indicator parameter for this objective; however, if the principal area-specific constituent of concern (ASCOC) in the project-specific IRDP is not uranium, an appropriate alternate indicator parameter will be designated. IEMP monitoring in the surface water courses at the basin-specific NPDES permitted outfalls address site discharge concerns.

Sampling, analyses, and evaluation will be conducted as follows:

- Specifically designated, installed control structures will be sampled once a month, *provided* that the qualifying storm event (next bullet) occurs and that sufficient discharge occurs to collect a sample.

- Influent and effluent grab samples will be collected during storm events of a magnitude of 0.5 inch of rainfall or greater within a 24-hour period.

- The influent and effluent samples will be analyzed for TSS at ASL B; for the effluent, an additional volume will be collected and analyzed for total uranium (or other area-specific indicator parameter) at ASL B.

- A trap efficiency will then be calculated from this TSS data, which will be compared to the anticipated trap efficiencies for the particular type of control structure to determine its effectiveness.

- Trap efficiency and effluent TSS will be trended to evaluate changes over time and the need for potential corrective actions.

- Effluent total uranium (or other area-specific indicator parameter) data will be trended to evaluate changes over time and the potential need for additional monitoring.

Project-specific IRDPs will designate:

- The control structure(s), if any, that will be sampled for this type of evaluation.

- The area-specific indicator parameter.

- The anticipated trap efficiency(ies) for the particular type(s) of control structures designated. (Anticipated trap efficiencies generally range from 50 to 80 percent for sediment traps, and 60 to 80 percent for sediment basins.)

- Any modifications to the evaluation frequency, rainfall event magnitude, or duration of such evaluation efforts.

- Any other modifications or qualifications, as appropriate.

If the trap efficiency of a particular control structure is less than anticipated for that type of structure, existing administrative and engineering controls specified in an IRDP will be evaluated for the watershed basin in which the control structure is located. Attempts to rectify the problem through improvements in administrative and engineering controls will be documented and tracked through the construction inspection process currently in place under the SWPPP. Improvements to administrative and engineering controls may include revisions to project-specific work and housekeeping procedures, repair or maintenance of existing control structures, minor retrofits to control structures, or the installation of additional control structures such as silt fences and checkdams.

The area-specific indicator parameter data will be compared to the surface water human-health-protective FRL for that parameter (Table 9-5 in the Operable Unit 5 ROD, DOE 1996e). If the

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trended measured values indicate exceedance of the FRL value, effluent monitoring for additional remediation-area-specific parameters will be initiated at the control structure. The frequency of monitoring and the selection of specific parameters to be monitored would be determined for each remediation area on an as-needed basis and would be described and documented in a project-specific post-IRDP document. Frequency and parameter designation would be coordinated with IEMP personnel so that the same monitoring occurred downgradient at the basin-specific NPDES permitted outfall and at other points downgradient of the control structure as appropriate, under the IEMP program. Measured values for the parameters would then be evaluated against the following criteria:

Potential surface water impact:

- Only in situations where surface-water COC concentrations at the downgradient, basin-specific, NPDES-permitted storm water outfall exceed the surface-water FRL or BTV would future action be considered.

Potential groundwater impact:

- Only in situations where surface-water COC concentrations at the corresponding IEMP surface water course sampling point (near the point where the protective glacial overburden has been breached by unlined site drainage courses) downgradient of the control structure exceed the concentration in the Great Miami Aquifer (GMA) would future action be considered.

In the situations listed above, the following actions would be contemplated:

- Scale up the expanded monitoring, continue the expanded monitoring as is, scale down the expanded monitoring, cease the expanded monitoring.
- Improve administrative and engineering controls, such as revisions to project-specific work and housekeeping procedures, repair or maintenance of existing control structures, minor retrofits to control structures, or the installation of additional control structures such as silt fences and checkdams.
- Modify the approach to be implemented in subsequent soil remediation projects to further minimize potential adverse impacts to the surface water pathway from soil remediation activities.

As discussed in Section 5.2.3, storm water run-off from the Former Production Area drainage basin will continue to be monitored under the IEMP to continue to fulfill the site's current NPDES and

Federal Facilities Compliance Agreement (FFCA) monitoring and reporting obligations. To the extent practical (dependent on sampling frequency, analysis turnaround times, etc.), surface water monitoring data collected under the sitewide IEMP monitoring program or under project-specific IRDPs will be reported within the framework of the IEMP reporting schedule.

### 5.1.4 Groundwater Pathway

Control Mechanisms

Impacts to the GMA might occur during the excavation of soil under the SCEP. The potential for impacts to the GMA is expected to be highest when the overlying glacial till is breached or is excavated to significantly reduce the effective till thickness. Therefore, for soil remediation projects to be initiated under the SEP, the strategic control mechanism to mitigate against potential adverse impacts to the GMA is as follows:

1. Identify known or reasonably expected impacted perched water zones using existing site characterization (geotechnical, hydrogeologic, groundwater monitoring, etc.) information.

    a. For deep excavations in projects in those areas identified under 1 above, as appropriate and practicable, implement dewatering of in situ perched water during deep excavation to control seepage into the open excavation; other project-specific controls may be implemented (Section 2.5.4).

2. Pump out the water (perched water or storm water) that accumulates in the open deep excavation to limit the volume of potential infiltration through this pathway.

3. Identify known or reasonably expected areas where the overlying glacial overburden is already or will be breached, or where it will be excavated to significantly reduce the effective till thickness.

    a. Where excavation to construct sediment basins or run-off collection channels extends into the sands and gravels of the GMA, create an infiltration barrier (typically by placing compacted clay) in the bottom of the feature to minimize the long-term potential for adverse impact through this pathway.

    b. For projects in those areas identified under 3 above, monitor select Type 2 GMA wells in the proximity of such projects to evaluate whether adverse impacts to the GMA occur during the soil remediation activity.

4. Identify deep excavations in projects that are to remain as a pond or lake where insufficient effective thickness of undisturbed glacial overburden will likely remain after excavation is complete.

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a. After the terminal extent of excavation has been reached (cleanup certified), create an infiltration barrier (e.g., compact existing clay or place compacted clay) in the bottom of the open excavation identified under 4 above to minimize future potential adverse impact through this pathway.

The actual mechanism(s) to be implemented will be determined by the project-specific IRDP. During the development of a project-specific IRDP, early efforts will focus on the identifications under mechanisms 1, 3, and 4 above; Aquifer Restoration and Wastewater Project personnel will be informed of these projects. For projects specifically designated under mechanisms 1, 3, and 4 above, Aquifer Restoration and Wastewater Project personnel will provide input to SCEP personnel during the development of project-specific IRDPs (e.g., what effective thickness of undisturbed glacial overburden is sufficiently protective of the GMA) so that the individual project will be protective of the GMA to the extent practicable. For projects specifically designated under mechanism 3 above, each project-specific IRDP will identify pre-existing (if any) Type 2 groundwater monitoring wells (to remain after well abandonment efforts) in proximity to and downgradient of the area to be excavated which will be used for project-specific groundwater monitoring; where the number or placement is insufficient, additional wells will be installed for this purpose.

Project-specific IRDPs will designate:

- Whether impacted perched water zones are known or reasonably expected to exist in the project area.
- Whether dewatering (or other appropriate project controls) will be implemented during deep excavation to control seepage of perched water into the open excavation; if dewatering is to be used, then the IRDP also will estimate the pumping rate required and designate how the water will be managed (e.g., conveyed to AWWT for final treatment, or discharged to surface water courses without treatment).
- Whether water (perched water or storm water) that accumulates in the open deep excavation will be pumped out; if so, then the IRDP also will designate how the water will be managed (e.g., pretreatment, conveyed to AWWT for final treatment, or discharged to surface water courses without treatment; see discussion in preceding surface water pathway subsection).
- Whether the overlying glacial overburden in the project area is already or will be breached, or whether it will be excavated to significantly reduce the effective till thickness.

- Whether an infiltration barrier will be created in the bottom of sediment basins or run-off collection channels.

- Whether any Type 2 groundwater monitoring wells in the proximity of the project will be monitored; if so, then the IRDP also will identify those wells, the sampling and analysis requirements (frequency, indicator parameters, etc.), and the duration of that monitoring effort. Unless specified otherwise in an IRDP, such project-specific groundwater monitoring will cease when soil cleanup is certified for that area (those certification units).

- Whether a deep excavation is anticipated to remain open as a lake or pond; what effective thickness of undisturbed glacial overburden is sufficiently protective of the GMA; and whether an infiltration barrier will be created in the bottom of the open deep excavation after the terminal extent of excavation has been reached (cleanup certified).

Monitoring

The sitewide management strategy for monitoring groundwater during remedial activities is described in detail in Section 3.0 of the IEMP (DOE 1997a), which lists the objectives, regulatory drivers, monitoring, data evaluation, and reporting requirements for the program. Sitewide monitoring of groundwater will continue under the IEMP during SCEP soil remediation. Aquifer Restoration and Wastewater Project personnel will use groundwater monitoring data collected under the IEMP monitoring program to assess the potential impact of remedial activities on groundwater quality within the GMA and will assist SCEP personnel in assessing the need to conduct project-specific groundwater monitoring to supplement the IEMP groundwater monitoring. Project-specific groundwater monitoring is briefly described above.

Data from any such project-specific groundwater monitoring effort will be used to assess the impact of the soil remediation activities on the GMA and will be reported in the IEMP reports to the extent practical (dependent on sampling frequency, analysis turnaround times, etc.). During implementation of SCEP soil remediation activities, the data will be evaluated in conjunction with Aquifer Restoration and Wastewater Project personnel to spot a trend or change in trend that could indicate a potential adverse impact to groundwater quality within the GMA. The data will be carefully scrutinized in an effort to determine whether the soil remediation activities are adversely affecting the GMA groundwater (e.g., vertical migration through the glacial overburden or as a result of surface water infiltration), or whether other conditions (migration of existing plume, groundwater remediation

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activities) are the likely impacting factors. In the event that data from project-specific groundwater monitoring indicate a potential adverse impact, an appropriate future course of action will be evaluated and implemented considering the following:

- Is this area of the GMA already planned for groundwater remediation? If not, should it be remediated (in accordance with the criteria in the OU5 ROD, DOE 1996e)
- If the answer to either of the above is yes: Is GMA groundwater remediation of this area already ongoing? If not, should GMA groundwater remediation for the area be re-prioritized?
- After project-specific groundwater monitoring ceases as previously determined, should monitoring of those wells be continued under the IEMP?
- What modifications, if any, can be retrofitted to that soil remediation project to mitigate the situation?
- What modifications to approach can be implemented in subsequent soil remediation projects to further minimize potential adverse impacts to the GMA from soil remediation activities?

## 5.2 COORDINATION WITH SITEWIDE MONITORING

The IEMP has been prepared in a manner that focuses on air, surface water, and groundwater monitoring, data evaluation, and reporting necessary to ensure protection of human health and the environment during sitewide remediation activities. The IEMP provides the central reporting mechanism to the regulators and the stakeholders for the ongoing environmental/emission control and monitoring activities at the FEMP.

The following subsections describe how the reporting of project-specific monitoring data collected under the SEP will be integrated into existing reporting programs established under the IEMP and its associated regulatory drivers. The integration of project-specific and sitewide monitoring, data evaluation, and reporting responsibilities is summarized in the following subsections.

### 5.2.1 Air Pathway

The sitewide air monitoring program is described in Section 6.0 of the IEMP (DOE 1997a). Descriptions of the objectives, regulatory drivers, monitoring, data evaluation, and reporting requirements for the program are provided therein. Sitewide air monitoring will continue under the

IEMP during remedial activities to be initiated under the SEP. Data from this program will be used to assess the impact of air emissions from remedial activities.

To the extent practical (dependent on sampling frequency, analysis turnaround times, etc.), data collected under the sitewide air monitoring program will be reported in accordance with their associated regulatory drivers and within the framework of the IEMP reporting schedule.

### 5.2.2 Surface Water Pathway

The sitewide surface water environmental monitoring program is described in Section 4.0 of the IEMP (DOE 1997a). Descriptions of the objectives, regulatory drivers, monitoring, data evaluation, and reporting requirements for the program are provided therein. Monitoring of surface water discharges from the Former Production Area drainage basin in accordance with NPDES and FFCA requirements will continue under the IEMP during remedial activities to be initiated under the SEP. Data from this program, in conjunction with information from project-specific surface water monitoring discussed in Section 5.1.3, will be used to assess the impact of remedial activities on Paddys Run and the Great Miami River.

To the extent practical (dependent on sampling frequency, analysis turnaround times, etc.), data collected under both the sitewide and project-specific monitoring programs will be reported in accordance with their associated regulatory drivers and within the framework of the IEMP reporting schedule.

### 5.2.3 Groundwater Pathway

The site's groundwater monitoring program is described in Section 3.0 of the IEMP (DOE 1997a). Descriptions of the objectives, regulatory drivers, monitoring, data evaluation, and reporting requirements for the program are provided therein. Sitewide monitoring of groundwater will continue under the IEMP during remedial activities to be initiated under the SEP. Data from this program, in conjunction with information from any project-specific groundwater monitoring discussed in Section 5.1.3, will be used to assess the impact of remedial activities on the GMA.

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To the extent practical (dependent on sampling frequency, analysis turnaround times, etc.), groundwater monitoring data will be reported in accordance with its associated regulatory drivers and within the framework of the IEMP reporting schedule.

# TABLE 5-1

## DUST CONTROL REQUIREMENTS

| Category | Remediation Activities/Areas Included | Dust Controls/Work Practices (to be applied progressively as environmental conditions dictate) | Site-Specific Limit or Ohio Standard |
|---|---|---|---|
| Paved roadways and paved parking areas | Activities:<br>• Hauling nonimpacted materials<br>• Hauling impacted materials<br>• Vehicle and equipment traffic<br>Areas:<br>All predetermined areas designed and improved specifically for vehicle traffic. Improvements include the application of materials such as asphalt or concrete that form a firm level surface for travel. | • Apply dust suppression agents.<br>• Minimize the amount of unnecessary traffic on unpaved roadways or unpaved parking areas.<br>• Limit speed to 15 mph during operation of equipment or vehicles.<br>• Apply dust suppression agents such as surfactants or crusting agents to inactive storage piles, or cover with tarpaulin, plastic, etc., if practical; for extended periods of planned inactivity, vegetate as a last resort if periodic application of crusting agent or protective cover proves ineffective.<br>• Apply appropriate dust suppression agents such as water or surfactants to material being transported by truck load beds to ensure the material will not become airborne; cover truck load bed when transported material is still likely to become airborne.<br>• Wheel wash prior to entering unpaved roadways.<br>• Remove, as practical, any clods, clumps, tracks, or visible deposits of soil or mud from unpaved roadways.<br>• Repair or resurface roadways/parking areas as needed, or use an alternative road surface as a last resort. | Limit:<br>Visible particulate emissions shall not exceed one (1) minute during any sixty (60)-minute observation period. |

# TABLE 5-1
# (Continued)

| Category | Remediation Activities/Areas Included | Dust Controls/Work Practices (to be applied progressively as environmental conditions dictate) | Site-Specific Limit or Ohio Standard |
|---|---|---|---|
| Unpaved roadways, unpaved parking areas, and wind erosion from storage piles | Activities:<br>• Hauling nonimpacted materials<br>• Hauling impacted materials<br>• Vehicle and equipment traffic<br>Areas:<br>All predetermined areas designed and improved specifically for vehicle traffic. Improvements include the application of gravel, shredded shingles, cinders, compaction, etc., to the delineated areas. | • Apply dust suppression agents.<br>• Minimize the amount of unnecessary traffic on unpaved roadways or unpaved parking areas.<br>• Limit speed to 15 mph during operation of equipment or vehicles.<br>• Apply dust suppression agents such as surfactants or crusting agents to inactive storage piles, or cover with tarpaulin, plastic, etc. if practical; for extended periods of planned inactivity, vegetate as a last resort if periodic application of crusting agent or protective cover proves ineffective.<br>• Apply appropriate dust suppression agents such as water or surfactants to material being transported by truck load beds to ensure the material will not become airborne; cover truck load bed when transported material is still likely to become airborne.<br>• Wheel wash prior to entering unpaved roadways.<br>• Remove, as practical, any clods, clumps, tracks, or visible deposits of soil or mud from unpaved roadways.<br>• Repair or resurface roadways/parking areas as needed, or use an alternative road surface as a last resort. | Limit:<br>Visible particulate emissions shall not exceed three (3) minutes during any sixty (60)-minute observation period. |



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# TABLE 5-1
## (Continued)

| Category | Remediation Activities/Areas Included | Dust Controls/Work Practices (to be applied progressively as environmental conditions dictate) | Site-Specific Limit or Ohio Standard |
|---|---|---|---|
| Project field activities and material handling/vehicle traffic on storage piles | Activities:<br>• Excavation<br>• Trenching<br>• Loading/Unloading<br>• Transportation to defined roadway (paved or unpaved)<br>• Load-in/load-out of storage piles<br>• Material placement into On-Site Disposal Facility<br>• Vehicle traffic on storage piles<br>Areas:<br>• Working faces<br>• Transition areas between working faces and defined (paved or unpaved) roadways<br>• Storage piles | • Apply dust suppression agents<br>• Minimize the amount of unnecessary traffic in and around field activities<br>• Limit speed to 15 mph during operation of equipment or vehicles<br>• Reduce rate of excavation<br>• Minimize height of drop during loading and unloading<br>• Change method of excavation & transport (e.g., from front-end loader dumping into a truck to a self-propelled pan)<br>• Apply dust suppression agents such as surfactants or crusting agents to storage piles<br>• Apply appropriate dust suppression agents such as water or surfactants to material being transported by truck load beds to ensure the material will not become airborne; cover truck load bed when transported material is still likely to become airborne | Standard:<br>Visible particulate emissions shall not exceed twenty percent (20%) opacity as a three (3)-minute average<br>[OAC 3745-17-07(B)(1)] |



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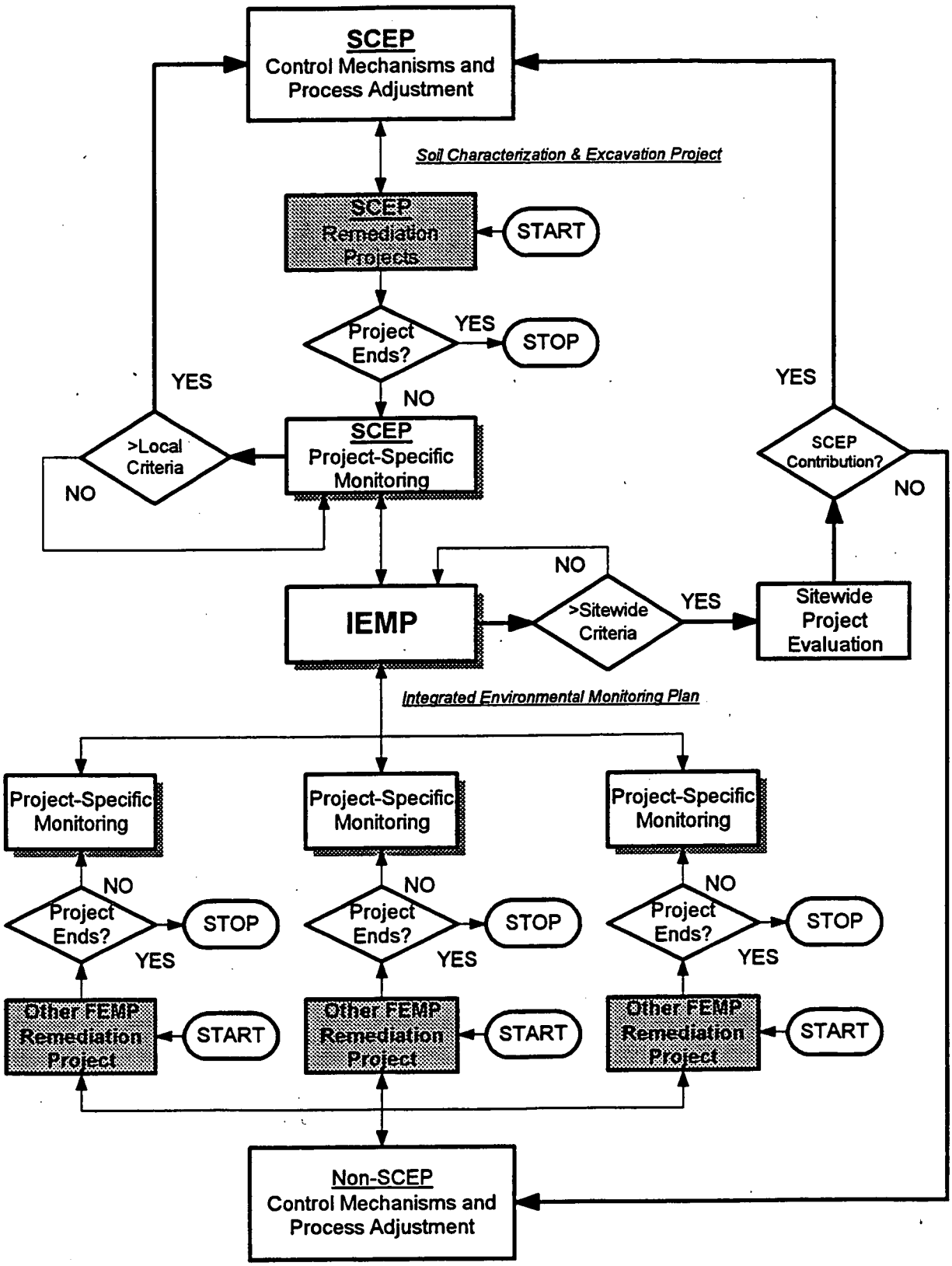
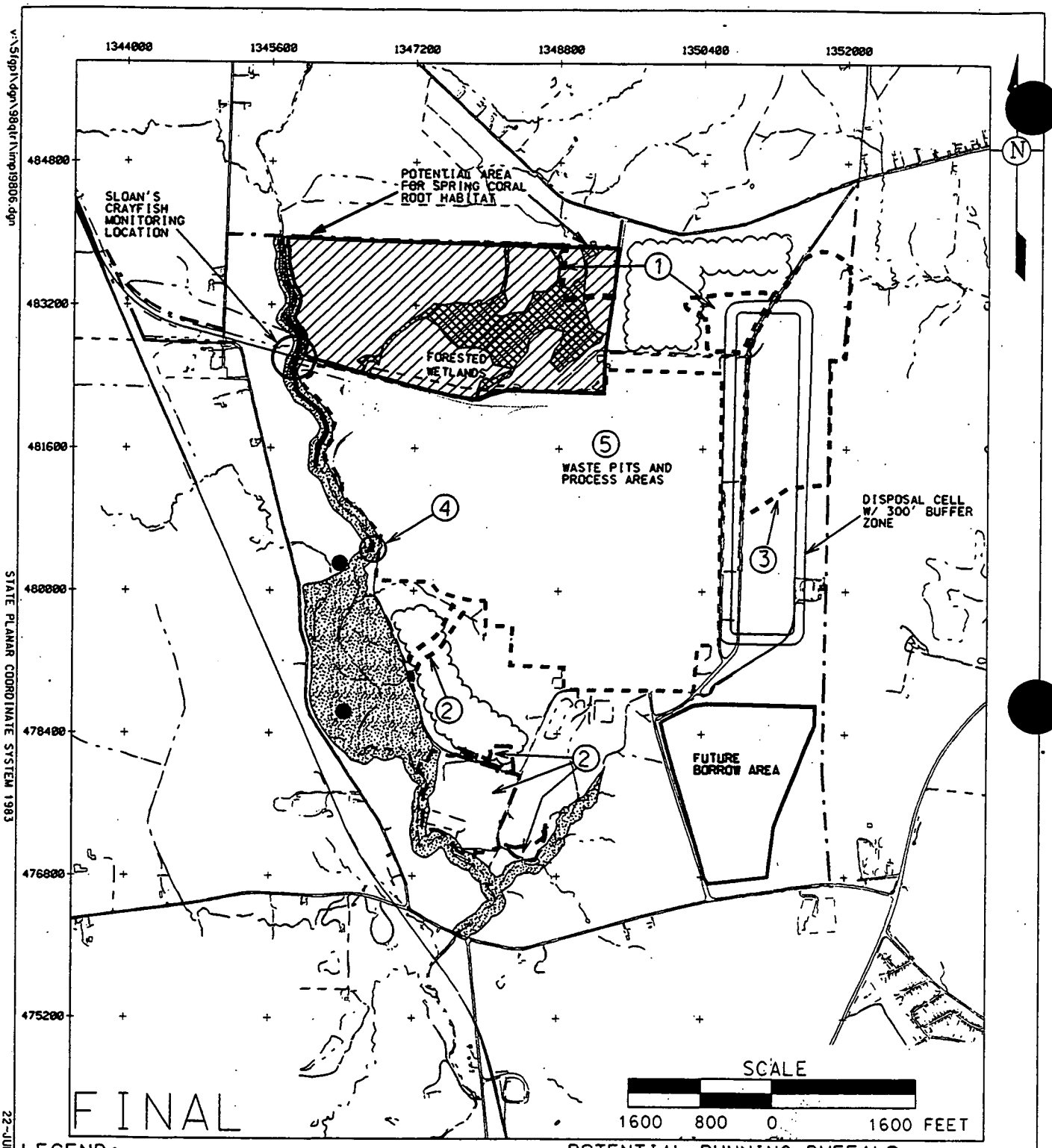



FIGURE 5-1 SITEWIDE AND PROJECT-SPECIFIC ENVIRONMENTAL MONITORING AND CONTROLS




LEGEND:

- FEMP BOUNDARY
- PADDYS RUN AND TRIBUTARIES RIPARIAN CORRIDOR
- SLOAN'S CRAYFISH AREA
- INDIANA BROWN BAT HABITAT
- WETLANDS
- NORTHERN WOODLOT AREA
- PINES
- POTENTIAL RUNNING BUFFALO CLOVER AREAS

| IMPACTED HABITAT AREAS: | | ACREAGE: |
|---|---|---|
| 1 | NORTHERN WOODLOT/PINES | 9.77 |
| 2 | SOUTHERN PINES/ WASTE UNITS | 24.32 |
| 3 | GRASSLAND | 55.10 |
| 4 | PADDYS RUN CORRIDOR | 11.07 |
| 5 | WETLANDS ASSOCIATED WITH WASTE PITS/PROCESS AREA | 10 |

FIGURE 5-2. PRIORITY NATURAL RESOURCE AREAS

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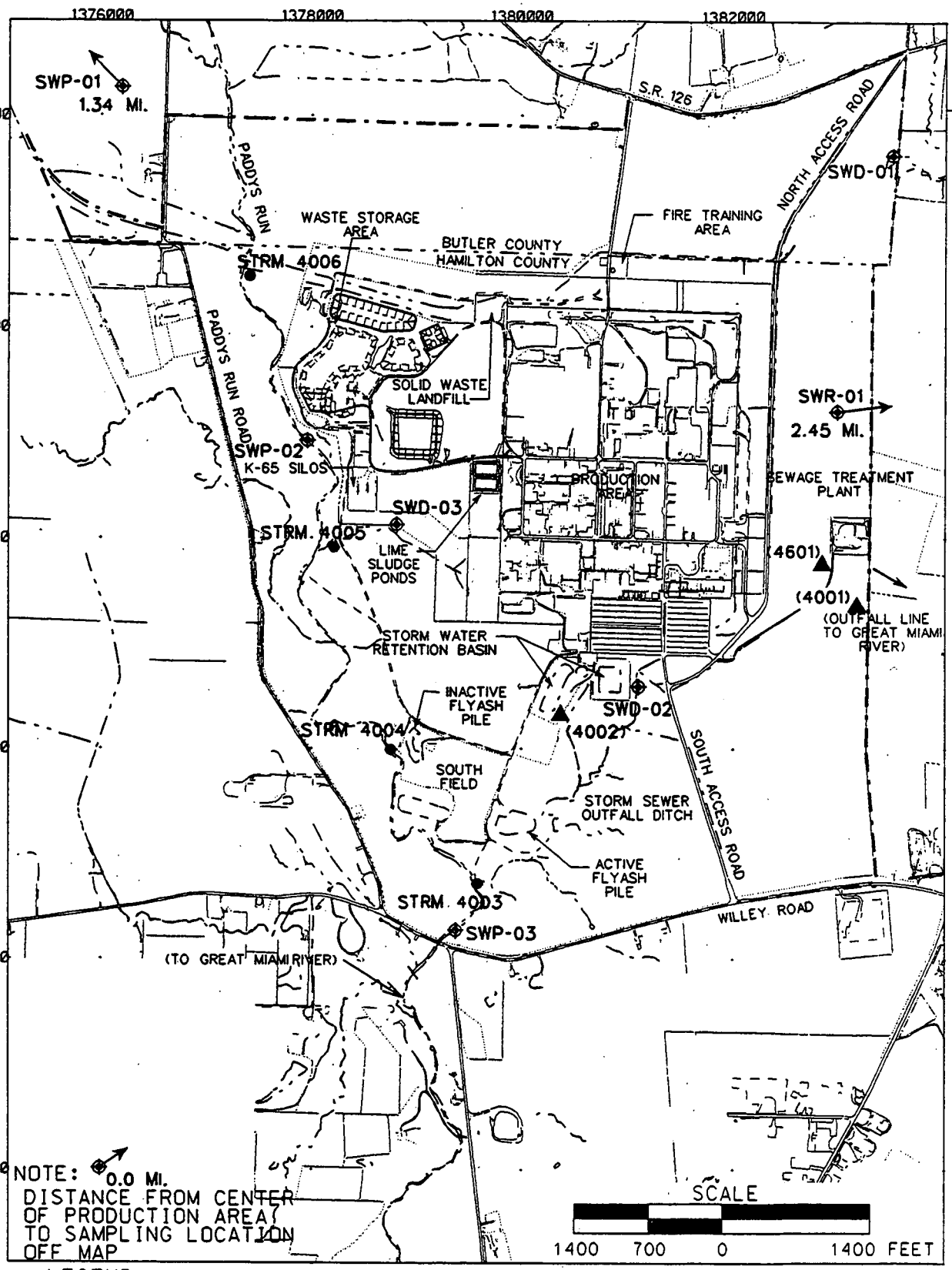


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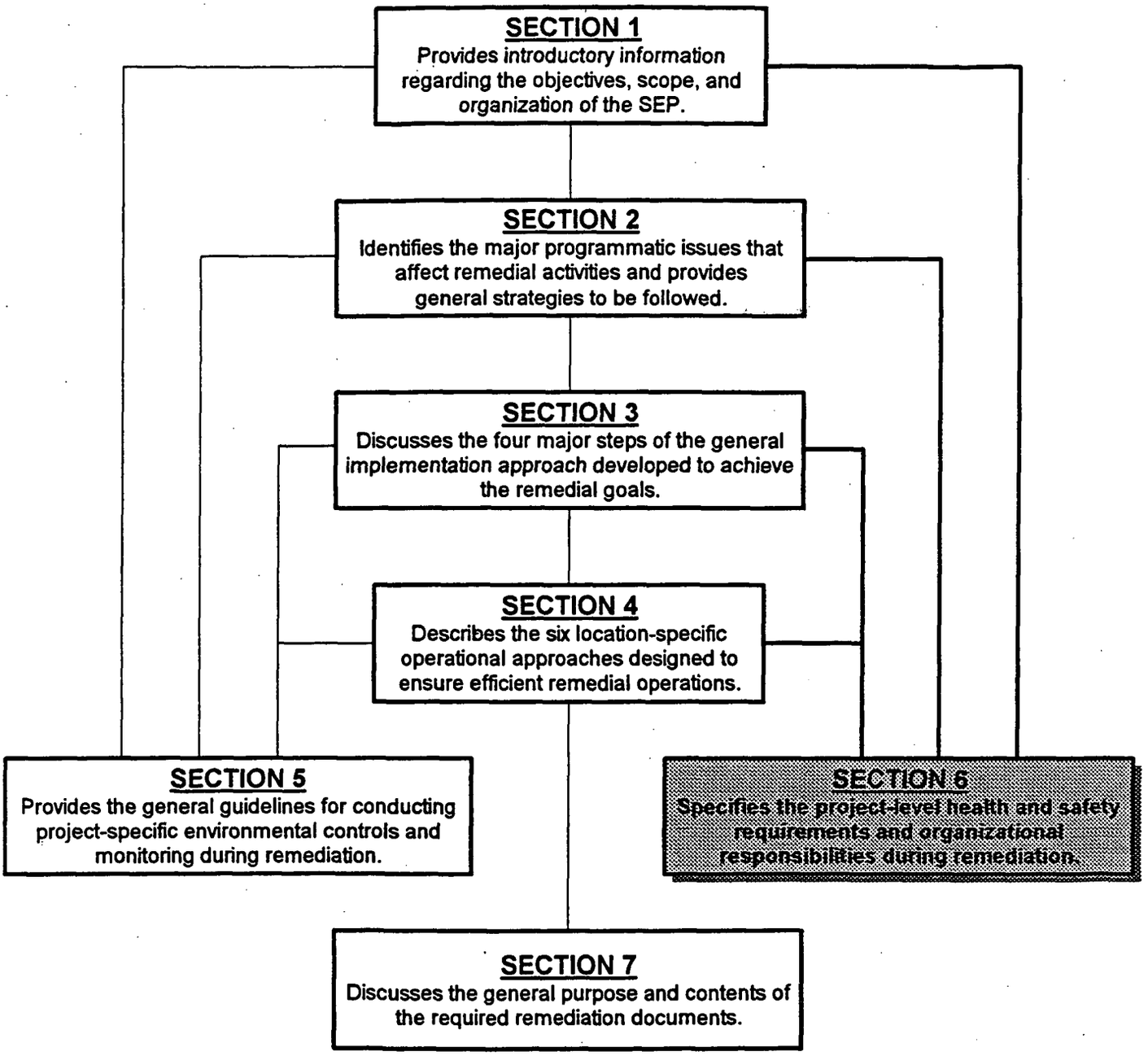
FIGURE 5-3. IEMP SURFACE WATER SAMPLE LOCATIONS

# SITEWIDE EXCAVATION PLAN




**APPENDIX A** - Soil Remediation ARARs and TBCs
**APPENDIX B** - Sitewide Sequencing Plan
**APPENDIX C** - Constituent of Ecological Concern Selection
**APPENDIX D** - Wood Sampling Program
**APPENDIX E** - SEP Quality Assurance Project Plan (QAPP)
**APPENDIX F** - Implementation of Construction and Waste Management Practices
**APPENDIX G** - Certification Design Rationale
**APPENDIX H** - Summary of Field Measurement and Laboratory Analytical Technologies
**APPENDIX I** - Sitewide Extent Of Contamination By Constituent

# 6.0 PROJECT HEALTH AND SAFETY

Fernald Environmental Management Project (FEMP) is required to comply with various health and safety standards during implementation of the Sitewide Excavation Plan (SEP). These standards include U.S. Department of Energy (DOE) Order 5480.4, "Environmental, Protection, Safety and Health Protection Standards"; DOE Order 440.1, "Worker Protection Management for DOE Federal and Contractor Employees"; FEMP RM-0021, "Safety Performance Requirements Manual"; 10 CFR Part 835; and FEMP RM-0020, "Radiological Controls Manual." The portions of these documents applicable to each remediation project will be delineated in Part 8 of the remediation subcontract. This section summarizes the project-specific health and safety requirements to be observed during remediation under this SEP.

All FEMP employees, visitors, vendors, contractors, and subcontractors are required to abide by the provisions of applicable Project-Specific Health and Safety Requirements Matrices (PSHSRMs) and/or Project-Specific Health and Safety Plans (PSHSPs) prepared by FEMP (DOE 1995h) as well as the FEMP-approved Safe Work Plan prepared by the subcontractor. Managers and supervisors are responsible for ensuring that the requirements of the applicable PSHSPs and PSHSRMs are met. All personnel have stop-work authority for imminent safety hazards resulting from noncompliance with the applicable health and safety practices.

All subcontractor activities conducted in support of this project are governed by the safety requirements specified within the remediation contract, which addresses environmental, occupational, industrial, and construction health and safety. In addition to the contract requirements, PSHSPs, and the requirements of this document, the subcontractor will comply with all federal, state, and local requirements [e.g., Occupational Safety & Health Act (OSHA), Subpart P - Excavations, 1926.650, .651, .652, and Appendix A through F].

## 6.1 PROJECT-SPECIFIC HEALTH AND SAFETY PLANS

The purpose of the PSHSP/PSHSRM and/or the Environment, Safety, Health and Training Requirements Matrix (ESH&TRM) is to provide health and safety guidance for protecting workers during all phases of work associated with the project. Specific health and safety guidance and

requirements for each major phase of excavation will be identified in a PSHSP/PSHSRM and/or ESH&TRM. Each project will be evaluated by Safety and Health to determine which documents will be developed.

The ESH&TRM is developed to aid the subcontractor in identifying the hazards associated with the project. The matrix is prepared to address minimum requirements for foreseen and known hazards existing at the time of contract. Actual conditions are subject to change. Additional mitigators may be required based on actual radiological, industrial hygiene, and safety conditions existing during work activities. The ESH&TRM will be included in each Invitation for Bid/Request for Proposal package to provide health and safety requirements for each discrete phase or activity in the project.

The Subcontractor shall use the ESH&TRM to determine the general and task-specific health and safety requirements when developing the safe work plan. The ESH&TRM includes a hazard analysis for each task and required mitigators, including personal protective equipment (PPE), engineering and administrative controls, pre-job planning and permits, personal training personnel and air monitoring, medical monitoring and medical surveillance, and decontamination and disposal procedures.

The PSHSRM/PSHSP or the subcontractor's proposed Safe Work Plan may be revised if tasks are added or removed from the list. When required, the PSHSRMs and the detailed PSHSP will be maintained at the project site; controlled copies will be kept in the project document control files. The PSHSP and PSHSRM will identify the following components:

- Project organization and responsibilities (PSHSP only)
- Hazards associated with the project tasks
- Worker training requirements
- PPE for each project task
- Medical surveillance requirements
- Frequency and types of air and personnel monitoring
- Site control measures
- Decontamination procedures
- Emergency response and contingency plans
- Additional permits required (e.g., confined-space evaluation)
- Other work practice requirements.

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When required, the PSHSP will be provided at mobilization. The plan shall be read, understood, and signed by the subcontractor and lower-tier subcontractors. The subcontractor and lower-tier subcontractors shall orient their employees to the plan, and employees will sign a sheet acknowledging that they understand the requirements.

The ESH&TRM will include health and safety requirements (handling guidance, permits, etc.) for materials that require special handling, as defined in Appendix F. Based on this information, the contractor will develop procedures/plans to handle these materials that will include PPE required, exposure monitoring, contamination control, and all other aspects of worker protection. These procedures/plans will complement the Environmental Contingency Plans in Section F.4.

## 6.2 SUBCONTRACTOR SAFE WORK PLANS

Subcontractors will be required to prepare a Safe Work Plan, and submit it to FEMP for approval. The subcontractor shall utilize the ESH&TRM and applicable contract documents to prepare the safe work plan.

The subcontractor Safe Work Plan will describe the work in sufficient detail to:

- Provide assurance to FEMP that:
  - The subcontractor has assessed the risks associated with the work, and addressed preventive measures for safety and health hazards
  - The work in progress complies with the health and safety and performance requirements specified in the subcontract documents
  - The subcontractor has safely planned the work in sufficient detail to meet schedule requirements.
- Provide a basis for FEMP's internal planning activities.

The Safe Work Plan will be used to brief the work force before each activity begins. The following items will be addressed in the subcontractor Safe Work Plan:

- A narrative description of the work to include the subcontractor's methods of performing work

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- Crew size and craft
- Sub-tier subcontractors with a description of their work (as applicable)
- Number and type of equipment to be used and the subcontractor's plan for repair and maintenance
- Training requirements and levels required to operate each piece of equipment to be used
- Critical sequence of work, along with the reason it is critical
- Methods of waste minimization, disposal, and cleanup
- A narrative description of a hazard analysis for each task. The hazards involved, mitigators, and controls will be well defined, practicable, and clearly written for workers in the field. Specialized equipment or training will be specifically addressed.
- OSHA requirements for competent persons, and those activities to be completed prior to start of work
- Occupational exposure monitoring in compliance with OSHA and applicable contract documents
- Radiological controls functional area of the Standards/Requirements Identification Document (S/RID).

## 6.3 EMERGENCY PREPAREDNESS

Health and safety emergencies during remedial activities are covered by the existing FEMP Emergency Preparedness Program. This program details the procedures to be followed at the FEMP in the event of an accident (spill) or emergency. The program provides a strategy for managing communications, site assessment, fire control, medical assistance, and monitoring equipment. Emergency phone numbers are provided in the program, which is distributed to participating mutual aid organizations and other local organizations, such as local fire departments, hospitals, etc., in the general vicinity of the FEMP.

The FEMP emergency organization is available 24 hours a day to respond to all emergencies and abnormal events. Any off-site emergency notifications will be made by Emergency Preparedness. All project personnel will be trained in Emergency Preparedness procedures.



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## 6.4 OCCUPATIONAL AIR MONITORING (Employee Exposure)

This section is to be used as a guide for occupational exposure monitoring. It contains basic requirements and strategy for occupational air monitoring associated with excavation projects. Project-specific monitoring strategies must be developed by FEMP when determined necessary by the cognizant FEMP Health & Safety Officer (HSO). The Subcontractor will incorporate its occupational exposure monitoring requirements into their FEMP-approved Safe Work Plan. These strategies will address the contaminants of concern for the specific project area.

### 6.4.1 Sampling Strategy

#### 6.4.1.1 Activities to be Sampled

Good work practices and engineering controls, including dust control measures, will maintain worker exposure levels of nonradioactive contaminants below OSHA/American Conference of Government and Industrial Hygienists (ACGIH) limits and exposures to airborne radioactive contaminants below 10 CFR 835 occupational exposure limits. Air monitoring will be performed to verify that worker exposures to contaminants are below these limits.

Monitoring will be conducted on those workers performing activities with the highest potential for exposure to the contaminants identified for the project. Those activities anticipated to have the highest exposure potential are:

- Workers on foot (e.g., spotters) in the active excavation area
- Equipment operators performing dumping, spreading and/or excavating
- Workers and equipment operators performing work within a Contamination Area.

In addition to personal sampling, radiological monitoring will be conducted at the perimeter of the active excavation area during remedial activities/construction to ensure that workers outside the project work area are not affected.

Monitoring requirements for all excavation work will be addressed in a project-specific air monitoring plan or the PSHSRM for that phase of the work as determined by FEMP HSO. All radiological monitoring activities will be conducted by FEMP Health & Safety personnel. The subcontractor shall conduct Industrial Hygiene monitoring (as required) and submit data to the FEMP HSO. The FEMP

Industrial Hygienist will conduct side-by-side occupational exposure monitoring periodically to verify subcontractor data.

The occupational air monitoring plan or PSHSRM will be reviewed every six months after the start of construction (or more often as needed) and will be modified as necessary by the HSO.

6.4.1.2 Contaminants of Concern

Air monitoring will be conducted for the contaminants identified or suspected within the project area. The following contaminants are likely to be encountered during excavation projects:

- Presumed asbestos-containing materials
- Dust, nuisance
- Metals
- Organic vapors
- Uranium (thorium if indicated as the isotope of concern).

Because of its relatively low concentrations, technetium-99 is not considered a contaminant of concern from a remedial worker health and safety standpoint.

6.4.1.3 Available Historical Data

In the preparation of project-specific monitoring requirements, FEMP Health & Safety personnel will use all available historical sample data [e.g., previous occupational and radiological monitoring/ sampling, remedial investigation/feasibility study (RI/FS) data, etc.]. This information will be considered when establishing initial PPE levels and sampling strategies. If occupational air monitoring data for an activity are not available, FEMP will implement a conservative approach in the specification of PPE until initial sample data become available.

6.4.1.4 Monitoring for Unidentified Contaminants

Air monitoring needs will be reviewed as work proceeds. Work activities will be reviewed, and available information on specific contaminants will be reviewed. The FEMP HSO will determine the need for worker exposure assessment/re-assessment based on the available information. Information to be reviewed, as available, includes:

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- Actual air monitoring data associated with the project (e.g., air monitoring results collected during excavation)
- Any chemicals/products used during the course of the project (e.g., glues, disinfectants, etc.)
- Reports of dusty conditions or the presence of unusual odors.

Material Safety Data Sheets (MSDSs) will be reviewed and evaluated by project construction management for any new products used during project work. If the MSDS indicates that a material to be used contains a hazardous component, a determination will be made as to the need for air monitoring based on the following factors: the potential for exposure considering the applicable occupational limits, the amount of the product to be used, the duration of the activity, and work practices and controls to minimize exposure.

### 6.4.2 Monitoring Methods and Frequency

#### 6.4.2.1 Personal Air Sampling Planned During Project Work

Asbestos

| | |
|---|---|
| Activity: | Handling/placement/covering of presumed asbestos-containing material |
| Frequency: | Subcontractor to collect samples daily, FEMP to collect samples weekly (when such activities are performed) |
| Number: | 25 percent of workers involved in each activity within the regulated asbestos area |
| Location: | Worker breathing zone |
| Method: | NIOSH 7400 or nationally recognized equivalent method (Note: NIOSH stands for the National Institute for Occupational Safety and Health.) |

Dust, Nuisance

| | |
|---|---|
| Activity: | General excavation activities |
| Frequency: | Monthly and as determined necessary by the FEMP Health & Safety representative |
| Number: | 25 percent of work force |
| Location: | Worker breathing zone |
| Method: | NIOSH 0600 or a nationally recognized equivalent method (Note: Direct reading instruments may be used at the direction of the FEMP Health & Safety Representative rather than using sample collection with subsequent analysis.) |

Metals

| | |
|---|---|
| Activity: | General excavation activities where metals have been determined to be a potential exposure concern |
| Frequency: | Monthly and as determined necessary by the Health & Safety Representative |
| Number: | 25 percent of work force |

Location: Worker breathing zone
Method: NIOSH 7300 or a nationally recognized equivalent method (Note: Direct reading instruments may be used at the direction of the FEMP Health & Safety Representative rather than using sample collection with subsequent analysis.)

Organic Vapors

Activity: General excavation activities where organic vapors have been determined to be a potential exposure concern
Frequency: As determined necessary by the Health & Safety Representative when materials with potential to produce organic vapors are discovered
Location: Worker breathing zone
Method: Direct reading photoionization detector (PID); sample collection with subsequent analysis by NIOSH/OSHA may be used upon review of particular impacted materials.

Airborne Radiological Contamination

Activity: Handling/placement/covering of radiologically contaminated material
Frequency: Daily (when such activities are performed)
Number: 25 percent of personnel in each work group (may vary based on work being performed and group being represented by sample)
Location: Worker breathing zone
Method: Lapel air samplers with in-line filters; samplers are collected after use and filters removed/replaced for counting on a low background counting instrument (after 7-day decay period); use "real time" dust monitoring data as an indicator of airborne radiological hazards in the field.

6.4.2.2 General Area Air Sampling Planned During Project Work

Asbestos

Activity: Handling/placement/covering of presumed asbestos-containing material
Frequency: Subcontractor to collect samples daily, FEMP to collect samples weekly (when such activities are performed)
Location: At the perimeter of the work area to include upwind and downwind locations
Method: NIOSH 7400 or a nationally recognized equivalent method.

Dust, Nuisance

Activity: General excavation activities
Frequency: Monthly and as determined necessary by the FEMP Health & Safety representative
Location: At the perimeter of the work area upwind and downwind
Method: NIOSH 0600 or a nationally recognized equivalent method (Note: Direct reading instruments may be used at the direction of the FEMP Health & Safety Representative rather than using sample collection with subsequent analysis.)

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Metals

| | |
|---|---|
| Activity: | General excavation activities where metals have been determined to be a potential exposure concern |
| Frequency: | Monthly and as determined necessary by the FEMP Health & Safety representative |
| Location: | At the perimeter of the work area upwind and downwind |
| Method: | NIOSH 7300 or a nationally recognized equivalent method (Note: Direct reading instruments may be used at the direction of the FEMP Health & Safety Representative rather than using sample collection with subsequent analysis.) |

Organic Vapors

| | |
|---|---|
| Activity: | General excavation activities where organic vapors have been determined to be a potential exposure concern |
| Frequency: | As determined necessary by the FEMP Health & Safety Representative |
| Location: | At the perimeter of the work area upwind and downwind |
| Method: | Direct reading PID (sample collection with subsequent analysis by NIOSH/OSHA recognized method may be used upon review of particular impacted materials.) |

Airborne Radiological Contamination

| | |
|---|---|
| Activity: | Handling/decontamination of radiologically contaminated material within a significantly contaminated area (e.g., from Production Area and waste storage/management units) |
| Frequency: | Daily (when such activities are performed) |
| Location: | At the perimeter of the work area to include upwind and downwind locations |
| Method: | Low-volume air samplers with in-line filters; filters are removed/replaced each day and counted on a low-background counting instrument (after 7-day decay period) |
| Note: | Generally, project-specific air monitoring is not required during remediation for soil contamination areas outside of the Former Production Area and waste storage/management units. |

### 6.4.3 Results and Action Levels

See Table 6-1 for monitoring levels and action levels.

### 6.4.4 Data Reporting and Documentation

Results of air monitoring will be documented and will be summarized/provided to project management for use, and will be supplied to the appropriate FEMP Health & Safety Officer. The HSO will ensure that all needed documentation is provided in a timely manner to the project personnel. Involved workers will be informed of the results of personal air sampling as required by OSHA and/or 10 CFR 835.

6.4.5 Quality Assurance

6.4.5.1 Calibration/Analysis Requirements

All monitoring/sampling will be performed by qualified and trained personnel using appropriate methods, and following manufacturer's instructions for equipment operation and maintenance.

Personal air sampling pumps will be calibrated before and after use each day. Nonradiological samples will be analyzed by appropriate OSHA or NIOSH methods, and radiological samples will be analyzed by FEMP-approved Radiological Control methods (to meet the limits specified in 10 CFR 835 and DOE/EH-0256T, DOE Radiological Controls Manual). Real-time air monitoring instruments will be calibrated according to manufacturer's recommendations before being used in the field.

6.4.5.2 Sample Chain of Custody

Collected samples will remain in the custody of the sampling personnel, transportation personnel, or analytical personnel (or locked) at all times. Chain of custody will be documented on forms that accompany the sample from collection through analysis.

6.4.5.3 Sample Blanks

Appropriate blanks, as defined by analytical method, will be provided for analysis.

6.4.5.4 Special Sample Storage/Handling Requirements

Special sample storage/handling requirements will conform to those of the OSHA or NIOSH analytical method in use.

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# TABLE 6-1

## OCCUPATIONAL MONITORING AND ACTION LEVELS

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| Asbestos | 0.1 (f/cc) 8-hour time-weighted average (TWA) limit (OSHA) | Workers performing work inside regulated asbestos areas will be required to wear an air purifying respirator with HEPA cartridges.<br><br>≥0.1 f/cc.<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Ensure controls prescribed in the OSHA asbestos standard including the use of an air purifying respirators with HEPA cartridges have been implemented. | ≥0.01 f/cc.<br>Modify work practices and/or engineering controls to ensure fiber levels outside the asbestos work area are maintained below this level. (When fiber levels exceed 0.1 f/cc, further analysis of the sample by TEM may be used to confirm the presence/absence of asbestos fibers on the sample.) Expand the controlled area. |
| Nuisance Dust (Respirable) | 3 mg/m$^3$ 8-hour TWA (ACGIH) | ≥1.5 mg/m$^3$.<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Require use of half-mask or full-face air purifying respirator s with HEPA cartridges.<br><br>≥15 mg/m$^3$.<br>**Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application.** Require use of full-face air purifying respirators with HEPA cartridges. | ≥1.5 mg/m$^3$.<br>Modify work practices and/or engineering controls to ensure dust levels outside the work area are maintained below this level. Expand the controlled area. |

000314

**TABLE 6-1**

(Continued)

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| (Total or Inhalable) | 10 mg/m$^3$ 8-hour TWA (ACGIH) | ≥5 mg/m$^3$ 8-hour TWA or ≥ 10 mg/m$^3$ 15 minute average<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Require use of half-mask or full-face air purifying respirators with HEPA cartridges.<br>≥50 mg/m$^3$<br>**Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application.** Require use of full-face air purifying respirators with HEPA cartridges. | ≥5 mg/m$^3$ 8-hour TWA or ≥ 10 mg/m$^3$ 15 minute average<br>Modify work practices and/or engineering controls to ensure dust levels outside the work area are maintained below this level. Expand the controlled area. |
| Metals | Various [1] e.g.;<br>lead: 0.050 mg/m$^3$ 8-hour TWA (OSHA);<br>arsenic: 0.010 mg/m$^3$ 8-hour TWA (OSHA) | ≥Action level [b]. (e.g., 0.030 mg lead/m$^3$ 8-hour TWA ≥0.005 mg arsenic/m$^3$ 8-hour TWA)<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Require use of half-mask or full-face air purifying respirators with HEPA cartridges, dependent on results. | ≥Action level [b].<br>Modify work practices and/or engineering controls to ensure metals levels outside the work area are maintained below this level (e.g., lead: 0.030 mg/m$^3$ 8-hour TWA; arsenic: 0.005 mg/m$^3$ 8-hour TWA). The controlled area will be expanded |

**TABLE 6-1**

(Continued)

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| Organic Vapors | Various [a] (see action levels) | Detection to 5 ppm 8-hour TWA, or detection to 25 ppm STEL (PID).<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application, work practices, and engineering controls. Require use of respirators with combination cartridges. Perform monitoring with direct reading instruments, or collect air samples to identify and quantify contaminants. Re-establish controls and PPE (e.g., respirator requirements) based on action level for the specific contaminant.<br>> 5 ppm 8-hour TWA, or > 25 ppm STEL (PID).<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Perform monitoring with direct reading instruments, or collect air samples to identify and quantify contaminants. Re-evaluate respirator requirements. | > 5 ppm.<br>Modify work practices and/or engineering controls to ensure vapor levels outside the work area are maintained below this level. Expand the controlled area. Perform monitoring with direct reading instruments, or collect air samples to identify and quantify contaminants. Re-establish controls based on action level [2] for the specific contaminant. |

000316

**TABLE 6-1**

(Continued)

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| Radiological | Applicable DAC's:<br>Uranium:<br>2E-11 :Ci/cc<br>Th-230:<br>3E-12 :Ci/cc<br>Th-232:<br>5E-13 :Ci/cc<br>Radon:<br>0.3 Working Levels (WL)<br>Thoron:<br>1.0 Working Levels (WL) | At 4 DAC-Hrs per week, as indicated by Breathing Zone air sample results with applied respiratory protection factor (if respirator worn), work practices, administrative controls, and engineering controls will be re-evaluated (e.g., dust control, respiratory protection) and proper application ensured. Respiratory protection types:<br>• Full Face Air Purifying Respirator (FFAPR) with HEPA or combination cartridge (50 PF)<br>• Full Face Powered Air Purifying Respirator (FFPAPR), Mask Mounted type (MM) with HEPA cartridge only or Belt mounted type (6A) with HEPA or combination cartridge (1000 PF). PAPR may be required for metal burning/torch cutting or highly contaminated work.<br><br>At ≥ 10% DAC, as indicated by General Area air sample results, re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Post the affected area as an Airborne Radioactivity Area.<br>At ≥ 1 DAC, as indicated by General Area air sample results, control occupational exposure by the use of respiratory protection (required at ≥ 1 DAC). Re-evaluate work practices, engineering controls, and any existing respiratory protection requirements (including applicable respiratory protection factors). | At 10% DAC, modify work practices and/or engineering controls to ensure airborne radiological contamination levels are maintained below 10% DAC at the perimeter and below 2% DAC outside of the posted construction area (based on a weekly average). If boundaries exceed 10% DAC (based on a weekly average) the radiological area boundary will be expanded. Perform monitoring with direct reading instruments, and collect air samples to verify boundaries are posted correctly. |

[a]Limit for occupational exposure control will be the current OSHA or ACGIH limit (whichever is lower).

[b]Action level for occupational exposure control will be the current OSHA or ACGIH limit (whichever is lower) x 0.5, or as otherwise established by OSHA.

# TABLE 6-1

## OCCUPATIONAL MONITORING AND ACTION LEVELS

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| Asbestos | 0.1 (f/cc) 8-hour time-weighted average (TWA) limit (OSHA) | Workers performing work inside regulated asbestos areas will be required to wear an air purifying respirator with HEPA cartridges.<br><br>≥0.1 f/cc.<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Ensure controls prescribed in the OSHA asbestos standard including the use of an air purifying respirators with HEPA cartridges have been implemented. | ≥0.01 f/cc.<br>Modify work practices and/or engineering controls to ensure fiber levels outside the asbestos work area are maintained below this level. (When fiber levels exceed 0.1 f/cc, further analysis of the sample by TEM may be used to confirm the presence/absence of asbestos fibers on the sample.) Expand the controlled area. |
| Nuisance Dust (Respirable) | 3 $mg/m^3$ 8-hour TWA (ACGIH) | ≥1.5 $mg/m^3$.<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Require use of half-mask or full-face air purifying respirator s with HEPA cartridges.<br><br>≥15 $mg/m^3$.<br>**Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application.** Require use of full-face air purifying respirators with HEPA cartridges. | ≥1.5 $mg/m^3$.<br>Modify work practices and/or engineering controls to ensure dust levels outside the work area are maintained below this level. Expand the controlled area. |

000318

**TABLE 6-1**

(Continued)

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| (Total or Inhalable) | 10 mg/m$^3$ 8-hour TWA (ACGIH) | ≥5 mg/m$^3$ 8-hour TWA or ≥ 10 mg/m$^3$ 15 minute average<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Require use of half-mask or full-face air purifying respirators with HEPA cartridges.<br>≥50 mg/m$^3$<br>**Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application.** Require use of full-face air purifying respirators with HEPA cartridges. | ≥5 mg/m$^3$ 8-hour TWA or ≥ 10 mg/m$^3$ 15 minute average<br>Modify work practices and/or engineering controls to ensure dust levels outside the work area are maintained below this level. Expand the controlled area. |
| Metals | Various [1] e.g.;<br>lead: 0.050 mg/m$^3$ 8-hour TWA (OSHA);<br>arsenic: 0.010 mg/m$^3$ 8-hour TWA (OSHA) | ≥Action level [b]. (e.g., 0.030 mg lead/m$^3$ 8-hour TWA ≥0.005 mg arsenic/m$^3$ 8-hour TWA)<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Require use of half-mask or full-face air purifying respirators with HEPA cartridges, dependent on results. | ≥Action level [b].<br>Modify work practices and/or engineering controls to ensure metals levels outside the work area are maintained below this level (e.g., lead: 0.030 mg/m$^3$ 8-hour TWA; arsenic: 0.005 mg/m$^3$ 8-hour TWA). The controlled area will be expanded |

**TABLE 6-1**

(Continued)

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| Organic Vapors | Various [a] (see action levels) | Detection to 5 ppm 8-hour TWA, or detection to 25 ppm STEL (PID).<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application, work practices, and engineering controls. Require use of respirators with combination cartridges. Perform monitoring with direct reading instruments, or collect air samples to identify and quantify contaminants. Re-establish controls and PPE (e.g., respirator requirements) based on action level for the specific contaminant.<br>> 5 ppm 8-hour TWA, or > 25 ppm STEL (PID).<br>Re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Perform monitoring with direct reading instruments, or collect air samples to identify and quantify contaminants. Re-evaluate respirator requirements. | > 5 ppm.<br>Modify work practices and/or engineering controls to ensure vapor levels outside the work area are maintained below this level. Expand the controlled area. Perform monitoring with direct reading instruments, or collect air samples to identify and quantify contaminants. Re-establish controls based on action level [2] for the specific contaminant. |

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**TABLE 6-1**

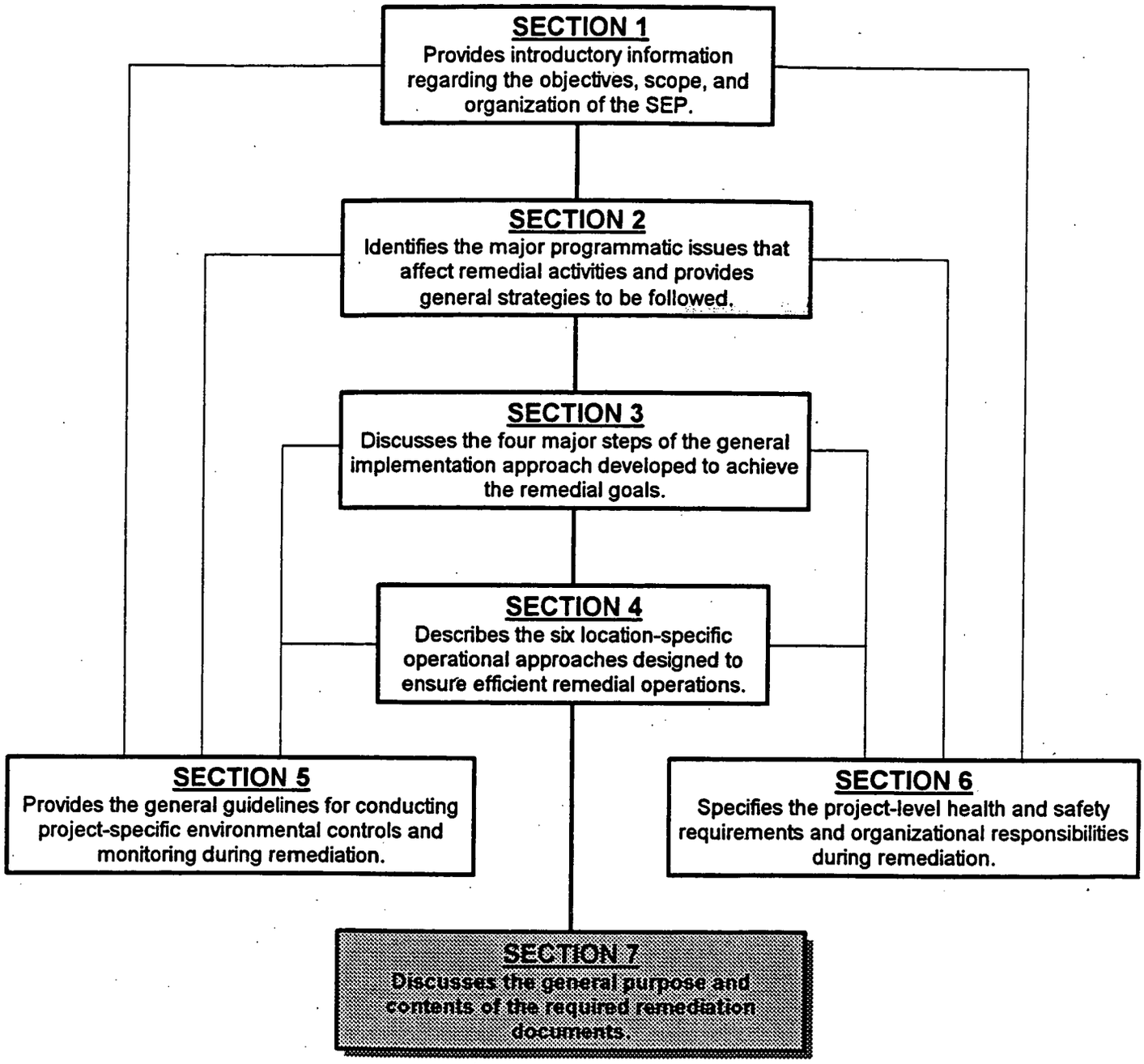
(Continued)

| Contaminant | Permissible Exposure Limits (PEL) or Derived Air Concentration (DAC) | Action Levels - Worker Protection | Action Levels - Perimeter |
|---|---|---|---|
| Radiological | Applicable DAC's:<br>Uranium:<br>2E-11 :Ci/cc<br>Th-230:<br>3E-12 :Ci/cc<br>Th-232:<br>5E-13 :Ci/cc<br>Radon:<br>0.3 Working Levels (WL)<br>Thoron:<br>1.0 Working Levels (WL) | At 4 DAC-Hrs per week, as indicated by Breathing Zone air sample results with applied respiratory protection factor (if respirator worn), work practices, administrative controls, and engineering controls will be re-evaluated (e.g., dust control, respiratory protection) and proper application ensured. Respiratory protection types:<br>• Full Face Air Purifying Respirator (FFAPR) with HEPA or combination cartridge (50 PF)<br>• Full Face Powered Air Purifying Respirator (FFPAPR), Mask Mounted type (MM) with HEPA cartridge only or Belt mounted type (6A) with HEPA or combination cartridge (1000 PF). PAPR may be required for metal burning/torch cutting or highly contaminated work.<br><br>At ≥ 10% DAC, as indicated by General Area air sample results, re-evaluate work practices and engineering controls (e.g., dust control) and ensure proper application. Post the affected area as an Airborne Radioactivity Area.<br>At ≥ 1 DAC, as indicated by General Area air sample results, control occupational exposure by the use of respiratory protection (required at ≥ 1 DAC). Re-evaluate work practices, engineering controls, and any existing respiratory protection requirements (including applicable respiratory protection factors). | At 10% DAC, modify work practices and/or engineering controls to ensure airborne radiological contamination levels are maintained below 10% DAC at the perimeter and below 2% DAC outside of the posted construction area (based on a weekly average). If boundaries exceed 10% DAC (based on a weekly average) the radiological area boundary will be expanded. Perform monitoring with direct reading instruments, and collect air samples to verify boundaries are posted correctly. |

[a]Limit for occupational exposure control will be the current OSHA or ACGIH limit (whichever is lower).

[b]Action level for occupational exposure control will be the current OSHA or ACGIH limit (whichever is lower) x 0.5, or as otherwise established by OSHA.

# SITEWIDE EXCAVATION PLAN




**APPENDIX A** - Soil Remediation ARARs and TBCs
**APPENDIX B** - Sitewide Sequencing Plan
**APPENDIX C** - Constituent of Ecological Concern Selection
**APPENDIX D** - Wood Sampling Program
**APPENDIX E** - SEP Quality Assurance Project Plan (QAPP)
**APPENDIX F** - Implementation of Construction and Waste Management Practices
**APPENDIX G** - Certification Design Rationale
**APPENDIX H** - Summary of Field Measurement and Laboratory Analytical Technologies
**APPENDIX I** - Sitewide Extent Of Contamination By Constituent

# 7.0 SOIL REMEDIATION DOCUMENTS

The Sitewide Excavation Plan (SEP) addresses sitewide planning for soil excavation and provides the management strategy and technical guidelines necessary to govern soil remediation at the Fernald Environmental Monitoring Project (FEMP). Information included in the SEP consists of methods and protocols that will be consistently used during each phase of remediation from predesign investigation to final cleanup certification. The SEP also presents area-specific information regarding the nature and extent of contamination as well as various physical conditions (e.g., depth of excavation) expected throughout the FEMP during remediation.

Area-specific integrated remedial design packages (IRDPs) will be prepared for each remediation area in phases that correlate to the sequence of implementing remedial action. Phasing of these remedial design deliverables will accomplish two goals: 1) expedite remediation to facilitate the accelerated plan and 2) incorporate the lessons learned. This concept was identified in the Operable Unit 5 FS Report (DOE 1995b), based on guidance on expediting remedial design and remedial action in "Guidance on EPA Oversight of Remedial Designs and Remedial Actions Performed by Potentially Responsible Parties" (EPA 1990a). The guidance suggests that accelerated cleanup can be achieved by phasing a project into meaningful remedial work elements that can be implemented on different schedules, an approach which results in acceleration of remedial design and remedial action. After completion of soil remedial action according to an area-specific IRDP, an area-specific Certification Design Letter (CDL) and Certification Report will be prepared to guide and document the certification process that is necessary to demonstrate attainment of all the remedial requirements listed in the SEP.

Figure 7-1 and Table 7-1 summarize types and timing of the planned soil remediation documents during typical steps of area-specific soil remediation. Figure 7-2 shows the hierarchy of the soil remediation documents as well as phasing of the sitewide soil remediation. As shown on Figure 7-2, the IRDPs address only the area-specific remedial actions. Following completion of the remedial action, certification will be conducted according to the general protocols provided in Sections 3.0 and 4.0 of this SEP and will be documented in the area-specific CDL and the Certification Report. This section describes the purposes, contents, and hierarchy of the three major area-specific soil remediation documents (i.e., IRDP, CDL, and Certification Report) to be prepared in phases during

the FEMP soil remediation according to the SEP management strategy and technical guidelines. Predesign investigations conducted prior to preparation of each of these documents will be documented through the development of PSPs and data summary reports. Finally, a description is given of three other sitewide future documents (i.e., Natural Resources Restoration Plan, Remedial Action Report, and Site Closeout Report) that are planned and/or required to complete the remediation process at the FEMP.

## 7.1 PROJECT-SPECIFIC PLANS

Project Specific Plans (PSPs) will be developed prior to all field investigations that are carried out to collect identified data needs for a remediation area. The PSPs will be developed and implemented during predesign, precertification, and certification activities (Figure 7-1). One or more predesign PSPs will be used to collect additional data needed to: 1) refine the estimated extent of excavation required to meet FRLs, 2) delineate above-WAC areas, and 3) determine the presence or absence of HWMU and UST COCs in their respective footprints. The PSP for precertification activities will be used to assess the readiness of the area for the certification and to develop the CDL. Prior to conducting the certification sampling, a PSP will be developed that reflects the sampling strategy and design presented in the Certification Design Letter (CDL). The results of the certification sampling will be recorded in certification reports. A data summary report will be generated for each PSP to provide a unique record of the findings for each PSP and will be incorporated into the appropriate document. Most of the data summary reports will be incorporated into the IRDPs. The content of PSPs and data summary reports are described in the following sections.

### 7.1.1 Content of Project-Specific Plans

Several PSPs will be developed in each remediation area to address the variety of characterization and geotechnical issues associated with the predesign, precertification, and certification activities. The general content of a PSP will reflect the following information:

- An introduction that provides the background information that is pertinent to the scope of work to be performed (including a history of former investigations and removal actions)
- The scope of work to be executed, including each type of investigative strategy (e.g., geoprobe borings, HPGe, etc.) and associated sampling locations, sample identification, and type of equipment

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- Justification for the list of COCs to be investigated (i.e, COCs that may exceed the FRLs and OSDF WAC)
- All applicable QA/QC protocols, including sample collection methods and equipment operation procedures
- Tables that summarize sample and/or boring locations, depths, analytes and anticipated coordinates. These are typically included as an appendix. Figures will also be presented to show sample locations, relative to existing data points and current modeled extent of excavation
- The analytical approach will be presented to show analytical methods, constituent holding times, and ASLs.
- A contingency plan that identifies potential additional sampling locations based on the analytical results of the initial investigation.

In addition, each PSP will be consistent with the SCQ, and the appropriate DQO will be attached as an appendix to the PSP.

7.1.2 Content of Data Summary Reports

Each PSP will be followed up with a Data Summary Report, if appropriate, or a data summary in the IRDP. The purpose of these reports is to briefly present the results of a field investigation. This information may be used later in the area-specific IRDP and Certification Design Letter to refine the excavation footprint and sampling design, respectively. At a minimum, each data summary report will include a:

- Summary of field activities and approved variances during implementation of the PSP
- Table of analytical results
- Figures and discussions of analytical trends
- Figures of cross-sections and plan views of sample locations, where appropriate
- Updated excavation models for areas exceeding the FRL and WAC, and refinement of HWMU and UST footprints.

## 7.2 INTEGRATED REMEDIAL DESIGN PACKAGE

The IRDPs will be prepared for individual areas or a combination of the remediation areas Figure 7-2. Area-specific information (e.g., results of the predesign investigation) required to conduct soil remediation according to the SEP technical guidelines and appropriate area-specific implementation approaches (Section 4.0) will be combined and presented in each IRDP. Each IRDP will also include an area-specific implementation plan that incorporates the area-specific elements of a Remedial Action (RA) work plan, design drawings, and specifications. The information to be provided in the general scope of work for each of these deliverables is summarized in Section 7.2.1. Each IRDP will incorporate the lessons learned concept so that remedial action can be streamlined for each subsequent phase of soil remediation.

### 7.2.1 Design Package Components

The IRDPs will provide area-specific details of implementation of the sitewide remediation strategy outlined in the SEP. The general content to be included in an IRDP is listed below.

Implementation Plan:

- Schedule of remedial activities
- Scope of work and boundaries of the data, including areas of remediation
- Summary of existing RI data, process knowledge, and/or additional predesign investigation data to perform remediation
- Summary of subsurface conditions (e.g., piping, structure foundation, pile, perched water zone, and soil geotechnical properties), if necessary
- Summary of known extent of contamination and special materials
- Summary of applicable final remediation levels (FRLs) and waste acceptance criteria (WAC)
- Identification of area-specific constituents of concern
- Anticipated excavation boundaries
- Area-specific access control requirements
- Area-specific excavation approaches

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- Excavation control elements (e.g., monitoring equipment)
- Erosion and surface water control, if necessary
- Dewatering and perched water control, if necessary
- Precertification evaluation protocols, to determine that actions are complete.

Design Drawings:

- Site preparation and temporary facilities location
- Excavation plan and cross-sections
- Excavation plan and design boundaries, model results, and characterization data used in the model
- Storm water control elements
- Erosion and sediment control
- Interim Grading Plan (to be conducted after certification)
- Decontamination facility utilities to be saved/removed
- Survey monuments

Specifications:

- General requirements
  - Summary of work
  - Submittal schedule
  - Health and safety requirements
  - Mobilization and site access
  - Quality assurance/quality control requirements
  - Management of impacted material
- Construction-related items
  - Dust control measures
  - Erosion control measures
  - Excavation requirements
  - Demolition requirements
  - Dewatering requirements
  - Waste handling/disposition
  - Interim restoration
  - Process piping.

- Project cost estimation
- Comment responses.

### 7.2.3 Schedule

The phasing of the remedial design deliverables is presented on Figure 7-2. Each IRDP is listed in the sequence in which remediation is anticipated to occur under the accelerated sitewide remediation plan. Integration with other projects' schedules were taken into consideration. Each IRDP will be submitted following completions of area-specific pre-excavation investigation and initial design activities. The submittal schedule for the IRDP deliverable is defined in Table 1-5. Soil remedial actions will commence and continue, with the schedules for remedial actions to be identified in the individual IRDPs.

### 7.2.4 Review and Finalization of Design Deliverables

Each IRDP will be submitted to EPA and OEPA for approval prior to implementation. DOE will formally respond to EPA and OEPA comments within 30 days of receipt of agency comments. Upon approval of the IRDP or conditional approval by the agencies of the responses to comments, remediation excavation may commence. Necessary revisions to the IRDP will then be incorporated and a final document transmitted. As a general practice, the FEMP does not intend to initiate IRDP-based field work unless either a conditional or final agency approval of the IRDP is obtained. Whenever possible, the submittal of draft IRDPs will be scheduled such that sufficient time is made available to submit a revised document for review and approval prior to the need to initiate excavation activities. Under select schedule-driven circumstances, the FEMP may need to request conditional approval of an IRDP based on agency review of detailed comment responses and/or change pages or revised drawings from the document. If a remediation area is determined to provide unique or unanticipated remediation challenges, DOE may request a formal preliminary review for a design deliverable not already considered in the Operable Unit 5 RD Work Plan (DOE 1996a) and this SEP.

## 7.3 CERTIFICATION DESIGN LETTER

A CDL will be prepared and submitted to the regulatory agencies following completion of the area-specific IRDP tasks, including precertification activities (Section 3.3), as a notification to initiate the certification process for the remediated areas. The CDLs will first provide a summary of the area-specific remediation completed and results of the precertification activities conducted according to the

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SEP guidelines. The main focus of the CDLs will be the delineation of certification units (CUs), the CU-specific certification COCs, the location of certification samples, and the certification sampling approaches. Once sample locations have been confirmed by field check as accessible for soil collection, they may not be moved without prior consent of the EPA and OEPA.

### 7.3.1 Contents

Although a formal regulatory review and comment-response process is not intended for the CDLs, they will provide the regulatory agencies opportunities to evaluate the certification approach before the actual certification process is completed. Modifications to the certification process can be incorporated upon specific regulatory requests, if necessary. Each certification design letter will also be combined into the final area-specific certification report at the end of a certification process for formal regulatory review comment and approval. The general content to be included in a CDL is as follows.

Implementation Plan:

- Schedule of the certification activities
- Scope of work and boundaries of the data, including areas of remediation
- Summary of the precertification scan and/or measurement data
- Summary of known pattern and/or extent of residual contamination
- Summary of applicable FRLs
- Identification of CU-specific constituents of concern for certification purposes
- Summary of the certification sampling/measurement and/or laboratory analysis methods

Design Drawings:

- CU delineation maps
- Certification sampling locations
- Storm water control elements during certification
- Erosion and sediment control during certification
- Survey monuments.

### 7.3.2 Schedule

In general, an area-specific CDL will be prepared within 30 days after successful completion of the remedial action specified in a corresponding area-specific IRDP and the precertification activities in the remediated area according to the SEP guidelines. Certification sampling and analysis will commence immediately after a regulatory review and approval of the CDL.

## 7.4 CERTIFICATION REPORT

The SEP and area-specific Implementation Plans (as part of the area-specific IRDPs) together will satisfy the RAWP requirements as presented in the Amended Consent Agreement (ACA) (EPA 1991). Certification Reports will be used to progressively demonstrate that the remedial action objectives are completed for soil remediation, although the Certification Report is not required in accordance with EPA guidance or the ACA. The intent of submitting a Certification Report for each phase of a remediation area is to receive acknowledgment that the pertinent operable unit remedial actions were achieved so that natural resource restoration can proceed as rapidly as possible. The certification reporting process will occur in two steps:

- First, following evaluation, graphical presentations of important new certification data demonstrating remediation progress (e.g., residual concentration contours of the primary COCs, pictures of the excavated areas, etc.) will be prepared, updated, and quickly loaded onto a website on the Internet to allow electronic access of the latest site conditions for the regulatory agencies.
- Second, upon completion of all certification data demonstrating that FRLs are achieved for all the CUs in the remediated area, a formal certification report will be submitted to the agencies. Upon regulatory acceptance of certification, the remediated area will be ready for interim grading or final natural resource restoration activities.

An area-specific Certification Report will be prepared after the remedial action and precertification activities are completed for each of the remediation areas described in Section 1.0. As the final area-specific remediation deliverable, the main objectives of the Certification Reports are to document what remedial actions occurred in specific areas, describe the certification process, present the data supporting the certification that the ASCOCs do not exceed the FRLs specified in the relevant RODs, satisfy HWMU and UST closure requirements, summarize the data/manifests generated during remediation for WAC attainment demonstration, and describe access controls implemented to prevent recontamination.

### 7.4.1 Contents

Each Certification Report will include the following:

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- Introduction. A general description will be included of how the area-specific remedy was implemented.

- Chronology of Events. Major events associated with the remedial action will be provided, beginning with the approvals of the IRDP and a selected construction subcontractor.

- Performance Standards and Construction Quality Control. The criteria or requirements that are necessary to demonstrate completion of remedial action in a remediation area as defined in the IRDP and the Certification Design Letter will be included.

- Construction Activities. A narrative description of construction activities undertaken for the relevant phase of remediation will be included. This includes an estimate of quantities excavated/treated/disposed, achievement of FRLs, and materials and/or equipment used. Participants in the remedial action will also be identified, including federal and state agencies, and construction contractors.

- Summary of Material and Data Tracking. A summary of data, records, and manifests generated during the remediation for material balance, WAC attainment, treatment, transportation, and disposition purposes will be provided.

- Certification that the Remedy Is Operational and Functional. Certification will be an affirmation that performance standards have been met for the excavation of contaminated material. The basis for the determination will also be provided.

- Statistical Summary Tables. Statistical analysis results will be provided which support the certification decision (Table 7-2).

- Summary of Project Cost. The final costs for the remediation phase will be summarized and compared to the original remedial action estimate provided in the IRDP.

Information on lessons learned will also be provided to facilitate improvement in each subsequent phase of remediation. Identification of problems encountered during excavation will be supplemented with proposed solutions to streamline the next phase of remediation.

### 7.4.2 Certification Report Outline

Each certification report will be organized to present the contents listed in Section 7.4.1, and all the details of an area-specific certification process conducted following precertification activities as described in the SEP sitewide management strategy and technical guidelines. Data generated throughout the remediation, precertification, and certification activities will also be presented and

analyzed to support the certification conclusions. Following is a model outline for the future Certification Reports.

## MODEL OUTLINE FOR THE CERTIFICATION REPORTS

**EXECUTIVE SUMMARY**
**LIST OF TABLES**
**LIST OF FIGURES**
**LIST OF ACRONYMS AND ABBREVIATIONS**

**1.0 INTRODUCTION**
- 1.1 Purpose
- 1.2 Background
- 1.3 Area Description
- 1.4 Scope
- 1.5 Objectives
- 1.6 Report Format
- 1.7 FEMP Certification Master Map

**2.0 CERTIFICATION APPROACH**
- 2.1 Certification Strategy
  - 2.1.1 Area Specific Constituents of Concern
  - 2.1.2 ASCOC Selection Criteria
  - 2.1.3 ASCOC Selection Process
- 2.2 Certification Approach
  - 2.2.1 Certification Design
- 2.2.2 Sample Selection Process
- 2.2.3 Certification Sampling
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5.2 Certification Conclusions

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References

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Any other relevant area-specific information and/or procedures that have not been already described in the SEP and are not suitable for the main text of a Certification Report will also be presented in appendices to facilitate more detailed review processes. Examples of topics to be presented in the appendix section may include:

- CU maps and statistical tables
- Certification data summary tables
- Certification PSPs
- WAC attainment summary
- Project cost summary
- Comment responses.

7.4.3 Schedule, Review and Finalization

The area-specific Certification Reports will be prepared for the phases established for the IRDPs, as described in Section 7.2. An independent QA review will be conducted on the Certification Report to verify that the content and quality of reported information meets the QA/QC protocols discussed in the QAPP (Appendix E). A draft area-specific Certification Report will be submitted generally within 120 days following completion of the certification activities conducted for a remediated area (i.e., receipt of data satisfying the FRLs). The DOE will formally address all EPA and OEPA comments on the draft certification reports through the submittal of a comment-response document generally within

30 days of receipt of the agencies' comments. Comments will be incorporated into each certification report, and revisions will be formally submitted for the reports.

## 7.5 OTHER RELATED FUTURE DOCUMENTS

Three other major sitewide or operable-unit-specific documents are planned and/or required to guide and document the completion of the remediation at the FEMP. They include the Natural Resource Restoration Plan, the Remedial Action Report, and the Site Closeout Report. The Natural Resource Restoration Plan generally defines the site restoration strategy. The Remedial Action Report and the Site Closeout Report are prepared to document completions of major remedial milestones. Table 7-3 summarizes and compares the scopes and contents of the Certification Report (including the Certification Design Letter), Remedial Action Report, and Site Closeout Report intended for the area-specific, operable-unit-specific, and sitewide scales, respectively. The following subsections describe the purposes and contents of these documents. Figure 7-3 shows the organizational structure of and relationships between the major remediation documents to be prepared.

### 7.5.1 Natural Resources Restoration Plan and Design Packages

Strategy for restoration of the natural resources after site remediation will be provided in the Natural Resources Restoration Plan (NRRP). A conceptual final land use design will be presented in the NRRP, as negotiated among DOE, regulators, the Natural Resource Trustees, and other stakeholders. In general, the NRRP will be consistent with the final land use scenario selected during the Operable Unit 5 FS (DOE 1995b) in which the site will be maintained as an undeveloped park after remediation. Any local, interim grading to be conducted immediately after certification of a remediated area will be designed (in the IRDP) considering the final sitewide grading plan presented in the final NRRP, to minimize the potential amount of rework during the sitewide final grading and restoration. The NRRP will also fulfill the requirements in the Amended Consent Agreement (EPA 1991) for a land use plan and an institutional control plan for Operable Unit 5.

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Area-specific Natural Resource Restoration Design Packages (NRRDPs) will be developed pursuant to the conceptual sitewide restoration set forth in the NRRP. The NRRDPs will contain detailed design drawings and specifications regarding final grading, site preparation, re-seeding, vegetation planting, installation of structures, and maintenance. DOE will obtain approval for each NRRDP from EPA, OEPA and Natural Resource Trustees prior to implementation.

### 7.5.2 Remedial Action Report

Upon completion of remedial action, each operable unit must complete a Remedial Action Report (EPA 1992b). The purpose and content of the Remedial Action Report is to document the activities that occurred under remediation for each operable unit. The Remedial Action Report shows how the remedial objectives for each operable unit were met and summarizes the information necessary for inclusion in the Site Closeout Report. One Remedial Action Report will be written that covers remediation of the Operable Unit 2 waste units, Operable Unit 5 soil, and Operable Unit 3 at- and below-grade debris; the Certification Reports for the individual soil remediation areas will be generally used as the basis for preparing the Remedial Action Report. Operable Unit 1, Operable Unit 4, and the remaining portions of Operable Units 3 and 5 will be addressed in separate remedial action reports.

A Remedial Action Report contains the following basic elements, which are similar to the content of a Certification Report, with a few exceptions:

- Introduction. This section provides a short general description of the site and the remedy implemented.
- Chronology. A summary of the major events associated with the remedial action is included.
- Performance Standards and Construction Quality Control. This section summarizes the criteria or requirements that the remedial action contractor met in completing the project and the basis for determining that the standard was met. This section also provides a summary of the implementation of the construction quality control plan and provides an assurance that the remedial action is complete.

- Final Inspection. This section documents the pre-final and final inspections conducted by the contracting party and contractor at the completion of construction.

- Certification that the Remedy is Operational and Functional. An affirmation is presented that the performance standards have been met.

- Summary of Project Costs. This section provides the final costs for the project and compares them to the original remedial action estimate.

### 7.5.3 Site Closeout Report

After the Remedial Action Report of the last operable unit has been submitted to show the successful implementation of remedial action, a Site Closeout Report will be prepared for the entire site. The Remedial Action Reports are generally used as the basis for preparing the Site Closeout Report and contribute to the ultimate decision regarding deletion from the Superfund National Priorities List (NPL) (EPA 1989). The Site Closeout Report shows that remediation of the entire site has been completed. It is important to note that in cases where waste has been left on site, such as at the FEMP, the five-year review procedures established in Section 121(e) of CERCLA, as amended by SARA, will continue to be appropriate regardless of the completion or deletion status of the site.

Site completion occurs when the following conditions have been met:

- Cleanup levels have been achieved and all cleanup actions have been successfully implemented pursuant to the RODs

- The site is protective of human health and the environment across all pathways of exposure

- The constructed remedy is operational and functional and performing according to engineering design specification

- The only activities remaining at the site are operations and maintenance (O&M) activities.

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Operable Unit 5 may be considered to have a Long-Term Response Action (LTRA) for cleanup of the

Great Miami Aquifer. If this is determined to be the case, an Interim Closeout Report will be prepared. It will contain final information for all completed operable units at the site and will describe the LTRA activities to be performed and the cleanup levels to be achieved for the LTRA portion of the site. Therefore, this report must be prepared after all the other operable unit cleanup activities have been finalized, and after those organizations have prepared their respective Remedial Action Reports. The interim report will act as the determining factor for designating sites as LTRA on the NPL and for internal Superfund tracking. At this point, OEPA will be expected to assume responsibility for the LTRA oversight. The Interim Closeout Report will be amended when cleanup levels are achieved to include final information for the LTRA operable unit (Operable Unit 5) to satisfy completion requirements. The Interim Closeout Report and the amendment together will constitute the final Site Closeout Report, which indicates that remediation of the entire site has been completed. This report should include the following:

- Summary of Site Condition: Site background, RI/FS results, ROD summary, design criteria, community relations, and cleanup activities performed will be summarized.

- Demonstration of QA/QC from Cleanup Activities: This includes documentation that QA/QC and sampling and analyses protocol were followed, results of on-site inspections, and equipment acceptance records.

- Monitoring Results: Sufficient data will be available to demonstrate that the cleanup levels specified in the RODs were achieved and that implemented remedies are performing at design specifications. This section would be contained in the amendment to the Interim Closeout Report for any LTRA operable units.

- Summary of Operation and Maintenance: Assurance will be given that:

  - O&M plans are in place and are sufficient to maintain the protectiveness of the remedy.

  - All necessary institutional controls (e.g., deed restrictions) are in place.

- Protectiveness: Results of the sitewide postremedial risk assessment will demonstrate the relative protectiveness of remediation at the FEMP.

- Bibliography: All referenced documents and any other documents relevant to completion of the site will be included.

NPL Deletion Criteria allow sites to be deleted from, or recategorized on, the NPL in instances where no further response is appropriate [Section 300.66(c)(7) of the NCP] when the EPA and the state agree that all response actions are completed. The deletion docket is not a continuation of the administrative record for the site, although documents contained in the administrative record should be referenced in the deletion docket if they are still available to the public.

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**TABLE 7-1**
**HIERARCHY AND CONTENT OF SOIL REMEDIATION DOCUMENTS**

| Sitewide | Reports Area-specific | Report content | Field Sitewide | Tasks Area-specific |
|---|---|---|---|---|
| Sitewide Excavation Plan (SEP) | | Sidewide soil remediation strategy, sequencing, and general procedures | Field scanning equipment evaluation/selection | |
| | | | | |
| Natural Resources Restoration Plan (NRRP) | | Sitewide final land use and natural resource restoration strategy | | |
| | Predesign Project Specific Plans<br>Predesign Data Summary Reports<br>Integrated Remedial Design Packages (IRDPs) | Area-specific remedial design package per SEP requirements | | Predesign investigation per SEP requirements |
| | | | | Remedial action according to SEP/IRDP |
| | | | | |
| | CERTIFICATION DESIGN LETTERs | Area-specific CU-delineation and certification sampling plan per SEP requirements | | Precertification scan per SEP requirements |
| | CERTIFICATION REPORTs | Area-specific WAC attainment, hot spot/FRL certification, and HWMU/UST closure records per SEP requirements | | Certification Sampling/Analysis per SEP requirements |
| | Natural Resources Restoration Design Package (NRRDP) | Area-specific natural resource restoration design and implementation plan consistent with the NRRP | | Interim grading/protection per SEP requirements |
| | | | | |
| | | | Final restoration per NRRP strategy | |

# TABLE 7-2
# EXAMPLE OF STATISTICAL INFORMATION TO BE INCLUDED IN THE CERTIFICATION REPORT

| | Analyte 1 | Analyte 2 | ... | Analyte N |
|---|---|---|---|---|
| Station Number 1<br>Station Number 2<br>:<br>Station Number *N* | Result & Qualifier<br>:<br>: | Result & Qualifier<br>:<br>: | ... | Result & Qualifier<br>:<br>: |
| FRL | Final Remedial Level | | | |
| Units | Units of measurement | | | |
| Conf. Level | Confidence Level: **95%** for primary COCs, **90%** for secondary COCs | | | |
| W-statistic Prob. | Shapiro-Wilk probability, the highest for either normal (raw data) or lognormal (log-transformed data) | | | |
| Test Procedure | The statistical test procedure used to determine certification compliance: **t-Test(N)** - t-Test assuming Normal distribution<br>**t-Test(LN)** - t-Test assuming Lognormal distribution<br>**Wilcox** - Wilcoxon Signed Rank assuming symetric but not Normal distribution<br>**Sign** - Sign Test if not Normal, Lognormal or symetric or too many non-detected results | | | |
| Sample Size | Number of sample results used in the statistical calculations.<br>Note: only the maximum of two duplicates is used; "R" or rejected data are not used in the calculations. | | | |
| Est. Mean | **Estimated Mean** based on Normal or Lognormal distributions or the **Median** for nonparametric tests (Wilcoxon/Sign Tests). | | | |
| UCL | Upper Confidence Limit on the Estimated Mean to compare against the FRL (Normal or Lognormal assumptions only). If the UCL is greater than or equal to the FRL than the analyte fails certification; otherwise the analyte passes. | | | |
| Prob. | The nonparametric probability that the true median is less the the FRL (nonparametric only). If this is greater than or equal to (1-Conf.Level) than the analyte fails certification; otherwise the analyte passes. | | | |
| Pass/Fail | Pass or Fail based on appropriate result of either the UCL comparison or the Probability comparison. | | | |
| Max Result | The maximum report result, irrespective of the data qualifier. | | | |
| 2x Rule P/F | If the maximum value is greater than or equal to 2xFRL then the analyte **Fails** hot-spot criteria; if not it **Passes**. | | | |
| a posteriori Sample Size Calculation | a posteriori sample size calculation to determine if sufficient number of samples were collected to adequately assess certification. | | | |
| | If the a posteriori sample size calculation is greater than the actual sample size then the analyte **Fails** the sample size requirements; if the sample size calculation is less than or equal to the actual sample size then there were sufficient samples taken (**Pass**). | | | |

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## TABLE 7-3

## REMEDIAL ACTION COMPLETION REPORTING

| Item | Certification Report* (Project-Level) | Remedial Action Report (Operable Unit-Specific) | Sitewide Closeout Report (All Operable Units) |
|---|---|---|---|
| 1. Chronology of events/summary of site conditions | Area-specific summary of major events associated with the remedial action | Site-wide summary of major events associated with the remedial action | Summary of site conditions from the RI/FS phase through completion of remedial action |
| 2. Demonstration of QA/QC and performance standards | Provides analytical assurance that the remedial action in an area is complete with a summary of the construction quality control plan | Demonstrates site-wide analytical assurance that the remedy is complete and summarizes the construction quality control plan | Demonstrates that QA/QC protocol was followed and sampling and analyses protocol was followed |
| 3. Final inspection | Summarize pre-final inspection | Summarize final inspection (including as-built drawings) | Summarize site-wide final inspections |
| 4. Certification that the remedy is operational and functional | Provide area-specific certification | Provide site-wide soil excavation certification | Provide assurance that site-wide post-remedial operation and maintenance plans are in place and effectively maintain the protectiveness of the remedy |
| 5. Project costs | Provide project costs | Provide overall remedial action costs and compare to original cost estimates | Not applicable |

| | | | |
|---|---|---|---|
| 6. Protectiveness | Not applicable | Not applicable | Summarize results of the post-remedial site-wide risk assessment |

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- SCEP Certification Reports may also provide some of the information necessary to complete the Remedial Action Reports for Operable Units 2, 3, and 5.

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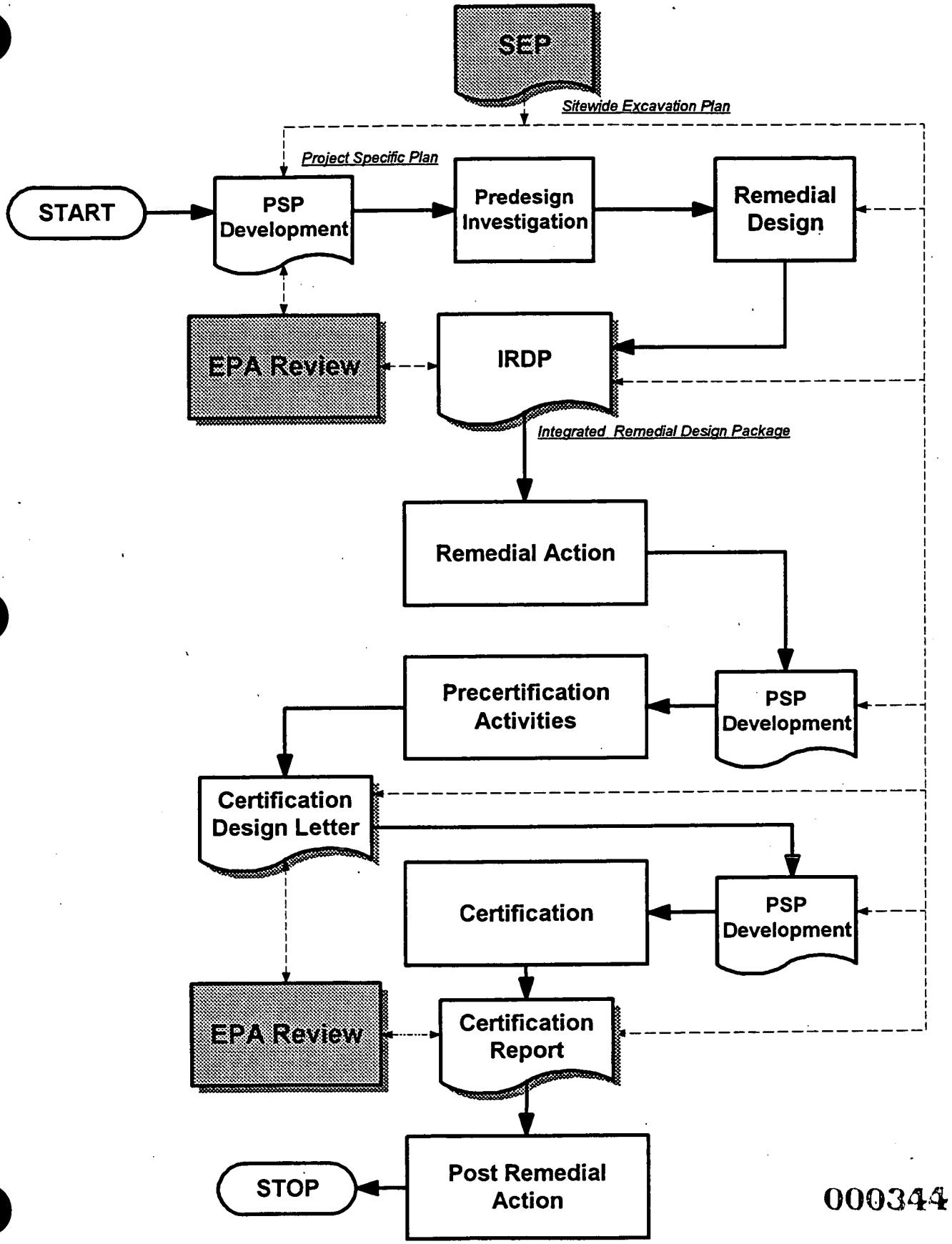




FIGURE 7-1 GENERAL AREA-SPECIFIC SOIL REMEDIATION PROCESS

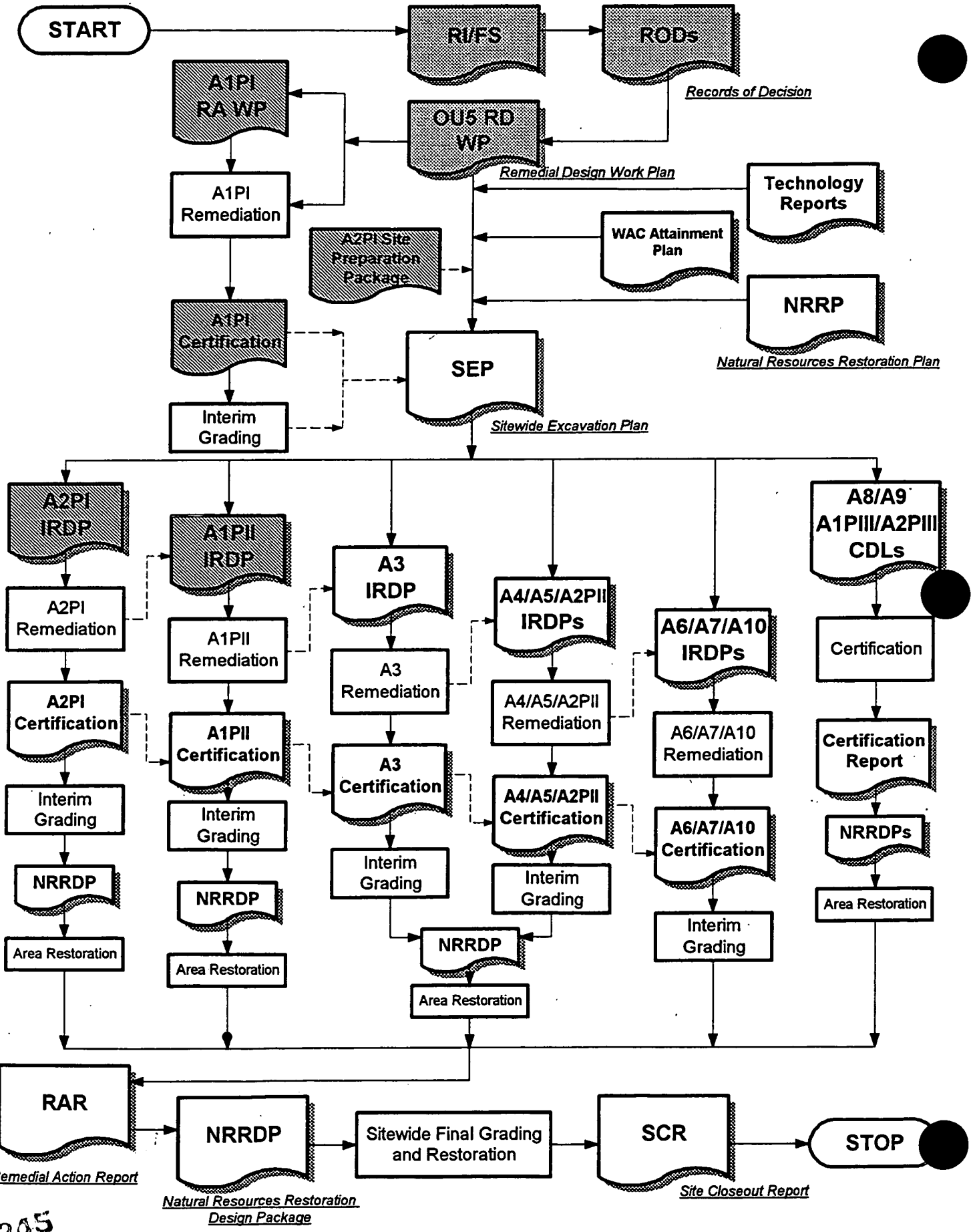


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FIGURE 7-2 PHASING OF THE SITE-WIDE SOIL REMEDIATION AND DELIVERABLES

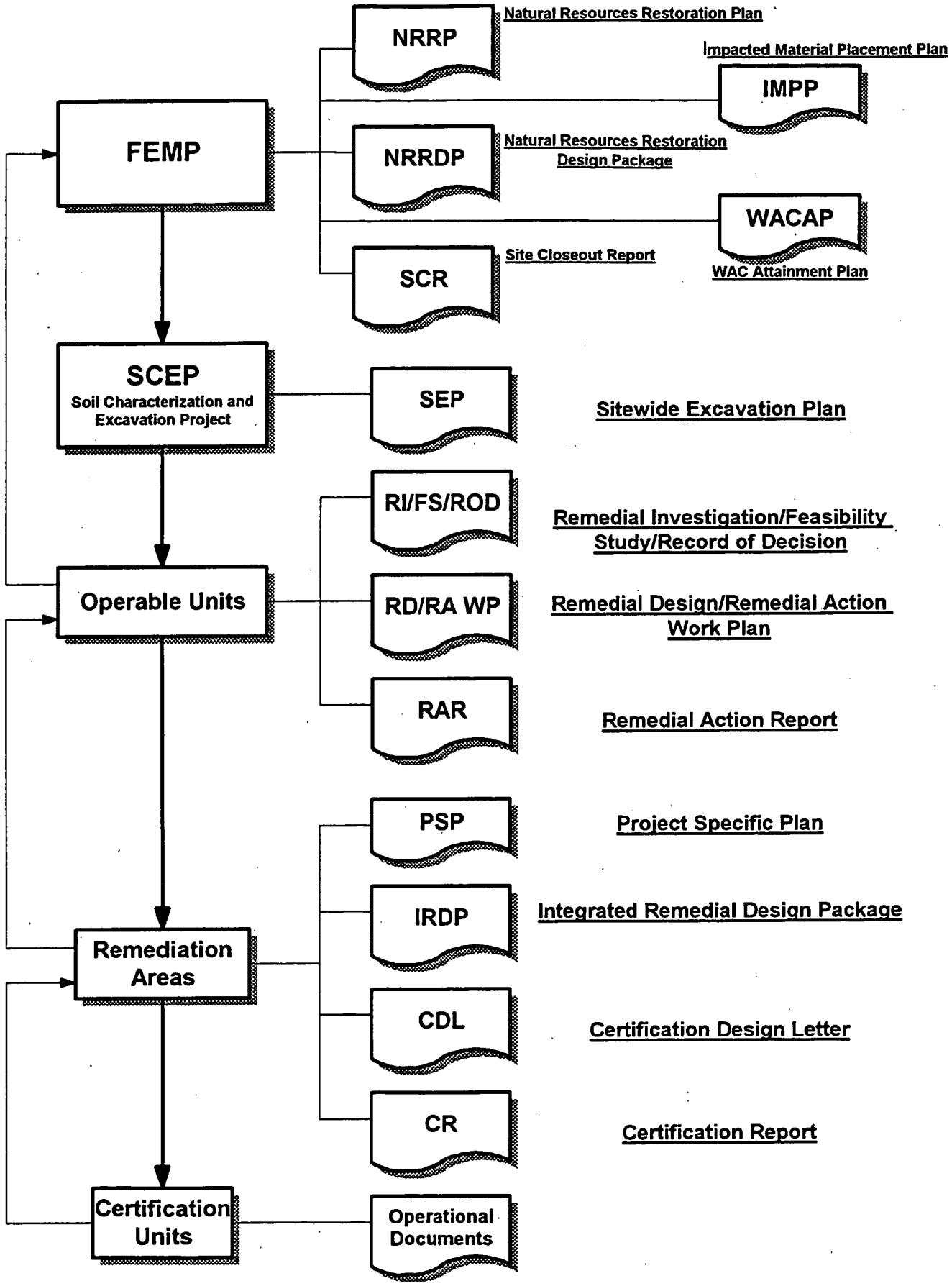


FIGURE 7-3 ORGANIZATIONAL STRUCTURE OF THE MAJOR REMEDIATION DOCUMENTS

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# SITEWIDE EXCAVATION PLA

## FERNALD ENVIRONMENTAL MANAGEMENT PR
## FERNALD, OHIO

**VOLUME II**
**APPENDICES A through I**

**JULY 1998**

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**FERNALD AREA OFFICE**

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# SITEWIDE EXCAVATION PLAN

## FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

## FERNALD, OHIO

**VOLUME II**

**APPENDICES A through I**

INFORMATION ONLY

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**FINAL**

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# APPENDIX A

## SOIL REMEDIATION ARARs AND TBCs

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Table A-1 Groupings of ARARs and TBCs Used in Table A-2 for the Sitewide Excavation Plan
Table A-2 Pertinent ARARs and TBCs for the Sitewide Excavation Plan

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ALARA | as low as reasonably achievable |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| AWWT | Advanced Wastewater Treatment [Facility] |
| BAT | Best Available Technology |
| BMP | Best Management Practice |
| CAMU | Corrective Action Management Unit |
| CEDE | Committed Effective Dose Equivalent |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COC | Constituent of Concern |
| CWA | Clean Water Act |
| DCG | Derived Concentration Guide |
| DF&O | Director's Findings and Orders |
| DOE | U. S. Department of Energy |
| EPA | U. S. Environmental Protection Agency |
| FEMP | Fernald Environmental Management Project |
| FR | Federal Register |
| FRL | Final Remediation Level |
| FS | Feasibility Study |
| GMA | Great Miami Aquifer |
| HSWA | Hazardous and Solid Waste Amendments |
| HWMU | Hazardous Waste Management Unit |
| IEMP | Integrated Environmental Monitoring Plan |
| IRDP | integrated remedial design package |
| LDR | Land Disposal Restriction |
| MCL | Maximum Contaminant Level [under SDWA] |
| MCL | Maximum Concentration Limit [under RCRA] |
| MCLG | Maximum Contaminant Level Goal [under SDWA] |
| mg | milligram |
| mg/kg | milligrams/kilogram |
| mg/L | milligrams/liter |
| mm | millimeter |
| mrem | millirem |
| MTR | Minimum Technology Requirements |
| NAAQS | National Ambient Air Quality Standards |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NHPA | National Historic Preservation Act |
| NPDES | National Pollutant Discharge Elimination System |
| NRC | Nuclear Regulatory Commission |
| NRIMP | Natural Resource Impact Monitoring Plan |
| NRRP | Natural Resources Restoration Plan |
| NWP | Nationwide Permit [Program] |
| OAC | Ohio Administrative Code |

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## LIST OF ACRONYMS AND ABBREVIATIONS
**(Continued)**

| | |
|---|---|
| OEPA | Ohio Environmental Protection Agency |
| OHPO | Ohio Historic Preservation Office |
| ORC | Ohio Revised Code |
| OSDF | On-Site Disposal Facility |
| OSWER | (EPA) Office of Solid Waste and Emergency Response |
| OU | Operable Unit (as numbered) |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| pCi | picoCurie |
| pCi/L | picoCuries/liter |
| ppm | parts per million |
| PRG | Preliminary Remediation Goal |
| R&A | relevant and appropriate |
| RCRA | Resource Conservation and Recovery Act |
| RD | remedial design |
| RM | river mile |
| ROD | Record of Decision |
| SCEP | Soil Characterization and Excavation Project |
| SDWA | Safe Drinking Water Act |
| SEP | Sitewide Excavation Plan |
| SIP | State Implementation Plan |
| TBC | to be considered |
| USC | United States Code |
| $\mu$Ci | microCurie |
| $\mu$Ci/L | microCurie/liter |
| $\mu$g | microgram |
| $\mu$g/L | micrograms/liter |
| VOC | volatile organic compound |

## INTRODUCTION

The Amended Consent Agreement (EPA 1991) requires that the compliance strategy for addressing the substantive requirements of permits which would otherwise be required, as well as other applicable or relevant and appropriate requirements (ARARs), be initiated at the start of remedial action. The Amended Consent Agreement requires the following specific information:

Identification of each permit that would have been required in the absence of the CERCLA 121(e)(1) permitting exemption

- Identification of the standards, requirements, criteria, or limitations that would normally have to be met to obtain the permits
- Explanation of how the remedial action will meet the substantive requirements, criteria, or limitations identified above.

The Amended Consent Agreement further states that a permitting plan containing the above items should be submitted as a design deliverable. As presented in Section 1.3.1.2 of the SEP, EPA and OEPA concurred with the submission of a compliance cross-reference (including substantive permitting requirements) as a substitute for a formal permitting plan.

This appendix has been prepared to fulfill those requirements. It presents a detailed listing of the substantive requirements of the ARARs and to be considered criteria (TBCs), provides remarks, where appropriate, on how the requirements pertain to the Soil Characterization and Excavation Project (SCEP), and presents appropriate cross-reference to where the substantive requirements are addressed.

The sitewide excavation work under the scope of the Soil Characterization and Excavation Project (SCEP) involves work in the areas of all operable units: the Waste Pit (Operable Unit 1), other Waste Units (Operable Unit 2), Former Production Area (Operable Unit 3), Silos (Operable Unit 4), and site soil under and around these operable units (Operable Unit 5). Although the soil in the Operable Unit 5 areas presented above includes soil within the geographic boundaries of Operable Units 1 and 4, as defined in the Amended Consent Agreement, the selected remedies for these operable units are clearly focused on remediation of the waste materials, not the underlying soils.

Thus, ARARs and TBCs from three Records of Decision (RODs) — the Final Record of Decision for Remedial Actions at Operable Unit 2 (DOE 1995), the Final Record of Decision for Remedial Actions at Operable Unit 5 (DOE 1996a), and the Operable Unit 3 Record of Decision for Final Remedial Action (DOE 1996b) — are pertinent to the soil (and associated at- and below-grade debris) remediation activities. The ARARs and TBCs listed in Table A-2 are compiled sequentially from those RODs. Although these ARARs and TBCs are consistent with each other, variations exist based on various remediation waste types that will be generated during remediation.

In the same manner as the RODs, the following three agreements with regulatory entities clarified and established enforceable regulatory requirements for the remediation activities under this remedial action project:

- RCRA/CERCLA Integrated Closures Director's Final Findings and Orders (OEPA 1996)
- Programmatic Agreement Regarding Disposition of Facilities under the Operable Unit 3 Record of Decision for Interim Remedial Actions at the Fernald Environmental Management Project (OHPO 1996)
- Programmatic Agreement Regarding Archeological Investigations at the Fernald Environmental Management Project (OHPO 1997).

Thus, entries summarizing the requirements of each of these have also been included.

The entries presented in Table A-2 are those that pertain directly to the scope of the remediation activities under this remedial action project. Those previously determined ARARs and TBCs that pertain to other projects which are implementing other components of the selected remedial actions that are outside the direct scope of the SCEP are not included:

- Those that pertain to on-site disposal are within the direct scope of the On-Site Disposal Facility (OSDF) remedial action project (see the OSDF remedial action project documents).
- Those that pertain to groundwater remediation are within the direct scope of the Aquifer Restoration remedial action project (see the aquifer restoration remedial action project documents).

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Those that pertain to environmental monitoring, that are not environmental-control oriented, are within the scope of the Integrated Environmental Monitoring Project [see the Integrated Environmental Monitoring Plan (IEMP) (DOE 1997)].

As briefly mentioned above, the individual entries are identified in the corresponding column on Table A-2 as to the ROD which was its source, using the abbreviation "Appl" or "R&A" or "TBC" to indicate the determination in the ROD as either "Applicable" or "Relevant and Appropriate" or "To Be Considered," respectively. Similarly, a checkmark (√) is used to indicate the pertinence of either the requirements identified under a new entry (primarily the agreements discussed above), or an ARAR/TBC entry identified in another ROD, to activities undertaken to implement the remediation activities under this remedial action project. This approach to identification of pertinent requirements is necessary because of the scope of the SEP remediation activities encompassing implementation of components of the selected remedies under three RODs.

To facilitate analysis of alternatives, the RODs presented ARARs and TBCs in chemical-specific, location-specific, and action-specific groupings. To facilitate planning and implementation of individual soil remediation projects under this SEP, the ARARs/TBCs presented in Table A-2 are grouped as shown on Table A-1.

## REFERENCES

Ohio Environmental Protection Agency, June 4, 1996, "OEPA's Director's Final Findings and Orders," U.S. EPA ID No. OH 6890008976, in the matter of RCRA/CERCLA Integrated Closures.

Ohio Historic Preservation Office, January 16, 1996, "Programmatic Agreement Regarding Disposition of Facilities under the Operable Unit 3 Record of Decision for Interim Remedial Actions at the Fernald Environmental Management Project."

Ohio Historic Preservation Office, March 6, 1997, "Programmatic Agreement Regarding Archeological Investigations at the Fernald Environmental Management Project."

U.S. Dept. of Energy, 1995, "Record of Decision for Remedial Actions at Operable Unit 2," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1996a, "Record of Decision for Remedial Actions at Operable Unit 5," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1996b, "Operable Unit 3 Record of Decision for Final Remedial Action," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1997, "Integrated Environmental Monitoring Plan," IEMP, 2505-WP-0002, Rev. 0, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Environmental Protection Agency, 1991, Consent Agreement as Amended under CERCLA Sections 120 and 106 (a), in the matter of U.S. Department of Energy, Feed Materials Production Center, Fernald, Ohio, U.S. EPA Region V.

## TABLE A-1

## GROUPINGS OF ARARs AND TBCs USED IN TABLE A-2 FOR THE SITEWIDE EXCAVATION PLAN

| Presentation Group | Topical Subdivision(s) | Table A-2 Pages |
|---|---|---|
| Natural and Cultural Resources | Threatened and Endangered Species Protection | 1-2 |
| | Archeological, Historic, and Cultural Resource Protection | 2-6 |
| Air Pathway | Noise Pollution Control | 7 |
| | Air Emissions | 7-20 |
| Surface Water Pathway | Floodplain/Wetlands Protection | 21-28 |
| | Discharge to Surface Water | 29-32 |
| Groundwater Pathway | Groundwater Protection | 33 |
| | Wells - Construction | 33 |
| | Wells - Abandonment | 34 |
| Soil Remediation | Closure of Underground Storage Tanks | 35 |
| | Closure of Hazardous Waste Management Units | 35-39 |
| | Radionuclide Concentrations | 40-44 |
| | Lead Concentration | 44 |
| | PCB Concentration | 45 |
| | Certification of Cleanup | 46-47 |
| Impacted Material Management | Definitions and General Facility Standards | 48-62 |
| | Management of Low-level Radioactive Material | 63 |
| | Management of Hazardous Remediation Waste | 64-71 |
| | Management of PCB-tainted Material | 72 |
| Post-Closure | Description of Post-closure Care | 73-75 |
| | Modifications to Post-closure Care Plan or Period | 75 |
| | Property Use Restrictions | 76 |
| | Post-closure Notice/Survey Plat | 77 |
| | Deed Notation | 78 |

# TABLE A-2

## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **NATURAL & CULTURAL RESOURCES** | | | | | | |
| | **THREATENED & ENDANGERED SPECIES PROTECTION** | | | | | |
| Procedures for Implementing the National Environmental Policy Act<br><br>40 CFR §6.302(h)<br><br>10 CFR Part 1021<br><br>Endangered Species Act<br>16 U.S.C. §1531, et seq.<br><br>Endangered and Threatened Wildlife and Plants<br>50 CFR §17.21, §17.31, §17.61, §17.71, and §17.94<br><br>Interagency Cooperation-Endangered Species Act<br>50 CFR §402.01 | All federal agencies must ensure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of the constituent elements essential to the conservation of a listed species within a defined critical habitat. Additional requirements apply if it is determined that a proposed activity could adversely affect these species or their habitat. | Appl | Appl | Appl | Findings of 1993-94 updated surveys at the FEMP property:<br>• Populations of the state-listed threatened Sloan's crayfish (*Orconectes sloanii*) are located in sections of Paddy's Run.<br>• Good habitat for the federally-listed endangered Indiana bat (*Myotis sodalis*) exists along Paddy's Run and the storm sewer outfall ditch.<br>• Suitable habitat exists in limited areas for the federal-listed endangered running buffalo clover (*Trifolium stoloniferum*), and only in the northern woodlot for the state-listed threatened spring corralroot (*Corallorhiza wisteriana*).<br>• Marginal habitat for the state-listed endangered cave salamander (*Eurycea lucifuga*) exists in a very limited single area.<br>• Neither habitat nor populations were located for the state-listed endangered mountain bindweed (*Polygonum cilinode*) and slender fingergrass (*Digitaria filiformis*). | Section 5.1 of the Sitewide Excavation Plan.<br>However, DOE does not expect to encounter any federal- or state-listed threatened or endangered species or critical habitat in the areas to be addressed by this remediation project; no additional surveys conducted or planned. |

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# TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **THREATENED & ENDANGERED SPECIES PROTECTION, continued** | | | | | | |
| Interagency Cooperation-Endangered Species Act<br>50 CFR §402.12(a), (b) | A biological assessment shall evaluate the potential effects of the action on listed and proposed critical habitat and determine whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary.<br><br>These procedures are required for federal actions that are "major construction activities." | Appl | Appl | Appl | No critical habitat is present on the Fernald property.<br><br>Updated surveys of the FEMP property in 1993 found marginal habitat for the state-listed endangered cave salamander (*Eurycea lucifuga*) exists in a very limited single area. | See preceding. |
| Endangered Species Regulations<br>ORC 1531.25 | No person shall take or possess any native species of wild animal, or any eggs or offspring thereof, that is endangered with state-wide extinction. | Appl | Appl | Appl | Updated surveys of the FEMP property in 1993-94 found populations of the state-listed threatened Sloan's crayfish (*Orconectes sloanii*) in sections of Paddy's Run. | See preceding. |
| Endangered Species Regulations<br>ORC 1518.02<br>OAC 1501:18-1 | No person shall root-up, injure, destroy, remove, or carry away on or from public highways, public property, or waters of the state, or on or from the property of another, without the written permission of the owner, lessee, or other person entitled to possession, any endangered plant listed in OAC 1501:18-1. | Appl | Appl | Appl | Surveys of the FEMP property in 1994 did not locate populations of the following plants: the federal-listed endangered running buffalo clover (*Trifolium stoloniferum*); the state-listed endangered mountain bindweed (*Polygonum cilinode*) and slender fingergrass (*Digitaria filiformis*); and the state-listed threatened spring corralroot (*Corallorhiza wisteriana*). | See preceding. |
| **ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCE PROTECTION** | | | | | | |
| Antiquities Act of 1906<br>16 U.S.C. §431<br><br>Historic Sites Preservation Act<br>16 U.S.C. §461-467 | No person may appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity situated or controlled by the Government of the United States without an applicable permit. Identification and preservation of cultural resources on federal lands is required, including natural landmarks. | Appl<br><br>√ | Appl<br><br>Appl | Appl<br><br>Appl | Proposed areas of disturbance will be surveyed and consultation will occur between DOE, the Advisory Council on Historic Preservation and the State of Ohio Historic Preservation Office (OHPO) as agreed | Section F.4.2 of the Sitewide Excavation Plan |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Archaeological Resources Protection Act<br>16 U.S.C. § 470aa-470ll<br><br>Procedures for Implementing the National Environmental Policy Act<br>40 CFR §6.301(c)<br><br>Protection of Archaeological Resources<br>43 CFR §7.4(a) | Whenever any Federal agency finds, or is notified, in writing, by an appropriate historical or archaeological authority, that its activities in connection with any Federal construction project or federally licensed project, activity, or program may cause irreparable loss or destruction of significant scientific prehistorical, historical, or archaeological data, such agency shall notify the Secretary of the Interior, in writing, and shall provide the Secretary with appropriate information concerning the project, program, or activity.<br><br>No person may excavate, remove, damage, or otherwise alter or deface or attempt to excavate, remove, damage, or otherwise alter or deface any archaeological resource located on public lands unless such activity is pursuant to a permit.<br><br>If an EPA activity may cause irreparable loss or destruction of significant scientific, prehistoric, historic, or archaeological data, the responsible official or the secretary of the Interior is authorized to undertake data recovery and preservation activities. | Appl | Appl | Appl | See preceding. | See preceding. |
| National Historic Preservation Act (NHPA)<br>16 U.S.C. §470<br><br>Protection of Historic Properties<br>36 CFR Part 800<br><br>Procedures for Implementing the National Environmental Policy Act<br>40 CFR §6.301(a), (b) | A federal agency (DOE) must take into account the effect of an undertaking on historic properties and accord the Advisory Council on Historic Preservation a reasonable opportunity to comment. Historic properties are defined as any prehistoric or historic district, building, site, structure, or object included in or eligible for inclusion in the National Register of Historic Places. This term includes artifacts, records, and persons released to and located within such properties. Historic properties that are to be substantially altered or demolished must be recorded for future use and reference. The purpose of this Act is not only to protect those properties listed in or eligible for the National Register of Historic Places, but also those properties that have not been listed or formally determined eligible for the listings.<br><br>The heads of all Federal agencies shall assume responsibility for the preservation of historic properties which are owned or controlled by such agency.<br><br>Prior to any Federal undertaking which may directly and adversely affect any National Historic Landmark, the head of the responsible agency shall, to the extent possible, minimize the harm to such landmark. | Appl | Appl | Appl | See preceding. | See preceding. |
| Archaeological and Historic Preservation Act<br>16 U.S.C. §469 | Upon discovery that a project may cause the irreparable loss, destruction, significant scientific finding, prehistorical finding, or loss of historical or archaeological data, DOE must notify the Dept. of the Interior in writing and provide appropriate information concerning the project. DOE must, with possible assistance from the OHPO, undertake recovery, protection, and preservation of the data. | √ | Appl | Appl | See preceding. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCE PROTECTION, continued** | | | | | |
| Executive Order 11593, Protection and Enhancement of Cultural Environment<br><br>3 CFR Part 54 | An inventory of a site with potential historic places is required for eligibility in the National Register of Historic Places. | √ | Appl | Appl | See preceding and following entries. | See preceding. |
| Programmatic Agreement Regarding Disposition of Facilities under the Operable Unit 3 Record of Decision for Interim Remedial Action at the Fernald Environmental Management Project (January 16, 1996) | • Prepare a report package describing the primary buildings and structures at the FEMP, using existing information to provide information regarding construction details, production process descriptions, design changes, current structural conditions, and current use. The report package is to include written descriptions, photographs, representative engineering drawings, and videotape, as appropriate. If existing documentation is not adequate, additional documentation will be obtained (i.e., additional photographs). Representative support buildings and structures are to be documented with photographs and written summaries as well.<br><br>• Prepare a separate report package describing the FEMP's role in the DOE weapons complex and the significance of the FEMP contribution to the U.S. defense. | | √ | √ | Draft reports have been submitted to the Ohio Historic Preservation Office (OHPO). Once finalized, both documents will be available to the public in the Public Environmental Information Center and archived as appropriate. | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Programmatic Agreement Regarding Archaeological Investigations at the Fernald Environmental Management Project (March 6, 1997) | Annual report packages, the first of which must be submitted on July 1,1997, must be submitted to the Ohio Historic Preservation Office (OHPO) and the Advisory Council on Historic Preservation (the Advisory Council) containing the following information:<br><br>1 list of all response actions and associated activities initiated within the year reported on;<br>2. map showing locations of above response actions/ associated activities;<br>3. list of response actions/associated activities conducted in previously surveyed (archeological survey) areas;<br>4. a list of surveys which identified no eligible historic properties;<br>5. a list of eligible historic properties that were avoided when implementing response actions and/or associated activities;<br>6. a list of Phase I-III reports generated; and<br>7. a map of locations of areas identified in item 6 and all properties identified.<br><br>DOE-FEMP must also submit any and all Phase I reports generated within the last year, and not previously submitted, with the annual report.<br><br>By September 2, 1997 (within 180 days of the signing of the Programmatic Agreement), submit to the OHPO and the Advisory Council a literature search, examination of aerial photographs, and use of a predictive model for all disturbed and/or contaminated areas of the FEMP (as defined in the Agreement). The predictive model is to utilize existing archeological data from the FEMP and surrounding area to determine the likelihood of additional archeological sites within the contaminated/disturbed areas and the spatial distribution, physical characteristics, and uses. | √ | √ | √ | In accordance with this programmatic agreement, the following will occur for each remediation area as needed:<br>• survey<br>• appropriate consultation with the OHPO and the Advisory Council<br>• appropriate data recovery for potential historic properties discovered.<br><br>Unexpected discoveries will be addressed accordingly (see Section F.4.2 of the SEP).<br><br>Draft reports are under preparation for submission to the OHPO and the Advisory Council. Once finalized, the reports will be available to the public in the Public Environmental Information Center and archived as appropriate. | See preceding. |



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# TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCE PROTECTION, continued** | | | | | | |
| Native American Graves Protection and Repatriation Act<br>25 U.S.C. §3001 et seq. | Identification and preservation of cultural resources on federal lands is required, including natural landmarks. DOE must consult with appropriate Indian tribes before the intentional excavation or removal after an inadvertent discovery of Native American cultural items including human remains and objects of cultural significance. | Appl | Appl | Appl | DOE will consult with likely culturally affiliated tribes to determine the excavation, treatment, analysis and preparation of any extra reviews, associated funerary objects, unassociated funerary objects, sacred objects, or objects of cultural patrimony. Consultation will be coordinated with NHPA compliance when possible. | See preceding. |
| 43 CFR Part 10 | Provides for the return of human remains and cultural objects from Native American graves to affiliated tribes. | Appl | ✓ | ✓ | | |
| American Indian Religious Freedom Act<br>42 U.S.C. §1996 | Provides for tribal access by native peoples to grave sites and sites of cultural, symbolic, or religious significance. | Appl | Appl | Appl | See preceding. | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **AIR PATHWAY** | | | | | | |
| | **NOISE POLLUTION CONTROL** | | | | | |
| Noise Control Act, as amended<br>42 U.S.C. §4901, *et seq.*<br><br>Noise Pollution and Abatement Act<br>42 U.S.C. §7641 | The public must be protected from noises that jeopardize health and welfare. | Appl | Appl | R&A | Appropriate engineering controls and best management practices will be implemented so that nuisance noise from vehicles and equipment will be reduced to the maximum practicable extent during conduct of the actions. | Section 5.1.2.1 of the Sitewide Excavation Plan |
| | **AIR EMISSIONS** | | | | | |
| Solid Waste and Infectious Waste Regulations,<br><br>Authorized, Limited, and Prohibited Solid Waste Disposal Methods<br>OAC 3745-27-05<br>ORC 3734.03 | Open dumping of solid waste is prohibited [OAC 3745-27-05(C)].<br><br>Solid waste disposal by means of open burning, as defined in OAC 3745-19, is permitted only as provided therein [OAC 3745-27-05(B)]. | Appl | Appl | Appl | | Addressed through the description of the selected remedy in the OU2 ROD (Section 9.0), OU5 ROD (Section 9.0), and OU3 ROD (Section 8.0) |
| Criteria for Classification of Solid Waste Disposal Facilities and Practices,<br>Air<br>[40 CFR §257.3-7] | Open burning of residential, commercial, institutional or industrial solid waste is prohibited. This requirement does not apply to infrequent burning of agricultural wastes in the field, silvicultural wastes for forest management purposes, land-clearing debris, diseased trees, debris from emergency clean-up operations, and ordnance [40 CFR §257.3-7]. | √ | √ | Appl | | |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Open Burning Standards,<br><br>Open Burning in Unrestricted Areas<br>OAC 3745-19-04© | Open burning is allowed for the following purposes [OAC 3745-19-04(C)]:<br><br>• Recognized horticultural, silvicultural, range, or wildlife management practices [OAC 3745-19-04(C)(5)].<br><br>• Disposal of land clearing waste if the following conditions are met [OAC 3745-19-04(C)(4)]:<br>- The fire is set only when atmospheric conditions will readily dissipate contaminants;<br>- The fire does not create a visibility hazard on roadways, railroad tracks, or air fields;<br>- The fire is located at a point on the premises no less than 1000 feet from any inhabited building not located on said premises. | ✓ | ✓ | Appl | | |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **AIR EMISSIONS, continued** | | | | | |
| General Provisions on Air Pollution Control,<br><br>Air Pollution Nuisances Prohibited<br>OAC 3745-15-07<br><br>ORC 3704.01-.05 | *Measures shall be taken to adopt and maintain a program for the prevention, control,* and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state.<br><br>The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors and combinations of the above in such a manner or in such amounts as to endanger the health, safety, and welfare of the public, or to cause unreasonable injury or damage to property shall be declared to be a public nuisance. It is unlawful for any person to cause, permit, or maintain any such public nuisance. | Appl | Appl | Appl | Only fugitive dust (dirt, flyash, bottom ash) is anticipated from this soil remedial action project.<br><br>Air pollution nuisance prohibitions will be met by employing best management practices for control of fugitive dust. | FEMP Fugitive Dust Control BAT Determination, and Section 5.1.2 of the Sitewide Excavation Plan |
| ORC 3734.02(I) | No owner or operator of a hazardous waste facility, in the operation of the facility, shall cause, permit, or allow the emission therefrom of any particulate matter, dust, *fumes, gas, mist, smoke, vapor, or odorous substances that, in the opinion of the* Director [of Environmental Protection, a.k.a., the Director of the OEPA], unreasonably interferes with comfortable enjoyment of life or property by persons living or working in the vicinity of the facility, or that is injurious to public health. Any such action is hereby declared to be a public nuisance. | √ | √ | R&A | | |
| Particulate Matter Standards,<br><br>Ambient Air Quality Standards<br>OAC 3745-17-02(B), (C), (D)<br><br>[National Primary and Secondary Ambient Air Quality Standards<br>40 CFR §50.6(a), (b), (c)] | The level of the primary and secondary 24-hour ambient air quality standards for particulate matter is a 150 $\mu g/m^3$, 24-hour average concentration [OAC 3745-17-02(C)].<br><br>The level of the primary and secondary annual ambient air quality standards for particulate matter is 50 $\mu g/m^3$, annual arithmetic mean (average) [OAC 3745-17-02(D)].<br><br>Particulate matter shall be measured in the ambient air as $PM_{10}$ (particles with an aerodynamic diameter less than or equal to a nominal 10 $\mu m$). | Appl | Appl | √ | The National Ambient Air Quality Standards (NAAQS) were established as regional goals that states were required to meet and maintain. These ambient air quality standards were never intended, nor are they appropriate, as air quality standards for individual facilities. The methods used by the states to comply with the NAAQS are the State Implementation Plan (SIPs), which include state-level regulations for emission controls or emission standards (included as separate entries). By meeting these pertinent individual requirements, FEMP emissions will not cause an exceedance of the NAAQS/Ohio Ambient Air Quality Standards. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Particulate Matter Standards,<br><br>Non-Degradation Policy<br>OAC 3745-17-05 | The significant and avoidable deterioration of air quality in any part of the area where presently existing air quality is better than the particulate ambient air quality standards in OAC 3745-17-02 (described above) shall be prohibited. | Appl | Appl | √ | Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions.<br><br>Also see preceding entry. | FEMP Fugitive Dust Control BAT Determination, and Section 5.1.2.2 of the Sitewide Excavation Plan |
| Particulate Matter Standards,<br><br>Control of Visible Particulate Emissions from Stationary Sources<br>OAC 3745-17-07(A)(1)(a) | Visible particulate emissions from any point source shall not exceed 20 percent opacity, as a 6-minute average, but shall not exceed 60 percent opacity, as a 6-minute average, at any time. Transient exceedance limits are included in this regulation. | Appl | Appl | Appl | All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions. | As necessary, point source monitoring requirements will be addressed in the appropriate IRDP. |
| Particulate Matter Standards,<br><br>Control of Visible Particulate Emissions from Stationary Sources<br>OAC 3745-17-07(B)(1) | Visible particulate emissions from any fugitive dust source shall not exceed 20 percent opacity, as a 3-minute average. | √ | √ | √ | Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions. | FEMP Fugitive Dust Control BAT Determination, and Section 5.1.2.2 of the Sitewide Excavation Plan |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **AIR EMISSIONS, continued** | | | | | |
| Particulate Matter Standards,<br><br>Control of Visible Particulate Emissions from Stationary Sources<br>OAC 3745-17-07 (B)(4), (5), (6) | There shall be no visible particulate emissions from any paved roadway or paved parking area except for a period of time not to exceed 6 minutes during any 60-minute observation period.<br><br>There shall be no visible particulate emissions from any unpaved roadway or unpaved parking area except for a period of time not to exceed 13 minutes during any 60-minute observation period.<br><br>There shall be no visible particulate emissions from any material storage piles except for a period of time not to exceed 13 minutes during any 60-minute observation period. | Appl | R&A | √ | Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions. | FEMP Fugitive Dust Control BAT Determination, and Section 5.1.2.2 of the Sitewide Excavation Plan |
| Particulate Matter Standards,<br><br>Restriction of Emission of Fugitive Dust<br>OAC 3745-17-08(B) | No person shall cause or permit any fugitive dust source to be operated; or any materials to be handled, transported, or stored; or a building (or its appurtenances) or a road to be used, constructed, altered, repaired, or demolished without taking or installing reasonably available control measures to prevent fugitive dust from becoming airborne. Such reasonably available control measures shall include, but are not limited to, one or more of the following which are appropriate to minimize or eliminate visible particulate emissions of fugitive dust.<br><br>• The use of water or other suitable dust suppression chemicals for the control of fugitive dust from the demolition of existing buildings or structures, construction operations, the grading of roads, or the clearing of land; or<br><br>• The periodic application of asphalt, oil, water, or other suitable dust suppression chemicals on dirt or gravel roads and parking lots, and any other surfaces that may cause emissions of fugitive dust. | Appl | R&A | Appl | This requirement is applicable only to certain cities in Butler and Hamilton Counties.<br><br>Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Particulate Matter Standards,<br><br>Restrictions on Particulate Emissions from Industrial Processes<br>OAC 3745-17-11 | The following are restrictions for particulates from any operation, process, or activity which releases or may release particulate emissions into the ambient air. These limits are based on the weight of material being processed.<br><br>Process Weight at Maximum Capacity (lb/hr) — Allowable Particulate Emission Rate (lb/hr)<br>100 — 0.551<br>200 — 0.877<br>400 — 1.40<br>600 — 1.83<br>800 — 2.22<br>1000 — 2.58<br><br>*These limits do not apply to generation of fugitive dust* subject to OAC 3745-17-08 (listed above). | Appl | | R&A | All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions. | See preceding. |
| Ambient Air Quality Standards for Non-methane Hydrocarbons<br>OAC 3745-21-02(C), -03(D) | The ambient air quality guidelines for nonmethane hydrocarbons is a maximum three hour arithmetic mean concentration of 160 $\mu g/m^3$, not to be exceeded between the hours of 6 and 9 a.m.<br><br>Hourly and 3-hour concentrations must be determined in accordance with prescribed methods. | | Appl | | The National Ambient Air Quality Standards (NAAQS) were established as regional goals that states were required to meet and maintain. These ambient air quality standards were never intended, nor are they appropriate, as air quality standards for individual facilities. The methods used by the states to comply with the NAAQS are the State Implementation Plan (SIPs), which include state-level regulations for emission controls or emission standards. By meeting these pertinent individual requirements, FEMP emissions will not cause an exceedance of the NAAQS/Ohio Ambient Air Quality Standards. | See preceding relevant Ohio air regulation citations. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **AIR EMISSIONS, continued** | | | | | |
| National Primary and Secondary Ambient Air Quality Standards<br>40 CFR §50.12<br><br>Ohio Lead Emissions, Ambient Air Quality Standards—Lead<br>OAC 3745-71-02(A) | The ambient air quality standards for lead shall be a maximum arithmetic mean of 1.5 micrograms per cubic meter during any calendar quarter. | R&A | R&A | | See preceding. | See preceding |
| National Primary and Secondary Ambient Air Quality Standards<br>40 CFR Part 50 | The following are the primary National Ambient Air Quality Standards (NAAQS): | R&A | | | Note that other NAAQSs are presented in preceding entries. | |
| | Criteria Pollutant / Primary Standard, ppm / Averaging Time | | | | | |
| | Carbon Monoxide — 9 — 8-hour | R&A | | | | |
| | 35 — 1-hour | | | | | |
| | Nitrogen Dioxide — 0.053 — Annual | R&A | | | | |
| | Ozone — 0.12 — 1-hour | R&A | | | | |
| | Sulfur oxides — 0.03 — Annual | R&A | | | | |
| | 0.14 — 24-hour | | | | | |



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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Permit to Install New Sources of Pollution<br>OAC 3745-31-05 (A)(3) | The installation or modification and operation of an air contaminant source, solid waste disposal facility, water pollution source, disposal system, land application of sludge, or public water system, must employ the best available technology.<br><br>The terms used in the above are defined in OAC 3745-15-01, unless otherwise defined in OAC 3745-31-01. | R&A | Appl | R&A | Appropriate control measures will be applied to all construction grading, excavation, loading/unloading and material management activities to reduce fugitive emissions.<br><br>All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions. | FEMP Fugitive Dust Control BAT Determination, and Section 5.1.2.2 of the Sitewide Excavation Plan |
| Standards of Performance for New Stationary Sources, Subpart OOO—Standards of Performance for Nonmetallic Mineral Processing Plants<br>40 CFR §60.672(a), (d), (e) | No owner or operator shall cause to be discharged into the atmosphere from a crusher any emissions which:<br><br>• Contain particulate matter in excess of 0.05 grams per dry cubic meter at standard conditions (g/dscm); and<br><br>• Exhibit greater than 7 percent opacity<br><br>Truck dumping of nonmetallic minerals into any crusher is exempt from these requirements. | R&A | √ | | It is not anticipated that a crusher will be used during this remedial action project.<br><br>All point sources associated with a remedial action project (i.e., sludge dewatering, etc.) will employ best available emissions control technologies to mitigate particulate emissions. | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **AIR EMISSIONS, continued** | | | | | |
| 40 CFR Part 61, Subpart M-National Emission Standard for Asbestos,<br><br>Standard for Waste Disposal for Manufacturing, Fabrication, Demolition, Renovation, and Spraying Operation<br>40 CFR §61.150 | (a) Discharge no visible emissions [of asbestos] to the outside air during the collection, processing, packaging, or transporting of any asbestos-containing waste material, or use one of the emission control methods specified in paragraphs (a)(1) through (4) of this section:<br><br>(1) Adequately wet asbestos-containing material (ACM). After wetting, seal all asbestos-containing waste material in leak-tight containers while wet; or, put materials that will not fit into containers without additional breaking into leak-tight wrapping. Label the containers or wrapped materials in accordance with 29 CFR 1910.1001(j)(2) or 1926.58(k)(2)(iii). ...<br><br>(4) Use an alternative emission control and waste treatment method that has received prior approval from the Administrator.<br><br>(5) As applied to demolition and renovation, the requirements above under paragraph (a) of this section do not apply to Category I non-friable ACM waste and Category II non-friable ACM waste that did not become crumbled, pulverized, or reduced to powder.<br><br>"Adequately wet" means sufficiently mix or penetrate with liquid to prevent the release of particulates; if visible emissions are observed coming from the asbestos-containing material, the material has not been adequately wetted [40 CFR §61.41]. | √ | √ | Appl | | See preceding, and following sections of the Sitewide Excavation Plan:<br><br>2.5.8 Special Materials<br>3.3.2.2 Special Materials<br>F.4.1.1 Asbestos |
| Asbestos Emission Control,<br><br>Standard for Asbestos Waste Handling<br>OAC 3745-20-05(B), (C)&(D) | (B) Discharge no visible emissions [of asbestos] during the collection, processing, packaging, transporting or deposition of any asbestos-containing waste material, and use one of the emission control methods below:<br><br>(1) Adequately wet asbestos-containing material and seal the material into durable leak-tight containers or enclosure system.<br><br>(2) For facilities where asbestos was not removed prior to demolition [or excavation], keep asbestos-containing waste adequately wet or sealed/encapsulated until collected for disposal. | | | | | |

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## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | (C) Seal all friable asbestos-containing waste material into durable leak-tight disposal containers or use an approved alternative disposal system in accordance with the following: | | | | | |
| | (1) Label all containers of asbestos-containing waste material:<br>DANGER<br>CONTAINS ASBESTOS FIBERS<br>AVOID CREATING DUST<br>CANCER AND LUNG DISEASE HAZARD<br>R.Q. Hazardous Substance<br>N.O.S. asbestos<br>ORM-E 9188 | | | | | |
| | (2) Seal asbestos-containing waste materials in plastic bags at least 6 mils (0.006 inch) thick, and seal that in a second clean, leak-tight plastic bag at least 6 mils thick; or | | | | | |
| | (4) Facility components coated with, covered or containing friable asbestos materials and removed in sections or units — Seal with leak-tight plastic at least 12 mils (0.012 inch) thick or leak-tight polypropylene woven fabric at least 10 mils (0.010 inch) thick; or | | | | | |
| | (3) Whenever necessary to prevent any asbestos-containing waste material from penetrating a container (bag or wrap) — Seal the materials using a combination of a 6 mils thick plastic bag and a leak-tight steel, plastic, or fiber drum, or reinforced disposal box, leak-tight polypropylene woven fabric bag, or similar suitable and durable container. Fit drums with a matching lid and lock-rims. Band and seal boxes with reinforced tape or in accordance with manufacturers recommendations; or | | | | | |
| | (5) Asbestos-containing waste materials, facility components, and contaminated debris may be disposed of using an alternative disposal system which has received prior approval from the Director. | | | | | |
| | (D) Prepare and secure any load of asbestos-containing waste material in a manner that prevents any visible emissions [of asbestos], load loss, and spillage or leakage of liquids. | | | | | |

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## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **AIR EMISSIONS, continued** | | | | | |
| Asbestos Emission Control,<br><br>Standard for Active Asbestos Disposal Sites<br>OAC 3745-20-06(A)&(B)<br><br>[40 CFR Part 61, Subpart M-National Emission Standard for Asbestos,<br><br>Standard for Active Waste Disposal Sites, 40 CFR §61.154] | (A) Each owner or operator of an active asbestos waste disposal site shall cause or permit no visible emissions [of asbestos] to the outside air; or shall comply with the requirements of paragraph (B) of this rule.<br><br>(B) Rather than meet the no visible emissions requirement of paragraph (A) of this rule, each owner or operator of an active asbestos waste disposal site shall comply with the following:<br><br>(1) There shall be no visible emissions from asbestos-containing waste materials during the on-site transportation, transfer, deposition or compacting operations.<br><br>(2) Deposition and burial operations shall be conducted in a manner which prevents handling by equipment or persons that causes asbestos-containing waste materials to be broken-up or dispersed before the materials are buried.<br><br>(3) As soon as practicable after deposition of the asbestos-containing waste materials but no later than at the end of each operating day, the asbestos-containing waste material deposited at the site during the operating day shall be buried with at least twelve inches of compacted nonasbestos-containing material. Alternatively, any owner or operator of an active asbestos waste disposal site may apply for approval of the Director [of Environmental Protection, a.k.a. Director of the OEPA] to utilize alternative control measures to bind dust, control wind erosion or convert [friable] asbestos to non-friable forms.<br><br>(4) During the unloading, deposition, burial, and initial compaction of asbestos-containing materials, the owner or operator of the active [asbestos] waste disposal site shall establish a restricted area adequate to deter the unauthorized entry of the general public and any unauthorized personnel from any location within one hundred feet of the operations, and shall display the following information on a sign not less than twenty by fourteen inches, so that it is visible before entering the restricted area:<br><br>ASBESTOS DUST HAZARD<br>Do Not Remain In Area Unless Your Work Requires It<br>Breathing Asbestos Dust Is Hazardous To Your Health | √ | √ | Appl | Pertinent to the management of asbestos-containing materials.<br><br>Also note that requirements from paragraphs (A) and (B) which are pertinent to disposal of asbestos-containing materials, are included in the OSDF Impacted Materials Placement Plan.<br><br>NOTE:<br>The sizing & language for warning signs under (B)(4) at left conflicts with that required by OSHA under 29 CFR §1926.1101(k)(7).<br><br>The FEMP will follow either the Ohio active asbestos waste disposal sites language or the OSHA required sign language:<br><br>DANGER<br><br>ASBESTOS<br><br>CANCER & LUNG DISEASE HAZARD<br><br>AUTHORIZED PERSONNEL ONLY<br><br>OSHA does not impose a minimum sign size. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Asbestos Emission Control,<br><br>Standard for Inactive Asbestos Disposal Sites<br>OAC 3745-20-07(C)<br><br>[40 CFR Part 61, Subpart M-National Emission Standard for Asbestos,<br><br>Standard for Inactive Waste Disposal Sites, for Asbestos Mills and Manufacturing and Fabricating Operations<br>40 CFR §61.151] | The owner or operator may use an alternate control method that has received prior approval of the Director [of Environmental Protection, a.k.a. Director of the OEPA] rather than comply with the requirements of paragraph (A) [emissions and cover requirements] or (B) [posting and access control requirements] of this rule. | √ | √ | Appl | These requirements for inactive asbestos waste disposal sites are very similar to those for active asbestos waste disposal sites under OAC 3745-20-06 (preceding entry). During soil remediation activities under this remedial action project, the requirements for active asbestos disposal sites (preceding entry) will be followed while managing friable asbestos-containing material.<br><br>Also note that requirements pertinent to disposal of asbestos-containing materials under paragraphs (A) and (C) of OAC 3745-20-07 are included in the OSDF Impacted Materials Placement Plan. | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **AIR EMISSIONS, continued** | | | | | |
| Asbestos Emission Control,<br><br>Standard for Inactive Asbestos Disposal Sites<br>OAC 3745-20-07(D)<br><br>[40 CFR Part 61, Subpart M-National Emission Standard for Asbestos,<br><br>Standard for Inactive Waste Disposal Sites for Asbestos Mills and Manufacturing and Fabricating Operations,<br>40 CFR §61.151(d)] | Each owner or operator of an inactive asbestos waste disposal site shall notify the Director [of Environmental Protection, a.k.a. the Director of the OEPA] in writing prior to disturbing or removing any asbestos-containing waste material. The notice shall contain: | ✓ | ✓ | ✓ | Submission of the project-specific IRDPs to OEPA constitute this notification. | |
| | • the reason for disturbing the waste, | | | | | The reason for disturbing the material is documented in the OU2, OU5 and OU3 RODs. |
| | • the procedures to be used to control emissions, | | | | | FEMP Fugitive Dust Control BAT Determination, the OSDF Impacted Materials Placement Plan, and following sections of the Sitewide Excavation Plan:<br><br>2.5.8 Special Materials<br>3.3.2.2 Special Materials<br>5.1.2.2 Fugitive Emissions<br>F.4.1.1 Asbestos |
| | • the duration of the operation, and | | | | Project schedules contained in project-specific IRDPs. | |
| | • the location of the final disposal site. | | | | | The OSDF, unless the OSDF WAC is not met; else, an off-site permitted/licensed disposal facility. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| National Emission Standards for Hazardous Air Pollutants,<br>Subpart H—National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities,<br>40 CFR §61.90, §61.91 and §61.92 - .97<br><br>[Radiation Protection of the Public and the Environment<br><br>DOE Order 5400.5 Chapter II (1)(b)] | Emissions of radionuclides (except radon-220 and radon-222) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.<br><br>To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to members of the public calculated using EPA-approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval. | Appl | Appl | Appl | | Section 6 of the Integrated Environmental Monitoring Plan (IEMP) and the following sections of the Sitewide Excavation Plan:<br><br>5.1.2.3 Airborne Radiological Particulates<br>5.1.2.4 Radon<br>5.1.2.5 Direct Radiation |
| National Emission Standards for Hazardous Air Pollutants,<br>Subpart Q—National Emission Standards for Radon Emissions From Department of Energy Facilities<br>40 CFR §61.190, §61.192 | No source at a DOE facility shall emit more than 20 pCi/m$^2$/sec of radon-222 as an average for the entire source into the air. | Appl | Appl | R&A | The existing distribution of contaminants within the site soils attains compliance with this requirement.<br><br>Will be addressed sitewide as necessary by the Integrated Environmental Monitoring Plan (IEMP). | |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **SURFACE WATER PATHWAY** | | | | | | |
| | **FLOODPLAIN/WETLANDS PROTECTION** | | | | | |
| Executive Order 11990, Protection of Wetlands | Federal agencies are required to take action to avoid adversely impacting wetlands wherever possible, to minimize wetland destruction, and to preserve the values of wetlands. | Appl | Appl | | Floodplain and wetland impacts associated with soil remediation activities will be minimized and avoided to the maximum extent practicable. Projects with unavoidable impacts will be undertaken in accordance with 33 CFR Parts 323 and 330.<br><br>A review of an overlay of each remediation area boundary on the FEMP Jurisdictional Wetland Delineation (Drwg. 75X-5500-G-00372) will be conducted to determine the approximate acreage of jurisdictional wetlands that will be dredged and filled during excavation of the remediation area. Dredge and fill activities within these wetlands will comply with the substantive requirements of Nationwide Permit Nos. 38 and 26 (subsequent entry) — promulgated in Appendix A of 33 CFR Part 330 (subsequent entry) and OEPA's corresponding State Water Quality Certification (see subsequent entry for OAC 3745-32). | Approximately 36 acres of jurisdictional wetlands and 9 acres of waters of the United States were identified on the FEMP property as a result of the 1993 Jurisdictional Wetlands & Waters of the U.S. (1993 FEMP Wetland Delineation). The U.S. Army Corps of Engineers officially approved the delineation on August 19, 1993. See also: Appendix H of the OU2 FS Report; Appendix J of the OU5 FS Report, and Appendix J of the OU3 RI/FS.<br><br>The Natural Resources Restoration Plan (NRRP); also, remedial action completion reports must include NEPA compliance, as per following sections of the Sitewide Excavation Plan:<br><br>1.4.2 Related Documents<br>7.4 Certification Report<br>7.5 Other Related Future Documents |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Procedure for Implementing the National Environmental Policy Act<br>40 CFR §6.302(a) | Federal agencies conducting certain activities must avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands, and avoid support of new construction in wetlands when a practicable alternative exists. | Appl | Appl | | See preceding. | See preceding. |
| Executive Order 11988, Floodplain Management<br><br>Procedures for Implementing the National Environmental Policy Act<br>40 CFR §6.302(b) | Federal agencies must evaluate the potential effects of actions they may take in a floodplain to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain. | Appl | Appl | | Remediation is needed, and can not be avoided. Nationwide Permit # 38 (subsequent entry) authorizes such remedial activity in a floodplain. The floodplain will not be developed as a result of this federal agency action. | An updated floodplain determination was conducted in October 1992 for Paddy's Run using the U.S. Army Corps of Engineers' standard HEC2 water surface profile analysis program. The 100-year flood elevations reach the western slope of the Inactive Flyash Pile and the toe of the South Field slope. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **FLOODPLAIN/WETLANDS PROTECTION, continued** | | | | | |
| DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements<br>10 CFR §1022.3(a), 3(b)(1), 3(b)(2), 3(b)(3), 3(b)(5), 3(b)(6), 3(c), 3(d), 3(e) | DOE shall exercise leadership and take action to:<br>• Avoid to the extent possible the long- and short-term adverse impacts associated with the destruction of wetlands and the occupancy and modification of floodplains and wetlands, and avoid direct and indirect support of floodplain and wetland development wherever there is a practicable alternative.<br>• Incorporate floodplain management goals and wetlands protection considerations into its planning, regulatory, and decision-making processes and shall to the extent practicable:<br>- Reduce the hazard and risk of flood loss.<br>- Minimize the impact of floods on human safety, health, and welfare.<br>- Restore and preserve natural and beneficial values served by the floodplain.<br>- Minimize the destruction, loss, or degradation of wetlands.<br>- Preserve and enhance the natural and beneficial values of wetlands.<br>• Undertake a careful evaluation of the potential effects of any DOE action taken in a floodplain and any new construction undertaken by DOE in wetlands not located in a floodplain.<br>• Identify, evaluate, and as appropriate, implement alternative actions which may avoid or mitigate adverse floodplain/wetlands impacts.<br>• Provide opportunity for early public review of any plans or proposals for actions in floodplains and new construction in wetlands. | Appl | Appl | Appl | 10 CFR Part 1022 is the DOE implementing regulation for Executive Orders 11988 and 11990 (see corresponding preceding entries). | Remediation decisions included avoidance to/ minimization of wetlands impacts. See: Appendix H of the OU2 FS Report; Appendix J of the OU5 FS Report, and Appendix J of the OU3 RI/FS.<br>Also, see preceding entries. |
| DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements<br>10 CFR §1022.5(b), (h) | This part shall apply to all proposed floodplain/wetlands actions, including those sponsored jointly with other agencies, where practicable alternatives to the proposed actions are still available.<br>The policies and procedures of this part which are applicable to floodplain actions shall apply to all proposed actions which occur in a wetlands located in a floodplain. | Appl | Appl | Appl | See preceding entries. | See preceding entries. |



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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements 10 CFR §1022.11 (a), (b), (c) | Concurrent with its review of a proposed action to determine appropriate NEPA requirements, DOE shall determine applicability of the floodplain management and wetlands protection requirements of this part.<br><br>In making a floodplain determination, DOE shall utilize the Flood Insurance Rate Maps (FIRMs) or the Flood Hazard Boundary Maps (FHBMs) prepared by the Federal Insurance Administration of the Department of Housing and Urban Development to determine if a proposed action is located in the base or critical action floodplain, as appropriate. For a proposed action in an area of predominately federal or state land holdings where FIRM or FHBM maps are not available, information shall be sought from the land administering agency (e.g., Bureau of Land Management, Soil Conservation Service, etc.) or from agencies with floodplain analysis expertise. | Appl | Appl | | See preceding entries. | See preceding entries. |
| DOE Compliance with Floodplain/ Wetlands Assessments 10 CFR §1022.12(a) | If DOE determines, pursuant to 10 CFR §§ 1022.5 and 1022.11, that this part is applicable to the proposed action, DOE shall prepare a floodplain/wetlands assessment, according to the requirements in this section (10 CFR §1022.12). | Appl | Appl | | See preceding entries. | See preceding entries. |
| DOE Compliance with Floodplain/ Wetlands Environmental Review Requirements 10 CFR §1022.15(a) | If DOE finds that no practicable alternative to locating in the floodplain/wetland is available, consistent with the policy set forth in Executive Order 11988, DOE shall, before taking action, design, or modify its action in order to minimize potential harm to or within the floodplain or wetland. | Appl | Appl | | See preceding entries. | See preceding entries. |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) General Regulatory Policies 33 CFR §323.3 | Permits will be required for the discharge of dredged or fill material into waters of the United States including wetlands. Certain discharges specified in 33 CFR Part 330 are permitted by that regulation (nationwide permits).<br><br>If a discharge of dredged or fill material is not permitted by 33 CFR Part 330 (Nationwide Permits), an individual section 404 permit will be required for the discharge of dredged or fill material into waters of the United States.<br><br>Discharges of dredged or fill material into waters of the United States done by or on behalf of any Federal agency, other than the Corps of Engineers, are subject to the authorization procedures of these regulations.<br><br>Remedial actions involving the discharge of dredge and fill material into these areas shall meet the substantive requirements of this section and 40 CFR Part 230. | Appl | <br><br><br><br><br><br><br><br>Appl | | See preceding entry for Executive Order 11990 (first Floodplain/Wetland Protection entry).<br><br>Discharges of dredged and fill material not authorized by a NWP will be conducted in accordance with the substantive requirements of these regulations. | See preceding entries. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **FLOODPLAIN/WETLANDS PROTECTION, continued** | | | | | |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit (NWP) Program<br>33 CFR Part 330 | The U.S. Army Corps of Engineers has authorized certain categories of activities involving the discharge of dredged and fill material into wetlands and waters of the United States under the NWP program. Activities involving the discharge of dredged and fill material will be conducted in accordance with the substantive requirements of applicable NWPs as required. Discharges not authorized by NWP will be conducted in accordance with the substantive requirements of 33 CFR Part 323 and 40 CFR Part 230. | √ | Appl | R&A | See preceding entries. | Following sections of the Sitewide Excavation Plan:<br>3.3.1 Implementation of Construction, Excavation, and Material-handling Activities<br>5.1.1 Natural Resource Impacts<br>5.1.3 Surface Water Pathway |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program<br>33 U.S.C. §1341(a)(1), (d)<br>33 CFR §330.1(c) | An activity is authorized under an Nationwide Permit (NWP) only if that activity and the permittee satisfy all of the individual NWP's terms and conditions. Potentially applicable NWPs include:<br>• Nationwide Permit #38 — Cleanup of Hazardous and Toxic Waste<br>- This permit authorizes specific activities required to affect the containment, stabilization or removal of hazardous or toxic waste materials that are performed, ordered, or sponsored by a government agency with established legal or regulatory authority provided the permittee notifies the district engineer.<br>- For discharges in special aquatic sites, including wetlands, the notification must include a delineation of affected special aquatic sites, including wetlands.<br>- This nationwide permit does not authorize the establishment of new disposal sites or the expansion of existing sites used for the disposal of hazardous or toxic waste. | Appl | Appl | R&A | See preceding entry for Executive Order 11990 (first Floodplain/Wetlands Protection entry). | January 17, 1992 letter from Donald R. Schregardus, Director of the OEPA, to the U.S. Army Corps of Engineers, "401 Certification — Grant," the OEPA conditionally certified that projects authorized by NWP #s 38 and 26 will comply with the applicable provisions of the Federal Water Pollution Control Act. |



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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | • Nationwide Permit #26 — Headwaters and Isolated Waters Discharges<br>- The discharge does not cause the loss of more than 10 acres of waters of the United States.<br>- The permittee notifies the district engineer if the discharge would cause the loss of waters of the United States greater than 1 acre.<br>- For discharges in special aquatic sites, including wetlands, the notification must also include a delineation of affected special aquatic sites, including wetlands.<br>- The discharge, including all attendant features, both temporary and permanent, is part of a single and complete project. | | | | | |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program<br><br>Section B(26) to Appendix A of 33 CFR Part 330 | Discharges of dredged or fill material into headwaters and isolated waters [under Nationwide Permit # 26] are approved provided:<br>• The discharge does not cause the loss of more than 10 acres of waters of the United States.<br>• The permittee notifies the district engineer if the discharge would cause the loss of waters of the United States greater than 1 acre.<br>• For discharges in special aquatic sites, including wetlands, the notification must also include a delineation of affected special aquatic sites, including wetlands.<br>• The discharge, including all attendant features, both temporary and permanent, is part of a single and complete project. | ✓ | ✓ | ✓ | See preceding and following entries. | See preceding and following entries. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **FLOODPLAIN/WETLANDS PROTECTION, continued** | | | | | |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program<br>33 CFR §330.4 (c)(1)<br><br>Ohio Section 401 State Water Quality Certifications<br>OAC 3745-32-02 | Section 401 State Water Quality Certification pursuant to Section 401 of the Clean Water Act, or waiver thereof, is required to prior to issuance or re-issuance of individual or nationwide permits authorizing (dredge and fill) activities which may result in a discharge into waters of the United States. State Water Quality Certification is granted provided:<br><br>1. The discharge does not prevent or interfere with the attainment or maintenance of applicable water quality standards; and<br><br>2. The discharge does not result in a violation of any applicable provisions of the Federal Water Pollution Control Act (a.k.a., Clean Water Act). | Appl | Appl | | See preceding and following entries. | January 17, 1992 letter from Donald R. Schregardus, Director of the OEPA, to the U.S. Army Corps of Engineers, "401 Certification — Grant," the OEPA conditionally certified that projects authorized by the NWP #s 38 and 26 (see previous entry) will comply with the applicable provisions of the Federal Water Pollution Control Act. |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program<br><br>Section C of Appendix A to 33 CFR Part 330 | In addition to the General Conditions, the following [Section 404 only] conditions apply only to activities that involve the discharge of dredge or fill material and must by followed in order for authorization of the nationwide permits to be valid:<br><br>• No discharge of dredged or fill material may consist of unsuitable material (e.g., trash, debris, car bodies, etc.). And material discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).<br><br>• Discharges of dredged or fill material into waters of the United States must be minimized or avoided to the maximum extent practicable at the project site, unless the District Engineer has approved a compensation mitigation plan for the specific regulated activity. | √ | √ | | See preceding entries. | The Natural Resources Restoration Plan (NRRP) |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **FLOODPLAIN/WETLANDS PROTECTION, continued** | | | | | |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) Nationwide Permit Program<br><br>Section C of Appendix A to 33 CFR Part 330 | Factors that the District Engineer will consider when determining the acceptability of appropriate and practicable mitigation include, but are not limited to:<br><br>• To be practicable, the mitigation must be available and capable of being done considering costs, existing technology, and logistics in light of overall project purposes.<br><br>• To the extent appropriate, permittees should consider mitigation banking and other forms of mitigation including contribution to wetland trust funds, which contribute to the restoration, creation, replacement, enhancement, or preservation of wetlands.<br><br>• Furthermore, examples of mitigation that may be appropriate and practicable include but are not limited to: reducing the size of the project; establishing buffer zones to protect aquatic resource values; and replacing the loss of aquatic resource values by creating, restoring, and enhancing similar functions and values. In addition, mitigation must address impacts and cannot be used to offset the acreage of wetland losses that would occur in order to meet the acreage limits of some of the nationwide permits. | √ | √ | | See preceding entries. | The Natural Resources Restoration Plan (NRRP) |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act) §404<br>(33 U.S.C. §1344)<br><br>Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material,<br>Subpart B—Compliance With the Guidelines, Restrictions on Discharge<br>40 CFR §230.10 | No discharge of dredged or fill material shall be permitted:<br>• If there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as, the alternative does not have other significant adverse environmental consequences.<br>• Unless appropriate and practicable steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem.<br><br>No discharge of dredged or fill material shall be permitted if it:<br>• Causes or contributes, after consideration of disposal site dilution and dispersion, to violations of any applicable state water quality standard.<br>• Violates any applicable toxic effluent standard or prohibition under section 307 of the Clean Water Act.<br>• Jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification or a habitat which is determined to be a critical habitat under the Endangered Species Act of 1973, as amended. | Appl | √ | √ | See preceding entries. | Appendix H of the OU2 FS Report; Appendix J of the OU5 FS Report, and Appendix J of the OU3 RI/FS. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DISCHARGE TO SURFACE WATER** | | | | | |
| Pollution to Waters of the State<br>ORC 6111.04 | No person shall cause pollution or place or cause to be placed any sewage, industrial waste, or other wastes in a location where they cause pollution of any waters of the state.<br><br>No person to whom a permit has been issued shall place or discharge, or cause to be placed or discharged, in any waters of the state any sewage, industrial waste, or other wastes in excess of the permissive discharges specified under such existing permit without first receiving a permit from the Director to do so.<br><br>Pollution to waters of the state is prohibited. | Appl | Appl | R&A | | FEMP Site NPDES Permit Number 1IO00004*ED, the FEMP Stormwater Pollution Prevention Plan (RM-0039), Section 4 of the Integrated Environmental Monitoring Plan (IEMP), and the following section of the Sitewide Excavation Plan:<br><br>5.1.3 Surface Water Pathway |
| Compliance with Ohio Water Pollution Control Requirements<br>ORC 6111.07(A), (C) | Failure to comply with water pollution control requirements is prohibited. | √ | Appl | Appl | | See preceding. |
| Water Quality Standards,<br><br>Criteria Applicable to All Waters<br>OAC 3745-1-04 | To every extent practical and possible, all surface waters of the State of Ohio shall be free from:<br><br>• Suspended solids or other substances that enter the waters as a result of human activity that will form putrescent or otherwise objectionable sludge deposits<br>• Floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation<br>• Materials entering the waters as a result of human activity producing color, odor or other conditions in such a degree as to create a nuisance<br>• Substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life and/or are rapidly lethal in the mixing zone<br>• Nutrients entering the waters in concentrations that create nuisance growths of aquatic weeds or algae | √ | R&A | R&A | | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DISCHARGE TO SURFACE WATER, continued** | | | | | |
| Water Quality Standards,<br><br>Antidegradation Policy<br>OAC 3745-1-05(A)&(B) | (A) Existing instream water uses as defined in OAC 3745-1-07 [subsequent entry] shall be maintained and protected. No further water quality degradation which would interfere with or become injurious to designated uses is allowable.<br><br>(B) Waters in which existing water quality is better than the criteria prescribed in these rules and exceeds those levels necessary to support propagation of fish, shellfish and wildlife and recreation in and on the water shall be maintained and protected. ... Degradation of water quality shall not interfere or become injurious to existing or planned uses, and the Director shall require that ... feasible management or regulatory programs pursuant to Section 208 and 303 of the Act [Clean Water Act], 33 U.S.C. Sections 1288 and 1313, be applied to nonpoint sources. | √ | √ | Appl | Soil remedial action projects will ensure that existing instream water uses of the Great Miami River and Paddy's Run will be maintained as health protective. | See preceding. |
| Water Quality Standards,<br><br>Great Miami River<br>OAC 3745-1-21 | Paddy's Run and the Great Miami River are designated as:<br>• Warm water aquatic life habitat<br>• Agricultural and industrial water supply<br>• Primary contact recreation<br><br>The Great Miami River between Ross Road (RM 95.7) to Taylorsville Dam (RM 92.6) is a state resource water, and RM 130 and 118 are public water supplies. | Appl | Appl | Appl | Discharges to the Great Miami River and Paddy's Run must not cause a violation of applicable numeric or narrative water quality standards for these designations.<br><br>The FEMP effluent discharge pipe, located at River Mile (RM) 24.73 on the Great Miami River, is downstream of the state resource waters and public water supplies. | See preceding. |
| National Pollutant Discharge Elimination System<br>40 CFR §122.26(a)(l)(ii),<br>40 CFR §122.26(b)(14)(v), (x) | A discharge composed entirely of storm water associated with industrial activity is required to obtain a NPDES permit.<br><br>These categories of facilities are considered to be engaging in "industrial activity":<br><br>• Landfills, land application sites, and open dumps that receive or have received any industrial wastes (waste that is received from any of the facilities described under this subsection), including those that are subject to regulation under Subtitle D of RCRA; and<br><br>• Construction activities including clearing, grading, and excavation that disturbs five acres or more of total land area. | Appl | Appl | Appl | Discharges of stormwater associated with industrial and/or construction activities are regulated in accordance with the existing FEMP NPDES Permit (Ohio EPA Number 1IO00004*ED), and the FEMP Stormwater Pollution Prevention Plan (RM-0039). | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Ohio NPDES Permits,<br><br>Ohio NPDES Permits Required<br>OAC 3745-33-02(A) | No person may discharge any pollutant or cause, permit, or allow a discharge of any pollutant [from a point source] without applying for and obtaining an Ohio NPDES permit in accordance w with the requirements of this Chapter, 3745-33. | √ | √ | √ | See preceding and following entries. | FEMP Site NPDES Permit (Ohio EPA Number 1IO00004*ED), and the FEMP Stormwater Pollution Prevention Plan (RM-0039). |
| Ohio NPDES General Permits,<br><br>Ohio NPDES Permit Required<br>OAC 3745-38-02(A) | No person may discharge any pollutant or cause, permit, or allow a discharge of any pollutant from a point source without either applying for and obtaining an Ohio NPDES permit in accordance w with the requirements of Chapter 3745-33 of the Administrative Code [preceding entry], ... or have authorization to discharge under an Ohio NPDES general permit in accordance with the requirements of this chapter [3745-38].<br><br>**NOTE:** In September 1992, the FEMP applied for an individual stormwater permit to cover its industrial stormwater discharges to Paddy's Run. On the basis of the information provided in the original FEMP Stormwater Permit Application, Ohio EPA has chosen to regulate FEMP site industrial stormwater discharges under the individual permit process (OAC 3745-33, preceding entry), by incorporating stormwater monitoring requirements at Paddy's Run into the NPDES permit. The site NPDES permit also addresses discharges of stormwater associated with construction activities by requiring a Stormwater Pollution Prevention Plan that defines the manner in which these discharges will be managed. | √ | √ | √ | In accordance with the note at left, the general permitting process described in OAC 3745-38 is not applicable to the FEMP site stormwater discharges. Rather, these are regulated within the context of the existing FEMP NPDES Permit (Ohio EPA Number 1IO00004*ED) and the FEMP Stormwater Pollution Prevention Plan (RM-0039), both of which derive their regulatory basis from OAC 3745-33 (preceding entry). | See preceding entries. |
| Rules and Regulations of the Hamilton County Soil and Water Conservation District Governing Earthwork for Unincorporated Hamilton County, Ohio | Temporary and/or permanent erosion and sediment control features and devices shall be designed and constructed in general accordance with the State of Ohio Temporary Erosion Control Specifications.<br><br>*Exempted* from these requirements are:<br><br>• *any public work performed by or under control of any governmental agency*, provided such operations do not cause instability of any adjacent or contiguous property and substantially equivalent sediment control policies are applied [3.10 E].<br><br>• *operations involving process and stockpiling of soils or rock materials where controlled by other regulations*, provided such operations do not cause instability of any adjacent or contiguous property [3.10 H]. | √ | TBC | TBC | | FEMP Site NPDES Permit (OEPA Number 1IO00004*ED), and the FEMP Stormwater Pollution Prevention Plan (RM-0039), and the following sections of the Sitewide Excavation Plan:<br><br>5.1.3 Surface Water Pathway<br>App F Implementation of Construction |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DISCHARGE TO SURFACE WATER, continued** | | | | | |
| Federal Water Pollution Control Act (a.k.a., Clean Water Act)<br><br>Subpart K—Best Management Practices (BMP) Programs<br>40 CFR §125.104 | BMP programs shall be developed in accordance with good engineering practices and:<br>1) Be documented in narrative form and include any necessary plot plans, drawings or maps;<br>2) Establish specific objectives for the control of toxic and hazardous pollutants:<br>(a) Each facility component or system shall be examined for its potential for causing a release of significant amounts of toxic or hazardous pollutants to waters of the United States due to equipment failure, improper operation, natural phenomena such as rain or snowfall, etc.<br>(b) Where experience indicates a reasonable potential for equipment failure (e.g., a tank overflow or leakage), natural condition (e.g., precipitation), or other circumstances to result in significant amounts of toxic or hazardous pollutants reaching surface waters, the program should include a prediction of the direction, rate of flow and total quantity of toxic or hazardous pollutants which could be discharged from the facility as a result of each condition or circumstance;<br>3) Establish specific BMPs to meet the objectives identified in (2) above, addressing each component or system capable of causing a release of significant amounts of toxic or hazardous pollutants to the waters of the United States. | | Appl | R&A | BMP requirements will be met by implementing FEMP's BMP Plan. The BMP Plan will be progressively updated to accommodate changing site activities during the conduct of CERCLA remedial actions. | Addressed as part of the selected remedy described in the OU5 ROD.<br><br>Also see preceding entries. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **GROUNDWATER PATHWAY** | | | | | | |
| | **GROUNDWATER PROTECTION** | | | | | |
| Safe Drinking Water Act<br>42 U.S.C. §1424(e) | All Federal financially assisted projects constructed in the area of a sole source aquifer and its principal recharge zone will be subject to EPA's review to insure that these projects are designed and constructed so that they do not create a significant hazard to public health. | Appl | Appl | Appl | A notice in 53 FR 15876 (May 4, 1988) designated the Buried Valley Aquifer System of the Great Miami/ Little Miami River Basins of southwestern Ohio as a sole or principal source of drinking water. The Fernald site is located above this aquifer. | EPA and OEPA review of project submittals |
| | **WELLS – CONSTRUCTION** | | | | | |
| Water Well Standards,<br><br>Pumping Wells<br>OAC 3745-9-08(C) | Pumps may only be primed with potable water. | | Appl | | Pertains to all well pumps that require priming. | The Sitewide CERCLA Quality Assurance Project Plan (SCQ), the Integrated Environmental Monitoring Plan (IEMP), and the individual project-specific plans for sampling. |
| Water Well Standards,<br><br>Monitoring Well Maintenance and Modification<br>OAC 3745-9-09(A) through (C), and (E) through (G) | Monitoring wells must be maintained or modified to avoid cross-contamination of groundwater. | | Appl | | Pertains to all groundwater wells and piezometers. | The Sitewide CERCLA Quality Assurance Project Plan (SCQ), the Integrated Environmental Monitoring Plan (IEMP), and the following section of the Sitewide Excavation Plan:<br>F.6.3 Monitoring Well Preservation |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **WELLS – ABANDONMENT** | | | | | |
| Water Well Standards,<br><br>Abandonment of Test Holes and Wells<br>OAC 3745-9-10 | Upon completion of testing, a test hole shall be either completely filled with grout or such other material as will prevent contaminants from entering groundwater.<br><br>If a well [or similar device] containing walls is not being used for obtaining groundwater or for determining the quality, quantity, or level of groundwater, it shall be completely filled with grout or other similar material as will prevent contaminants from entering groundwater, or maintained in strict accordance with all applicable requirements of OAC 3745-9-09. | | Appl | Appl | After they are no longer needed, wells, peizometers and lysimeters are to be properly plugged and abandoned in accordance with these requirements. | The Sitewide CERCLA Quality Assurance Project Plan (SCQ), the Integrated Environmental Monitoring Plan (IEMP), and the following section of the Sitewide Excavation Plan:<br>F.6.1 Plugging and Abandonment<br>F.6.2 Monitoring Well Excavation |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **SOIL REMEDIATION** | | | | | | |
| **CLOSURE OF UNDERGROUND STORAGE TANKS** | | | | | | |
| General Requirements<br><br>OAC 1301:7-7-36<br><br>40 CFR §§280.61 through .66 | Owner or operators of petroleum or hazardous substance underground storage tank (UST) systems must, in response to a confirmed release from the UST system, comply with abatement measures, site characterization, product removal, investigations for soil and groundwater cleanup, and corrective action plan, except for USTs excluded under 40 CFR §280.10(b) and UST systems subject to RCRA Subtitle C corrective action requirements under Section 3004(u) of RCRA, as amended. | | Appl | √ | Risk-based closures are to be performed for USTs with media contamination as integrated with the CERCLA soil remediation activities. | Risk-based soil cleanup levels, known as FRLs, are established in the RODs.<br><br>Following sections of the Sitewide Excavation Plan:<br>2.1.1.2 Underground Storage Tanks<br>2.2.6 UST Closure<br>4.0 Location-Specific Excavation Approaches<br>App F Implementation of Construction |
| **CLOSURE OF HAZARDOUS WASTE MANAGEMENT UNITS** | | | | | | |
| OEPA Closure Plan Review Guidance for RCRA Facilities (Interim Final)<br>September 1, 1993 | Federal Regulations of May 2, 1986 (50 FR 16422) and March 19, 1987 (52 FR 8704) modified the closure performance standard such that risk assessment, or what constitutes "decontamination" of a site, may be considered by EPA as a closure option. On December 8, 1988 (see OAC 3745-67-28), the OEPA adopted the equivalent of the EPA's March 19, 1987 regulations, clarifying that risk assessment may be a closure option. It is OEPA and its Division of Hazardous Waste Management (DHWM) practice to consider risk assessment/risk-based closure as a possible third option for closure for all types of units [hazardous waste management units (HWMUs) and solid waste management units (SWMUs)]. | | TBC | √ | Risk-based closures are to be performed for HWMUs with media contamination as integrated with the CERCLA soil remediation activities (see following entry). | Risk-based soil cleanup levels, known as FRLs, are established in the RODs.<br><br>Following sections of the Sitewide Excavation Plan:<br>2.1.1.1 Hazardous Waste Management Units<br>2.2.5 HWMU Closure<br>4.0 Location-Specific Excavation Approaches<br>App F Implementation of Construction |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| RCRA/CERCLA Integrated Closure Director's Final Findings and Orders (June 4, 1996)<br><br>Section V.1 | The Respondent ... shall comply with the closure regulations contained in OAC rules 3745-66-11(A) and (B), 3745-66-11(C) as applicable, 3745-66-14, and 3745-66-16 through 3745-66-20 as applicable for the HWMUs [hazardous waste management units] listed in Attachment A [to these Orders]. | | √ | √ | Pertinent to closures of HWMUs presented in Table 2-1 of the Sitewide Excavation Plan (derived from the DF&O's Attachment A) during the CERCLA soil remediation activities | See subsequent entries in this table for those OAC rules determined by the RODs as ARARs. While OAC 3745-66-11 and -14 are presented in the next two entries, entries for 3745-66-16 through -20 for post-closure are addressed in the subsequent Post-Closure presentation group of this table. |
| RCRA/CERCLA Integrated Closure Director's Final Findings and Orders (June 4, 1996)<br><br>Section V.1 | The Respondent ... shall comply with the closure regulations contained in OAC rules 3745-66-11(A) and (B), 3745-66-11(C) as applicable, 3745-66-14, and 3745-66-16 through 3745-66-20 as applicable for the HWMUs [hazardous waste management units] listed in Attachment A [to these Orders]. | | √ | √ | Pertinent to closures of HWMUs in preceding entry during the CERCLA soil remediation activities. | See preceding and subsequent entries. |
| Closure and Post-Closure Under Interim Standards<br><br>Closure Performance Standard<br>OAC 3745-66-11<br><br>[40 CFR §265.111] | The owner or operator shall close his facility or hazardous waste management unit (HWMU) in a manner that:<br><br>(A) minimizes the need for further maintenance;<br><br>(B) controls, minimizes, or eliminates, to the extent necessary to protect public health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere; and<br><br>(C) complies with these closure requirements. | √ | Appl | Appl | Pertinent to closures of HWMUs during the CERCLA soil remediation activities; also cited in RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>**NOTE:** These requirements are the same as those for new hazardous waste facilities under OAC 3745-55-11 (40 CFR §264.111).<br><br>**NOTE:** DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | Following sections of the Sitewide Excavation Plan:<br>2.1.1.1 Hazardous Waste Management Units<br>2.2.5 HWMU Closure<br>4.0 Location-Specific Excavation Approaches<br>App F Implementation of Construction |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **CLOSURE OF HAZARDOUS WASTE MANAGEMENT UNITS, continued** | | | | | |
| Closure and Post-Closure Under Interim Standards<br><br>Disposal or Decontamination of Equipment, Structures and Soils<br>OAC 3745-66-14<br><br>[40 CFR §265.114] | During the partial and final closure periods, all contaminated equipment, structures, and soils must be properly disposed of or decontaminated [to risk-based cleanup levels] [i.e., clean closed, have risk-based closure, or be closed in place], unless otherwise specified in:<br><br>OAC 3745-66-97<br>Closure and Post-Closure Under Interim Standards: [Tank System] Closure and Post-Closure Care<br><br>OAC 3745-67-28<br>Surface Impoundments: Closure and Post-Closure Care<br><br>OAC 3745-67-58<br>Surface Impoundments: [Waste Piles] Closure and Post-Closure Care<br><br>OAC 3745-67-80<br>Surface Impoundments: [Land Treatment Facility] Closure and Post-Closure Care<br><br>OAC 3745-68-10<br>Landfills, Incinerators, Thermal Treatment, Miscellaneous Units: Closure and Post-Closure | √ | Appl | Appl | Pertinent to closures of the identified HWMUs during the CERCLA soil remediation activities; also cited in RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>NOTE: These requirements are the same as those for new hazardous waste facilities under OAC 3745-55-14 (40 CFR §264.114), with corresponding cross-references presented therein. | Risk-based soil cleanup levels, known as FRLs, are established in the RODs.<br><br>Also see preceding entry. |
| Surface Impoundments: [Surface Impoundments] Closure and Post-Closure Care<br>OAC 3745-67-28 | At closure of a surface impoundment HWMU, the owner or operator must remove or decontaminate [to risk-based cleanup levels] all waste residues, contaminated waste containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate.<br><br>If the owner or operator demonstrates that not all contaminated soils can be practically removed or decontaminated [to risk-based cleanup levels], he must close the HWMU and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills under OAC 3745-66-10 to 3745-66-20 and OAC 3745-68-10 (40 CFR §264.310). | | √ | √ | Pertinent to closure of surface impoundment HWMUs during the CERCLA soil remediation activities, as cited in a preceding entry.<br><br>NOTE: These requirements are the same as those for new hazardous waste facilities under OAC 3745-56-28 (40 CFR §264.228). | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Hazardous Waste New Facility Corrective Action, Closure and Post-Closure Requirements<br><br>[Container Storage Area]<br>Closure<br>OAC 3745-55-78<br><br>[40 CFR §264.178] | At closure of a container storage area HWMU, the owner or operator must remove all hazardous waste and hazardous waste residues from the containment system. Remaining containers, liners, bases, and soil containing or contaminated with hazardous waste or hazardous waste residues must be removed or decontaminated [to risk-based cleanup levels]. | √ | R&A | √ | Pertinent to closures of container storage area HWMUs during the CERCLA soil remediation activities<br><br>NOTE: There are no corresponding requirements for interim status hazardous waste facilities under OAC 3745-65, -66, or -67 (40 CFR Part 265). | See preceding. |
| Landfills, Incinerators, Thermal Treatment, Miscellaneous Units: Closure and Post-Closure<br>OAC 3745-68-10(A)<br><br>[40 CFR §265.310(a)] | At final closure of a HWMU as a landfill ... the owner or operator must cover the HWMU ... with a final cover designed and constructed to:<br><br>• provide long-term minimization of migration of liquids through the closed HWMU;<br>• function with minimum maintenance;<br>• promote drainage and minimize erosion or abrasion of the cover;<br>• accommodate settling and subsidence so that the cover's integrity is maintained; and<br>• have a permeability less than or equal to the permeability of any bottom liner system or natural subsoil present. | √ | R&A | √ | Pertinent to HWMUs that are "closed in place" — i.e., all contaminated soils can not practically be removed or decontaminated [to risk-based cleanup levels] — during the CERCLA soil remediation process.<br><br>NOTE: DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs rather than close in-place (close as a landfill). | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **CLOSURE OF HAZARDOUS WASTE MANAGEMENT UNITS, continued** | | | | | |
| RCRA/CERCLA Integrated Closure Director's Final Findings and Orders (June 4, 1996)<br><br>Section V.2<br><br>in lieu of<br><br>Closure and Post-Closure Under Interim Standards<br><br>Closure Plan; Amendment of Closure Plan<br>OAC 3745-66-12 | The Respondent ... are hereby exempted from complying with OAC rule 3745-66-12 for the HWMUs identified in Attachment A of these Orders, provided that the Respondent:<br><br>a. Submits the documents contained in Attachment C [of these Orders] to Ohio EPA in accordance with the dates established pursuant to the ACA [Amended Consent Agreement]. Within one week after submitting these documents to Ohio EPA, the Respondent shall submit a cross-reference index which contains pertinent page and section identifications for each HWMU that is contained in the documents and said index shall be cumulative and reference all previous document locations. ...<br><br>d. Implements the final remedies as reflected in the Records of Decision issued in accordance with the ACA. | | √ | √ | Pertinent to closures of HWMUs listed in preceding entries (see Table 2-1 of the Sitewide Excavation Plan, derived from the DF&O's Attachment A) during the CERCLA soil remediation activities.<br><br>DOE will submit the cross-reference index for the listed HWMUs accordingly. | Following sections of the Sitewide Excavation Plan:<br>2.1.1.1 Hazardous Waste Mangement Units<br>2.2.5 Hazardous Waste Management Unit Closure<br>3.3.1.3 Treatment, Special Handling and Disposal Options.<br>3.4.7 Certification Reports |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **RADIONUCLIDE CONCENTRATIONS** | | | | | |
| Radiation Protection of the Public and the Environment<br><br>DOE Order 5400.5 Chapter I (4) and Chapter II (2) | An "as low as reasonably achievable (ALARA)" process is to be used in planning and carrying out all DOE activities that have the potential to cause radiation exposure to the public. ALARA requires judgement with respect to what is reasonably achievable. Factors that relate to societal, technological, economic, and other public policy considerations shall be evaluated to the extent practicable.<br><br>Factors to be considered, at a minimum, include:<br><br>• Maximum dose to members of the public;<br>• Collective dose to the population;<br>• Alternative processes, such as alternative treatment of discharge streams, operating methods, or controls;<br>• Doses for each process alternative;<br>• Cost for each of the technological alternatives;<br>• Examination of the changes in cost among alternatives; and<br>• Changes in societal impact associated with process alternatives (e.g., differential doses from various pathways).<br><br>Except for meeting requirements of NEPA, qualitative analyses are acceptable, in most instances, for ALARA judgements, especially when the potential doses are well below the dose limit. The bases for these judgements should be documented. More detailed analyses should be considered if the decision might result in doses that approach the limit. | TBC | TBC | | In addition to the evaluations conducted as part of the CERCLA selection of remedy process [the short- and long-term risk assessments of the Comprehensive Remedial Action Risk Evaluation (CRARE) within the feasibility studies (FSs)], documentation of "equivalent evaluations" for environmental ALARA are performed in accordance with the "FEMP Environmental ALARA Plan" and retained as part of the site and project records.<br><br>Also addressed through the approved selected remedy in the RODs. An ALARA goal is set in the OU5 ROD for the total uranium FRL. | Following sections of the Sitewide Excavation Plan:<br><br>2.1.3 Final Remediation Levels<br>2.1.5.2 Radiological Hot Spots<br>2.1.5.3 ALARA Requirements<br>2.2.2 Certifying FRL Attainment<br>2.2.3 Detection of and Criteria for Hot Spots<br>3.3.1.4 ALARA Implementation<br>3.3.3 Precertification Activities<br>3.4.6 Implementation Strategy for Hot Spot Criteria<br>3.4.7 Certification Report |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **RADIONUCLIDE CONCENTRATIONS, continued** | | | | | |
| Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,<br><br>Subpart B—Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites<br>40 CFR §192.12(a)<br><br>Subpart C—Implementation<br>40 CFR §192.20 | Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials, the concentration of radium-226 in land averaged over any area of 100 $m^2$ shall not exceed the background level by more than:<br>• 5 pCi/g averaged over the first 15 cm of soil below the surface, and<br>• 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface.<br><br>Compliance with this requirement should be shown through measurements performed within the accuracy of currently available types of field and laboratory instruments in conjunction with reasonable survey and sampling procedures. | R&A | R&A | R&A | Met through the selection of FRLs based on risk assessment, followed by certification of cleanup. The selected remedy in the OU2 and OU5 RODs established more stringent clean-up levels for radium-226 of 1.7 pCi/g, as opposed to 5.0 pCi/g above background. | See preceding. |
| Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings,<br><br>Subpart C—Implementation<br>40 CFR §192.21(f) and §192.22(b) | Where radionuclides other than radium-226 and its decay product are present in sufficient quantity and concentration to constitute a significant radiation hazard from residual radioactive materials, remedial actions shall, in addition to satisfying the standards of Subpart A in 40 CFR §192.02 and Subpart B in 40 CFR §192.12 (both listed above), reduce other residual radioactivity to levels that are ALARA. | R&A | R&A | R&A | The approved selected remedy in the OU5 ROD set an ALARA goal for the total uranium FRL. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Postclosure Standards for Uranium and Thorium Mill Tailings, Subpart D— Standards for the Management of Uranium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended<br>40 CFR §192.32 (b)(2) | The requirements for the management of uranium byproduct materials after closure of a disposal area [40 CFR §192.32(b)(1)] shall not apply to any portion of a disposal site which contains a concentration of radium-226 in land, averaged over areas of 100 $m^2$, which, as a result of uranium byproduct material, does not exceed the background level by more than the limits specified in 40 CFR §192.12(a) (see above). | R&A | R&A | R&A | | See preceding. |
| Management of Thorium Mill Tailings, Subpart E— Standards for the Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended<br>40 CFR §192.40 - §192.42 | The following are requirements for the management of thorium byproduct materials:<br>• The provisions for the management of uranium byproduct material (40 CFR §192.32) shall apply to thorium byproduct material and:<br>- Provisions applicable to the element uranium shall also apply to the element thorium<br>- Provisions applicable to radon-222 shall also apply to radon-220<br>- Provisions applicable to radium-226 shall also apply to radium-228<br>With the concurrence of EPA, alternative provisions may be substituted for any of the above requirements provided the alternative provisions will provide at least an equivalent level of protection for human health and environment. | R&A | R&A | R&A | | See preceding. |
| Radiation Protection of the Public and the Environment,<br>DOE Order 5400.5 Chapter IV (4)(a) | Guidelines for residual concentrations of radionuclides other than thorium and radium shall be derived from the basic dose limits by means of an environmental pathway analysis using specific property data where available. Procedures for these derivations are given in DOE/CH-8901. Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 $m^2$. | TBC | | | Considered in the development of the selected remedy in the OU2 and OU5 RODs. | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Radiation Protection of the Public and the Environment,<br><br>DOE Order 5400.5 Chapter IV (4)(a)(1)<br><br>10 CFR Part 834 (PROPOSED) | If the average residual concentration of radionuclides in any surface or below- surface area less than or equal to 25 $m^2$ exceeds the limit or guideline by a factor of $(100/A)^{0.5}$ [where A is the area (in square meters) of the region in which the concentrations are elevated], limits for "hot spots" shall also be developed and applied.<br><br>Procedures for calculating these hot spots limits, which depend on the extent of the elevated local concentrations, are given in DOE/CH-8901. In addition, reasonable efforts shall be made to remove any source of radionuclide that exceeds 30 times the appropriate limit in the soil, irrespective of the average concentration in the soil. | TBC | TBC | | | See preceding. |
| **RADIONUCLIDE CONCENTRATIONS, continued** | | | | | | |
| Radiation Protection of the Public and the Environment,<br><br>DOE Order 5400.5 Chapter IV (4)(a)(2)(3)<br><br>10 CFR Part 834 (PROPOSED) | The generic guidelines for residual concentrations of radium-226, radium-228, thorium-230, and thorium-232 are:<br><br>• 5 pCi/g, averaged over the first 15 cm of soil below the surface; and<br><br>• 15 pCi/g, averaged over 15-cm-thick layers of soil more than 15 cm below the surface.<br><br>These guidelines take into account ingrowth of radium-226 from thorium-230 and of radium-228 from thorium-232, and assume secular equilibrium. If both thorium-230 and radium-226, or both thorium-232 and radium-228, are present and not in secular equilibrium, the appropriate guideline is applied as a limit for the radionuclide with the higher concentration. If other mixtures of radionuclides occur, the concentrations of individual radionuclides shall be reduced so that either the dose for the mixture will not exceed the basic dose limit or the sum of the ratios of the soil concentration of each radionuclide to the allowable limit for that radionuclide will not exceed 1. Explicit formulas for calculating residual concentrations guidelines for mixtures are given in DOE/CH-8901. | TBC | TBC | | Included as it is more restrictive than the federal standard in 40 CFR §192.02, .12(a), .20, .21(f), .22(b), .32(b)(2), .40-.42. | See preceding. |
| Guidelines for Residual Radioactive Material—Surface Contamination<br><br>DOE Order 5400.5 Chapter IV (4)(d)<br><br>10 CFR Part 834 (PROPOSED) | These generic surface contamination guidelines are applicable to existing structures and equipment. These guidelines are generally consistent with standards of the NRC (1982) and functionally equivalent to Section 4, "Decontamination for Release for Unrestricted Use," of Regulatory Guide 1.86, but apply to nonreactor facilities. These limits apply to both interior equipment and building components that are potentially salvageable or recoverable scrap. If a building is demolished, the guidelines in paragraph IV (6)(a) are applicable to the resulting contamination in the ground. | | TBC | | Will be used for any process facility building or structures built and/or used for the remedial action, including the AWWT, soil staging, etc. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **LEAD CONCENTRATION** | | | | | |
| Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER Directive # 9355.4-12 (July 14, 1994) | EPA recommends using 400 ppm soil lead as a screening level for lead in soil for residential scenarios at CERCLA sites and at RCRA Corrective Action sites. Residential areas with soil lead below 400 ppm generally require no further action. Site-specific preliminary remediation goals (PRGs) at CERCLA sites and media cleanup standards at RCRA corrective action facilities for residential land use are described. | TBC | TBC | | The selected remedy in the OU2 and OU5 RODs established this value as the lead FRL. | Following section of the Sitewide Excavation Plan: 2.1.3 Final Remediation Levels |
| | **PCB CONCENTRATION** | | | | | |
| Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions, Subpart A— Applicability, Definitions 40 CFR §761.3 | PCB materials which appear at concentrations less than 50 ppm are excluded from the PCB disposal requirements in this regulation. | R&A | √ | R&A | Operable Unit 2 does not contain PCB materials which have a concentration greater than 50 mg/kg (ppm by weight). | Following sections of the Sitewide Excavation Plan: 2.5.8 Special Materials; 3.3.2.2 Special Materials; F.4.1 Materials Which Require Special Handling |
| Subpart G— PCB Spill Cleanup Policy, Requirements for PCB Spill Cleanup 40 CFR §761.125(c) | PCBs at a concentration of greater than 50 mg/kg (ppm by weight) are subject to TSCA decontamination requirements in 40 CFR §761.120(b).<br><br>Soil in restricted access areas contaminated by a PCB spill shall be cleaned to 25 mg/kg PCBs [40 CFR §761.125(c)(3)(v)]. At such times as restricted access areas (other than outdoor electrical substations) are converted to another use, the spill site shall be cleaned up to the non-restricted access area requirements of 40 CFR §761.125(c)(4)(v).<br><br>Soils in non-restricted access areas contaminated by a PCB spill shall be cleaned to 10 mg/kg PCBs, provided that the soil is excavated to a minimum depth of 10 inches. The excavated soil will be replaced with clean soil (i.e., containing less than 1 mg/kg PCBs), and the spill site will be restored (e.g., replacement of turf) [40 CFR §761.125(c)(4)(v)]. | | TBC | TBC | Soil containing PCBs will be excavated as necessary to attain FRLs; soil concentrations are expected to be less than 50 mg/kg PCBs.<br><br>The OU5 ROD established FRLs for the PCBs Arochlor-1254 and Arochlor-1260 as 0.13 mg/kg. | Following section of the Sitewide Excavation Plan: 2.1.3 Final Remediation Levels |
| Subpart G— PCB Spill Cleanup Policy, Sampling Requirements 40 CFR §761.132 | Criteria that the EPA uses to determine the adequacy of the cleanup of spills resulting from the release of regulated PCB materials at concentrations of ≥50 mg/kg. Applies to spills which occur after May 4, 1987. | | | TBC | Applies to spills of regulated PCB materials (i.e., those that have a concentration ≥50 mg/kg) that occurred after May 4, 1987. | See preceding |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **CERTIFICATION OF CLEANUP** | | | | | |
| Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media<br>EPA 230/02-89-042<br>NTIS PB89-234959<br>February 1989 | This EPA guidance document describes methods for testing whether soil chemical concentrations at a site are statistically below a cleanup standard or ARAR. If it can be reasonably concluded that the remaining soil or treated soil at a site has concentrations that are statistically less than relevant cleanup standards then the site can be judged protective of human health and the environment. | TBC | √ | | | Following sections of the Sitewide Excavation Plan:<br>2.2.2 Certifying FRL Attainment<br>3.4 Certification<br>App G Certification Design Rationale |
| RCRA/CERCLA Integrated Closure Director's Final Findings and Orders (June 4, 1996)<br>Section V.4<br>in lieu of<br>Closure and Post-Closure Under Interim Standards<br>Certification of Closure<br>OAC 3745-66-15 | For the HWMUs identified in Attachment A of these Orders, the Respondent ... are hereby exempted from complying with OAC rule 3745-66-15 provided that they submit Remedial Action Reports for the HWMUs contained in operable units 1, 3, and 5 within 60 days from completion of remedial activities at each operable unit, which is determined by the U.S. EPA, in accordance with CERCLA. These Remedial Action Reports shall certify that the HWMUs contained in operable units 1 and 3 have been closed, and that the environmental media in operable unit 5 has been managed, in accordance with the final remedies contained in the Records of Decision and in accordance with the Director's closure performance standards. Attachment C [of these Orders] summarizes the documents that will be provided during remediation process. These CERCLA documents contain the substantive requirements of the RCRA and Ohio hazardous waste closure regulations. | | √ | √ | Pertinent to closures of HWMUs listed in preceding entries (from Table 2-1 of the Sitewide Excavation Plan, derived from the DF&O's Attachment A) during the CERCLA soil remediation activities. | Following sections of the Sitewide Excavation Plan:<br>2.2.5 HWMU Closure<br>3.4 Certification<br>7.3 Certification Design Letter<br>7.4 Certification Report<br>7.5 Other Related Future Documents |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **IMPACTED MATERIAL MANAGEMENT** | | | | | | |
| | **DEFINITIONS & GENERAL FACILITY STANDARDS** | | | | | |
| Resource, Conservation, and Recovery Act<br>42 U.S.C. §6903 (27) | Solid waste means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations and from community activities, but does not include source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954. | Appl | √ | √ | | Following sections of the Sitewide Excavation Plan:<br>3.0 General Implementation Approach<br>App F Implementation of Construction |
| Solid Waste and Infectious Waste Regulations,<br><br>Definitions<br>OAC 3745-27-01 (B)(40) | Solid wastes means such unwanted residual solid or semisolid material as results from industrial, commercial, agricultural, and community operations, *excluding earth or material from construction, mining, or demolition operations, or other waste materials of the type that would normally be included in demolition debris, nontoxic flyash, spent nontoxic foundry sand, and slag and other substances that are not harmful or inimical to public health,* and includes, but is not limited to, garbage, tires, combustible and noncombustible material, street dirt, and debris.<br><br>Solid waste does not include any material that is an infectious waste or a hazardous waste.<br><br>For the purpose of this definition, "semisolid material" does not contain liquids which can be readily released under normal climatic conditions, as determined by method 9095 (paint filter liquids test) in SW-846: "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods". | Appl | √ | √ | | See preceding. |
| Solid Waste and Infectious Waste Regulations,<br><br>Definitions<br>OAC 3745-27-01 (B)(15)<br>OAC 3745-27-30 (A), (E), (H)<br><br>ORC 3734.021 (A)(1)(c), (d) | Infectious waste is defined by nine categories of waste including human blood specimens and blood products, sharp wastes used in the treatment or inoculation of human beings, and any other waste materials generated in the diagnosis, treatment, or immunization of human beings.<br><br>A generator who places all sharp infectious wastes and all unused hypodermic needles, syringes, and scalpel blades into a "SHARPS" container before they are transported and who generates less than 50 lbs. of infectious wastes each month and does not hold a certificate of registration as a generator of infectious wastes may transport and dispose of infectious wastes in the same manner as solid wastes.<br><br>Treated infectious wastes can be transported and disposed in the same manner as noninfectious waste.<br><br>Infectious waste that is also radioactive shall be managed in accordance with applicable Ohio Department of Health and U.S. Nuclear Regulatory Commission regulations. | Appl | √ | | | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| Identification and Listing of Hazardous Waste,<br><br>Definition of Hazardous Waste<br>OAC 3745-51-03(A)<br><br>[Identification and Listing of Hazardous Waste, Subpart A—General, Definition of Hazardous Waste<br>40 CFR §261.3(a)] | A solid waste is a hazardous waste, if:<br><br>(1) it is not excluded from regulation as a hazardous waste under OAC 3745-51-04(B) [40 CFR §261.4(b)]; and<br><br>(2)(a) it exhibits any of the characteristics of hazardous waste identified in OAC 3745-51-20 to 3745-51-24, with certain exceptions noted therein; or<br><br>(2)(b) it is listed as hazardous waste in OAC 3745-51-31 to 3745-51-33 [40 CFR §§ 261.30 - 261.35]; or<br><br>(2)(c) it is a mixture of solid and hazardous wastes;<br><br>(2)(d) it is a mixture of hazardous wastes as defined in OAC 3745-51-03(A)(2)(a) to 3745-51-03(A)(2)(c) [three previous bullets in this entry] and source material, special nuclear material, or by product material, as defined by the Atomic Energy Act of 1954, as amended, 42 U.S.C. 2011 et seq., or other radionuclides. However, only the hazardous components of the mixture are subject to regulation for purposes of this [OAC 3745-51] chapter. | Appl | √ | √ | | See preceding. |
| | (2)(e) Wastewater mixed with a RCRA F-listed spent solvent waste, whose concentration is less then the following *de minimis* levels before *or* at introduction to the headworks of a Clean Water Act-regulated system, *is not a listed hazardous waste*:<br>1 mg/L: carbon tetrachloride; tetrachloroethene; and trichloroethene.<br>25 mg/L: the remaining listed spent solvents. | | | | This Hazardous Waste Mixture Rule Exclusion is pertinent to management of perched water and other remediation-generated wastewaters, particularly near the Fire Training Facility (HWMU 1) and Sludge Drying Beds (HWMU 41). | Following section of the Sitewide Excavation Plan:<br><br>2.5.4 Perched Water |



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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Identification and Listing of Hazardous Waste,<br><br>Exclusions<br>OAC 3745-51-04(B)(4)<br><br>[Identification and Listing of Hazardous Waste, Subpart A—General, Exclusions<br>40 CFR §261.4(b)(4)] | The following are not hazardous wastes: fly ash waste, bottom ash waste, slag waste, and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels. | Appl | √ | √ | | See preceding. |
| Identification and Listing of Hazardous Wastes,<br><br>Requirements for Recyclable Materials<br>OAC 3745-51-06(A)(3)<br><br>[40 CFR §261.6] | The following recyclable materials are not subject to regulation under rules 3745-50-40 to 3745-50-62 or Chapters 3745-52 to 3745-57 and 3745-65 to 3745-69 of the Ohio Administrative Code [Parts 262 through 266 or 268, 270, or 124 of 40 CFR], and are not subject to the notification requirements of Chapter 3734 of the Ohio Revised Code [Section 3010 of RCRA]:<br><br>(b) used batteries (or used battery cells) returned to a battery manufacturer for regeneration;<br><br>(c) used oil that exhibits one or more of the characteristics of hazardous waste but is recycled in some other manner than being burned for energy recovery;<br><br>(d) scrap metal. | √ | √ | Appl | Pertinent to remediation generated materials. Recycling of remediation generated materials may be conducted. | Operable Unit 3 Integrated RD/RA Work Plan |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Termination of Operating Licenses for Nuclear Reactors<br><br>Section C.4<br>Decontamination for Release for Unrestricted Use<br><br>U.S. Nuclear Regulatory Commission Regulatory Guide 1.86<br>(June 1974) | A reasonable effort shall be made to eliminate residual surface radiological contamination and to achieve the acceptable surface contamination levels stated in this guide. | √ | √ | TBC | Pertinent to releasing to off-site any potentially radiologically-contaminated materials.<br><br>Radiation surveys will be performed prior to releasing any potentially radiologically- contaminated materials off-site to demonstrate compliance with the surface contamination levels stated in this guide. | Operable Unit 1 Design Criteria Package |
| Identification and Listing of Hazardous Waste, Subpart A—General, Definition of Hazardous Waste<br>40 CFR §261.3 | Debris means solid material exceeding a 60-mm particle size that is intended for disposal and that is a manufactured object, plant or animal matter, or natural geologic material. | √ | Appl | Appl | Applicable to hazardous debris that will be disposed of off-site. | Operable Unit 1 Design Criteria Package, and following sections of the Sitewide Excavation Plan:<br><br>1.3.2.4 Remediation Debris<br>2.5.10 Off-Site Shipments<br>F.5.2 Off-Site Disposal |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| Land Disposal Restrictions, Subpart A—General, Definitions Applicable to This Part<br>40 CFR §268.2 | Hazardous debris means debris that contains a listed hazardous waste, or that exhibits a characteristic of hazardous waste. | √ | Appl | Appl | "contains a listed hazardous waste" portion is not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD. | See preceding. |
| Hazardous Waste Regulations<br><br>Contained-In Policy<br><br>58 FR 48092<br>(September 14, 1993)<br>Proposed rule.<br><br>58 FR 59976<br>(November 12, 1993)<br>Notice to extend comment.<br><br>59 FR 10778<br>(March 8, 1994)<br>Clarification, partial withdrawal. | Hazardous soil means soil that contains RCRA hazardous waste(s) listed in Subpart D of 40 CFR Part 261, or that exhibits one or more of the characteristics of a hazardous waste as defined in Subpart C of 40 CFR Part 261.<br><br>This proposed rule recommends contained-in determinations for hazardous debris, hazardous soil and other environmental media.<br><br>Any person may petition the Regional Administrator to exclude, under 261.3(f)(2) or 261.3(g) of this chapter, hazardous debris and hazardous soil or other environmental media, including but not limited to groundwater, surface water, and sediment, from regulation as hazardous waste. The petition for a contained-in determination must include information sufficient to demonstrate that specific constituent concentrations in the hazardous debris, hazardous soil, or other environmental media to be excluded do not pose a hazard to human health and the environment at that site. (Such a petition is not necessary for remedial actions conducted pursuant to RCRA or CERCLA authorities provided that a similar determination is made by the Regional Administrator based on substantially equivalent information including public notice and comment requirements). | | TBC | TBC | Will be considered for managing treated soil that is contaminated with RCRA waste. | Addressed in the selected remedy in the OU5 ROD.<br><br>Following sections of the Sitewide Excavation Plan:<br><br>3.3 Remedial Action<br>App F Implementation of Construction |
| Ohio Petroleum Contaminated Soil Policy<br>OEPA Policy<br>PP.01-03-200 | The basis of the "contained in" policy is that environmental media, such as soil or groundwater, are not considered to be waste material. Because they are not a solid waste, the mixture rule, as set forth in OAC 3745-51-03, does not apply when they become contaminated with a listed hazardous waste but only contains the waste.<br><br>The result of this policy is that if the waste constituents can be removed, the soil is no longer considered to contain a hazardous waste. Therefore, since soil is not a waste material it does not have to be de-listed in order for it to be used for its intended purpose. However, as long as the soil contains the waste material, it must be managed as a hazardous waste.<br><br>If this concept is applied to petroleum-contaminated soil, the soil containing a petroleum hydrocarbon would not need to be managed as a solid waste if the contaminants were removed. | TBC | TBC | | Allows for treated/clean soil to be used as backfill. Thus, any soil below FRLs can be backfilled or otherwise used as clean soil. | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| Hazardous Waste Management System: General, Subpart B—Definitions<br>40 CFR §260.10 | Remediation waste means all solid and hazardous waste, and all media (including groundwater, surface water, soils, and sediments) and debris, which contain listed hazardous wastes or which themselves exhibit a hazardous waste characteristic, that are managed for the purpose of implementing corrective action requirements under 40 CFR §264.101 and RCRA section 3008(h). For a given facility, remediation wastes may originate only from within the facility boundary, but may include waste managed in implementing RCRA sections 3004(v) or 3008(h) for releases beyond the facility boundary. | R&A | √ | √ | Under the Consent Agreement as amended in 1991 (a.k.a., the ACA), remediation at the FEMP is conducted under the authorities of CERCLA as well as RCRA sections 3004(v) and 3008(h). | Following sections of the Sitewide Excavation Plan:<br>1.3.2.1 Soil and Sediment<br>1.3.2.6 Corrective Action Management Unit Rule<br>2.1 Remediation Drivers<br>2.2.1 Demonstrating OSDF WAC Attainment |
| CERCLA Compliance with Other Laws Manual Section 2.7 | Placement/disposal of waste does not occur under the following circumstances:<br>• waste is consolidated within a unit (including an area of contamination that can be viewed as a single unit);<br>• waste is capped in place, including grading prior to capping;<br>• waste is treated in situ; and<br>• waste is processed within the unit in order to improve its structural stability for closure or for movement of equipment over the area. | TBC | √ | TBC | See following entry on the Corrective Action Management Unit. | See following entry. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| Corrective Action Management Unit<br><br>Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,<br>Subpart S-<br>40 CFR §264.552<br>(58 FR 865829, February 16, 1993) | For the purpose of implementing remedies under Sec. 264.101 or RCRA Section 3008(h), the EPA Regional Administrator may designate an area at the facility as a corrective action management unit (CAMU). One or more CAMUs may be designated at a facility under the following conditions:<br>1) Emplacement of remediation wastes into or within a CAMU does not constitute land disposal of hazardous wastes.<br>2) Consolidation or emplacement of remediation wastes into or within a CAMU does not constitute creation of a unit subject to minimum technology requirements.<br>3) The CAMU shall facilitate the implementation of reliable, effective, protective, and cost-effective remedies.<br>4) Waste management activities associated with the CAMU shall not create unacceptable risks to humans or to the environment resulting from exposure to the wastes.<br>5) The CAMU shall include uncontaminated areas of the facility only if including such areas for the purpose of managing remediation waste is more protective than management of such wastes at contaminated areas of the facility.<br>6) Areas within the CAMU, where wastes remain in place after closure of the CAMU, shall be managed and contained so as to minimize future releases, to the extent practicable.<br>7) The CAMU shall expedite the timing of remedial activity implementation, when appropriate and applicable.<br>8) The CAMU shall enable the use, when appropriate, of treatment technologies (including innovative technologies) to enhance the long-term effectiveness of remedial actions by reducing the toxicity, mobility, or volume of wastes that will remain in place after closure of the CAMU.<br>9) The CAMU shall, to the extent practicable, minimize the land area of the facility upon which wastes will remain in place after closure of the CAMU.<br>The owner/operator shall provide sufficient information to enable the Regional Administrator to designate a CAMU in accordance with the criteria in Sec. 264.552.<br>**Note:** RCRA regulated units (HWMUs) within a CAMU are fully subject to RCRA closure regulations. | R&A | Appl | R&A | Per the selected remedy in the OU5 ROD:<br>• the FEMP property (bounded by its property boundaries) is designated as a CAMU;<br>• consolidation or management of on-site remediation wastes into or within the CAMU does not constitute creation of a unit subject to minimum technology requirements (MTRs) [OAC 3745-68-101 and 40 CFR §265.301(a)] and does not invoke land disposal restrictions (LDRs)[OAC 3745-59 and 40 CFR §§268.40 through .44]. | Section 9.1.8 of the OU5 ROD, and following section of the Sitewide Excavation Plan:<br>1.3.2.6 Corrective Action Management Unit Rule |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| Generator Standards,<br><br>Hazardous Waste Determination<br>OAC 3745-52-11(A) through (F) | A person who generates a solid waste must determine if that waste is a hazardous waste using the following method: | √ | R&A | R&A | | Following sections of the Sitewide Excavation Plan:<br><br>2.1.1 RCRA<br>2.1.2 Waste Acceptance Criteria<br>3.1 Predesign Investigation<br>3.3.1 Implementation of Construction, Excavation, and Material-handling Activities<br>3.3.2 Impacted Materials Handling and Tracking<br>3.6 Record Keeping and Information Management |
| [Standards Applicable to Generators of Hazardous Waste, Subpart A—General, Hazardous Waste Determination<br>40 CFR §262.11] | 1) First determine if the waste is excluded from regulation (not a solid waste) under OAC 3745-51-04 (40 CFR §261.4). | | | | | |
| | 2) If the waste is not excluded from regulation, then determine if the waste is listed as a waste ("listed waste") in OAC 3745-51-30 to 3745-51-33 (Subpart D of 40 CFR Part 261). | | | | Not pertinent for on-site disposal because of the CAMU rule (see preceding entry); pertinent for off-site treatment or disposal. | See preceding entry, and following sections of the Sitewide Excavation Plan:<br><br>2.5.10 Off-Site Shipments<br>F.5.2 Off-Site Disposal |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | 3) For purposes of complying with OAC 3745-59 (40 CFR Part 268), or if the waste is not a "listed waste" per step 2 above, then determine if the waste is a "characteristic waste" as identified in OAC 3745-51-20 through 3745-51-24 (Subpart C of 40 CFR Part 261), by either (a) testing the waste using appropriate methods, or (b) applying knowledge of the hazardous characteristic of the waste in light of the materials or processes used ("process knowledge"). | | | | Per the RODs, pertinent only to the following areas:<br><br>In OU2:<br>approx. 300 cubic yards of lead-containing soil in the South Field Firing Range.<br><br>In OU5:<br>1) Abandoned sump west of Pilot Plant;<br>2) Area between KC-2 Warehouse and RR tracks;<br>3) Trap Range;<br>4) Paddy's Run streambank fill materials west of OU4's Silos 1-4;<br>5) Scrap Metal Pile area; and<br>6) Area north of maintenance building. | Sections 7.4 (@ p. 7-5), 9.1 (@ p. 9-2), and 10.2.2 (@ p. 10-4) of the OU2 ROD; Section 9.1.1 (@ p. 9-6) and Table 9-1 of the OU5 ROD |
| Interim [Status Hazardous Waste Facility] Standards —General Provisions,<br><br>General Provisions<br>OAC 3745-65-13 through -16<br><br>[Interim Status Hazardous Waste Facility Standards, Subpart B—General Facility Standards<br>40 CFR §§265.13 through .16] | Owners/operators of a facility must obtain chemical and physical analyses of a representative sample of each hazardous or nonhazardous waste to be treated, stored or disposed of at the facility prior to treatment, storage or disposal. At a minimum, the analysis must contain all the information which must be known to treat, store or dispose of the waste, and may include using existing published or documented data on the waste or on waste generated from similar processes ("process knowledge") [OAC 3745-65-13]. | ✓ | R&A | R&A | Pertinent to management of hazardous waste. | Following sections of the Sitewide Excavation Plan:<br><br>3.3.2 Impacted Materials Handling and Tracking<br>4.0 Location-Specific Excavation Approaches<br>F.5 Excavated Material Management |
| | The facility owner/operator must prevent the unknowing entry, and minimize the possibility of unauthorized entry, to the active portion of the facility unless certain conditions apply [OAC 3745-65-14]. | | | | Controls which limit access to the FEMP will remain in place throughout remediation activities. | F.2.1 Establishing Excavation Boundaries and Access Controls |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| | The facility operator must maintain and inspect all monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment that are important to preventing human health hazards. The frequency of inspection may vary by item, and should be based on the rate of possible deterioration of the equipment/item and the probability of an environmental or human health incident if the deterioration, malfunction, or operator error goes undetected [OAC 3745-65-15].<br><br>The facility operator must train personnel for procedures relevant to the positions in which they are employed [OAC 3745-65-16]. | | | | | F.8 Remediation Maintenance Activities |
| Hazardous Waste Facility Environmental Impact<br><br>ORC 3734.05(D)(6)(c) | A hazardous waste facility installation and operation permit shall not be approved unless it is proven that the facility represents the minimum adverse environmental impact, considering the state of available technology, the nature and economics of various alternatives and other pertinent considerations | √ | Appl | √ | **NOTE:** Incorrectly cited in RODs as OAC 3745.05(D)(6)(c). | Appendix H of OU2 FS, Appendix J of OU5 FS, and Appendix J of OU3 RI/FS. |
| Hazardous Waste Facility Minimum Risk<br><br>ORC 3734.05(D)(6)(d) | A hazardous waste facility installation and operation permit shall not be approved unless it is proven that the facility represents the minimum risk of all the following:<br><br>1) contamination of groundwater and surface water;<br>2) fires or explosions from treatment, storage, or disposal methods;<br>3) accidents during transportation;<br>4) impact to public health and safety;<br>5) air pollution; and<br>6) soil contamination. | √ | Appl | √ | **NOTE:** Incorrectly cited in RODs as OAC 3745.05(D)(6)(d). | OU2, OU5, and OU3 FS Reports and RODs.<br><br>Also, see preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Interim [Status Hazardous Waste Facility] Standards—General Provisions,<br><br>Preparedness and Prevention<br>OAC 3745-65-31 through -35, and -37<br><br>[Interim Status Hazardous Waste Facility Standards, Subpart C—Preparedness and Prevention<br>40 CFR §§265.31 through .35, and .37] | TSD facility operators must design, construct, maintain and operate facilities to minimize the possibility of fire, explosion or any unplanned sudden or non-sudden release of hazardous waste to air, soil, or surface water which might threaten human health or the environment. | √ | R&A | R&A | | See two preceding entries.<br><br>For waste that is dispositioned for off-site disposal, see the Operable Unit 1 Design Criteria Package. |
| Interim [Status Hazardous Waste Facility] Standards—General Provisions,<br><br>Contingency Plan and Emergency Procedures<br>OAC 3745-65-51, -52, -55 and -56<br><br>[Interim Status Hazardous Waste Facility Standards, Subpart D—Contingency Plan and Emergency Procedures<br>40 CFR §265.51, .52, .55 and .56] | Each facility operator must have a contingency plan designed to minimize hazards to human health and the environment due to fires, explosions, or any unplanned releases of hazardous waste constituents to air, soil or surface/groundwater. | √ | R&A | R&A | Pertinent to on-site facilities that treat, store, or dispose of hazardous waste. | FEMP Emergency Plan (PL-3020); all HWMUs identified in Table 2-1 of the Sitewide Excavation Plan (and the subset identified previously in this table) are addressed in Section G: Contingency Plan of the RCRA Part B Permit Application.<br><br>Also, see three preceding entries.<br><br>For waste that is dispositioned for off-site disposal, see the Operable Unit 1 Design Criteria Package. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Hazardous Waste Incinerators [and Miscellaneous Units],<br><br>Environmental Performance Standards<br>OAC 3745-57-91 and -92<br><br>[Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,<br>Subpart X—Miscellaneous Units,<br>40 CFR §§264.601 through .603] | Prevention of any release that may have adverse effects on human health or the environment includes, but is not limited to:<br><br>A. Migration of waste constituents in the groundwater or subsurface environment.<br><br>B. Migration of waste constituents in surface water, or wetlands or on the soil surface.<br><br>C. Migration of waste constituents in the air.<br><br>Monitoring, tests, analytical data, inspections, response, and reporting procedures and frequencies must ensure compliance with pertinent portions of the OAC. | √ | R&A | √ | Pertinent to on-site facilities that treat, store, or dispose of hazardous waste in miscellaneous units unless the CAMU Rule is applied. | See preceding. |
| Radioactive Waste Management<br><br>DOE Order 5820.2A<br>Chapter III (3)(d) | Low-level waste shall be characterized with sufficient accuracy to permit proper segregation, treatment, storage, and disposal. This characterization shall ensure that, upon generation after processing, the actual physical and chemical characteristics and major radionuclide content are recorded and known during all stages of the waste management process.<br><br>Waste characterization data shall be recorded on a waste manifest and shall include:<br><br>• the physical and chemical characteristics of the waste;<br>• volume of the waste (total of waste and any solidification or absorbent media);<br>• weight of the waste (total of waste and any solidification or absorbent media);<br>• major radionuclides and their concentrations; and<br>• packaging date, package weight, and external volume. | TBC | √ | TBC | The CERCLA RI/FS process established the nature and extent of contamination at the FEMP. During excavation, monitoring will be performed in accordance with of the Sitewide Excavation Plan and individual IRDPs, and results will be documented in order to determine if impacted material meets the OSDF WACs or offsite WACs. These sources of characterization information (RI/FS sampling, pre-design investigations, FRL attainment, WAC attainment) will provide the required manifest information. | Addressed throughout the CERCLA RI/FS and selection of remedy process, culminated in the OU2, OU5 and OU3 RODs; OSDF Impacted Materials Placement Plan; following section of the Sitewide Excavation Plan:<br><br>3.3.2 Impacted Materials Handling and Tracking |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| Waste Treatment<br><br>DOE Order 5820.2A Chapter III (3)(f) | Waste treatment techniques such as incineration, shredding, and compaction to reduce volume and provide more stable waste forms shall be implemented as necessary to meet performance requirements. Use of waste treatment techniques to increase the life of the disposal facility and improve the long-term facility performance, by improved site stability and reduction of infiltrating water, is required to the extent it is cost effective.<br><br>The development of large scale waste treatment facilities shall be supported by the appropriate National Environmental Policy Act documentation.<br><br>Operation of waste treatment facilities shall be supported by adequate documentation. | TBC | TBC | TBC | Based upon CERCLA RI/FS data, the majority of the impacted material from OU2, OU5 & OU3 will meet the OSDF WACs and thus the performance objectives of the OSDF & DOE Order 5820.2A without treatment. This has been demonstrated through the modeling performed in the FSs to establish the OSDF WACs.<br><br>Two categories of impacted materials may need to be treated before disposal. Toxicity characteristic soil from seven areas will be quantified & treated to the extent necessary to remove the toxicity characteristic that cause them to be regulated as hazardous. Physical sizing & treatment as per the OSDF Impacted Material Placement Plan will be conducted as needed on debris for proper waste placement and stability within the OSDF. Some physical treatment might also be necessary for the sludge from the OU2 Lime Sludge Ponds to decrease the moisture content before placement into the OSDF. | Addressed throughout the CERCLA RI/FS and selection of remedy process, culminated in the OU2, OU5 and OU3 RODs; OSDF Impacted Materials Placement Plan; following sections of the Sitewide Excavation Plan:<br><br>1.3.2.7 RCRA Characteristic Waste Disposal<br>2.1.1.3 Toxicity Characteristic Hazardous Wastes<br>3.3.2 Impacted Materials Handling and Tracking<br>F.5 Excavated Material Management |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEFINITIONS & GENERAL FACILITY STANDARDS, continued** | | | | | |
| Radioactive Waste Management<br><br>DOE Order 5820.2A Chapter III (3)(g) | The volume of waste and number of shipments of low-level wastes shall be minimized and the shipments will be conducted based on plans developed by field organizations.<br><br>Generators shall provide an annual forecast in the third quarter of the fiscal year to the field organizations managing the off-site disposal facility to which the waste is to be shipped.<br><br>Generators must receive advance approval from the receiving facility and shall certify prior to shipment that waste meets the receiving facility waste acceptance criteria. The certification program shall be auditable and able to withstand independent review. | TBC | TBC | TBC | The volume of impacted material to be disposed onsite in the OSDF will be minimized through a number of programs. First, extensive sampling has been performed during the CERCLA RI/FS process and the extent of excavation has been established using this data. Combined with the sampling/monitoring that will be performed during excavation in accordance with Section 3.3 of the Sitewide Excavation Plan and individual IRDPs, this will confirm that only impacted materials are excavated and sent to disposal. Compliance with the FEMP Pollution Prevention and Waste Minimization Awareness Plan will minimize the amount of low-level waste (i.e., equipment and personal protective equipment) generated during remediation. | FEMP Pollution Prevention and Waste Minimization Awareness Plan; also see preceding. |
| Control of Residual Radioactive Material<br><br>DOE Order 5400.5 Chapter IV (6)(b)<br><br>10 CFR Part 834 (PROPOSED) | Interim storage must provide:<br><br>1) Control and stabilization features shall be designed to provide, to the extent reasonably achievable, an effective life of 50 years with a minimum life of at least 25 years. | √ | TBC | | The selected remedies are for a permanent remedy, not for interim storage; any short-term management of impacted material to be employed is to facilitate implementation of the permanent remedy. | The approved selected remedy in the OU2 and OU5 RODs, associated remedial design documents (i.e., IRDPs). |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | 2) Controls shall be designed such that radon-222 concentrations in the atmosphere above facility surfaces or openings in addition to background levels, will not exceed:<br>(a) 100 pCi/L at any given point;<br>(b) An annual average concentration of 30 pCi/L over the facility site; and<br>(c) An annual average concentration of 3 pCi/L at or above any location outside the facility site.<br>(d) Flux rates from the storage of radon producing wastes shall not exceed 20 pCi/m$^2$/sec, as required by 40 CFR Part 61. | | | | | |
| | 3) Controls shall be designed such that concentrations of radionuclides in the groundwater and quantities of residual radioactive material will not exceed applicable federal or state standards. | | | | | Section 5.0 of the Sitewide Excavation Plan, for environmental controls to be implemented during remediation. |
| | 4) Access to a property and use of on-site material contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls such as those described in 40 CFR Part 192. These control features should be designed to provide, to the extent reasonable, an effective life of at least 25 years. | | | | | Section 3.0 and Appendix F of the Sitewide Excavation Plan and IRDPs, for access controls to be implemented during remediation. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **MANAGEMENT OF LOW-LEVEL RADIOACTIVE MATERIAL** | | | | | |
| Low-level Radioactive Waste Generation<br><br>DOE Order 5820.2A Chapter III (3)(c) | Technical and administrative controls shall be directed to reducing the gross volume of waste generated and/or the amount of radioactivity requiring disposal. Waste reduction efforts shall include consideration of process modification, process optimization, materials substitution, and decontamination.<br><br>All DOE low-level waste generators shall establish auditable programs to assure that the amount of low-level waste generated and/or shipped for disposal is minimized.<br><br>Each DOE low-level waste generator shall separate uncontaminated waste from low-level waste to facilitate cost-effective treatment and disposal.<br><br>Each DOE low-level waste generator preparing a design for a new process or process change shall incorporate principles into the design that will minimize the generation of low-level waste. | TBC | TBC | TBC | Implementation of the FEMP Pollution Prevention and Waste Minimization Awareness Plan will confirm that all newly generated waste is minimized during remediation. Additionally, excavation controls such as rapid test methodology and additional laboratory sampling will be implemented to confirm that only impacted material with contamination that is potentially above the FRLs is being excavated and sent to disposal. Physical sampling of the impacted materials and/or rapid test method methodology will also confirm that only material that exceeds the OSDF WAC is sent offsite for disposal. | Addressed throughout the CERCLA RI/FS and selection of remedy process, culminated in the OU2, OU5 and OU3 RODs; also, FEMP Pollution Prevention and Waste Minimization Awareness Plan. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **MANAGEMENT OF HAZARDOUS REMEDIATION WASTE** | | | | | |
| Identification and Listing of Hazardous Waste,<br><br>Residues of Hazardous Waste in Empty Containers<br>OAC 3745-51-07(A) &(B)<br><br>[Identification and Listing of Hazardous Waste,<br>Subpart A—General, Residues of Hazardous Waste in Empty Containers<br>40 CFR §261.7] | Any hazardous waste remaining in either an empty container or an inner liner removed from an empty container is not subject to regulation under 40 CFR Parts 261 through 265 (RCRA requirements). A container is empty if:<br><br>1) All wastes have been removed that can be removed using the practices commonly employed to remove materials from that type of container (e.g., pouring, pumping, and aspirating); and<br><br>2) No more than 2.5 cm (1 inch) of residue remains on bottom of the container or inner liner; or<br><br>3) No more than 3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is less than or equal to 110 gal. in size, or no more than 0.3 percent by weight of the total capacity of the container remains in the container or inner liner if the container is greater than 110 gal. in size. | √ | R&A | Appl | Pertinent when containerizing: soil contaminated by RCRA waste; any treatment residues exhibiting RCRA characteristics including soil decontamination residues. | Following sections of the Sitewide Excavation Plan:<br><br>2.5.8 Special Materials<br>3.3.2.2 Special Materials<br>App F Implementation of Construction |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued** | | | | | | |
| Closure and Post-Closure Under Interim Standards,<br><br>Condition of Containers<br>OAC 3745-66-71<br><br>Compatibility of Containers<br>OAC 3745-66-72<br><br>Management of Containers<br>OAC 3745-66-73<br><br>Inspections<br>OAC 3745-66-74<br><br>Special Requirements for Ignitable or Reactive Waste<br>OAC 3745-66-76<br><br>Special Requirements for Incompatible Wastes<br>OAC 3745-66-77<br><br>[Interim Status Standards,<br>Subpart I—Use & Management of Containers,<br>40 CFR §§265.171 through .174, .176 and .177] | If a container holding hazardous waste is not in good condition (e.g., severe rusting, apparent structural defects) or begins to leak, the owner or operator must transfer the hazardous waste from this container to a container that is in good condition or manage the waste in some other way that complies with this requirement. | √ | R&A | Appl | Pertinent to handling containers holding environmental media contaminated with RCRA waste. | See preceding. |



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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| [New Facilities] Corrective Action, Closure and Post-Closure Requirements<br><br>Containment<br>OAC 3745-55-75<br><br>[Interim Status Hazardous Waste Facility Standards, Subpart I—Use & Management of Containers<br>40 CFR §§265.175(a) through (c)] | A containment system for RCRA container storage areas must be designed and operated to provide:<br><br>1) A sufficiently impervious base, which is sloped to collect any leaking liquids.<br>2) Sufficient capacity to contain liquids.<br>3) Prevention of run-on into the containment system.<br>4) A sump to prevent overflow of the collection system.<br><br>Storage areas for containers holding only wastes that do not contain free liquids need not have a containment system, provided that:<br><br>1) The storage area is sloped or is otherwise designed and operated to drain and remove liquid resulting from precipitation, or<br>2) The containers are elevated or are otherwise protected from contact with accumulated liquid. | √ | R&A | Appl | Pertinent to handling soil contaminated with RCRA listed or characteristic hazardous waste. A Part B Permit Application for RCRA storage has been submitted to the OEPA. | See preceding. |
| [New Facilities] Surface Impoundments, Waste Piles, and Tanks<br><br>[Waste Piles] Design and Operating Requirements<br>OAC 3745-56-51(A) through (F) | A waste pile used to store or treat hazardous waste must have:<br><br>1) A liner that is designed, constructed, and installed to prevent any migration of waste out of the pile into the adjacent subsurface soil or groundwater or surface water at any time during the active life (including the closure period) of the waste pile, and<br>2) A leachate collection and removal system immediately above the liner that is designed, constructed, maintained, and operated to collect and remove leachate from the pile. | √ | R&A | √ | Pertinent to on-site hazardous waste piles used for longer than 90 days unless the CAMU Rule is applied. | Addressed through remedial design documents (IRDPs). |
| | The owner/operator must design, construct, operate, and maintain a run-on control system capable of preventing flow onto the active portion of the pile during peak discharge from at least a 25-yr storm and manage a runoff management system to collect and control at least the water volume resulting from a 24-hr, 25-yr storm. | √ | R&A | √ | | |
| | If the pile contains any particulate matter which may be subject to wind dispersal, the owner or operator must cover or otherwise manage the pile to control wind dispersal. | √ | R&A | √ | | FEMP Fugitive Dust Control BAT Determination, and Section 5.1.2.2 and Appendix F of the Sitewide Excavation Plan |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **MANAGEMENT OF HAZARDOUS REMEDIATION WASTES, continued** | | | | | |
| Monitoring and Inspection<br>OAC 3745-56-54(A) and (B) | During construction or installation, liners and cover systems must be inspected for uniformity, damage, and imperfections. | √ | R&A | √ | | |
| | Collection and holding facilities associated with run-on and runoff control system must be inspected weekly and be emptied or otherwise managed expeditiously after storms to maintain design capacity of the system. | √ | R&A | √ | | FEMP Stormwater Pollution Prevention Plan (RM-0039), and Appendix F of the Sitewide Excavation Plan |
| Special Requirements for Ignitable or Reactive Waste<br>OAC 3745-56-56(A) and (B)<br><br>Special Requirements for Incompatible Wastes<br>OAC 3745-56-57(A), (B) and (C)<br><br>[Subpart L—Waste Piles,<br>40 CFR §§264.251 through .259] | Ignitable, reactive, or incompatible waste must not be added to a waste pile, unless specified in OAC 3745-56-56(A) and (B) or 57(A), (B) and (C). | √ | R&A | √ | The CERCLA RIs did not find evidence of ignitive or reactive material on-site. Impacted and non-impacted materials management will be segregated and managed in separate piles, based upon intended disposition (waste acceptance criteria). | Following sections of the Sitewide Excavation Plan:<br>3.3.2 Impacted Materials Handling and Tracking<br>4.0 Location-Specific Excavation Approaches<br>F.5 Excavated Material Management |



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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Temporary Units<br><br>Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,<br>Subpart S-<br>40 CFR §264.553 (a), (b)<br>(58 FR 865829, February 16, 1993) | For temporary tanks and container storage areas used for treatment or storage of remediation wastes during remedial activities, the Regional Administrator may determine that a design, operating, or closure standard applicable to such units may be replaced by alternative requirements which are protective of human health and the environment.<br><br>Any temporary unit to which alternative requirements are applied shall be:<br><br>• located within the facility boundary; and<br>• used solely for treatment or storage of remediation wastes. | R&A | ✓ | R&A | Pertinent to short-term management/storage of impacted materials during the CERCLA soil remediation activities. IRDPs can designate and utilize temporary units to facilitate remediation within the already designated CAMU. Alternative requirements which are protective of human health and the environment may be used in lieu of the design, operating, or closure requirements that would otherwise apply to such units under RCRA. | Following section of the Sitewide Excavation Plan:<br><br>1.3.2.6 CAMU Rule |
| Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,<br>Subpart DD—Containment Building<br>40 CFR §§264.1100 through .1102<br><br>57 FR 37194<br>(August 18, 1992) | The owner or operator is not subject to the definition of land disposal in RCRA Section 3004(k) provided that the unit:<br><br>1) Is a completely enclosed, self-supporting structure that is designed and constructed of synthetic materials of sufficient strength and thickness to support themselves, the waste contents, and any personnel and heavy equipment that operate within the unit, and to prevent failure due to pressure gradients, settlement, compression, or uplift, physical contact with the hazardous wastes to which they are exposed, climatic conditions, and the stresses of daily operation, including the movement of heavy equipment within the unit and contact of such equipment with containment walls;<br><br>2) Has a primary barrier for management of solids, in addition to a liquid collection system and secondary containment for management of liquids.<br><br>3) Has controls sufficient to prevent fugitive dust emissions to meet the no visible emission standard in Sec. 264.1101(c)(1)(iv); and<br><br>4) Is designed and operated to ensure containment and prevent the tracking of materials from the unit by personnel or equipment.<br><br>At closure, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components, contaminated subsoil, and structures and equipment contaminated with waste and leachate, and handle them as a hazardous waste. | ✓ | R&A | R&A | Pertinent to excavated RCRA hazardous soil and sediment that may require short-term management/ storage during the CERCLA soil remediation activities.<br><br>DOE does not anticipate utilizing containment buildings. | Following sections of the Sitewide Excavation Plan:<br><br>3.3.2 Impacted Materials Handling and Tracking<br>4.0 Location-Specific Excavation Approaches<br>F.5 Excavated Material Management |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued** | | | | | |
| Procedures for Planning and Implementing Offsite Response Actions ("The CERCLA Offsite Rule")<br>40 CFR §300.400 | Materials from remediation of a CERCLA site ("CERCLA waste") may only be transferred to offsite facilities that are in compliance with Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), or other applicable federal and state requirements. Only U.S. EPA has the authority to determine whether the facility in question meets the acceptability criteria and is acceptable for receiving CERCLA waste from offsite. A determination of acceptability for a potential receiving facility is to be made in advance (prior to initiating transportation offsite, and optimally prior to making offsite treatment/ storage/disposal contract arrangements).<br><br>Materials covered under this rule ("CERCLA waste") are any hazardous substance, pollutant, or contaminant as defined under CERCLA sections 101(14) and 101(33). Samples of waste sent to a laboratory for characterization are exempt from the rule, as are certain treatability study waste.<br><br>The receiving facility must meet compliance and release criteria presented therein. Facility is defined as the receiving unit(s) that directly stores, treats, or disposes of the CERCLA waste. Non-receiving units at the facility need not be in compliance in order for the U.S. EPA to determine that the receiving unit meets acceptance criteria. U.S. EPA may deem a facility acceptable even if certain minor violations have occurred at the facility.<br><br>If a facility does not meet the criteria for receiving CERCLA wastes, the rule presents notification, determination, appeal/review and reinstatement procedures. | √ | √ | Appl | Pertinent to preparation of materials for off-site disposition. | Operable Unit 1 Design Criteria Package, and following sections of the Sitewide Excavation Plan:<br><br>2.5.10 Off-Site Shipments<br>F.5.2 Off-Site Disposal |
| [Hazardous Waste] Generator Standards<br>OAC 3745-52-20 through -23, and -30 through -33<br><br>[40 CFR §§262.20 through .23, and .30 through .33] | Before transporting hazardous waste or offering hazardous waste for transportation off-site ("pre-transport"), for either treatment or disposal, general requirements for the generator require a manifest [OAC 3745-52-20 through -23] in accordance with the requirements specified therein. Pre-transport requirements also include appropriate packaging [OAC 3745-52-30], labeling [OAC 3745-52-31], marking [OAC 3745-52-32], and placarding [OAC 3745-52-33], in accordance with the requirements specified therein. | √ | Appl | Appl | Pertinent to preparation of RCRA hazardous waste (and mixed waste) for off-site treatment and/or disposal. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Implementation of the United Nations Recommendations, International Maritime Dangerous Goods Code, and the International Civil Aviation Organization's Technical Instructions<br><br>59 FR 67390 (December 29, 1994)<br><br>as amended by<br><br>60 FR 26796 (May 18, 1995) | These rules (final rule was effective October 1, 1995) comprehensively revise the Hazardous Materials Regulations (HMR), 49 CFR Parts 171-173, 177, and 178, with respect to hazard communication, classification, and packaging requirements based on United Nations recommendations. | √ | √ | Appl | These Hazardous Materials Regulations are requirements embedded in both the state (OAC) and federal (CFR) regulations in both the generator standards (preceding entry) and the transporter standards (subsequent entry). | See preceding generator standards entry and subsequent transporter standards entry. |
| [Hazardous Waste] Land Disposal Restrictions<br>OAC 3745-59<br><br>[Land Disposal Restrictions, Subpart D—Treatment Standards<br>40 CFR §§268.40 through .44] | A restricted hazardous waste may be land disposed only if:<br><br>1) An extract of the waste or of the treatment residue of the waste does not exceed the value shown in 40 CFR §268.41.<br>2) It is treated using a technology specified in 40 CFR §268.42(a) or an equivalent treatment method.<br>3) The constituent concentrations in the waste or treatment residue of the waste do not exceed the value shown in 40 CFR §268.43. | √ | Appl | Appl | Not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD.<br><br>Applicable to those RCRA hazardous wastes that will be dispositioned off site. | See three preceding entries. |
| Land Disposal Restrictions, Subpart D—Treatment Standards, Treatment Standards Expressed as Concentrations in Waste Extract<br>40 CFR §268.41 | The maximum concentration of lead (5.0 mg/L) may not be exceeded whether it is the extract of a waste or waste treatment residual. | R&A | Appl | | Not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD.<br><br>Applicable to those RCRA hazardous wastes that will be disposed of off-site. | See four preceding entries. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **MANAGEMENT OF HAZARDOUS REMEDIATION WASTE, continued** | | | | | |
| Land Disposal Restrictions, Subpart D—Treatment Standards, Contaminated Debris 40 CFR §268.45 | Hazardous debris must be treated before land disposal unless the EPA determines that the debris is no longer contaminated with hazardous waste or the debris is treated to the waste-specific treatment standard for the waste contaminating the debris.<br><br>Provided the debris does not exhibit a RCRA characteristic it is not subject to regulation under 40 CFR 260, 261 to 266, 268, or 270 if:<br><br>1) The hazardous debris has been treated using one of the required extraction or destruction technologies specified in 40 CFR §268.45; or<br>2) The debris, considering the extent of contamination, is determined to no longer be contaminated with hazardous waste. | √ | Appl | Appl | Not applicable to on-property disposal within a CAMU under the CAMU Rule as invoked under the OU5 ROD.<br><br>Applicable to those RCRA hazardous wastes that will be disposed of off-site. | See five preceding entries. |
| [Hazardous Waste] Transporter Standards OAC 3745-53-20 through -22, -30 and -31<br><br>[40 CFR §§263.20 through .22, .30 and .31] | General requirements for the transporter during transportation of hazardous waste for off-site treatment and/or disposal require acceptance and handling of hazardous waste and use of the manifest system [OAC 3745-53-20], compliance with the manifest [OAC 3745-53-21], and recordkeeping [OAC 3745-53-22], in accordance with the requirements specified therein. Appropriate response actions must be taken for any hazardous waste discharge during transportation [OAC 3745-53-30 and -31], in accordance with the requirements specified therein. | √ | Appl | Appl | Pertinent to transportation of RCRA hazardous wastes for off-site treatment and/or disposal. | See six preceding entries. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **MANAGEMENT OF PCB-TAINTED MATERIAL** | | | | | |
| Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions,<br><br>Subpart D—Storage and Disposal, Disposal Requirements<br>40 CFR §761.60(a)(4) | Any nonliquid PCBs at concentrations 50 mg/kg or greater in the form of contaminated soil, rags, or other debris shall be disposed of in an incinerator which complies with 40 CFR §761.70, or in a chemical waste landfill which complies with 40 CFR §761.75. | | Appl | Appl | Pertinent if soil or other material containing PCBs above 50 mg/kg is excavated. PCBs were detected in soil beneath the Fire Training Facility. | Following sections of the Sitewide Excavation Plan:<br><br>3.3.2 Impacted Materials Handling and Tracking<br>4.0 Location-Specific Excavation Approaches<br>F.5 Excavated Material Management |
| Subpart D—[PCB] Storage and Disposal, Disposal Requirements<br>40 CFR §761.60(e) | Any person who is required to incinerate PCBs or PCB items under this subpart and who can demonstrate that an alternate method of destroying PCBs or PCB items can achieve a level of performance equivalent to the requirements under 40 CFR §761.70 may submit a written request to either the Regional Administrator or the Director, Exposure Evaluation Division, for an exemption from the incineration requirements of 40 CFR §§ 761.70 or 761.60. The applicant must show that the alternate method of destroying PCBs will not present an unreasonable risk of injury to health or the environment. | | Appl | Appl | Pertinent only if PCB contaminated soil is greater than 50 mg/kg and is treated on-property using a method besides incineration.<br><br>DOE neither currently anticipates any such material nor on-property treatment for any such material under the soil remediation projects. | See preceding entry, plus following sections of the Sitewide Excavation Plan:<br><br>2.5.10 Off-Site Shipments<br>F.5.2 Off-Site Disposal |
| Subpart D—[PCB] Storage and Disposal, Storage for Disposal<br>40 CFR §761.65 | This section applies to the design of storage areas to be used for later disposal of PCBs at concentrations of 50 ppm (mg/kg or mg/L) or greater. | | Appl | Appl | Pertinent to storage of PCB-contaminated material at 50 ppm or greater.<br><br>DOE does not currently anticipate any such material under the soil remediation projects. | See two preceding entries. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| **POST-CLOSURE** | | | | | | |
| | **DESCRIPTION OF POST-CLOSURE CARE** | | | | | |
| [New Facilities Hazardous Waste] Surface Impoundments, Waste Piles, and Tanks,<br><br>[Waste Piles] Post-Closure<br>OAC 3745-56-58(B)<br><br>[Subpart L—Waste Piles,<br>40 CFR §§264.251 through .259] | If, after removing or decontaminating all residues and making all reasonable effort to effect removal or decontamination of contaminated components, subsoil, structures and equipment, the owner/operator finds that not all contaminated subsoil can be practically removed or decontaminated, he must close the unit/facility and perform post-closure care in accordance with OAC 3745-57-10.<br><br>**NOTE:** If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | R&A | | Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | Currently addressed in the OSDF Post-closure Care and Inspection Plan, which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed.<br><br>Will also be addressed in the Certification Report and Remedial Action Report — see following sections of the Sitewide Excavation Plan:<br><br>1.4.2 Related Documents<br>2.2.5 HWMU Closure<br>3.4.7 Certification Report<br>3.5.3.6 Postremediation/post-closure Care and Inspection<br>7.4 Certification Report<br>7.5 Other Related Future Documents |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| [New Facilities Hazardous Waste] Incinerators [and Miscellaneous Units],<br><br>[Miscellaneous Units] Environmental Performance Standards<br>OAC 3745-57-93<br><br>[Subpart X—Miscellaneous Units,<br>40 CFR §§264.601 through .603] | If a treatment or storage miscellaneous unit has contaminated soil or groundwater that cannot be completely removed or decontaminated during closure, the unit must also meet the requirements of OAC 3745-57-91 during the post-closure care period. The post-closure plan under OAC 3745-55-18 must specify the procedures that will be used to satisfy this requirement.<br><br>A miscellaneous unit that is a disposal unit must be maintained in a manner that complies with OAC 3745-57-91 during the post-closure care period.<br><br>**NOTE:** If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | R&A | | Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | See preceding. |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Care and Use of Property<br>OAC 3745-66-17(A)<br><br>[40 CFR §265.117(a)(2)] | Post-closure care of hazardous waste management units must begin after completion of closure of the unit and continue for 30 years after that date unless shortened by the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] in accordance with OAC 3745-66-18(G) (40 CFR §117(a)(2)).<br><br>**NOTE:** If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | Appl | | **NOTE:** Identified in the OU5 ROD as applicable only to existing hazardous waste management units (HWMUs); also cited in RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | See preceding. |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Care and Use of Property<br>OAC 3745-66-17(A)(1)<br><br>[40 CFR §265.117(a)(1)] | Post-closure care...must consist of at least the following:<br><br>• monitoring and reporting; and<br><br>• maintenance and monitoring of waste containment systems.<br><br>**NOTE:** If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | See preceding. |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DESCRIPTION OF POST-CLOSURE CARE, continued** | | | | | |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Plan; Amendment of Plan<br>OAC 3745-66-18(A)&(C) | The owner of a hazardous waste disposal unit shall have a written post-closure plan, which shall identify the activities that will be carried on after closure of each unit and the frequency of those activities, and include at least:<br><br>• a description of the planned monitoring activities and frequencies at which they will be performed;<br>• a description of the planned maintenance activities and frequencies at which they will be performed, to ensure (a) the integrity of the cap and final cover or other containment systems, and (b) the functioning of the monitoring equipment; and<br>• the name, address and telephone number of the person or office to contact about the hazardous waste disposal unit or facility during the post-closure period.<br><br>NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | See preceding. |
| | **MODIFICATIONS TO POST-CLOSURE CARE PLAN OR PERIOD** | | | | | |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Plan; Amendment of Plan<br>OAC 3745-66-18(D) | The owner may amend the post-closure plan any time during the active life of the facility or during the post-closure period.<br><br>NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | See preceding. |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Plan; Amendment of Plan<br>OAC 3745-66-18(G) | The post-closure plan and length of the post-closure period may be modified any time prior to the end of the post-closure care period. A modification of the post-closure plan may include, where appropriate, the temporary suspension rather than permanent deletion of one or more post-closure care requirements. At the end of the specified period of suspension, the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] would then determine whether the requirements should be permanently discontinued or reinstated to prevent threats to human health and the environment.<br><br>NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>Only pertinent to those units where risk-based FRLs are not met. DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **PROPERTY USE RESTRICTIONS** | | | | | |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Care and Use of Property<br>OAC 3745-66-17©<br><br>[40 CFR §265.117(c)] | Post-closure use of property on or in which hazardous waste remain after partial or final closure must never be allowed to disturb the integrity of the final cover, liner(s), or any other component of the containment system, or the function of the facility's monitoring systems, unless the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] approves otherwise.<br><br>NOTE: If clean (or risk-based) closure is performed, then post-closure care is not required. | √ | Appl | √ | NOTE: Identified in the OU5 ROD as applicable only to existing hazardous waste management units (HWMUs); also cited in RCRA/CERCLA Integrated Closure DF&O @ V.1.<br><br>DOE intends, and anticipates being able, to clean (risk-based) close all identified HWMUs. | Currently addressed in the OSDF Post-closure Care and Inspection Plan, which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed. |
| Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings<br>Subpart A--<br>40 CFR §192.02(a) | Controls of residual radioactive materials from inactive uranium processing sites shall be designed to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years, and provide protection of groundwater. | R&A | R&A | | Most pertinent to the design and closure of the On-Site Disposal Facility. | Addressed by selected remedies of OU2 and OU5 RODs in establishment of FRLs. |
| Long-Term Management of Residual Radioactive Material<br><br>DOE Order 5400.5<br>Chapter IV (6)(d)<br><br>10 CFR Part 834<br>(PROPOSED) | Controls of residual radioactive materials from inactive uranium processing sites shall be designed to be effective for up to 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years, and provide protection of groundwater. | | TBC | | | Addressed by selected remedies of OU2 and OU5 RODs in establishment of FRLs. |
| | For long-term management of uranium, thorium, and their decay products, access to a property and use of on-site materials contaminated by residual radioactive material should be controlled through appropriate administrative and physical controls such as those described in 40 CFR 192. These controls should be designed to be effective to the extent reasonable for at least 200 years. | TBC | TBC | | | |

## TABLE A-2 (Continued)
## PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| Control of Residual Radioactive Material Above the Guidelines<br><br>DOE Order 5400.5 Chapter IV (6) | Residual radioactive material with concentrations above the generic guidelines (see chemical-specific requirements) shall be managed in accordance with Chapter II, Requirements for Radiation Protection of the Public and the Environment, and operational and control requirements. | TBC | √ | | | See preceding. |
| Supplemental Limits and Exceptions for Residual Radioactive Material<br><br>DOE Order 5400.5 Chapter IV (7) | If special specific property circumstances indicate that the concentration guidelines or authorized limits are not appropriate, supplemental limits or an exception may be requested to those guidelines or limits. | TBC | √ | | | See preceding. |
| Release of Property<br><br>DOE Order 5400.5 Chapter II (5) | Real property (land and structures), personal property, materials, and equipment shall be released if the concentration of radioactivity is within the limits of residual radioactive contamination. | TBC | √ | | | See preceding. |
| **POST-CLOSURE NOTICE/SURVEY PLAT** | | | | | | |
| Closure and Post-Closure Under Interim Standards,<br><br>Survey Plat<br>OAC 3745-66-16 | The owner shall submit -- to the local zoning authority, or the authority with jurisdiction over local land use, and to the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] -- a survey plat, prepared and certified by a professional land surveyor, indicating the location and dimensions of landfill cells or other hazardous waste disposal units with respect to permanently surveyed benchmarks. The plat must contain a note, prominently displayed, which states the owner's obligation to restrict disturbance of the hazardous waste disposal unit in accordance with OAC 3745-66-17(C). | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. | Currently addressed in the OSDF Post-closure Care and Inspection Plan, which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed. |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Notices<br>OAC 3745-66-19(A) | The owner shall submit -- to the local zoning authority, or the authority with jurisdiction over local land use, and to the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] -- a record of the type, location, and quantity of hazardous waste disposed of within each cell or disposal unit of the facility. | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. | See preceding. |

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# TABLE A-2 (Continued)
# PERTINENT ARARs AND TBCs FOR THE SITEWIDE EXCAVATION PLAN

| Citation | Requirement | OU2 ROD | OU5 ROD | OU3 ROD | Remarks | Cross-Reference |
|---|---|---|---|---|---|---|
| | **DEED NOTATION** | | | | | |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Notices<br>OAC 3745-66-19(B) | The owner shall record, in accordance with state law, a notation on the deed of the facility property, or on some other instrument which is normally examined during title search, that will notify in perpetuity the potential purchasers of the property that:<br><br>• the land has been used to manage hazardous wastes;<br>• its use is restricted under the Ohio Administrative Code closure and post-closure rules; and<br>• a survey plat and record of the type, location, and quantity of hazardous wastes disposed of within each cell or hazardous waste unit of the facility as required by OAC 3745-66-16 and OAC 3745-66-19(A) have been filed with the local zoning authority or the authority with jurisdiction over local land use and the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection]. | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. | Currently addressed in the OSDF Post-closure Care and Inspection Plan, which notes in its Prologue that it can be revised at a later date to expand the scope of coverage to encompass the entire FEMP site as needed.<br><br>Will also be addressed in the NRRP. |
| Closure and Post-Closure Under Interim Standards,<br><br>Post-closure Notices<br>OAC 3745-66-19© | If the owner or any subsequent owner of the land upon which a hazardous waste disposal unit was located wishes to remove hazardous wastes and hazardous waste residues in satisfaction of the criteria in OAC 3745-66-17(C), the owner may request that the Director [of the OEPA, a.k.a. the Ohio Director of Environmental Protection] approve either:<br><br>• the removal of the notation on the deed to the facility property or other instrument normally examined during title search; or<br>• the addition of a notation to the deed or instrument indicating the removal of the hazardous waste. | √ | √ | √ | Cited in the RCRA/CERCLA Integrated Closure DF&O @ V.1. | See preceding. |

# APPENDIX B

# SITEWIDE SEQUENCING PLAN

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# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AWWT | Advanced Wastewater Treatment Facility |
| D&D | Decontamination and Dismantlement |
| FEMP | Fernald Environmental Management Project |
| IRDP | Integrated Remedial Design Package |
| OSDF | On-Site Disposal Facility |
| SSP | Sitewide Sequencing Plan |
| WAC | waste acceptance criteria |

## B.1 INTRODUCTION

This Sitewide Sequencing Plan (SSP) represents the current estimated order in which the at- and below-grade remediation areas within the Fernald Environmental Management Project (FEMP) will be addressed. The SSP is largely derived from schedules in the Fernald Site Soil Remediation Plan (DOE 1998), which was released in January 1998 and will be updated as needed. The sequence of excavation activities ultimately depends on complex relationships between demolition of above-ground facilities, proper material placement ratios within the On-Site Disposal Facility (OSDF), and schedules for waste pit and silo remediation activities relative to other parts of the site. Therefore, the process of integration into the remediation plan baseline will inevitably result in refinements of the sequencing. This sequencing plan must be viewed as a living document that is subject to modification based on the ongoing planning, design, and construction activities at the FEMP.

### B.1.1 Purpose of Plan

The purpose of this SSP is to present the overall sequencing strategy and to explain the objectives and criteria that were used in sequence development. The SSP describes soil excavation sequencing between, and within, the major remediation areas of the FEMP. The major remediation areas are shown on Figure B-1.

As the major areas of the FEMP are remediated, potentially contaminated corridors will be left unremediated until the sitewide effort nears completion. These corridors (Figure B-2) include haul routes as well as areas used for remedial actions expected to extend beyond the time required to conduct soil excavation (e.g., South Plume pipeline).

### B.1.2 Integration of Sitewide Sequencing Plan with Design

The SSP for the FEMP will be used in developing integrated remedial design packages (IRDPs) for each of the major remediation areas. During the development of IRDPs and implementation of field activities, it is likely that the need for sequence changes will be identified (e.g., a need for additional soil to mix with construction debris placed in the OSDF). When necessary, the SSP will be updated to address any significant changes in the excavation sequencing. The latest version of the SSP will serve as a reference source for IRDP development in each successive area.

B.1.3 Format

The SSP consists of text and conceptual drawings that illustrate excavation sequencing. Criteria that were used to develop the soil excavation sequencing are presented in Section B.2. The actual sequencing of areas to be remediated is described and presented in Section B.3 and on Figures B-3 through B-17.

## B.2 SEQUENCING STRATEGY

### B.2.1 Sequencing Objectives

The overall goal of soil remediation at the FEMP is to remove soil that presents an unacceptable risk to human health and the environment. Objectives of the sequencing strategy are to remediate the soil in a cost effective and efficient manner, protect human health and the environment, and provide the proper ratio of bulk materials to the OSDF.

#### B.2.1.1 Protect Human Health and the Environment

During remediation, procedures will be implemented to protect human health and the environment by minimizing potential exposure to contamination and avoiding cross-contamination. This will be achieved by:

- Generally excavating areas from upgradient to downgradient
- Controlling haul routes through contaminated areas to minimize cross-contamination of certified clean areas
- Using paved roads, to the extent practical, to minimize dust generation and avoid cross-contamination.

Exposure of the environment to contamination will be minimized by prioritizing the remediation of potential source areas as soon as practical. For example, the Southern Waste Units (i.e., Inactive Flyash Pile, South Field, and Active Flyash Pile) will be remediated early in the sequencing process because they are a source of contamination to the Great Miami Aquifer.

Another important factor for protection of human health and the environment is avoiding slope stability problems. Geotechnical analysis of soil samples may be performed during the pre-excavation investigation if data are needed to determine safe-cut slopes for temporary and long-term conditions.

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B.2.1.2 Optimize Effectiveness and Efficiency

The steps that will be taken to make the sequencing cost-effective and efficient include the following:

- Minimize double handling of material
- Establish large work areas to provide efficient equipment utilization
- Minimize haul distances as much as possible
- Minimize unneeded treatment of water
- Minimize sheeting and shoring of excavated slopes.

B.2.1.3 Achieving Objectives

To achieve the sequencing objectives, a phased excavation approach will be used to ensure that cost-saving measures, enhanced excavation techniques, and identified problems are incorporated into successive areas undergoing excavation. The phased approach is provided in Section B.3.

B.2.2 Sequencing Assumptions

Some of the information that will affect sequencing decisions will not be known until remediation is actually underway and/or virtually completed in a given area. For example, the initial excavation extent delineated in the IRDP for the Former Production Area may be modified during the remedial action due to the heterogeneous distribution of subsurface contamination. The current sequencing plan is based on the following assumptions:

- Quantities and locations of contaminated soil to be excavated are estimated based on current data and modeling
- The North Rail Yard will be removed as part of site remediation after material from the Operable Unit 1 Waste Pits (Area 6) has been sent off site
- The OSDF will not need the rail yard for delivery of material
- The Advanced Wastewater Treatment Facility (AWWT) will be remediated after closure of the OSDF
- In all but the final sequence step, there will be a debris stockpile located in an unremediated area. Generally, bulk-stored surface debris from an unremediated area will be hauled to the OSDF with the soil from the active excavation area.
- Operational knowledge and existing data indicate that some areas of the FEMP will not require large excavations. These areas will be surveyed as part of a precertification

process. Localized impacts within these areas will be excavated as required and the areas certified.

- Groundwater and corresponding construction dewatering will not affect the excavation sequence. However, dewatering may affect the protocols within a given isolated excavation.

- The FEMP property west of Paddys Run (except for the railroad corridor) will not require excavation. The area is generally upwind of the FEMP site and is not expected to be contaminated.

B.2.3 Excavation Criteria

Excavation of contaminated material from the FEMP will consist of removing approximately two million cubic yards of soil and at- and below-grade structures. To achieve the objectives previously described, the following sequencing criteria were established:

- Complete excavation ahead of the north-to-south OSDF construction

- Work in isolated drainage areas for efficient collection and handling of surface water

- Complete continuous excavations at one time. Avoid splitting a large and continuous excavation into multiple pieces.

- Utilize existing production area drainage systems to the extent practical

- Schedule large excavations when the entire area is available and accessible to assure capability to excavate continuously

- Perform excavation from upgradient to downgradient as much as possible

- Minimize double handling by planning excavated soil generation to coincide with placement capacities and schedules

- Avoid hauling contaminated soil through certified remediation areas

- Identify and utilize haul routes to the OSDF that are as direct as possible

- Minimize loading to the AWWT by redirecting uncontaminated flow from certified areas as early as possible.

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B.2.4 Sequence Development Steps

The prioritized steps that were used to develop the Sitewide Sequencing Plan are as follows:

- Identify areas of risk near the OSDF footprint. To eliminate slope failure risk in the vicinity of the OSDF, all soil excavation and certification in the vicinity of the OSDF must be completed well ahead of actual cell construction.

- Identify existing and proposed drainage areas. Excavation should be performed within distinct drainage areas. Generally, it should begin within an existing drainage area and end within a proposed future drainage area (a large and continuous excavation is considered one drainage area). Large areas of excavation should be completed as one unit to allow surface water to be collected and handled more efficiently.

- Prioritize continuing sources of contamination. Continuing sources of contamination are identified and will be selected for early removal.

- Prioritize areas from upgradient to downgradient. Excavation is planned to proceed from an upgradient to a downgradient surface water direction to minimize the potential for certified areas to become recontaminated by run-off from contaminated areas that are upgradient.

- Estimate and coordinate quantities. Soil excavation quantities will be compared and coordinated with 1) estimated debris in an area, 2) estimated debris to be generated from above-grade decontamination and dismantlement (D&D) in other areas that will be addressed at the same time, and 3) OSDF construction material requirements.

## B.3 EXCAVATION SEQUENCING PLAN

Some of the remediation areas (Figure B-1) are subdivided into phases and sectors to facilitate logistic and schedule considerations. These component areas are dependent on and/or related to excavation in other remediation areas, as described below.

Figures B-3 through B-17 present excavation sequencing of the component areas. Conceptual haul routes to the OSDF and proposed excavation drainage patterns are also shown on the figures. The drainage patterns will depend on the proposed restoration topography and will capture the general flow of construction water from the active remediation area. Drainage patterns are expected to be maintained only until certification is achieved for the area. Beyond that point in time, the flow would be redirected away from active remediation areas. Each phase of the excavation sequence is discussed below.

B.3.1 Remediation Area 1, Phase I (Figure B-3)

Excavation and certification of Remediation Area 1, Phase I was completed prior to the approval of the Sitewide Excavation Plan to allow construction and completion of the first cell of the OSDF. During Phase I, the North Entrance Road was relocated to the east in preparation for construction of the first cell of the OSDF. Excavated soil from Phase I was placed in the temporary east and west stockpiles within the area.

B.3.2 Remediation Area 2, Phase I - Southern Waste Units (Figure B-4)

The Southern Waste Units consist of the South Field and the Active and Inactive Flyash Piles. Excavation of the SWUs will be the first large-scale remediation task to generate material for the OSDF. The completion of this activity is required prior to initiating excavation actions in Remediation Area 3. The proposed haul road to the OSDF will be constructed through Remediation Areas 2, 7, 6, and 3. Run-off from the area will be collected in retention basins and pumped to the Storm Water Retention Basins.

B.3.3 Remediation Area 8 - West of Paddys Run (Figure B-5)

Based on existing data, process knowledge, and wind patterns at the site, Remediation Area 8 is not expected to contain contamination at levels that would require excavation. It is anticipated that precertification activities will commence in this area in 1998 without excavation. As shown on Figure B-5, Area 8 is divided into three phases, with Phase III and Phase II separated by the railroad corridor. The current schedule indicates that Area 8, Phase I is to be certified in 1998, Phase II in 1999, and Phase III in 2003.

B.3.4 Remediation Area 1, Phase II, Sector 1 - Southeast Portion of FEMP (Figure B-6)

The remediation of this area will provide a source of borrow material to construct the OSDF. Construction of an associated sediment pond will also occur during this activity. The proposed haul route to the OSDF will be the existing North Entrance Road.. Surface water drainage will be directed to the new sediment pond.

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B.3.5 Remediation Area 1, Phase II, Sectors 2 and 3 - OSDF Footprint and Sewage Treatment Plant (Figure B-7)

This task must be completed before construction begins on Cells 4 and 5 of the OSDF and before the final portion of the new North Entrance Road can be completed. Completion of this task depends on 1) finishing the new Sewage Treatment Plant, which must be on-line before demolition and excavation of the old Sewage Treatment Plant can begin; 2) closure of Hazardous Waste Management Unit 4, the sludge drying beds at the old Sewage Treatment Plant; and 3) removing at- and below-grade structures associated with the old Sewage Treatment Plant. The potential contamination of this area consists primarily of wind-blown radiological contaminants from the Former Production Area and the incinerator at the old Sewage Treatment Plant. The proposed haul route to the OSDF will be the existing North Entrance Road. Surface water drainage will be directed to the new sediment pond.

B.3.6 Remediation Area 2 Phase III - South-Central Portion of FEMP (Figure B-8)

Based on existing data and process knowledge, Remediation Area 2, Phase III is not expected to contain contamination at levels that would require excavation. It is anticipated that precertification activities will begin in this area in 1999.

B.3.7 Remediation Area 3 - North End of the Former Production Area and Lime Sludge Ponds Figure B-9)

Excavation of soil and at- and below-grade structures will not proceed until demolition of above-grade structures in Remediation Area 3 is completed. Excavation activities in the eastern portion of Remediation Area 3 will be completed ahead of OSDF construction planned in the same area to prevent potential undermining and stability problems. Surface-water drainage will be directed to the B Street drainage ditch, which flows south to the Storm Water Retention Basins. The haul routes from the Lime Sludge Ponds and to the OSDF will be on the New Haul Road and/or Second Street. Perched water encountered during the excavation of Remediation Area 3 may be contaminated with organic constituents listed under the Resource Conservation and Recovery Act. If so, the water will be treated at the AWWT facility.

B.3.8 Remediation Area 4A - East Central Portion of Former Production Area (Figure B-10)

Remediation in this area will begin after the demolition of above-grade structures in the area and excavation activities in Remediation Area 3 are completed or near completion. Surface water drainage will be directed to the active storm drain within Area 4. Haul routes to the OSDF will be on Second Street initially and will be moved to First Street after D&D activities in Remediation Area 4B are completed. Second Street will be maintained as the haul route to Operable Unit 1 for material that is to be shipped off site.

B.3.9 Remediation Area 2, Phase II (Figure B-11)

Remediation Area 2, Phase II is not expected to contain significant contamination and it is anticipated that minimal excavation will take place. Any excavation in Area 2, Phase II is likely to be coincident with Area 4A excavation. Therefore, the present plan is to include the bid package for Area 2, Phase II as part of the Area 4A bid package. Since little or no excavation is anticipated for Area 2, Phase II, and any excavation that is needed will be of the surgical type, surface water drainage will remain in its ambient state. The haul route to the OSDF will be along the Area 2, Phase I haul road to Second Street, east on Second Street to Area 4A, and then Second Street or First Street to the OSDF.

B.3.10 Remediation Area 4B - West Central Portion of Former Production Area (Figure B-12)

Remediation of Area 6 will proceed after demolition of above-grade structures and the completion of excavation activities in Remediation Area 4A. The hauling corridor for OSDF materials removed from Remediation Area 4B will be First Street, and Second and A Streets will be the primary haul roads to Operable Unit 1 for stockpiling of material to be shipped off site. Surface water drainage will be directed to the SWRBs.

B.3.11 Remediation Area 5 - Administration Area (Figure B-13)

Remediation of Area 6 will proceed after demolition of above-grade structures in the area and the completion of excavation activities in Remediation Area 4B. Surface water drainage will be directed to the Biodenitrification Surge Lagoon. The proposed haul route to the OSDF will initially be First Street, until Area 4A is complete, and then shift to an identified corridor through the main parking lot.

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B.3.12 Remediation Area 1, Phase III - North Area of FEMP (Figure B-14)

This area is not expected to contain significant contamination and it is anticipated that precertification activities will be initiated without excavation. Therefore, there is no specific sequencing order for Remediation Area 1, Phase III, and precertification activities may be implemented at any time. If precertification activities indicate the need for excavation, an excavation plan will be developed and implemented to remove the contaminated soil. Surface water drainage will be directed to the Biosurge Lagoon.

B.3.13 Remediation Area 6 - Waste Pit Area, Biodenitrification Surge Lagoon, Solid Waste Landfill, Rail Yard Corridor, and OSDF West Corridor (Figure B-15)

Soil excavation will proceed in this area after all material in the waste pits and biodenitrification surge lagoon has been removed for off-site disposal. Material from the Solid Waste Landfill that meets the on-site waste acceptance criteria (WAC) will be placed in the OSDF. Surface water drainage will be directed to the Biodenitrification Surge Lagoon. The proposed haul route to the OSDF will change over time. Initially, the Area 2, Phase I haul road will be used until Remediation Area 3 is finished, then Second Street, then First Street until Remediation Area 4B is closed, and finally the rail yard access road to deliver material to the OSDF via the OSDF west corridor.

B.3.14 Remediation Area 7 - Silo Area (Figure B-16)

The excavation of soil in Remediation Area 7 will begin after the silo materials and structures have been removed for off-site disposal. Surface-water drainage will be directed to the Operable Unit 4 basin constructed for surface water management. The haul road to the OSDF will be along a designated corridor in Remediation Area 5.

B.3.15 Remediation Area 9 - Off-Property Soil (Figure B-17)

Area 9 is the off-property area adjacent to the eastern boundary of the FEMP. Precertification activities will be conducted in this area to determine if the area can be passed to the certification process or whether excavation and restoration plans need to be developed.

B.3.16 Remediation Area 10 - AWWT and Long-Term Corridors (Figure B-18)

Area 10 is the AWWT and associated long-term corridors. The AWWT facility is sequenced in the final step because of the long-term operation of the aquifer restoration system and the use of the AWWT facility in supporting other remediation activities. Parallel to or immediately following remediation of the AWWT facility, the remaining long-term corridors at the site would be remediated. These include the South Entrance Road, the South Plume Pipeline, the South Field Pump System, and the Outfall Line.

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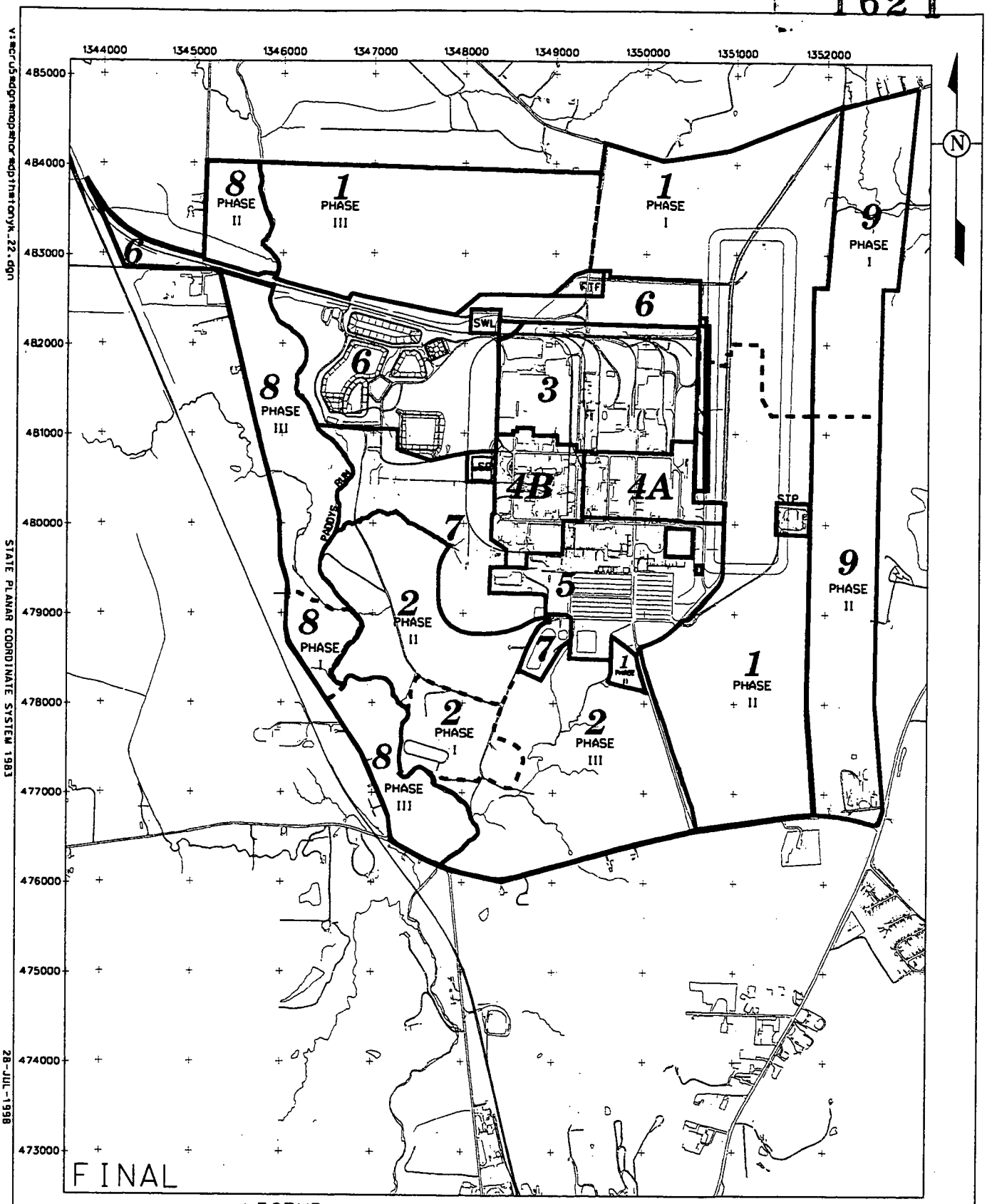
## REFERENCES

U.S. Department of Energy, 1998, Fernald Site Soil Remediation Plan, Revision, January Draft, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, Ohio.




LEGEND:

REMEDIATION AREA BOUNDARY

PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

STATE PLANAR COORDINATE SYSTEM 1983

28-JUL-1998

FIGURE B-1. SITE REMEDIATION AREAS 1 THROUGH 9

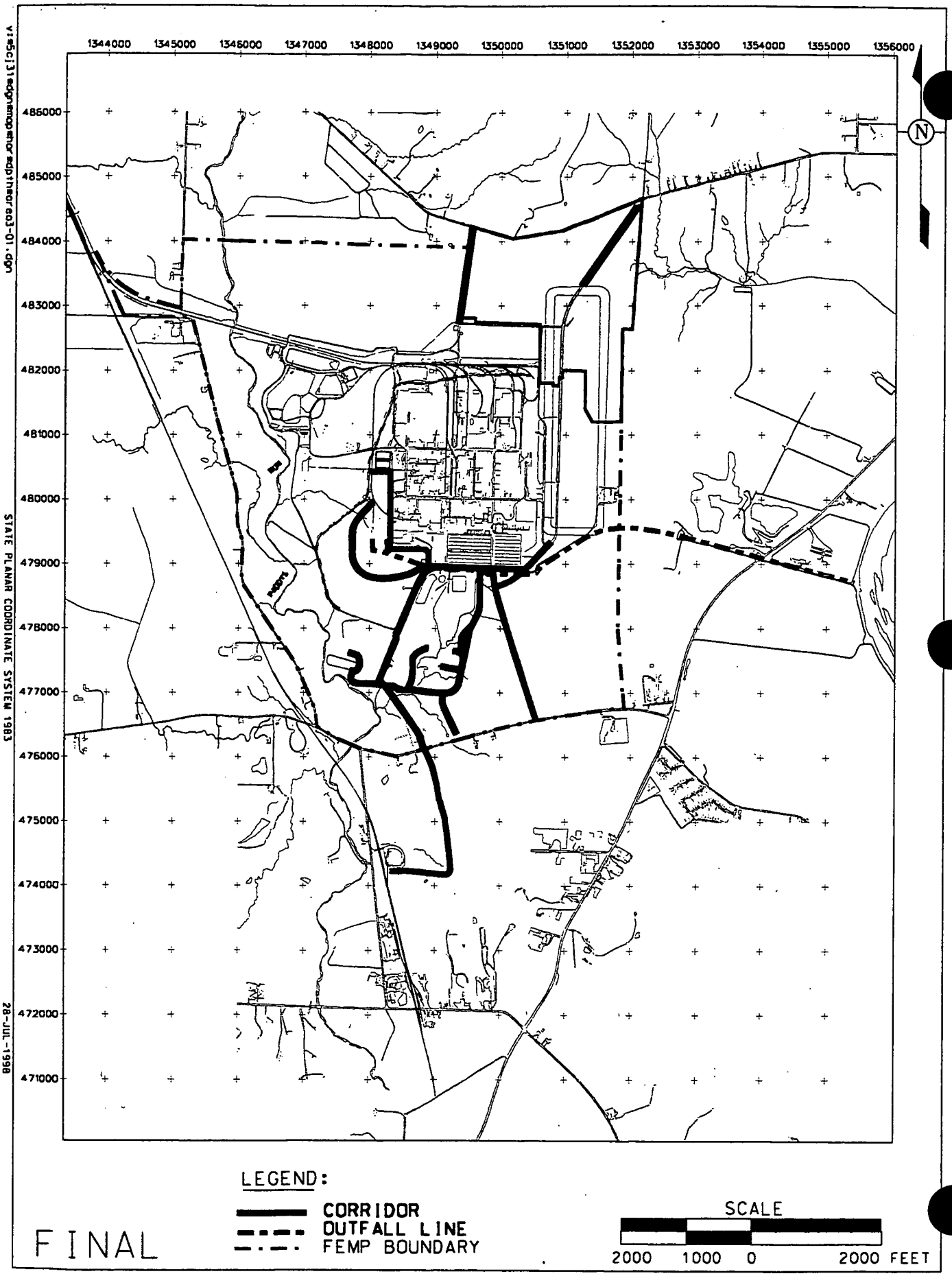



FIGURE B-2. LONG TERM CORRIDORS (AREA 10)

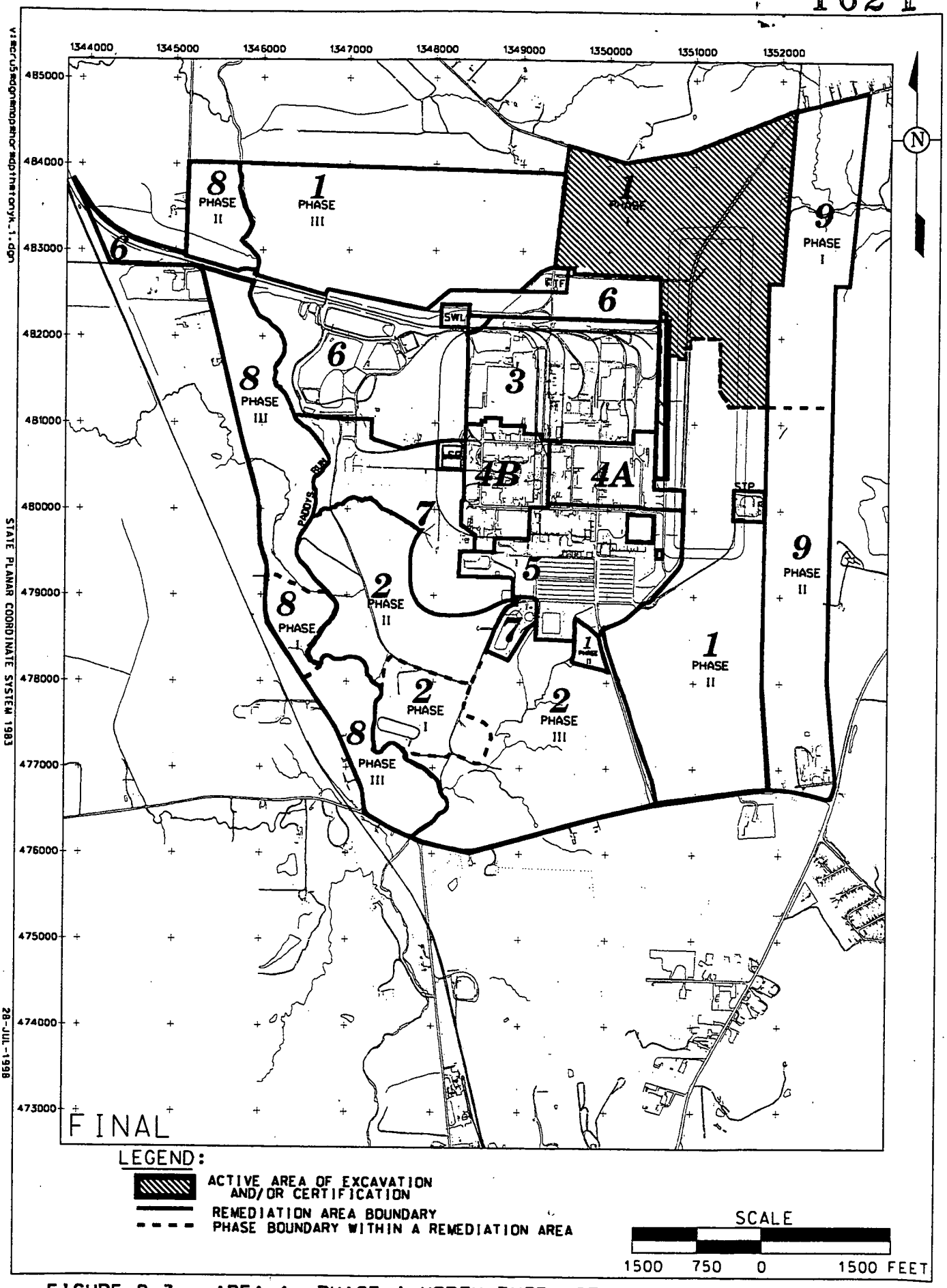



FIGURE B-3. AREA 1, PHASE I NORTH ENTRANCE ROAD AND OSDF FOOTPRINT

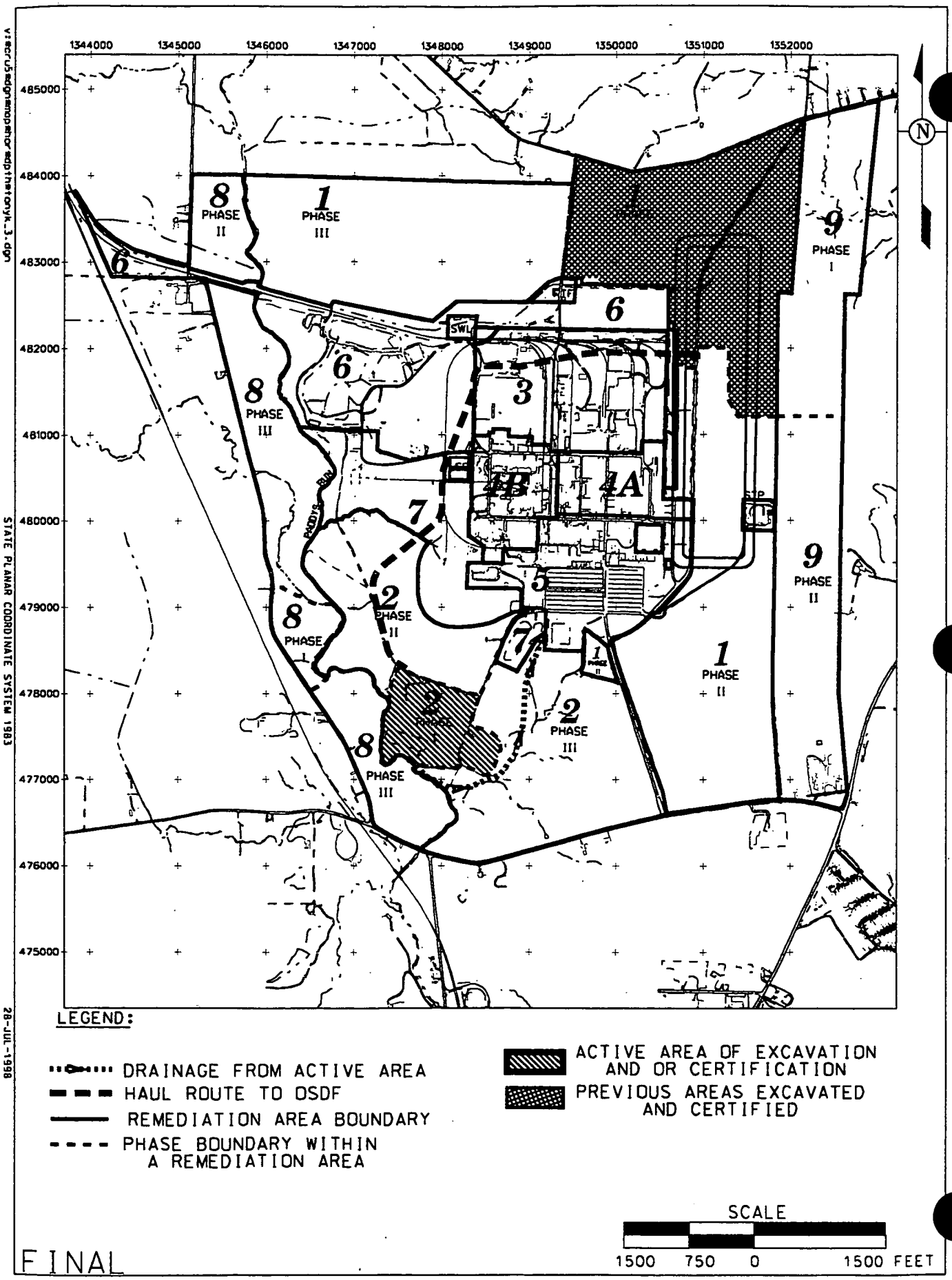



FIGURE B-4. AREA 2, PHASE I SOUTHERN WASTE UNITS

STATE PLANAR COORDINATE SYSTEM 1983

28-JUL-1998

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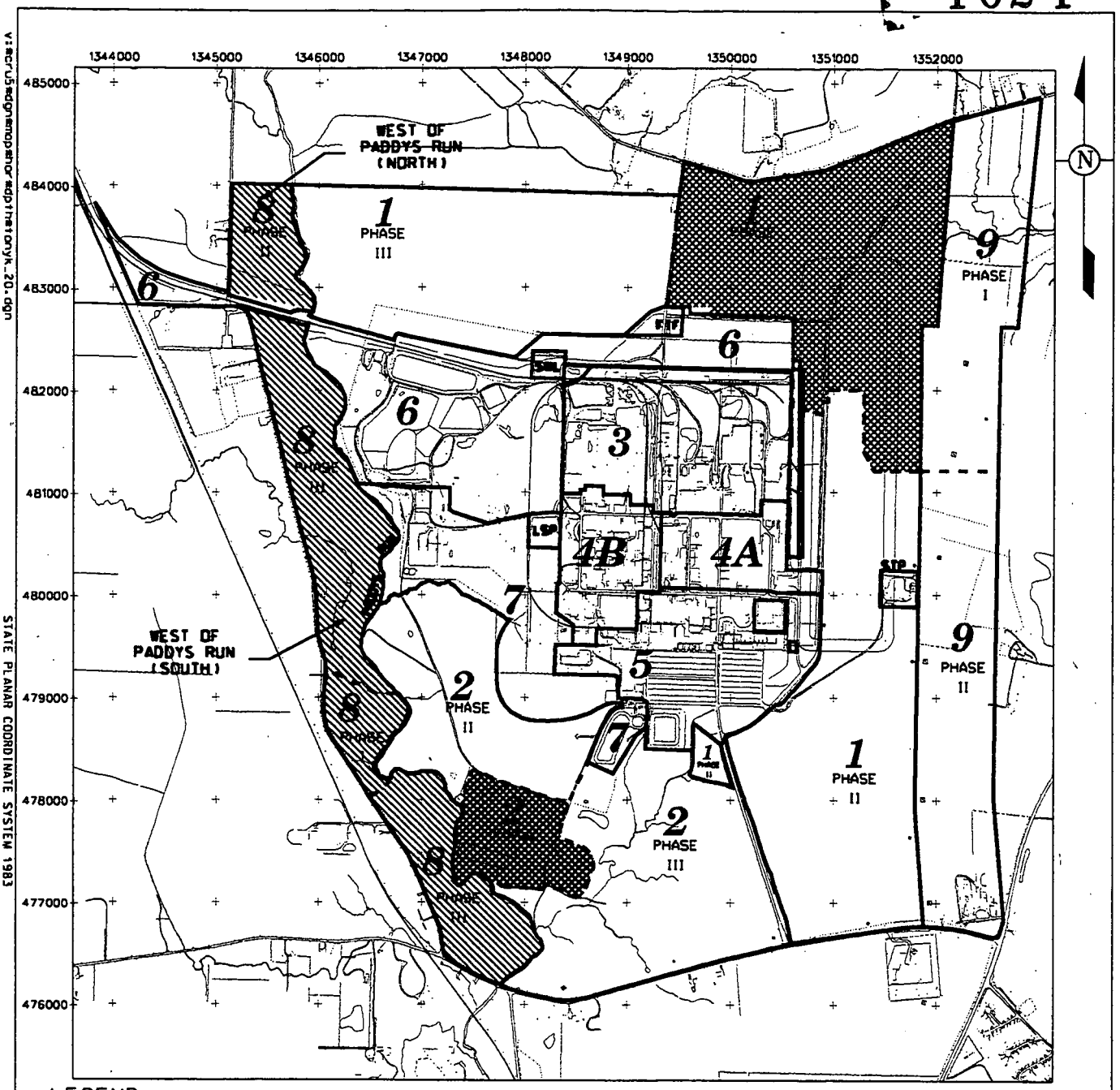


LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-5. AREAS WEST OF PADDY'S RUN



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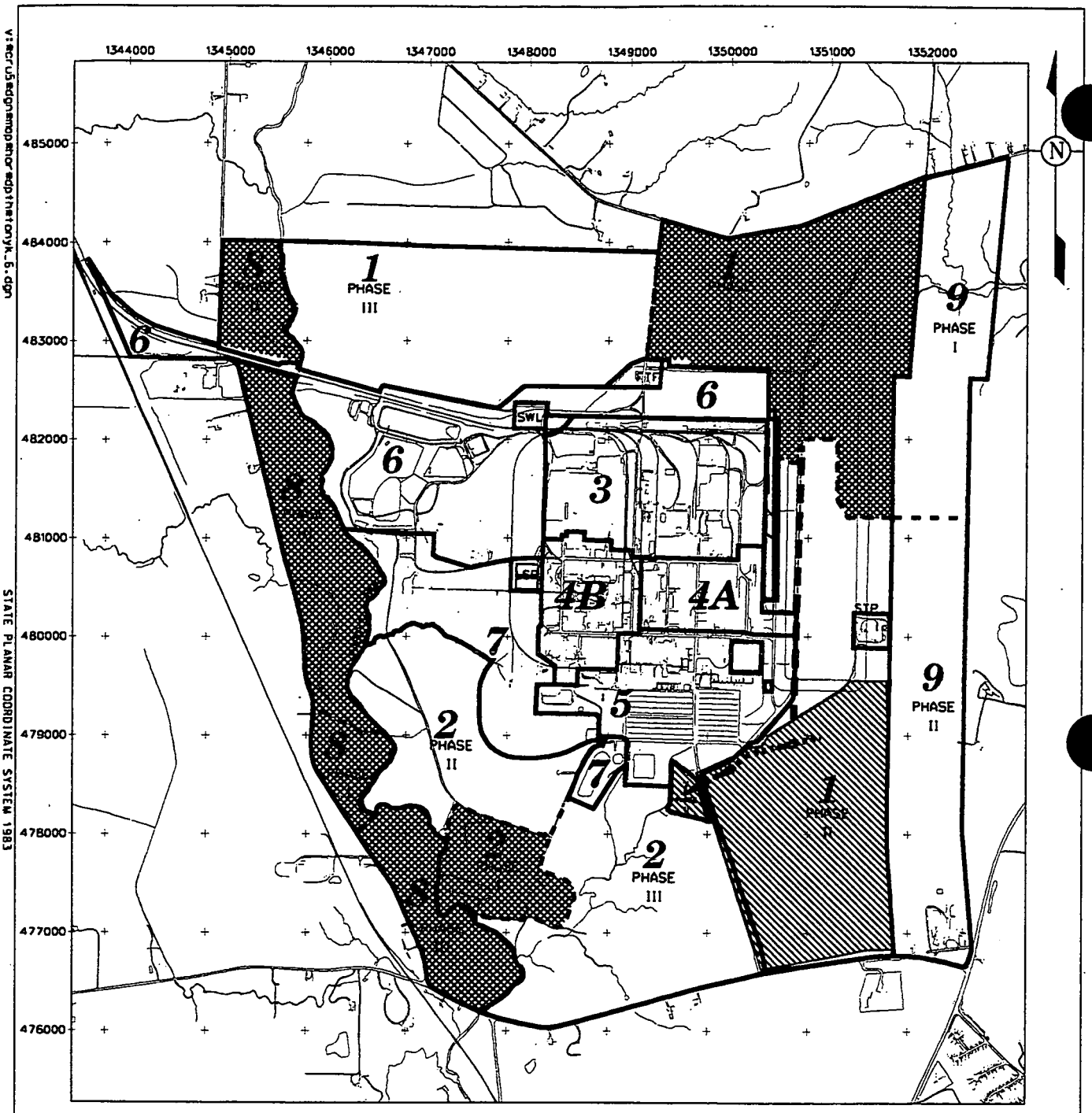
STATE PLANAR COORDINATE SYSTEM 1983
28-JUL-1998




LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA
- HAUL ROUTE TO OSDF

SCALE

1500 750 0 1500 FEET

DRAFT
FINAL

FIGURE B-6. AREA 1, PHASE II, SECTOR I: SOUTHEAST PORTION OF FEMP

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STATE PLANAR COORDINATE SYSTEM 1983

28-JUL-1998

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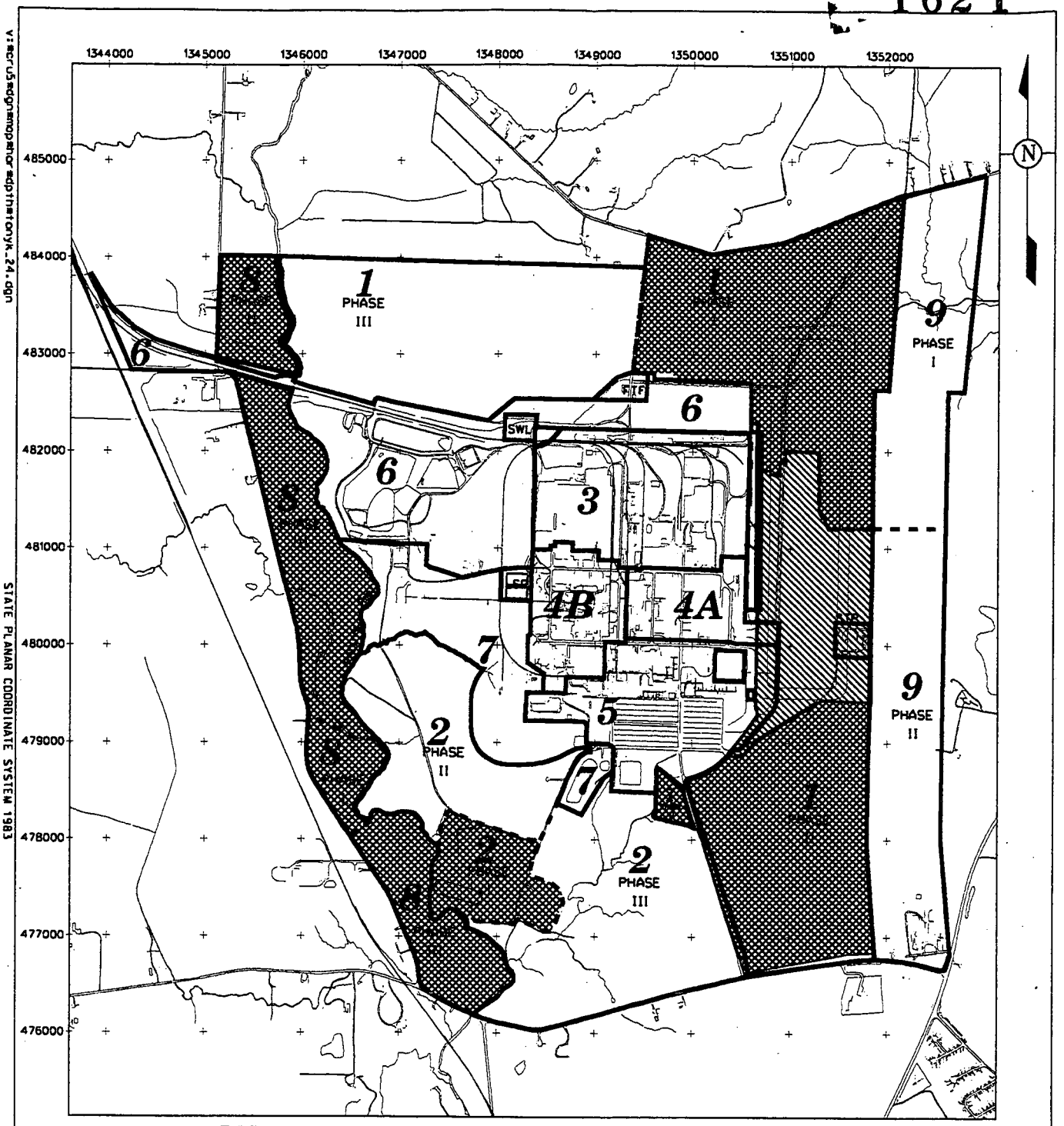


LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-7. AREA 1, PHASE II SECTOR 2 & 3: OSDF FOOTPRINT AND SEWAGE TREATMENT PLANT



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STATE PLANAR COORDINATE SYSTEM 1983
28-JUL-1998

LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-8. AREA 2, PHASE III: SOUTH-CENTRAL PORTION OF THE FEMP

STATE PLANAR COORDINATE SYSTEM 1983

28-JUL-1998

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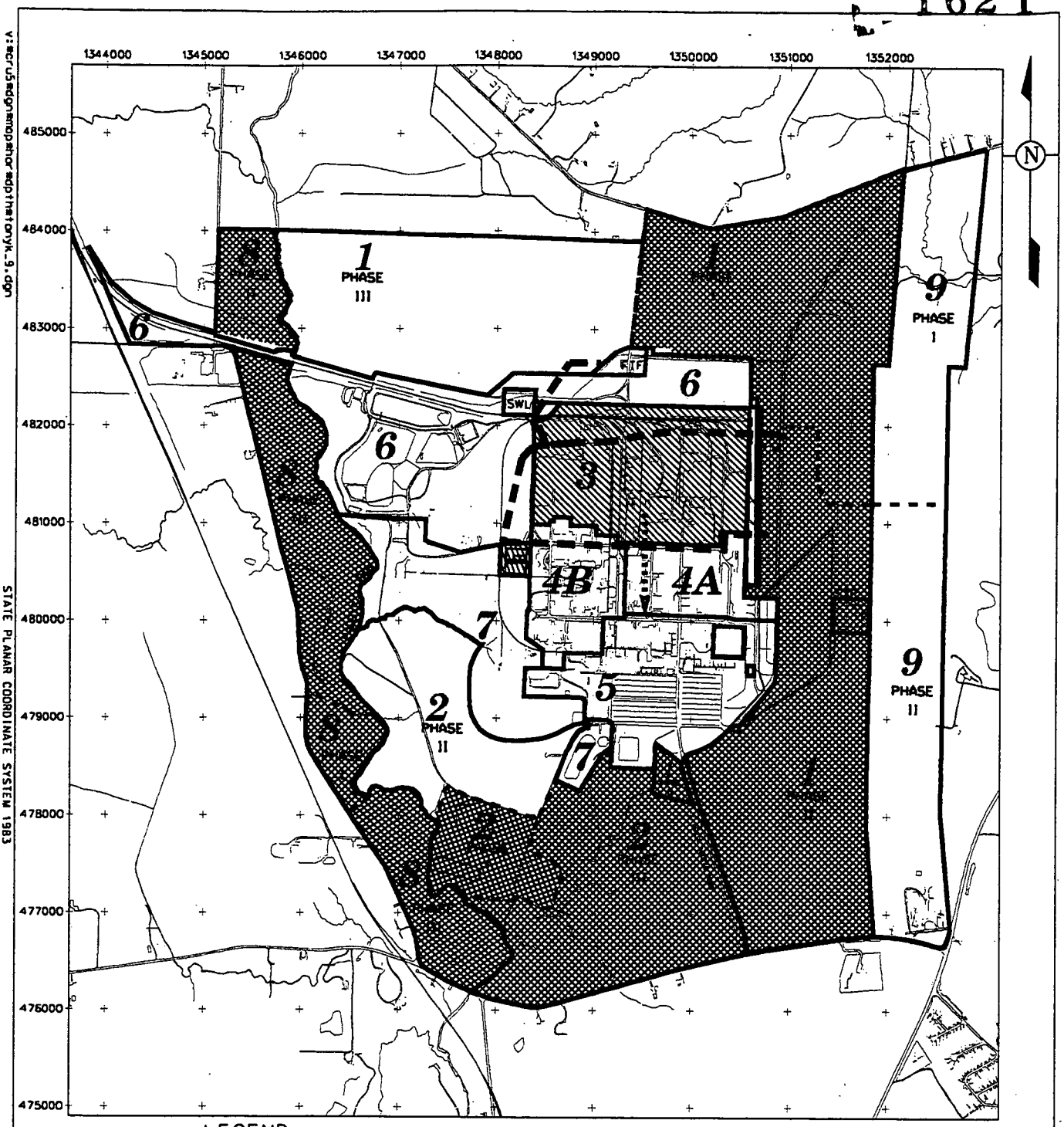


LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-9. AREA 3: NORTH END OF FORMER PRODUCTION AREA AND LIME SLUDGE PONDS

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STATE PLANAR COORDINATE SYSTEM 1983

28-JUL-1998

LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

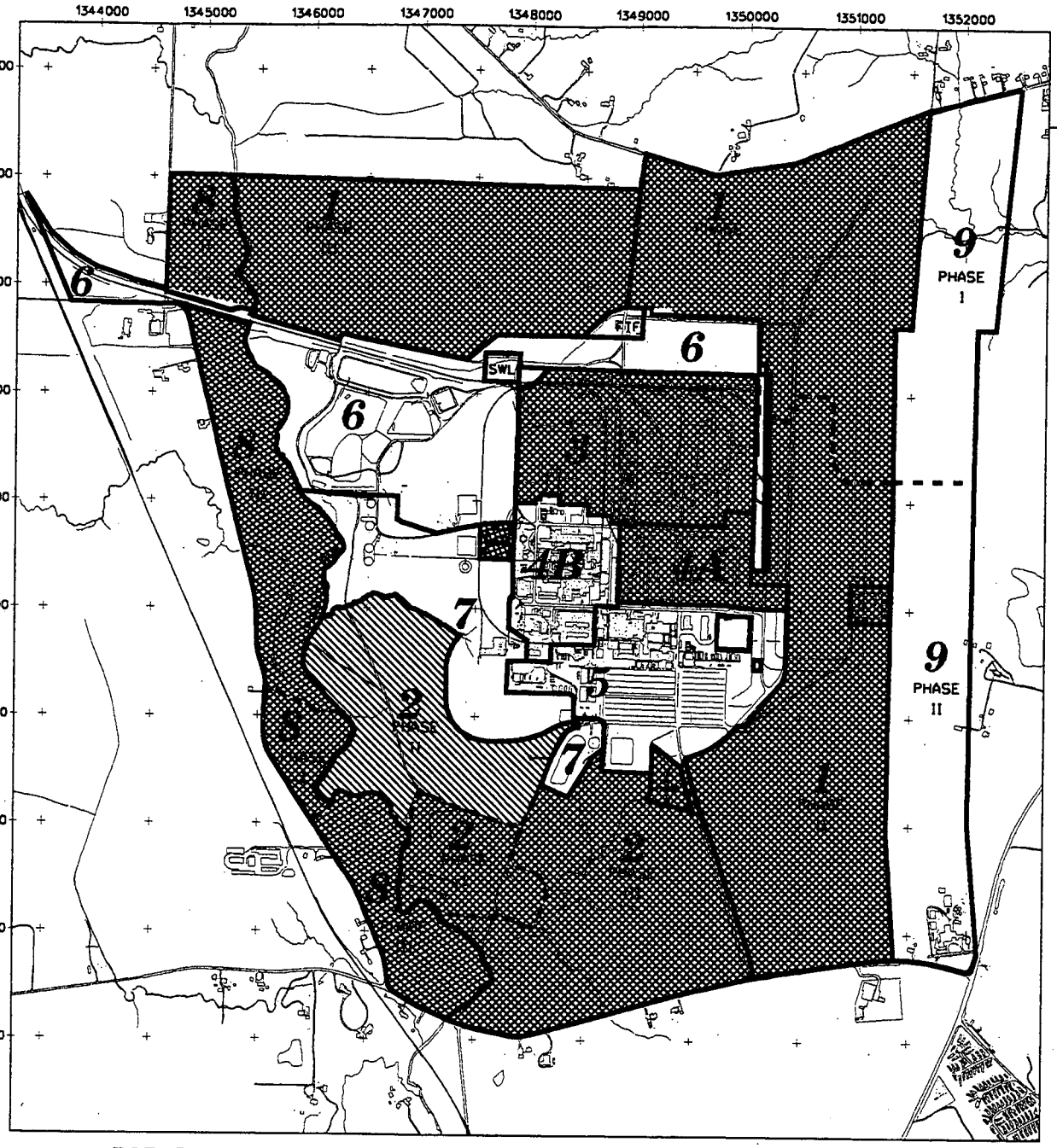
1500 750 0 1500 FEET

FINAL

B-10. AREA 4A: EAST CENTRAL PORTION OF FORMER PRODUCTION AREA

STATE PLANAR COORDINATE SYSTEM 1983

28-JUL-1998




LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-11. AREA 2, PHASE II

STATE PLANAR COORDINATE SYSTEM 1983

28-JUL-1998

LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-12. AREA 4B: WEST CENTRAL PORTION OF FORMER PRODUCTION AREA

STATE PLANAR COORDINATE SYSTEM 1927

28-JUL-1998

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LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

STATE PLANAR COORDINATE SYSTEM 1927

28-JUL-1998

FIGURE B-13. AREA 5: ADMINISTRATION AREA

LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

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STATE PLANAR COORDINATE SYSTEM 1927

28-JUL-1998

FIGURE B-14. AREA 1, PHASE III: NORTH AREA OF FEMP

LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-15. AREA 6: WASTE PIT AREA, SOLID WASTE LANDFILL, RAILYARD CORRIDOR INCLUDING FORMER FIRE TRAINING FACILITY, AND OSDF WEST CORRIDOR

LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-16. AREA 7: SILO AREA

LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-17. AREA 9: OFF-PROPERTY SOIL

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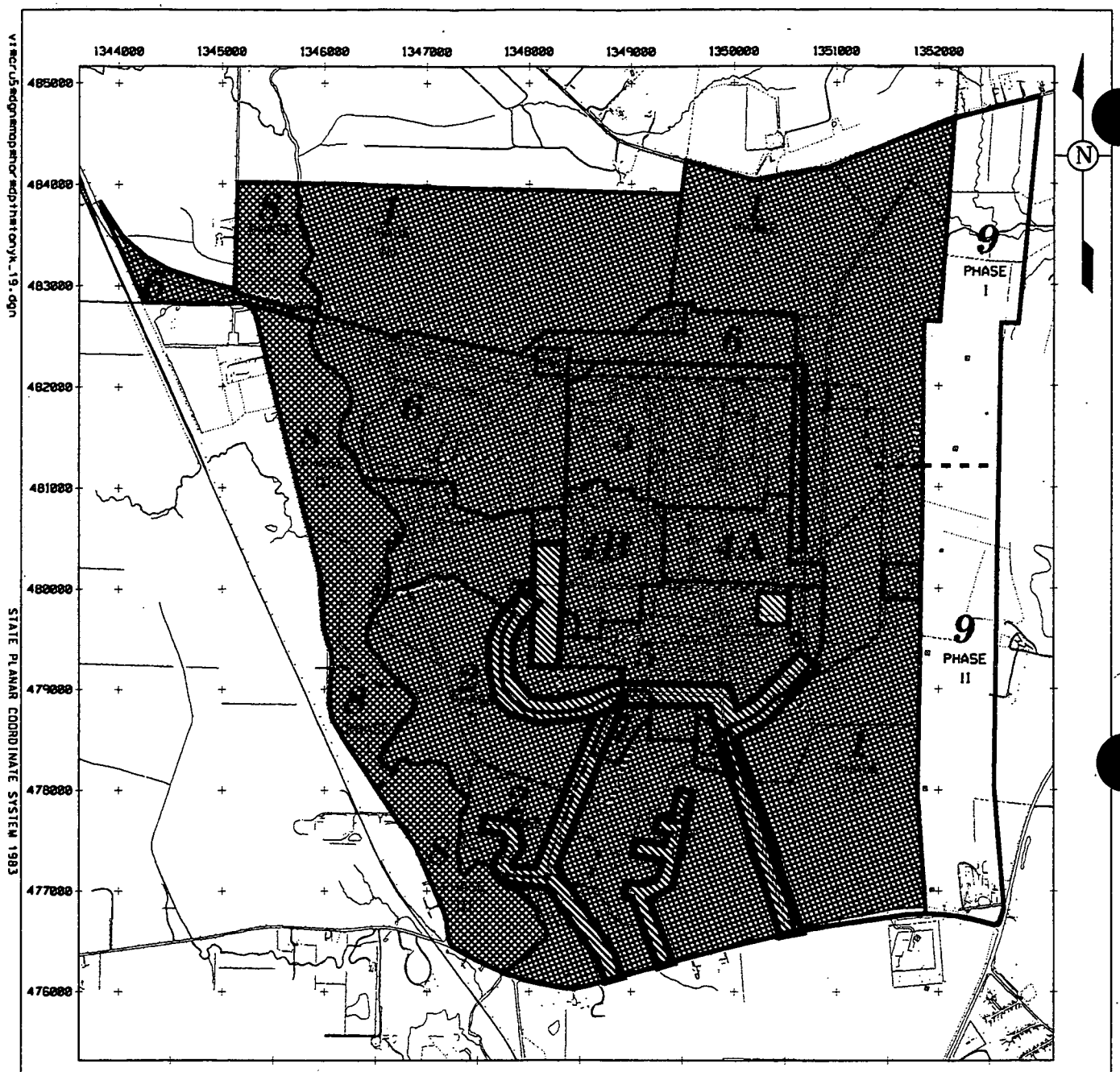
STATE PLANAR COORDINATE SYSTEM 1927
28-JUL-1998




LEGEND:

- ACTIVE AREA OF EXCAVATION AND/OR CERTIFICATION
- PREVIOUS AREAS EXCAVATED AND CERTIFIED
- DRAINAGE FROM ACTIVE AREA
- HAUL ROUTE TO OSDF
- REMEDIATION AREA BOUNDARY
- PHASE BOUNDARY WITHIN A REMEDIATION AREA

SCALE

1500 750 0 1500 FEET

FINAL

FIGURE B-18. ADVANCED WASTE WATER TREATMENT FACILITY AND LONG-TERM CORRIDORS

# APPENDIX C

## SELECTION OF ECOLOGICAL CONSTITUENTS OF CONCERN

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# LIST OF ACRONYMS

| | |
|---|---|
| ASCOC | area-specific constituent of concern |
| BTV | benchmark toxicity value |
| CAWQC | chronic ambient water quality criteria |
| CERCLA | Comprehensive Environmental Responses, Compensation and Liability Act |
| COECs | Constituents of Ecological Concern |
| DOE | U.S. Department of Energy |
| DOI | U.S. Department of Interior |
| EPA | Environmental Protection Agency |
| FEMP | Fernald Environmental Management Project |
| FRL | final remediation level |
| FS | feasibility study |
| FTF | Fire Training Facility |
| HEA | Habitat Equivalency Analysis |
| IEMP | Integrated Environmental Monitoring Plan |
| $K_d$ | soil/water partition coefficient of COEC |
| $LC_{50}$ | lethal concentration to 50 percent of a test population |
| mg/kg | milligrams per kilogram |
| NA | not applicable |
| NEPA | National Environmental Policy Act |
| NPDES | National Pollutant Discharge Elimination System |
| NRIA | Natural Resource Impact Assessment |
| NRRP | Natural Resource Restoration Plan |
| NRT | Natural Resource Trustee |
| OSDF | On-Site Disposal Facility |
| OU | operable unit |
| PAHs | polynuclear aromatic hydrocarbons |
| RI | remedial investigation |
| ROD | Record of Decision |
| SARA | Superfund Amendments and Reauthorization Act |
| SED | Sitewide Environmental Database |
| SEP | Sitewide Excavation Plan |
| SERA | Sitewide Ecological Risk Assessment |
| SWF&IM | Surface Water Flow & Infiltration Model |
| SWUs | Southern Waste Units |
| UST | underground storage tank |
| TCLP | Toxicity Characteristic Leaching Procedure |

## C.1 INTRODUCTION

As part of the process of restoring the Fernald Environmental Management Project (FEMP) site to its final land use, the U.S. Department of Energy (DOE) must ensure that ecological receptors are not adversely impacted by residual contamination that may remain after remediation is complete. This appendix to the Sitewide Excavation Plan (SEP) provides a means of ensuring the protection of ecological receptors by establishing a screening process for Constituents of Ecological Concern (COECs). This screening considers COECs during the planning and implementation of FEMP remedial activities rather than waiting until remedial actions have been completed. When the Operable Unit 5 (OU5) Record of Decision (ROD) (DOE 1996a) was signed, DOE recognized the need to evaluate the impact of contaminants on ecological receptors on and around the property. This was accomplished with the publication of the Sitewide Ecological Risk Assessment (SERA), which was conducted as part of the OU5 Remedial Investigation (RI) (DOE 1995a). The SERA contains a preliminary evaluation of potential risks to all organisms that may be exposed to contaminants within OU5, exclusive of humans and domestic animals.

Consideration of the information developed in the SERA was to have been deferred until after all human health driven remediation had been completed (DOE 1995b). However, as negotiations with the FEMP Natural Resource Trustees progressed, it became clear that, in order to resolve all trustee concerns, ecological impacts were to be considered before completion of remedial activities.

Final land use planning is being accelerated in the form of the Natural Resource Restoration Plan (NRRP) (DOE 1997a), which addresses establishing an undeveloped park at the FEMP. This proposed park will feature wildlife habitat as one of its central land uses. Anticipated postexcavation ecological risks could directly affect some of the organisms in these habitats. This would influence the development of the final land use plan.

To better define these risks, a second ecological risk screening has been conducted. The screening process used to evaluate postexcavation ecological risk is consistent with the U.S. Environmental Protection Agency (EPA)'s "Framework for Ecological Risk Assessment" (EPA 1992). This framework involves problem formulation, analysis through characterization of exposure and ecological effects, and risk characterization. As a screening level assessment, all of these steps have been accomplished in a very conservative manner. The characterization of exposure is estimated using

media-specific maximum concentrations, with no consideration of habitat use, bioavailability, duration of exposure, secondary impacts, etc. Characterization of ecological effects is accomplished by comparing the media-specific maximum concentrations to literature-derived benchmark toxicity values (BTVs) that are considered protective of ecological receptors. To add to the conservatism, the lowest BTV was used to screen, with no regard to site-specific receptors, background conditions, field verification, etc.

An alternative perspective, however, is to consider this screening as a process of problem formulation only, with the remaining steps of the risk assessment process to be conducted after excavation has been completed and data can be collected. This approach constitutes a preliminary characterization of exposure and effects. Because of the conservative nature of this screening process, it effectively eliminates the potential COECs that cause no harm to ecological receptors and focuses attention on the parameters that need to be investigated further at the completion of remedial activities. In this light, a more complex characterization of exposure and ecological effects will be conducted to more realistically characterize ecological risk at the FEMP.

### C.1.1 Purpose

The purpose of this document is to determine what COECs will remain a concern to ecological receptors after remedial activities have been completed. To accomplish this, maximum sitewide concentrations of potential COECs are compared to media-specific BTVs. After eliminating all potential COECs where maximum concentrations are less than corresponding BTVs, the remaining COECs are evaluated against anticipated postexcavation soil concentrations. From these evaluations, a sampling strategy is established to investigate any COECs that may be a concern after remedial activities have been completed.

### C.1.2 Scope

This screening is applicable to non-radiological contamination within all excavation areas at the FEMP, as defined in the SEP. It expands on the scope of the SERA by including a screen of source area OUs. The Former Production Area (OU3), Waste Pit Area (OU1), K-65 Silos (OU4) and the Southern Waste Units (SWUs) (OU2) were not included in the SERA evaluation, but are included in this screening. The SERA has adequately addressed all radiological concerns at the FEMP, as described in

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Section C.1.3.1.3. Therefore, further evaluation of radiological concerns was not carried out for this screening.

C.1.3 Background

This section provides an overview of activities related to this updated COEC evaluation, including a SERA summary as well as a discussion of how Natural Resource Trusteeship and the soil certification process relate to this evaluation.

C.1.3.1 Synopsis of the Sitewide Ecological Risk Assessment

As stated above, an evaluation of ecological risk has already been conducted as part of the OU5 RI. The methods and results of the SERA form the basis for the sitewide re-evaluation of COECs presented in this appendix. The SERA was used to evaluate risks from radiological and non-radiological COECs.

C.1.3.1.1 Non-Radiological Constituent of Ecological Concern in Soil

To determine relative risks to ecological receptors from the non-radiological characteristics of COECs in soil, soil concentrations of contaminants were compared to screening concentrations. These screening concentrations, known as BTVs, are COEC- and media-specific values. They are derived from available literature and are considered to be protective of ecological receptors. Constituents exceeding these BTVs were regarded as COECs for the FEMP. Section C.2.1 provides more detail regarding the establishment of BTVs for soil.

For soil, the SERA divided the FEMP into seven separate study areas (Areas A-G, Figure C-1). These study areas were based on habitat type and, to a lesser extent, the home range of potential ecological receptors and land-use history (DOE 1995a). Existing RI/feasibility study (FS) surface soil (0-6 inches deep) data were obtained for all constituents within each study area, excluding all source OUs at the FEMP.

The representative concentrations for each constituent were determined using statistical methods outlined in the FEMP Baseline (human health) Risk Assessment Addendum and subsequent U.S. EPA guidance. This procedure calls for the calculation of the upper 95 percent confidence limit on the arithmetic mean for normally or lognormally distributed data. When a COEC was not detected in a

sample, the concentration for that sample was set at one half the detection limit. Data sets that were not normally or lognormally distributed, contained few (less than 7) detects, or contained a large portion (greater than 50 percent) of nondetects, were declared to have an undefined distribution. For data with an undefined distribution, the 95th percentile value of the maximum detected value was used as the representative concentration. For most parameters, this was the maximum concentration found within each study area. The areas evaluated in the SERA often had undefined data distributions since COECs were either not detected or were detected at very low concentrations.

C.1.3.1.2 Non-Radiological Constituents of Ecological Concern in Surface Water and Sediment

For surface water and sediment, two reaches of Paddys Run were investigated: Paddys Run On-Property and Paddys Run Off-Property. The Great Miami River was divided into three reaches. Reach One consisted of the Great Miami River upstream of the FEMP outfall. Reach Two extended from the FEMP outfall downstream to the mouth of Paddys Run. Reach Three encompassed the section of river downstream of the confluence with Paddys Run. Representative concentrations from all five sections of stream were calculated and compared against BTVs. Section C.2.1 provides additional detail on the selection of BTVs for surface water and sediment.

The SERA also evaluated drinking water exposure to terrestrial receptors from several sources on-property and off-property. In addition to the five reaches of Paddys Run and the Great Miami River, several on-property drainages were also evaluated. The screening approach was used for drinking water impact, as representative concentrations were compared to BTVs. Section C.2.1 provides additional detail on the selection of BTVs for drinking water.

C.1.3.1.3 Radiological Constituent of Ecological Concern

Dose rates from exposure to radioactive COECs in surface soil, surface water, and sediment were calculated for representative ecological receptors at the FEMP. The results of this radiation dose assessment indicated that doses derived from on- and off-property media concentrations of radioactive COECs did not exceed a target level dose (36.5 rad/year) established by the International Atomic Energy Agency (1992). Therefore, radiological impacts on ecological receptors at the site were not recommended for further consideration during development of the land use plan.

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C.1.3.2 Overview of the FEMP Natural Resource Trusteeship Process

Comprehensive Environmental Response Compensation and Liability Act (CERCLA) §107 imposes responsible party liability for injury to natural resources due to the release or threat of release of a hazardous substance. This liability was extended to federal facilities under the Superfund Amendments and Reauthorization Act (SARA) §120. Natural resources are defined in CERCLA as land, fish, wildlife, biota, air, water, groundwater, drinking water supplies, and other such resources owned or managed by federal or state government, or by an Indian tribe. CERCLA, Executive Order 12580, and the National Contingency Plan collectively require that certain federal and state officials act on behalf of the public as trustees for natural resources. Trustees for the FEMP are DOE, the Department of Interior (DOI), and the State of Ohio (as represented by Ohio EPA). Therefore, DOE-FEMP has a dual role as both a responsible party potentially liable for injury to FEMP natural resources and a trustee for those resources.

The Trustees are responsible for determining if natural resources at the FEMP have been injured and how to restore, replace, or acquire the equivalent natural resources to compensate for the injury. By taking advantage of its dual role, DOE-FEMP has initiated negotiations with the other FEMP Natural Resource Trustees (NRTs) to resolve all trustee concerns. These negotiations have been ongoing since 1994. Since that time, the NRTs have tentatively agreed to pursue compensation for natural resource injury through restoration plans rather than damage awards. This will be accomplished through the development of the Natural Resource Impact Assessment (NRIA), which uses existing information and conservative assumptions to establish a level of impact due to FEMP releases and remedial actions (DOE 1997b). The amount of compensation in the form of restoration acreage will then be estimated using Habitat Equivalency Analysis (HEA), which has been used by DOI at other sites. HEA calculates a required restoration acreage based on negotiated annual percent service losses and gains for a given area from the time of release to the completion of the remedy. The resulting restoration acreage is then planned for in the NRRP, which establishes conceptual restoration plans for each excavation area at the FEMP (DOE 1997a).

The approach summarized above is consistent with DOE headquarters requirements regarding Natural Resource Trusteeship (DOE 1997c). By implementing agreed-to restoration projects rather than disputing NRT damage claims in court, DOE-FEMP will save taxpayers a significant amount of

money. This is especially true given that some of the restoration planned is already required by the National Environmental Policy Act (NEPA) (e.g., mitigation, wetlands mitigation).

C.1.3.3 Relationship to Excavation/Certification Process

As stated above, media-specific BTVs will be compared to existing and anticipated postexcavation maximum concentrations at the FEMP. Based on this process, a list of COECs will be developed that may remain a concern after remedial activities have been completed. Sampling for these COECs will occur within each area of concern during predesign, precertification and/or certification sampling. The purpose of these sampling efforts will be to further characterize the concentrations of the COECs at the completion of remediation. Because of the very conservative screening methodology used, postexcavation BTV exceedances do not necessarily indicate that impact to ecological receptors will occur. Instead, post-excavation exceedances indicate only that further investigation may be warranted. Therefore, certification will not depend on characterization of COECs.

## C.2 ESTABLISHMENT OF BENCHMARK TOXICITY VALUES

The BTVs used to screen against maximum soil concentrations are very conservative. There are no considerations for site-specific ecological receptors, bioavailability and receptor uptake, background conditions, or final land use. For instance, the lowest value found in the literature was used for COECs when they did not have a SERA BTV. The SERA BTVs were not revised, since they have already been approved for site use with the approval of the OU5 RI. The following sections provide additional detail in the selection of BTVs.

### C.2.1 Use of Sitewide Ecological Risk Assessment Benchmark Toxicity Values

The BTVs used to develop the SERA COEC list were obtained from a variety of sources. When possible, BTVs in the SERA were selected that considered impacts to ecological receptors. However, limited information was available with respect to protection standards for ecological receptors. In many instances, surface soil benchmarks developed to be protective of human health had to be employed. To the extent possible, these values were compared to ecological toxicity data published in the literature to help ensure that they were protective of ecological receptors (DOE 1995a).

For surface water, chronic ambient water quality criteria (CAWQC) were used as BTVs, when available. Hardness-dependent CAWQC were adjusted with site-specific water hardness values. When



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CAWQC were not available, a surrogate BTV was calculated from published acute toxicity data. Administered concentrations lethal to 50 percent of a test population ($LC_{50}$) were divided by 100 to determine a conservative chronic value that was used as a BTV. In other instances, "lowest observed effect levels" were divided by 10 to calculate a BTV. For sediment, BTVs for inorganic constituents were determined from published values or sediment quality criteria. Nonpolar organics were modeled to determine interstitial water concentrations, while polar organics were assumed to be completely dissolved in the interstitial water. These values were compared to the appropriate surface water BTV (DOE 1995a).

The SERA also evaluated drinking water exposure to terrestrial receptors from several sources on-property and off-property. For drinking water BTVs, (referred to as "drinking water benchmarks" in the SERA), human health drinking water criteria were used. If these values were not available, human health risk-based criteria were used. Finally, if risk-based criteria were not available, the surface water aquatic BTV was used as a screen (DOE 1995a).

### C.2.2 Use of Other Benchmark Toxicity Values Not Established in the Sitewide Ecological Risk Assessment

If no SERA BTV was derived, then a search of several databases for media-specific BTVs was conducted. Ecological databases searched included the U.S. EPA Region III Ecological Screening Database (1994) and the Oak Ridge National Laboratory Screening Benchmarks for Ecological Risk Assessment Database (DOE 1996b). The lowest available concentration listed in these three sources is the BTV.

## C.3 SCREENING APPROACH

This section describes the methodology used to screen potential COECs. Results of this approach are presented in Section C.4.0.

### C.3.1 Soil

A total of 103 potential soil COECs have been identified at the FEMP. The preliminary list of COECs was formed by combining all the constituents investigated in the SERA with the list of constituents in the OU5 ROD that had a final remediation level (FRL) assigned to them (DOE 1995a, 1996a). This section presents the details and logic of the screening process that has been established to determine

which of the 103 soil COECs need to be considered following remediation. COECs retained by the screening process will be evaluated during certification design for potential analysis as part of the soil certification process. Table C-1 provides a summary list of all potential COECs evaluated, along with the results, which are discussed in Section C.4.0.

#### C.3.1.1 Screen Constituents of Ecological Concern Benchmark Toxicity Values Against Final Remediation Levels

The first step in screening the 103 potential soil COECs is to compare the BTVs against the established FRLs. The soil certification program will verify that FEMP soil will be remediated to concentrations below FRLs. If a BTV is greater than the FRL for a constituent, then soil will also be remediated to concentrations below the BTV. Therefore, all COECs with a BTV above the FRL can be eliminated from further consideration. Potential COECs were also eliminated if the SERA did not assign a BTV and none was available from the two additional services used. Radiological COECs were not compared against BTVs. Instead, they were eliminated from further consideration based on the results of the radiological risk assessment in the SERA.

#### C.3.1.2 Screen Remaining Constituents of Ecological Concern Benchmark Toxicity Values Against Maximum Soil Concentrations Obtained from the Sitewide Environmental Database

The second step in screening the remaining soil COECs is to compare each BTV to the maximum sitewide concentration. The RI/FS process at the FEMP resulted in a large data set for comparing the remaining soil COECs against the maximum concentrations. If no soil concentrations were identified above the BTV at the FEMP, the COEC can be eliminated from further screening since it is unlikely that the COEC is on site at concentrations potentially harmful to ecological receptors.

Soil data were pulled from the Sitewide Environmental Database (SED) according to the query criteria listed in Section 2.5.2. This process ensures that the most complete data set is used for making comparisons.

#### C.3.1.3 Screen Remaining Constituents of Ecological Concern Individually

A third step in the screening of soil COECs is to examine each remaining COEC and its BTV exceedances individually. In some cases where very few sitewide samples exceed the BTV, a review of available data indicates that a particular COEC will not impact ecological receptors. Samples that

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exceeded a BTV were evaluated with respect to location, depth, nearby concentrations, and other circumstances surrounding the samples in question. Based on these evaluations, some potential COECs may be eliminated from further consideration. For instance, a COEC may have only one BTV exceedance from a sample location that no longer exists due to erosion, construction activities, removal actions, etc. When adjacent soil samples show that no contamination is present, that particular COEC can be eliminated from further consideration. Also, some COECs may not be of concern due to site-specific information not considered when establishing BTVs. For instance, established BTVs do not account for background soil concentrations.

#### C.3.1.4 Screen Remaining Constituents of Ecological Concern Against Maximum Postexcavation Soil Concentrations

All COECs that are retained following the review of sitewide concentrations will be evaluated based on postexcavation soil concentrations. Postexcavation soil is the soil that lies outside the estimated extent of excavation at the FEMP. A preliminary estimate of the extent of the excavation was developed using the spatial distribution of total uranium in site soil. It was assumed that any excavation would remove soil containing uranium concentrations in excess of the applicable total uranium FRL. To reflect this, results from samples with a uranium concentration that exceeded the uranium FRL were excluded from the postexcavation data set. This provided a conservative estimate of samples from soil that would remain after the FRL-driven excavation was complete.

The postexcavation concentrations are presented on contour maps that show the height above or depth below excavation where the sample point exceedance is located. Sample locations above excavation are represented by negative contours (dashed lines) while the locations below excavation are represented by positive contours (solid lines). If a boring within the excavation footprint was found to have no BTV exceedances, the height above excavation contours defaulted to existing surface elevations. The sample point exceedances are also shown as being either bounded, with samples below the BTV exceedances from the same location but at a greater depth, or unbounded, with no information available regarding the depth of BTV exceedance. By presenting postexcavation data in this manner, decision makers may consider the potential for increases or decreases in exposure to ecological receptors as the excavation design changes.

It is important to note that there are several limitations to using the uranium footprint for estimating postexcavation soil concentrations. First, actual excavation depths will change as a result of predesign investigations, finalization of designs, and field implementation. Also, the berms and other associated soils within Remediation Area 6 (Waste Storage Area) are not included in the postexcavation contour data set. Even though a significant amount of soil will be excavated within the Waste Storage Area, current surface soil samples appear as postexcavation data points. Additionally, the uranium excavation footprint does not account for foundation and utilities removal within the Former Production Area.

The postexcavation data evaluation cannot determine for certain whether or not a contaminant will be removed or exposed through excavation, although the evaluation does illustrate the effectiveness of assuming that current excavation will address most potential COECs. As shown in Section C.4.1.5, the majority of potential COECs evaluated are either completely removed or presented as only sporadic exceedances. Given the conservative screening approach of using maximum concentrations and BTVs, the sporadic postexcavation BTV exceedances are not likely to be a concern. Nevertheless, additional data will be evaluated as part of predesign and/or certification sampling.

### C.3.2 Surface Water and Sediment

It is anticipated that COECs for surface water and sediment will be addressed through the sitewide remediation of soil and other source materials. The Integrated Environmental Monitoring Plan (IEMP) will be used to verify protection of aquatic receptors through its sitewide environmental monitoring and reporting protocol. Specific methodologies for surface water and sediment review are presented below.

#### C.3.2.1 Sitewide Ecological Risk Assessment Surface Water and Sediment Constituents of Ecological Concern

To determine the specific potential COECs that will be monitored in the IEMP, a qualitative review of the SERA surface water and sediment COECs will be conducted and presented in Section C.4.2. In general, there is much more information available with respect to BTVs for surface water and sediment than for soil. As stated in Section C.2.1, the BTVs used in the SERA were usually CAWQC. These values are considered appropriate for a sitewide screen of protectiveness to ecological receptors.

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The SERA also evaluated drinking water from several sources on and off FEMP property to terrestrial receptors. This evaluation will consider both aquatic and terrestrial receptors by screening against the lower of the two BTV concentrations.

Similar to the soil screening process, surface water and sediment BTVs will be compared against corresponding FRLs. Consideration will also be given to how BTVs compare to background concentrations. For some COECs water quality standards were not available and alternative methods were used for obtaining a BTV. These BTVs will be re-evaluated in light of updated information from regulatory agencies or from the literature. Potential COECs that remain will be monitored under the IEMP program. Pursuant to the IEMP, trends in future BTV exceedances will be evaluated on a case-by-case basis.

C.3.2.2 Postexcavation Surface Water and Sediment Modeling

To evaluate the potential for BTV exceedances in restored surface water habitats at the FEMP, such as wetland or open water habitat, cross-media modeling was conducted to predict the contaminant concentrations in surface water and sediment at the outlet of each drainage area after the sitewide remediation of soil and other source material to postexcavation soil concentrations.

C.3.2.2.1 Conceptual Model

As rain falls within a drainage area, a portion of it becomes runoff. Depending on the land surface conditions, runoff can then erode the surface soil and transport contaminants from the surface soil in both the dissolved form and solid form (e.g., adsorbed to soil particles moving with the runoff). The dissolved contaminant in the runoff is defined as the contaminant in the surface water. The contaminant in the solid (adsorbed to soil particles) is defined as the contaminant in the sediment. The contaminant in both surface water and sediment from the contaminated area will be diluted by the surface water and sediment from the uncontaminated area when it migrates toward the outlet of the drainage area.

C.3.2.2.2 Technical Approach

The model used to calculate the contaminant concentration in surface water and sediment is the Surface Water Flow and Infiltration Model (SWF&IM) (DOE 1993) developed for the FEMP and OU5 RI/FS. The SWF&IM is a combination of the FEMP-specific hydrological input parameters and several

hydraulic and transport models used to simulate the various physical and chemical processes involved in the transport of contaminants from surface soil into surface water. In the SWF&IM, the FEMP was divided into several drainage areas. The runoff calculation from each drainage area was performed by using HEC-1 Model with a 1-year, 24-hour storm event. Each drainage area was further divided into several sub-areas with different contaminant conditions. Figure C-2 shows all the drainage areas and sub-areas.

C.3.2.2.3 Input Parameters

The present configuration of the SWF&IM is based on existing watershed information and not anticipated postexcavation runoff and drainage patterns. However, this configuration is considered adequate to evaluate the potential for BTV exceedances in postexcavation surface water and sediment for three reasons:

1) Most runoff from the restored site will drain to the same outfall locations as the current drainage configuration.

2) The existing model assumes steady-state conditions. This implies it is relatively insensitive to variations in flow rates through the system if the total water balance is maintained.

3) The existing model used maximum concentrations which provide a measure of conservatism to the evaluation.

The soil/water partitioning coefficient ($K_d$) is used to estimate each chemical's mobility in the model. The $K_d$ value is the ratio of the COEC concentration in soil to its concentration in water when the two concentrations are in equilibrium. A high $K_d$ value would be representative of a COEC that has a tendency to bind to soil and is therefore less mobile in water. Depending on the chemical form of the COEC (specifically for inorganics), the $K_d$ value can vary substantially. The $K_d$ values listed in the RI Report that were used in this modeling task are presented in Table C-2.

The modeled parameters were selected based on a preliminary evaluation of postexcavation COECs. The updated soils evaluation presented in Section C.4.1 resulted in a slightly different list of postexcavation COECs; thallium and manganese were eliminated and lead and several polynuclear aromatic hydrocarbons (PAHs) were added. Therefore, lead, fluoranthene, phenanthrene, and pyrene were not considered in the SWF&IM. However, since postexcavation concentrations of lead and

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PAHs are not highly elevated and their $K_d$ values are relatively high, the revised parameters are not a concern.

Postexcavation soil concentrations located within each sub-area were assigned as the soil concentration for each sub-area. As a conservative measure, maximum concentrations were used rather than calculated representative concentrations. If a postexcavation soil concentration was not presented in a sub-area, a background soil concentration was assigned to this sub-area. For inorganics, if a background concentration was not available, the OU5 FS-defined detection limit was used. The soil concentrations for all sub-areas of drainage areas in the modeling are shown in Table C-3. In Table C-3, the soil concentration was indicated as not applicable (NA) in a sub-area if postexcavation soil concentrations were not presented and no background concentration was available.

C.3.3 Off-Property Constituents of Ecological Concern

Off-property areas are designated as Area 9 for soil remediation purposes. Off-property areas immediately east of the FEMP and the corridor containing the FEMP outfall line will be certified to ensure that soil contaminant concentrations meet the off-property FRLs as defined in the OU5 ROD (DOE 1996a). Area 9, Phase I includes the eastern off-property area adjacent to Area 1, Phase I, and Area 9, Phase II includes the eastern, off-property area adjacent to Area 1, Phase II, and Area 9, Phase III is the corridor containing FEMP outfall line to the Great Miami River. Areas north, south and west of the FEMP will only be certified if the certification of adjacent on-property areas indicates the need to do so.

As part of the certification of Area 9, the presence of contaminants which exceed BTVs will be evaluated. Similar to on-property COECs, all potential off-property COEC BTVs will be compared to off-property FRLs. Remaining COECs will then be compared against existing data. Potential COECs that remain will be investigated during certification sampling. Consistent with the approach for on-property areas, the certification of off-property areas will be driven only by the off-property FRLs and not by the BTVs.

## C.4 RESULTS AND DISCUSSION

This section presents the results of the updated COEC screening process. Based on these results, a path forward will be established to determine concentrations of COECs after remedial activities have been completed.

### C.4.1 Soil

This section presents the results and discussion of the screening process for the 103 non-radiological soil COECs. The logic for each step of the screening process is presented in Section C.3.1.

#### C.4.1.1 Screen of Constituents of Ecological Concern Benchmark Toxicity Values Against Final Remediation Levels

The first step in the soil COEC screening process was to eliminate COECs with BTVs above the FRL. As a result of this screening, 50 COECs were eliminated and 53 remain for further consideration in the screening process. Table C-1 identifies the remaining 53 COECs evaluated during this step as those having entries for frequency of detection and maximum concentration.

#### C.4.1.2 Screen of Remaining Constituents of Ecological Concern Benchmark Toxicity Values Against Maximum Soil Concentrations Obtained from the Sitewide Environmental Database

The second step in the soil COEC screening process was to eliminate those remaining COECs where the maximum sitewide concentration is below the BTV. As a result of this screening, 21 more soil COECs were eliminated, and 32 remain for further consideration in the screening process. Table C-1 identifies the remaining soil COECs as those with "yes" entries in the columns labeled "Individual Screen and Retain for Postexcavation Evaluation."

#### C.4.1.3 Screen Remaining Constituents of Ecological Concern Individually

As the third step in the soil COEC screening process, the 32 remaining COECs and their respective BTV exceedances were evaluated individually to determine if there are reasons they may not pose a threat to ecological receptors at the FEMP. As a result of this screening, eight COECs can be eliminated from further consideration in the screening process, as follows:

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Aluminum

Approximately half of the 1,600-plus analyses for aluminum at the FEMP show an exceedance of the BTV of 10,103 mg/kg (Table C-1), which is unlikely given that aluminum was not a common by-product of former production operations. Appendix D of the OU5 RI indicated that aluminum was not a significant contaminant at the FEMP (DOE 1995a). In addition, the data are clustered within a range up to 27,500 mg/kg, thus indicating that background soil aluminum concentrations at the FEMP are higher than the BTV. Indeed, the 95th percentile average soil background concentration for aluminum is above the BTV, at 11,700 mg/kg (Table C-1). A further review of the aluminum data indicates that there are only two concentrations above this range, and because they are considerably higher, they likely represent a high proportion of clay mineral in the soil sample, contamination, or a poor laboratory analysis. One concentration of 87,000 mg/kg was identified at Boring 11138 at a depth of 4 to 4.5 feet. As discussed below, soil from Boring 11138 is no longer present (see discussion of cobalt), and there were no elevated concentrations of aluminum in the remaining borings adjacent to and east of 11138. The other elevated concentration of 142,000 mg/kg was identified at a depth of 4 to 4.5 feet from Boring 1573, located north of the Plant 1 pad. This sample was taken from an area where deep excavations are anticipated, thus remediating the concentration. In addition, other samples analyzed for aluminum in the vicinity of the Plant 1 pad showed no elevated concentrations. Therefore, aluminum will not be considered further as a COEC at the FEMP.

Cobalt

Cobalt was found to exceed the BTV of 50 mg/kg in only one of 1,066 samples, with a result of 105 mg/kg identified in Boring 11138 at a depth of 4 to 4.5 feet (Table C-4). This boring was located along the edge of Paddys Run just west of the K-65 Silos and within the area that recently eroded from the bank of Paddys Run. Since the soil containing the BTV exceedances is no longer present, and because remaining borings directly east of 11138 show no BTV exceedances for cobalt, it can be eliminated from further consideration as a COEC.

Mercury

Mercury was found to exceed the BTV of 5.0 mg/kg in only one of 1,148 samples. A non validated result of 18.6 mg/kg was identified in a surface sample within the production area near the laboratory building (Table C-4). Other samples collected from this area and analyzed for mercury showed no concentrations above the BTV. Moreover, data from this boring show the sample is bounded at depth.

Because future remedial activities in this area will result in the removal of this soil where the BTV exceedance was identified, mercury can be eliminated from further consideration as a COEC.

Nickel

Nickel was also found to exceed the BTV of 100 mg/kg in only one of 1,071 samples, with a result of 186 mg/kg (Table C-4). Again, this exceedance was identified in Boring 11138 at a depth of 4 to 4.5 feet. Since the soil containing the BTV exceedances is no longer present, and because remaining borings adjacent to Boring 11138 show no BTV exceedances for nickel, it can be eliminated from further consideration as a COEC.

Vanadium

Vanadium was also found to exceed the BTV of 150 mg/kg in only one of 1,066 samples, with a result of 190 mg/kg (Table C-4). Like cobalt and nickel, the only BTV exceedance for vanadium was identified in Boring 11138 at a depth of 4 to 4.5 feet. Since the soil containing the BTV exceedances is no longer present, and because remaining borings adjacent to Boring 11138 show no BTV exceedances for vanadium, it can be eliminated from further consideration as a COEC.

Benzene

Three of the 1,109 samples analyzed for benzene exceeded the 0.1 mg/kg BTV (Table C-4). All three samples were associated with underground storage tanks (USTs) within the Former Production Area, which were removed in the early 1990s as part of the UST closure program. Because of the inconsistent postremoval soil data available, USTs will be evaluated on a case-by-case basis to ensure compliance with FRLs. The UST investigations will also be used to ensure protection of ecological receptors, similar to postexcavation evaluations specified in this appendix. Therefore, benzene will be considered, but through existing FRL-driven sampling efforts rather than additional COEC sampling. Toluene and ethyl benzene will be investigated in a similar manner. However, as Table C-4 shows, a limited number of BTV exceedances are present that do not appear to be associated with USTs. Because of this, toluene and ethyl benzene have been carried forward as part of the postexcavation contour evaluation.

Carbon Tetrachloride

Carbon tetrachloride was found to exceed the BTV of 0.3 mg/kg in only two of the 1,079 samples, with non-validated results of 1.1 and 1.2 mg/kg (Table C-4). Both results were detected in surface soil samples at boring location P6PSP-8, located within the Former Production Area near Plant 6. A third analysis from a surface sample at this same location showed an undetected carbon tetrachloride concentration of 0.75 mg/kg. In addition, other analyses for carbon tetrachloride in this vicinity showed no detected concentration above the BTV. Because of these factors and because future remedial activities in this area will result in the removal of this soil where the BTV exceedance was identified, carbon tetrachloride can be eliminated from further consideration as a COEC.

Pentachlorophenol

Pentachlorophenol was found to exceed the BTV of 0.1 mg/kg in only one of 913 samples. A result of 0.26 mg/kg was identified in a sample at 2 to 2.5 feet in the Fire Training Facility (FTF). Other samples analyzed for pentachlorophenol in the FTF show concentrations below the BTV. Also, future remedial actions are likely to result in the removal of soil from which this concentration was identified. Because of these factors, pentachlorophenol will not pose a threat to ecological receptors at the FEMP, and therefore, will be eliminated from further consideration as a COEC.

C.4.1.4 Screen Remaining Constituents of Ecological Concern Against Maximum Postexcavation Soil Concentrations

Of the 24 potential COECs that remain, postexcavation soil contour maps have been developed pursuant to the approach described in Section C.3.1.4. These maps provide an idea of the extent of contamination that is to be expected after excavation for each of the potential COECs evaluated.

The results and discussion presented below detail each of the potential COECs retained for postexcavation soil investigation. A summary of these findings is found on Table C-1. In general, further characterization is required for antimony, cadmium, lead, molybdenum, silver, and a suite of PAHs. All other potential COECs have been eliminated from further review.

C.4.1.4.1 Potential Constituents of Ecological Concern Eliminated from Further Review Barium

According to the OU5 RI, barium compounds were involved in plant operations, but the 500 mg/kg BTV eliminates most soil concentrations from concern (DOE 1995a). Table C-4 shows that only

15 BTV exceedances out of 1,153 samples were detected sitewide. Most of these concentrations will be addressed through existing excavation plans. As Figure C-9 indicates, there is only one postexcavation exceedance for barium, and it is several feet below the excavation depth and bounded. For these reasons, barium can be eliminated from further consideration.

Copper

Eight out of 1,088 samples exceeded the 100 mg/kg soil BTV (Table C-4). As Figure C-10 shows, all of these samples will be removed as part of FRL-driven excavation. Therefore, no further action for copper is required.

Manganese

The SERA determined that manganese was a risk to ecological receptors in what is now Area 1, Phase I (DOE 1995a). However, as Figure C-11 shows, this finding might be more a function of the relation between the BTV and background conditions rather than FEMP-induced contamination. The BTV of 1,500 mg/kg is close to the FS background value of 1,400 mg/kg. Manganese is a major component of soil, with a typical range of concentrations from 100 to 4,000 mg/kg (Dragun 1988). Furthermore, manganese was not used in operations at the FEMP (DOE 1995a). Given that only 100 mg/kg separate the BTV from background, sporadic exceedances of BTVs can be expected. The results of certification sampling in Area 1, Phase I appear to support this case. Figure C-11 shows that Area 1, Phase I certification sampling resulted in sporadic BTV exceedances with no defined pattern or highly elevated levels of contamination (Table C-4). In addition, the highest concentration of manganese recorded at the FEMP (12,200 mg/kg, Table C-4) is from Boring 11138, which is no longer present as described in Section C.4.1.3. For these reasons, manganese can be eliminated from further consideration.

Selenium

Sitewide detected BTV exceedances of selenium appear to be centered around the Southern Waste Units (SWUs) (Table C-4). These results are consistent with the findings of the OU5 RI, which stated that selenium was not used in FEMP operations but is a minor component of flyash (DOE 1995a). This is also supported by the evaluation of postexcavation concentrations. Only two BTV exceedances occur, and both are bounded (Figure C-12). Since a considerable amount of soil will be excavated to

remediate the SWUs, and since the two postexcavation exceedances are well above or below excavation and bounded, no further action is required.

Thallium

Only seven out of 1,062 samples exceeded the BTV for thallium (Table C-4). These results are consistent with the findings of the OU5 RI, which determined that thallium was not a major source of contamination at the FEMP, since it is only a minor constituent of flyash and was not used in process operations (DOE 1995a). Six of seven samples were collected for determination of $K_d$ values under the OU5 FS Work Plan Addendum (DOE 1995c). As part of this program, Toxicity Characteristic Leaching Procedure (TCLP) analyses were conducted on the six samples, with no concentrations detected. This indicates that thallium is unlikely to be bioavailable. Furthermore, all six samples were located at a depth of 2.5 feet below the surface (Figure C-13, Table C-4). Surface samples did not exceed BTVs. Therefore, thallium is not considered a concern to ecological receptors.

Zinc

The SERA identified zinc as a concern around the FTF. The OU5 RI concluded that zinc was used in processes at the FEMP, but was not a major source of contamination. However, it did recognize the zinc contamination in the FTF (DOE 1995a). These findings are supported with the presentation of sitewide BTV exceedances in Table C-4, where only 6 of the 1,080 zinc samples exceeded the 500 mg/kg BTV. The only postexcavation BTV exceedance of zinc is shown in the FTF area (Figure C-14). As is the case with cadmium, this sample (No. 057008, Boring 1672) is from soil that was remediated under Removal Action No. 28. Since no other postexcavation BTV exceedances are present, no further action is required.

Ethyl benzene and Toluene

As discussed in Section C.4.1.3, ethyl benzene and toluene have been investigated based on postexcavation concentrations. These results are shown on Figures C-15 and C-16. As expected, the postexcavation results are associated with USTs within the Former Production Area. Therefore, ethyl benzene and toluene will be addressed with benzene through FRL-driven investigations of removed USTs.

C.4.1.4.2 Potential Constituents of Ecological Concern Requiring Further Characterization
Antimony

Postexcavation BTV exceedances of antimony are shown on Figure C-3. The antimony exceedances appear clustered around the Plant 1 Pad, the Sewage Treatment Plant, the Active Flyash Pile, the K-65 Silos, and the Waste Storage Area. These results are consistent with the findings of the OU5 RI, which listed these areas as potential sources of antimony contamination (DOE 1995a). Therefore, antimony will be carried forward for analysis around the Sewage Treatment Plant, the Active Flyash Pile, the Plant 1 Pad, the Waste Storage Area, and the K-65 Silos.

Cadmium

While cadmium exceedances are widespread, concentrations are not significantly elevated, with a reported maximum concentration of 12.4 mg/kg (Table C-4). These results are consistent with the findings of the OU5 RI, which determined that cadmium is a significant contaminant at the FEMP. After excavation, however, it appears that cadmium BTV exceedances are limited to the vicinity of the Active Flyash Pile, the Waste Storage Area, the K-65 Silos, and several locations in the Former Production Area (Figure C-4). These areas will be evaluated as part of predesign and/or certification sampling.

The single exceedance found within Area 2, Phase II (Sample No. 055988) is a non-validated, isolated sample located 10 feet below the surface, in an area where no excavation is anticipated (Table C-4, Figure C-4). The sample appears to be an anomaly, and no further action is required.
Sample No. 057008 is from Boring No. 1672 by the FTF. Removal Action No. 28 addressed soil contamination around the FTF in 1993, and verification samples showed that the cadmium-contaminated soils were removed. Because of this, no further action is required in the vicinity of the FTF.

Lead

Postexcavation BTV exceedances for lead are located in two isolated areas; the former trap range and the former firing range (Figure C-5). Elevated levels of lead in these areas are consistent with the sitewide BTV exceedances listed on Table C-4, where the majority of exceedances are from Area 2, Phase I. These findings are also consistent with the SERA, which found lead to be a concern in the vicinity of the trap range. It should also be noted that the SERA also determined that there was a risk

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to ecological receptors in a portion of what is now Area 1, Phase I (DOE 1995a). However, certification sampling revealed that lead concentrations above the BTV were not present (Figure C-5).

Lead contamination in the vicinity of the trap range is of particular concern because of the potential exposure to avian species. Many birds ingest sand and pebbles to assist in digestion of food. This process can lead to direct ingestion of spent lead shot with contaminated areas such as the trap range (LaGrega 1994).

The concern for lead around the trap range will be addressed in two phases. First, most of the lead-contaminated soil will be excavated to meet the 400 mg/kg FRL or treated in situ to remove the toxicity characteristic. After excavation to meet the lead FRL or 400 mg/kg, the soil will be evaluated against the lead BTV of 200 mg/kg during the certification process prior to being removed for use as borrow material for the On-Site Disposal Facility (OSDF). The OSDF will provide limited habitat for ecological receptors, so additional exposure is not a major concern.

For the firing range in Area 2, Phase I, contaminated soil failing the TCLP test will be excavated and staged for treatment decisions prior to off-site disposal.

Molybdenum

The SERA identified molybdenum as a risk to ecological receptors in what is now Area 1, Phase I, Area 1, Phase II, and Area 2, Phase II (DOE 1995a). Area 1, Phase I certification results, as well as an analysis of existing data, reveal that there is no risk in these areas. Postexcavation soil results show elevated concentrations of molybdenum in several areas across the northern portion of the site (Figure C-6). A review of the analytical data for the perimeter areas of the FEMP indicate that the molybdenum results may have been influenced by sample and/or laboratory bias. With the exception of one detection that falls below the BTV, all detections of molybdenum in all SERA study areas were generated by a single laboratory during a specific period of time. These results are questionable, given that adjacent samples in each study area that were collected and analyzed at different times did not detect molybdenum. These findings are supported by Area 1, Phase 1 certification sampling results. Those results show that molybdenum was rarely detected in any certification unit, and the maximum reported concentration across all certification units surveyed was 3.1 mg/kg (DOE 1997d). Therefore,

when considering sample and laboratory information for all molybdenum samples within all study areas, the validity of the results is in doubt.

However, the OU5 RI determined that molybdenum is a significant contaminant of the FEMP, because of its association with flyash and uranium ore (DOE 1995a). Since postexcavation exceedances appear in several locations, molybdenum will be investigated further within certain portions of the Former Production Area, K-65 Silos, and the Active Flyash Pile/Southfield (Figure C-6).

Silver

The SERA identified silver risk to ecological receptors in what is now essentially Area 2, Phase II (DOE 1995a). This is supported by the presentation of sitewide BTV exceedances, which seem to be clustered around the K-65 Silos (Table C-4). The southern portion of the K-65 Silos were included in the area-specific SERA evaluation (as part of Study Area G, Figure C-1), which is adjacent to the northern perimeter of Area 2, Phase II. The OU5 RI stated that silver was present in elevated concentrations in the "area west of the K-65 Silos" (DOE 1995a). Furthermore, the OU5 RI revealed that silver is a component of flyash and was used as an algicide in Plant 4 heat exchangers. These findings are supported by the presentation of postexcavation concentrations, where BTV exceedances are present around the K-65 Silos, the Waste Storage Area, the Active Flyash Pile, and several areas within the Former Production Area (Figure C-7). Therefore, predesign and/or certification sampling will be evaluated during and after excavation of these areas.

PAHs

PAHs investigated for postexcavation concentrations include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. These compounds have been grouped together in this discussion since they are from a similar source (petroleum products and incomplete combustion of hydrocarbon fuels). Sitewide BTV exceedances are limited, with benzo(b)fluoranthene being the most abundant at 28 exceedances in 966 samples (Table C-4). The postexcavation contours show that all of the PAHs anticipated after excavation are limited to three areas: just north of the maintenance building, north of the K-65 Silos, and within the FTF (Figure C-8). Therefore, predesign and/or certification sampling will include the PAHs listed previously to investigate potential future impact to ecological receptors.



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C.4.2 Surface Water and Sediment

This section describes the results of the surface water and sediment COEC evaluation described in Section C.3.2. These results will be addressed through implementation of the IEMP, as necessary.

C.4.2.1 Sitewide Ecological Risk Assessment Surface Water Constituents of Ecological Concern

Based on the comparison of SERA BTV-exceeded surface water COECs to surface water FRLs, the only potential COECs that should be evaluated in the IEMP are barium, cadmium, and silver (Table C-5). All other potential COECs have FRLs at a lower concentration than their corresponding BTVs, with the exception of aluminum, ammonia, manganese, and several organics. These potential COECs were not retained for the reasons outlined below.

Aluminum

Similar to the aluminum analysis for soil, the surface water BTV is a lower concentration than the 95th percentile background concentrations in both Paddys Run and the Great Miami River (Table C-5). These background concentrations are supported by IEMP monitoring data (DOE 1997e; DOE 1998). Also, as the evaluation of aluminum in soil shows, there are no major sources of aluminum contamination at the FEMP. Since aluminum is ubiquitous in soils around the FEMP, concentrations in surface water are related to background conditions rather than FEMP-induced contamination.

Ammonia

The SERA referenced EPA warmwater criteria as the source of BTV for ammonia. This criterion, though, is temperature and pH dependent, and the lowest concentrations listed (1.1 mg/L at various temperatures and pH 9) is higher than the SERA BTV for ammonia (1.0 mg/l, Table C-5). Given the average temperature and pH of Paddys Run as 12.5°C and 7.8 respectively, the ammonia warmwater criterion applicable to the FEMP would be 1.3 mg/l (EPA 1993).

Also, the only BTV exceedance for ammonia recorded in the SERA was within the reach of the Great Miami River upstream of the FEMP outfall line. These results indicate that there is no impact at all to Paddys Run, and any impacts to the Great Miami River are not attributable to the FEMP.

Nevertheless, as a warmwater criterion applicable to Paddys Run, ammonia has been included as a monitoring parameter for compliance with the FEMP National Pollutant Discharge Elimination System

(NPDES) permit. Pursuant to the NPDES permit process, effluent concentration limits of specified criteria pollutants have been established for surface water discharges at the FEMP. These concentration limits are site-specific levels that EPA has determined will ensure compliance with the warmwater criteria and protection of human health and ecological receptors. For ammonia, the FEMP NPDES permit does not require effluent limits, but rather specifies monitoring. This is because EPA determined that the FEMP would not contribute concentrations of ammonia that may compromise warmwater criteria. Continued effluent concentration exceedances trigger a well-established process to ensure compliance with the NPDES permit. The IEMP has incorporated all NPDES sampling efforts at the FEMP effluent line and stormwater discharge locations.

Manganese

Like aluminum, manganese is an ubiquitous component of the soil minerals around the FEMP. The background concentration in the Great Miami River is close to the SERA BTV (Table C-5). This is also the case for soil and sediment, as shown in Section C.4.1.4.1 and in the discussion below. Because of these high background values when compared to BTVs, sporadic exceedances of BTVs in all media can be expected. This is especially true for surface water, since results from the SERA and the IEMP are based on unfiltered samples (DOE 1995a, DOE 1997f).

In addition to the issues regarding background, the BTV for manganese is exceptionally conservative. Since water quality criteria were not available, the SERA used an $LC_{50}$ acute toxicity benchmark and divided it by 100 to obtain a chronic toxicity BTV. In using this BTV, the SERA pointed out that "examination of the results of acute and chronic toxicity values seldom exceed 10 (i.e., $LC_{50}/10=$ chronic value) and ratios above 20 ($LC_{50}/20$) have not been observed" (DOE 1995a).

Organics

1, 2-dichloroethene and trichloroethene were found to exceed drinking water BTVs in the pilot plant drainage ditch. The OU5 RI determined that neither of these compounds are a significant contaminant at the FEMP (DOE 1995a). The pilot plant drainage ditch will be remediated as part of soil excavation, so the possibility of future exposure will be greatly reduced. Also, the exceedances were not highly elevated above the BTV (Table C-5). Therefore, 1, 2-dichloroethene and trichloroethene will not be investigated any further.

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C.4.2.2 Sitewide Ecological Risk Assessment Sediment Constituents of Ecological Concern

For sediment, manganese background concentrations are greater than the BTV of 300 mg/kg, and the FRL for phenanthrene is below its BTV (Table C-5). Therefore, these constituents will not be investigated any further. Other SERA COECs will be sampled pursuant to IEMP monitoring protocol. As stated in the IEMP, remediation of sediment in Paddys Run and the Great Miami River is not expected (DOE 1997f).

C.4.2.3 Postexcavation Surface Water and Sediment Modeling

Surface water and sediment modeling was conducted for COECs using postexcavation concentrations in several source blocks across the FEMP. The surface water modeling results for each drainage basin modeled are listed in Table C-6. Sediment results are presented in Table C-7. These results illustrate that the only calculated postexcavation exceedance is manganese. This finding appears to be an artifact of the way data gaps were handled in this modeling exercise. When a representative postexcavation concentration was not available for a given sub-basin, the FS background concentration was used. In the case of manganese, this value was 1,400 mg/kg (Table C-3). This background value was high enough to dominate the modeling results.

For sediments, the manganese background concentration exceeds the BTV. No single SERA BTV was established for silver, so a BTV was derived from the Oak Ridge National Laboratory screening benchmark for the ecological risk assessment database (DOE 1996b). Silver exceeds this BTV slightly, but the conservative nature of the modeling suggests that silver will not be an ecological concern in restored aquatic habitats.

C.4.3 Off-Property Constituents of Ecological Concern

Only lead, molybdenum and toluene have BTV values that are lower than the off-property FRLs (DOE 1996a). Therefore, by meeting the off-property FRLs, all BTV values will be met with the exception of lead, molybdenum and toluene. It is considered unlikely that concentrations of these constituents will be found between the BTV and the off-property FRL. However, if area-specific constituent of concern (ASCOC) evaluations determine that any of these parameters may be present, certification data will be compared to the BTVs to identify trends or patterns in BTV exceedances that may cause ecological risk.

## C.5 CONCLUSIONS AND RECOMMENDATIONS

This section summarizes the results of the updated COEC screening process, and outlines the path forward for further investigation once excavation activities have been completed.

### C.5.1 Summarize Final Constituents of Ecological Concern

Table C-1 lists the final soil COECs that will be investigated further after excavation activities have been completed. The COECs to be carried forward include antimony, cadmium, lead, molybdenum, silver, and a suite of PAHs. The specific areas to be investigated are shown individually on Figures C-3 to C-8 and summarized on Figure C-17. These COECs will be investigated pursuant to the process outlined below.

The results of the surface water evaluation are shown on Table C-5. Surface water COECs include barium, cadmium, and silver. These COECs will be monitored on an ongoing basis as part of the IEMP. Further actions will be addressed as required through the protocol established in the IEMP. Sediment COECs include barium, cadmium, cyanide, iron, lead, and zinc. These COECs will also be addressed through the IEMP.

### C.5.2 Predesign and/or Certification Sampling Strategy

The intent of the sampling strategy for soil COECs is to determine concentrations of COECs in given areas after excavation and regrading activities have been completed. Representative postexcavation concentrations will be screened against corresponding BTVs to determine if there will be a potential impact to ecological receptors. The strategy can be divided into the following tasks: parameter and location selection, sampling and analytical methods, and determination of representative concentrations. Detail on each of these actions is provided below.

Parameters to be sampled have been determined based on the screening conducted above. The locations where these parameters will be analyzed for have been determined based on two factors: the location of postexcavation BTV exceedances and the presence of adjacent areas where data gaps exist. The outlined areas on Figures C-3 to C-8 represent the locations where the given COECs will be sampled in conjunction with certification sampling. If all or part of a certification unit is located within an outlined area, the given COECs will be sampled. Usually sampling will be conducted during

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certification. However, if a particular COEC is also an ASCOC for a given area and predesign sampling is needed, this data may be evaluated as well.

The areas outlined for further investigation were qualitatively delineated based on anticipated postexcavation concentrations and the presence of adjacent data gaps. An area was included for further evaluation if unbounded postexcavation BTV exceedances were identified. In general, these locations were expanded to include areas where no data are present. It is important to note that the data gaps included are based on sitewide extent of contamination figures (Appendix I) in addition to the anticipated postexcavation results. Also, the delineation considers the fact that for some areas, no data exist because no contamination is expected. In other words, it is assumed that the OU5 RI did an adequate job of identifying and characterizing the significant sources of contamination at the FEMP.

By considering the factors outlined above, the general areas of concern include the Waste Storage Area, the K-65 Silos, the SWUs, several areas within the Former Production Area, and the Sewage Treatment Plant. Certification units within these areas will be sampled for the appropriate COECs. Essentially, COECs will be added to the ASCOC list for the certification units in question. It should be reiterated that certification will not be contingent on BTV exceedances. As stated in Section C.1.3.3, postexcavation sampling efforts are used to further characterize concentrations of COECs at the completion of remediation. BTVs are never intended to be considered site-specific threshold values that must be met during remediation.

The procedure for determining representative concentrations within each certification unit will be conducted as described in Section 3.4. This represents the first movement away from a conservative screening process and toward a site-specific analysis of ecological risk. The certification sampling process will represent the first opportunity to evaluate actual postexcavation soil concentrations in a manner specifically intended for determining soil concentrations. In other words, certification will be the first chance to use the COEC data for its intended purpose. The review of existing data resulted in an interpretation of data from many different projects, with different intended uses, analytical support levels, etc. Anticipated postexcavation concentrations are based on excavation footprints that are not complete, and which will likely change over the course of remedial design. It is partly for these reasons that maximum concentrations are used as a conservative screen. In the case of certification

sampling, however, representative concentrations would provide a more accurate portrayal of site conditions.

All documentation of the above process will be included in existing mechanisms, as set forth by the SEP. Parameters, sampling locations and methods, analytical methods, etc. will be specified in appropriate Project Specific Plans and Certification Design Letters. Results, discussion, and recommendations will be reported in corresponding certification reports.

C.5.3 Path Forward for Constituents of Ecological Concern that Remain a Concern

If certification sampling reveals that the remaining soil concentration for a constituent still exceed the BTV, then further investigation is warranted. The approach will be consistent with U.S. EPA Framework for Ecological Risk Assessment (EPA 1992), and will consist of three steps: problem formulation, analysis, and risk characterization. For problem formulation, DOE, regulators, and Natural Resource Trustees will determine the goals of the risk assessment. At this stage, considerations will be given to the planned final land use, the receptors potentially at risk, the characteristics of the COECs in question, pertinent regulatory issues, and the acceptable level of impact. The end result of this process will be a conceptual model which identifies the environmental values to be protected (assessment endpoints), and the data needed to conduct the assessment, or measurement endpoints (EPA 1992).

The next step is the analysis phase, where exposure and ecological effects are characterized. For the characterization of exposure, factors to be considered in addition to the magnitude and extent of contamination include the bioavailability of the contaminants and the spatial and temporal exposure to the ecological receptors in question. Ecological effects can be characterized through laboratory and/or controlled field observations of stressor/response relationships and comparisons with reference sites. The end result of this phase is the development of a cause/effect relationship between the contaminant and the ecological effects. This relationship is then supported or refuted through an extrapolation of assessment endpoints from measurement endpoints.

In the risk characterization phase, the likelihood of effects occurring as a result of contaminant exposure are evaluated. This involves two steps: risk estimation and risk description. Estimation involves a comparison of the exposure and stressor/response profiles quantified in the analysis phase.

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Uncertainties are also summarized. The risk description summarizes the results of the risk estimation and uncertainty analysis to assess a level of confidence for the risk assessment. The risk description also interprets ecological significance, where the magnitude of the identified risks to the assessment endpoints are described.

Communication between risk assessors and DOE and regulatory decision makers will continue throughout this process, to ensure that the goals and objectives of any investigation will be met. Also, the process will be conducted essentially in sequence. If, during the characterization of exposure phase, it is determined that a given constituent is not bioavailable, then further actions will not be required.

The overall screening process is a conservative approach for narrowing the list of potential COECs that may need to be evaluated further. By considering the remaining potentials COECs pursuant to the procedures outlined above, DOE, regulators, and Natural Resource Trustees will be ensured that risks to ecological receptors are adequately addressed.

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# TABLE C-1
## SUMMARY OF ALL SOIL COECs EVALUATED

| COEC | FS Detection Limit (mg/kg) | FS Background (mg/kg) | Soil FRL (mg/kg) | Soil BTV (see note 1) | Frequency of Detection | Maximum Concentration (mg/kg) | Individual Screen | Retain for Post-Excavation Evaluation | Sample Post-Excavation |
|---|---|---|---|---|---|---|---|---|---|
| Antimony | 0.5 | ND | 96 | 10 | 124/623 | 59.8 | | yes | yes |
| Cadmium | 0.1 | 0.91 | 82 | 5 | 508/1134 | 12.4 | | yes | yes |
| Lead | 0.05 | 26.4 | 400 | 200 | 1859/1882 | 9790 | | yes | yes |
| Molybdenum | 13 | 2.7 | 2900 | 10 | 650/1634 | 29.9 | | yes | yes |
| Silver | 1.3 | ND | 29000 | 10 | 513/1093 | 36.4 | | yes | yes |
| Benzo(a)anthracene | 0.0007 | NA | 20 | 1 | 165/966 | 310 | | yes | yes |
| Benzo(a)pyrene | 0.0007 | NA | 2 | 1 | 139/963 | 260 | | yes | yes |
| Benzo(b)fluoranthene | 0.0007 | NA | 20 | 1 | 154/966 | 220 | | yes | yes |
| Benzo(g,h,i)perylene | 0.0007 | NA | - | 1 | 94/901 | 150 | | yes | yes |
| Benzo(k)fluoranthene | 0.0007 | NA | 200 | 1 | 133/966 | 140 | | yes | yes |
| Chrysene | 0.002 | NA | 2000 | 1 | 158/901 | 310 | | yes | yes |
| Dibenzo(a,h)anthracene | 0.0005 | NA | 2 | 0.088 | 61/965 | 79 | | yes | yes |
| Fluoranthene | - | NA | - | 10 | 214/900 | 790 | | yes | yes |
| Indeno(1,2,3-cd)pyrene | 0.004 | NA | 20 | 1 | 106/966 | 150 | | yes | yes |
| Phenanthrene | 0.001 | NA | - | 5 | 199/965 | 900 | | yes | yes |
| Pyrene | - | NA | - | 10 | 219/900 | 610 | | yes | yes |
| Barium | 1.3 | 120 | 68000 | 500 | 1152/1153 | 3610 | | yes | |
| Copper | 0.5 | 20 | 220000 | 100 | 1018/1088 | 695 | | yes | |
| Manganese | 1 | 1400 | 4600 | 1500 | 1680/1682 | 12200 | | yes | |
| Selenium | 1.3 | 0.72 | 5400 | 3 | 167/995 | 16.1 | | yes | |
| Thallium | 1 | 0.58 | 91 | 6.3 | 180/1062 | 22.7 | | yes | |
| Zinc | - | 82 | 120000 | 500 | 1056/1080 | 2150 | | yes | |
| Ethylbenzene | 0.01 | NA | 5100 | 0.1(a) | 29/1103 | 4.47 | | yes | |
| Toluene | 0.001 | NA | 100000 | 0.1 | 237/1124 | 2100 | | yes | |
| Aluminum | - | 11700 | - | 10103 | 1675/1676 | 142000 | yes | | |
| Cobalt | 0.3 | 16 | 740 | 50 | 1005/1066 | 105 | yes | | |
| Mercury | 0.13 | 0.3 | 7.5 | 5 | 125/1148 | 18.6 | yes | | |
| Nickel | 4 | 34.3 | 15000 | 100 | 993/1071 | 186 | yes | | |
| Vanadium | 1 | 38 | 5100 | 150 | 1061/1066 | 190 | yes | | |

**TABLE C-1**
**(Continued)**

| COEC | FS Detection Limit (mg/kg) | FS Background (mg/kg) | Soil FRL (mg/kg) | Soil BTV (see note 1) | Frequency of Detection | Maximum Concentration (mg/kg) | Individual Screen | Retain for Post-Excavation Evaluation | Sample Post-Excavation |
|---|---|---|---|---|---|---|---|---|---|
| Benzene | 0.001 | NA | 850 | 0.1(a) | 18/1109 | 0.342 | yes | | |
| Carbon Tetrachloride | 0.001 | NA | 2.1 | 0.3(a) | 5/1079 | 1.2NV | yes | | |
| Pentachlorophenol | 0.9 | NA | 2.3 | 0.1 | 6/913 | 1.1 | yes | | |
| 1,1,1-Trichloroethane | 0.001 | NA | - | 7000 | 123/1098 | 9.4NV | | | |
| 1,1,2-Trichloroethane | 0.001 | NA | 4.3 | 0.3(a) | 8/1079 | 0.014 | | | |
| 2-Butanone | - | NA | - | 47000 | 62/836 | 0.2 | | | |
| 4,4'-DDE | - | NA | - | 0.1 | 8/800 | 0.038 | | | |
| 4,4'-DDT | - | NA | - | 0.1 | 6/801 | 0.019 | | | |
| Acenapthene | - | NA | - | 4700 | 42/891 | 140 | | | |
| Acetone | 0.007 | NA | 43000 | 8000 | 172/1076 | 0.45 | | | |
| Benzoic Acid | - | NA | - | 310000 | 47/751 | 1.1 | | | |
| Bis(2-ethylhexyl)phthalate | 0.22 | NA | 820 | 70 | 323/892 | 11 | | | |
| Boron | 4 | NA | 7400 | 7000 | 15/20 | 36 | | | |
| Butylbenzyl phthalate | - | NA | - | 1600 | 12/890 | 0.75 | | | |
| Chromium | 1.3 | 21 | 300 | 250 | 1130/1140 | 115 | | | |
| Cyanide | 0.33 | 0.27 | 120000 | 50 | 220/939 | 22.8 | | | |
| di-n-butyl phthalate | - | NA | - | 63000 | 79/899 | 6.1 | | | |
| Endrine keytone | - | NA | - | 23 | 5/799 | 0.019 | | | |
| Fluorene | - | NA | - | 3100 | 45/892 | 180 | | | |
| Fluoride | 0.7 | NA | 78000 | 1 | 0 | NA | | | |
| Naphthalene | - | NA | - | 3100 | 46/891 | 96 | | | |
| n-nitrosodiphenylamine | 0.2 | NA | 51 | 20 | 6/891 | 1.3 | | | |
| Phenol | - | NA | - | 1 | 22/885 | 0.73 | | | |
| Xylenes, total | 0.001 | NA | 920000 | 160000 | 52/1082 | 6100 | | | |
| Arsenic | | | 12 | 30 | | | | | |
| Beryllium | | | 1.5 | 56 | | | | | |
| Uranium, total | | | 82 | 230 | | | | | |
| 1,1-dichloroethene | 0.001 | NA | 0.41 | - | | | | | |
| 1,2-dichloroethane | 0.001 | NA | 0.16 | 870(b) | | | | | |
| 2-methylnaphthalene | - | NA | - | - | | | | | |
| 3,3'-dichlorobenzidine | 0.2 | NA | 0.55 | - | | | | | |

**TABL[illegible]**
**(Continued)**

| COEC | FS Detection Limit (mg/kg) | FS Background (mg/kg) | Soil FRL (mg/kg) | Soil BTV (see note 1) | Frequency of Detection | Maximum Concentration (mg/kg) | Individual Screen | Retain for Post-Excavation Evaluation | Sample Post-Excavation |
|---|---|---|---|---|---|---|---|---|---|
| 4-methyl-2-pentanone | | | 2500 | 3900 | | | | | |
| 4-methylphenol | 0.2 | NA | 250 | - | | | | | |
| 4-nitroaniline | 0.9 | NA | 150 | - | | | | | |
| Acenaphthylene | - | NA | - | - | | | | | |
| Aroclor-1254 | | | 0.13 | 1 | | | | | |
| Aroclor-1260 | | | 0.13 | 1 | | | | | |
| Bis(2-chloroisopropyl)ether | 0.22 | NA | 420 | - | | | | | |
| Bromodichloromethane | | | 4 | 10 | | | | | |
| Bromoform | 0.001 | NA | 31 | - | | | | | |
| Bromomethane | 0.001 | NA | 8200 | - | | | | | |
| Carbazole | | | 12 | 32 | | | | | |
| Carbon Disulfide | | | 5000 | 7800 | | | | | |
| Chlordane (alpha) | | | 0.19 | 0.49 | | | | | |
| Chlordane (gamma) | | | | 0.49 | | | | | |
| Chlorobenzene | | | 340 | 1600 | | | | | |
| Chloroform | | | 45 | 100 | | | | | |
| Dibenzofuran | - | NA | - | - | | | | | |
| Dieldrin | | | 0.015 | 0.04 | | | | | |
| Diethyl Phthalate | - | NA | - | - | | | | | |
| Di-n-octyl phthalate | | | 1100 | 1600 | | | | | |
| Heptachlorodibenzofurans | 0.000006 | NA | 0.0009 | - | | | | | |
| Heptachlorodibenzo-p-dioxins | 0.000006 | NA | 0.0009 | - | | | | | |
| Methylene chloride | | | 37 | 85 | | | | | |
| N-nitroso-di-n-propylamine | 0.2 | NA | 0.2 | - | | | | | |
| Octachlorodibenzofuran | 0.000013 | NA | 0.0088 | - | | | | | |
| Octachlorodibenzo-p-dioxin | | | 0.0088 | 4 | | | | | |
| Tetrachloroethene | | | 3.6 | 25 | | | | | |
| Tributyl Phosphate | 0.04 | NA | 250 | - | | | | | |
| Trichloroethene | | | 25 | 58 | | | | | |
| Vinyl Chloride | 0.001 | NA | 0.13 | 0.3(a) | | | | | |





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**TABLE C-1**
**(Continued)**

| COEC | FS Detection Limit (mg/kg) | FS Background (mg/kg) | Soil FRL (mg/kg) | Soil BTV (see note 1) | Frequency of Detection | Maximum Concentration (mg/kg) | Individual Screen | Retain for Post-Excavation Evaluation | Sample Post-Excavation |
|---|---|---|---|---|---|---|---|---|---|
| Cesium-137 | | | 1.4 (pCi/g) | see note 2 | | | | | |
| Lead-210 | | | 38 (pCi/g) | see note 2 | | | | | |
| Neptunium-237 | | | 3.2 (pCi/g) | see note 2 | | | | | |
| Plutonium-238 | | | 78 (pCi/g) | see note 2 | | | | | |
| Plutonium-239/240 | | | 77 (pCi/g) | see note 2 | | | | | |
| Radium-226 | | | 1.7 (pCi/g) | see note 2 | | | | | |
| Radium-228 | | | 1.8 (pCi/g) | see note 2 | | | | | |
| Strontium-90 | | | 14 (pCi/g) | see note 2 | | | | | |
| Technetium-99 | | | 30 (pCi/g) | see note 2 | | | | | |
| Thorium-228 | | | 1.7 (pCi/g) | see note 2 | | | | | |
| Thorium-230 | | | 280 (pCi/g) | see note 2 | | | | | |
| Thorium-232 | | | 1.5 (pCi/g) | see note 2 | | | | | |
| Uranium-238 (carcinogen) | | | 262 (pCi/g) | see note 2 | | | | | |

Note 1: With exceptions noted below, all BTVs are from the SERA
(a)U.S. EPA Region III Flora and Fauna (U.S. EPA 1994)
(b)U.S. EPA Region III Fauna (U.S. EPA 1994)

Note 2: BTVs were not calculated for radionuclides; they were eliminated through SERA radiological assessment.

ND = Not detected at concentrations above method detection limits
NA = Not applicable
NV = Not validated

**TABLE C-2**
**PARTITION COEFFICIENTS ($K_d$) FOR SWF&IM MODEL**

| COEC | $K_d$ (kg/L) |
|---|---|
| Antimony | 250 |
| Cadmium | 500 |
| Silver | 180 |
| Molybdenum | 90 |
| Manganese | 180 |
| Thallium | 1500 |
| Benzo(b)fluoranthene | 20600 |
| Benzo(a)pyrene | 5290 |
| Benzo(a)anthracene | 2220 |
| Benzo(g,h,i)perylene | 94200 |
| Benzo(k)fluoranthene | 38400 |
| Chrysene | 2220 |
| Dibenzo(a,h)anthracene | 5170 |
| Indeno(1,2,3-cd)pyrene | 253000 |

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# TABLE C-3
## DRAINAGE SUB-BASIN POST-EXCAVATION SOIL CONCENTRATIONS (mg/kg)

| Area | Antimony | Cadmium | Silver | Molybdenum | Manganese | Thallium | Benzo(b)-fluoranthene | Benzo(a)-pyrene | Benzo(a)-anthracene | Benzo(g,h,i)-perylene | Benzo(k)-fluoranthene | Chrysene | Dibenzo(a,h)-anthracene | Indeno(1,2,3-cd)-pyrene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 560A | 1.3 | 1.9 | 1.3 | 13.3 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 560B | 1.3 | 4.9 | 6.2 | 2.7 | 1400 | 15.6 | NA | NA | NA | NA | NA | NA | NA | NA |
| 560C | 1.3 | 3.4 | 5.6 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| SWL | 20 | 4.6 | 13.6 | 7.1 | 1400 | 20.6 | 1.2 | NA | NA | NA | NA | NA | NA | NA |
| 560D | 1.3 | 0.91 | 4.1 | 14.9 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 570A | 1.3 | 1.6 | 7.8 | 8.9 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 570B | 1.3 | 4.2 | 2.7 | 2.4 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 570C | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 570D | 1.3 | 4.8 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 570 | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 570as | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 13 | NA | NA | NA | NA | NA | NA | NA | NA |
| 575A | 1.3 | 1.3 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 575B | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| SF | 1.3 | 3 | 9.2 | 7.5 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 580A | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 581A | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 581B | 1.3 | 0.91 | 1.3 | 2.7 | 1965 | 21.3 | NA | NA | NA | NA | NA | NA | NA | NA |
| 581C | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 581D | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 582A | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 582B | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| AFP | 21.7 | 5.1 | 14.1 | 13.5 | 1900 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PAA | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | 1.4 | NA | 1 | NA | NA | NA | NA | NA |
| PAB | 1.3 | 7.6 | 23.7 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PAC | 1.3 | 2 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PAD | 1.3 | 0.91 | 2.5 | 5.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PAE | 1.3 | 6.3 | 4.2 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PAF | 1.3 | 1.1 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PAG | 1.3 | 2.3 | 7 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PAH | 1.3 | 0.91 | 1.3 | 9 | 1400 | 0.58 | 6 | 24 | 5.1 | 2.2 | 3.1 | 5 | 1.1 | 2.2 |
| PAI | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| LSP | 1.3 | 1.1 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| WPAA | 1.3 | 4.1 | 1.3 | 4.3 | 1400 | 0.58 | 2.3 | 8.6 | 17 | 5.9 | NA | 17 | 1 | 4.9 |
| WPA,OU1 | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| WPA, OU4 | 1.3 | 0.91 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| NEb | 1.3 | 0.91 | 1.3 | 11.3 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |

*Cadmium background concentration is 0.91 mg/kg, manganese background concentration is 1400 mg/kg, thallium background concentration is 0.58 mg/kg, and molybdenum background concentration is 2.7 mg/kg; A detection limit of 1.3 mg/kg was used for antimony and silver.

# TABLE C-4
# SITEWIDE SOIL BTV EXCEEDANCES

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1573 | 56912 | 19901101 | 4 | 4.5 | 481621.035 | 1349517.533 | Aluminum | 142000 | - | 10103 | mg/kg | NORMAL |
| 11138 | 70487 | 19930808 | 5.5 | 6 | 480501.961 | 1346796.294 | Aluminum | 87000 | J | 10103 | mg/kg | NORMAL |
| 11378 | 200158 | 19940708 | 2 | 2.5 | 484405.821 | 1352071.963 | Aluminum | 27500 | J | 10103 | mg/kg | NORMAL |
| ASI-8 | 103692 | 19920930 | 1.5 | 2 | 480249.58 | 1351462.542 | Aluminum | 27000 | - | 10103 | mg/kg | NORMAL |
| 11373 | 200086 | 19940706 | 2 | 2.5 | 476875.594 | 1351355.031 | Aluminum | 26400 | J | 10103 | mg/kg | NORMAL |
| 11162 | 122520 | 19930725 | 6.5 | 7 | 480517.412 | 1346872.153 | Aluminum | 26100 | - | 10103 | mg/kg | NORMAL |
| P18-14C-825514 | P18-14C-825514 | 15 January 1997 | 0 | 0.33 | 482514 | 1350825 | Aluminum | 26100 | - | 10103 | mg/kg | NORMAL |
| ASI-19 | 103666 | 19920929 | 1 | 1.5 | 479988.014 | 1351529.085 | Aluminum | 25700 | - | 10103 | mg/kg | NORMAL |
| 1981 | 112181 | 19930514 | 19 | 21 | 477395.523 | 1348495.355 | Aluminum | 25500 | J | 10103 | mg/kg | NORMAL |
| 11371 | 200058 | 19940710 | 2 | 2.5 | 478098.33 | 1348126.018 | Aluminum | 25500 | J | 10103 | mg/kg | NORMAL |
| 1888 | 67717 | 19920223 | 5 | 6 | 482154.235 | 1348292.88 | Aluminum | 25200 | - | 10103 | mg/kg | NORMAL |
| NAR-4-14C-M | NAR-4-14C-M | 12 March 1997 | 4.92 | 5.25 | 484364.100197 | 1351962.77205 | Aluminum | 25200 | - | 10103 | mg/kg | NORMAL |
| P17-32C-835920 | P17-32C-835920 | 16 January 1997 | 0 | 0.33 | 481920 | 1350835 | Aluminum | 24800 | - | 10103 | mg/kg | NORMAL |
| P17-32C-835920 | P17-32C-835920 | 16 January 1997 | 0 | 0.33 | 481920 | 1350835 | Aluminum | 24800 | - | 10103 | mg/kg | NORMAL |
| 11099 | 121419 | 19930710 | 6 | 6.5 | 479770.905 | 1348509.817 | Aluminum | 24700 | - | 10103 | mg/kg | NORMAL |
| NAR-1-7C-MP | NAR-1-7C-MP | 8 March 1997 | 1 | 1.33 | 482221.813234 | 1350896.55777 | Aluminum | 24700 | - | 10103 | mg/kg | NORMAL |
| NAR-3-15C-M | NAR-3-15C-M | 13 March 1997 | 2.08 | 2.42 | 482629.604111 | 1350949.76885 | Aluminum | 24500 | - | 10103 | mg/kg | NORMAL |
| NAR-5-12C-M | NAR-5-12C-M | 17 March 1997 | 0.75 | 1.08 | 482492.454341 | 1350955.22115 | Aluminum | 24000 | - | 10103 | mg/kg | NORMAL |
| NAR-1-14C-MP | NAR-1-14C-MP | 8 March 1997 | 0.5 | 0.83 | 482571.558272 | 1350911.19576 | Aluminum | 23900 | - | 10103 | mg/kg | NORMAL |
| NAR-1-13C-MP | NAR-1-13C-MP | 8 March 1997 | 0.5 | 0.83 | 482537.990705 | 1350907.43141 | Aluminum | 23900 | - | 10103 | mg/kg | NORMAL |
| P17-32C-850820 | P17-32C-850820 | 16 January 1997 | 0 | 0.33 | 481820 | 1350850 | Aluminum | 23800 | - | 10103 | mg/kg | NORMAL |
| P18-14C-857434 | P18-14C-857434 | 15 January 1997 | 0 | 0.33 | 482434 | 1350857 | Aluminum | 23700 | - | 10103 | mg/kg | NORMAL |
| NAR-1-10C-MP | NAR-1-10C-MP | 10 March 1997 | 1.42 | 1.75 | 482365.401484 | 1350915.08922 | Aluminum | 23400 | - | 10103 | mg/kg | NORMAL |
| O20-00C-1-M | O20-00C-1-M | 27 January 1997 | 0 | 0.33 | 483831 | 1349992 | Aluminum | 23100 | - | 10103 | mg/kg | NORMAL |
| ASI-16 | 103817 | 19921006 | 1.5 | 2 | 480032.518 | 1351803.984 | Aluminum | 23000 | - | 10103 | mg/kg | NORMAL |
| NAR-2-1C-M | NAR-2-1C-M | 11 March 1997 | 1.17 | 1.5 | 482786.461335 | 1350954.26656 | Aluminum | 23000 | - | 10103 | mg/kg | NORMAL |
| 1969 | 110339 | 19930322 | 0.5 | 1 | 477662.362 | 1348231.073 | Aluminum | 22800 | - | 10103 | mg/kg | NORMAL |
| 11375 | 200114 | 19940707 | 2 | 2.5 | 478904.115 | 1351253.389 | Aluminum | 22600 | J | 10103 | mg/kg | NORMAL |
| A1P1ST1-8C-M | A1P1ST1-8C-M | 11 March 1997 | 0.5 | 0.83 | 483329 | 1351856 | Aluminum | 22600 | - | 10103 | mg/kg | NORMAL |
| ASI-8 | 103689 | 19920930 | 1 | 1.5 | 480249.58 | 1351462.542 | Aluminum | 22500 | - | 10103 | mg/kg | NORMAL |
| 11374 | 200100 | 19940707 | 2 | 2.5 | 478230.275 | 1350480.989 | Aluminum | 22500 | - | 10103 | mg/kg | NORMAL |
| 11369 | 200030 | 19940711 | 2 | 2.5 | 479915.53 | 1347209.139 | Aluminum | 22500 | J | 10103 | mg/kg | NORMAL |
| ASI-19 | 103669 | 19920929 | 1.5 | 2 | 479988.014 | 1351529.085 | Aluminum | 22400 | - | 10103 | mg/kg | NORMAL |
| 1981 | 112180 | 19930514 | 17 | 19 | 477395.523 | 1348495.355 | Aluminum | 22400 | J | 10103 | mg/kg | NORMAL |
| 11379 | 200172 | 19940709 | 2 | 2.5 | 482586.876 | 1350587.638 | Aluminum | 22200 | - | 10103 | mg/kg | NORMAL |
| 11380 | 200186 | 19940709 | 2 | 2.5 | 482461.511 | 1348047.947 | Aluminum | 22200 | - | 10103 | mg/kg | NORMAL |
| 11370 | 200044 | 19940710 | 2 | 2.5 | 478963.245 | 1347929.618 | Aluminum | 22100 | - | 10103 | mg/kg | NORMAL |
| Q19C-858287 | Q19C-858287 | 5 November 1996 | 0 | 0.33 | 483278.556 | 1351858.317 | Aluminum | 22000 | - | 10103 | mg/kg | NORMAL |
| O20-00C-8A-M | O20-00C-8A-M | 27 January 1997 | 0 | 0.33 | 483943 | 1350559 | Aluminum | 21600 | - | 10103 | mg/kg | NORMAL |

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# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAR-1-16C-MP | NAR-1-16C-MP-D | 11 March 1997 | 2.42 | 2.75 | 482683.783525 | 1350932.28281 | Aluminum | 21400 | - | 10103 | mg/kg | DUPLICATE |
| NAR-4-9C-M | NAR-4-9C-M-D | 12 March 1997 | 1.17 | 1.5 | 483704.32 | 1351514.61 | Aluminum | 21400 | - | 10103 | mg/kg | DUPLICATE |
| NAR-1-16C-MP | NAR-1-16C-MP | 11 March 1997 | 2.25 | 2.58 | 482683.783525 | 1350932.28281 | Aluminum | 21100 | - | 10103 | mg/kg | NORMAL |
| NAR-3-16C-M | NAR-3-16C-M | 11 March 1997 | 2.08 | 2.42 | 482677.375616 | 1350946.43118 | Aluminum | 21000 | - | 10103 | mg/kg | NORMAL |
| 11088 | 121155 | 19930709 | 1 | 1.5 | 481688.606 | 1349539.452 | Aluminum | 20800 | - | 10103 | mg/kg | NORMAL |
| 1888 | 67714 | 19920223 | 0 | 1.5 | 482154.235 | 1348292.88 | Aluminum | 20800 | - | 10103 | mg/kg | NORMAL |
| P18-14C-857434 | P18-14C-857434-D | 15 January 1997 | 0 | 0.33 | 482434 | 1350857 | Aluminum | 20800 | - | 10103 | mg/kg | DUPLICATE |
| P18-12C-854372 | P18-12C-854372 | 26 December 1996 | 0 | 0.33 | 482372.29 | 1350854.8 | Aluminum | 20800 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-21D | 40153 | 19920407 | 0 | 0.5 | 481368.046 | 1348454.719 | Aluminum | 20700 | - | 10103 | mg/kg | NORMAL |
| P19C-707586 | P19C-707586 | 14 January 1997 | 0 | 0.33 | 483586.94 | 1350707.45 | Aluminum | 20700 | - | 10103 | mg/kg | NORMAL |
| NAR-3-8C-M | NAR-3-8C-M | 8 March 1997 | 2.42 | 2.75 | 482283.131545 | 1350925.07206 | Aluminum | 20700 | - | 10103 | mg/kg | NORMAL |
| O20-00C-2-M | O20-00C-2-M | 27 January 1997 | 0 | 0.33 | 483840 | 1350189 | Aluminum | 20600 | - | 10103 | mg/kg | NORMAL |
| 1964 | 112648 | 19930417 | 5 | 6.5 | 477448.237 | 1347949.306 | Aluminum | 20500 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-5-MP | OSB-5C-5-MP | 9 April 1997 | 0.5 | 0.83 | 481009 | 1350622 | Aluminum | 20500 | - | 10103 | mg/kg | NORMAL |
| 11166 | 121372 | 19930709 | 3 | 4.5 | 480477.412 | 1346872.154 | Aluminum | 20400 | - | 10103 | mg/kg | NORMAL |
| 11377 | 200143 | 19940708 | 2 | 2.5 | 480734.608 | 1351699.766 | Aluminum | 20300 | - | 10103 | mg/kg | NORMAL |
| NAR-5-2C-M | NAR-5-2C-M | 19 March 1997 | 0.58 | 0.92 | 481949.765403 | 1350935.8894 | Aluminum | 20100 | - | 10103 | mg/kg | NORMAL |
| 1972 | 110584 | 19930408 | 2.5 | 4 | 477987.353 | 1348022.38 | Aluminum | 20000 | - | 10103 | mg/kg | NORMAL |
| NAR-6-9C-M | NAR-6-9C-M | 13 March 1997 | 2.17 | 2.5 | 483695.954917 | 1351520.93624 | Aluminum | 20000 | - | 10103 | mg/kg | NORMAL |
| 11381 | 200200 | 19940712 | 2 | 2.5 | 481345.06 | 1347767.831 | Aluminum | 19900 | J | 10103 | mg/kg | NORMAL |
| Q19C-944600 | Q19C-944600 | 5 November 1996 | 0 | 0.33 | 483600.697 | 1351944.413 | Aluminum | 19900 | - | 10103 | mg/kg | NORMAL |
| Q19C-944600 | Q19C-944600 | 5 November 1996 | 0 | 0.33 | 483600.697 | 1351944.413 | Aluminum | 19900 | - | 10103 | mg/kg | NORMAL |
| 11108 | 122090 | 19930724 | 0 | 0.5 | 479873.665 | 1350027.391 | Aluminum | 19800 | - | 10103 | mg/kg | NORMAL |
| 11158 | 122102 | 19930722 | 7 | 7.5 | 480491.062 | 1346863.194 | Aluminum | 19700 | - | 10103 | mg/kg | NORMAL |
| NAR-4-9C2-M | NAR-4-9C2-M-D | 12 March 1997 | 0.83 | 1.17 | 483704.32 | 1351514.61 | Aluminum | 19700 | - | 10103 | mg/kg | DUPLICATE |
| Q19C-631785 | Q19C-631785 | 5 November 1996 | 0 | 0.33 | 483785.486 | 1351631.807 | Aluminum | 19600 | - | 10103 | mg/kg | NORMAL |
| 11096 | 122955 | 19930805 | 1 | 1.5 | 479963.416 | 1348447.695 | Aluminum | 19400 | - | 10103 | mg/kg | NORMAL |
| Q20C2-M-6 | Q20C2-M-6 | 13 March 1997 | | | 483905.84 | 1351710.15 | Aluminum | 19400 | - | 10103 | mg/kg | NORMAL |
| NAR-5-15C-M | NAR-5-15C-M | 13 March 1997 | 1 | 1.5 | 482627.448148 | 1350967.63927 | Aluminum | 19300 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-15-MP | OSB-5C-15-MP | 8 April 1997 | 0.5 | 0.83 | 481080 | 1350673 | Aluminum | 19300 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-70 | 40142 | 19920408 | 0 | 0.5 | 481324.583 | 1348543.789 | Aluminum | 19200 | - | 10103 | mg/kg | NORMAL |
| 11376 | 200129 | 19940708 | 2 | 2.5 | 480126.482 | 1351027.005 | Aluminum | 19200 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-13-MP | OSB-3C-13-MP | 14 April 1997 | 0.5 | 0.83 | 480871 | 1350607 | Aluminum | 19100 | - | 10103 | mg/kg | NORMAL |
| P17-34C-873163 | P17-34C-873163 | 30 December 1996 | | | 482163.58 | 1350873.5 | Aluminum | 19100 | - | 10103 | mg/kg | NORMAL |
| P17-34C-873163 | P17-34C-873163 | 30 December 1996 | | | 482163.58 | 1350873.5 | Aluminum | 19100 | - | 10103 | mg/kg | NORMAL |
| NAR-5-10C-M | NAR-5-10C-M | 17 March 1997 | 0.92 | 1.25 | 482398.359908 | 1350957.91144 | Aluminum | 19100 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-5-MP | OSB-2C-5-MP | 1 April 1997 | 0.5 | 0.83 | 480700 | 1350737 | Aluminum | 19100 | - | 10103 | mg/kg | NORMAL |
| NAR-4-9C2-M | NAR-4-9C2-M | 12 March 1997 | 0.83 | 1.17 | 483704.32 | 1351514.61 | Aluminum | 19000 | - | 10103 | mg/kg | NORMAL |
| 11162 | 122519 | 19930724 | 5 | 5.5 | 480517.412 | 1346872.153 | Aluminum | 18900 | - | 10103 | mg/kg | NORMAL |
| O20-00C-8A-M | O20-00C-8A-M-D | 27 January 1997 | 0 | 0.33 | 483943 | 1350559 | Aluminum | 18900 | - | 10103 | mg/kg | DUPLICATE |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NAR-4-2C-M | NAR-4-2C-M | 12 March 1997 | 1.25 | 1.58 | 482863.193465 | 1351002.28344 | Aluminum | 18900 | - | 10103 | mg/kg | NORMAL |
| ASI-16 | 103805 | 19921006 | 0.17 | 0.33 | 480032.518 | 1351803.984 | Aluminum | 18800 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-4-MP | OSB-2C-4-MP | 1 April 1997 | 0.5 | 0.83 | 480642 | 1350828 | Aluminum | 18800 | - | 10103 | mg/kg | NORMAL |
| NAR-6-2C-M | NAR-6-2C-M | 13 March 1997 | 1.67 | 2 | 482893.382328 | 1351029.091 | Aluminum | 18700 | - | 10103 | mg/kg | NORMAL |
| NAR-1-15C-MP | NAR-1-15C-MP | 8 March 1997 | 0.5 | 0.83 | 482628.04614 | 1350911.32156 | Aluminum | 18700 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-1-MP | OSB-2C-1-MP | 1 April 1997 | 0.5 | 0.83 | 480632 | 1350751 | Aluminum | 18700 | - | 10103 | mg/kg | NORMAL |
| 11088 | 121151 | 19930709 | 0 | 0.5 | 481688.606 | 1349539.452 | Aluminum | 18600 | - | 10103 | mg/kg | NORMAL |
| LSP-K65-TR-2 | 114767 | 19930525 | 0 | 6 | 480456.376 | 1348074.99 | Aluminum | 18600 | - | 10103 | mg/kg | NORMAL |
| P17-34C-856128 | P17-34C-856128 | 30 December 1996 | | | 482128.28 | 1350856.37 | Aluminum | 18600 | - | 10103 | mg/kg | NORMAL |
| P17-34C-856128 | P17-34C-856128 | 30 December 1996 | | | 482128.28 | 1350856.37 | Aluminum | 18600 | - | 10103 | mg/kg | NORMAL |
| NAR-4-3C-M | NAR-4-3C-M | 12 March 1997 | 1.58 | 1.92 | 483002.355736 | 1351049.18766 | Aluminum | 18600 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-12-MP | OSB-5C-12-MP | 8 April 1997 | 0.5 | 0.83 | 481035 | 1350703 | Aluminum | 18600 | - | 10103 | mg/kg | NORMAL |
| 11160 | 121763 | 19930714 | 5.5 | 6 | 480471.062 | 1346863.194 | Aluminum | 18500 | J | 10103 | mg/kg | NORMAL |
| 11379 | 200171 | 19940709 | 0 | 0.17 | 482586.876 | 1350587.638 | Aluminum | 18500 | - | 10103 | mg/kg | NORMAL |
| NAR-5-11C-M | NAR-5-11C-M | 17 March 1997 | 1 | 1.33 | 482410.577287 | 1350949.20882 | Aluminum | 18500 | - | 10103 | mg/kg | NORMAL |
| ASI-13 | 103742 | 19921001 | 1 | 1.5 | 480107.59 | 1351672.383 | Aluminum | 18400 | - | 10103 | mg/kg | NORMAL |
| SWL-SS-10 | 111309 | 19930402 | 0 | 0.5 | 482276.015 | 1348228.199 | Aluminum | 18400 | J | 10103 | mg/kg | NORMAL |
| 11194 | 122076 | 19930723 | 1 | 1.5 | 481671.306 | 1348699.774 | Aluminum | 18300 | - | 10103 | mg/kg | NORMAL |
| ASI-13 | 103733 | 19921001 | 0.17 | 0.33 | 480107.59 | 1351672.383 | Aluminum | 18100 | - | 10103 | mg/kg | NORMAL |
| ASI-16 | 103808 | 19921006 | 0.33 | 0.5 | 480032.518 | 1351803.984 | Aluminum | 18100 | - | 10103 | mg/kg | NORMAL |
| 11086 | 122660 | 19930726 | 2.5 | 3 | 482295.759 | 1350084.253 | Aluminum | 18100 | - | 10103 | mg/kg | NORMAL |
| LSP-SB-03 | 114510 | 19930505 | 0.5 | 1 | 480464.988 | 1348199.94 | Aluminum | 18000 | - | 10103 | mg/kg | NORMAL |
| 11098 | 122785 | 19930806 | 0 | 0.5 | 479780.865 | 1348460.627 | Aluminum | 18000 | - | 10103 | mg/kg | NORMAL |
| NAR-4-13C-M | NAR-4-13C-M | 12 March 1997 | 2.5 | 2.83 | 484251.007616 | 1351871.09834 | Aluminum | 18000 | - | 10103 | mg/kg | NORMAL |
| 1726 | 67155 | 19910701 | 18 | 19.5 | 477346.843 | 1348570.615 | Aluminum | 17900 | - | 10103 | mg/kg | NORMAL |
| 11087 | 121203 | 19930714 | 1 | 1.5 | 481798.467 | 1349531.68 | Aluminum | 17700 | - | 10103 | mg/kg | NORMAL |
| PA-SS-08 | 122254 | 19930724 | 1 | 1.5 | 480809.317 | 1349477.132 | Aluminum | 17700 | - | 10103 | mg/kg | NORMAL |
| Q17C-687220 | Q17C-687220-D | 20 November 1996 | 0 | 0.33 | 481220 | 1351687 | Aluminum | 17700 | - | 10103 | mg/kg | DUPLICATE |
| Q17C-687220 | Q17C-687220-D | 20 November 1996 | 0 | 0.33 | 481220 | 1351687 | Aluminum | 17700 | - | 10103 | mg/kg | DUPLICATE |
| LSP-SB-02 | 114508 | 19930505 | 0.5 | 1 | 480539.987 | 1348074.939 | Aluminum | 17600 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-5-MP | PUMP1-C-5-MP | 7 March 1997 | 0 | 0.33 | 479475 | 1350576 | Aluminum | 17600 | J | 10103 | mg/kg | NORMAL |
| 11164 | 121387 | 19930710 | 4.5 | 6 | 480497.412 | 1346872.154 | Aluminum | 17500 | - | 10103 | mg/kg | NORMAL |
| 11105 | 122421 | 19930730 | 2.5 | 3 | 480250.656 | 1349861.207 | Aluminum | 17500 | - | 10103 | mg/kg | NORMAL |
| ASI-16 | 103802 | 19921006 | 0 | 0.17 | 480032.518 | 1351803.984 | Aluminum | 17400 | - | 10103 | mg/kg | NORMAL |
| P1P6 | 99183 | 19930122 | 2 | 3 | 481266.063 | 1348795.459 | Aluminum | 17400 | - | 10103 | mg/kg | NORMAL |
| 11369 | 200029 | 19940711 | 0 | 0.17 | 479915.53 | 1347209.139 | Aluminum | 17400 | - | 10103 | mg/kg | NORMAL |
| NAR-3-13C-M | NAR-3-13C-M | 11 March 1997 | 2.83 | 3.17 | 482542.69412 | 1350940.64992 | Aluminum | 17400 | - | 10103 | mg/kg | NORMAL |
| NAR-3-10C-M | NAR-3-10C-M | 9 March 1997 | 1.25 | 1.75 | 482394.950442 | 1350933.82045 | Aluminum | 17400 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-1-MP | OSB-5C-1-MP | 9 April 1997 | 0.5 | 0.83 | 480920 | 1350612 | Aluminum | 17400 | - | 10103 | mg/kg | NORMAL |
| 11220 | 70634 | 19930810 | 5.5 | 6 | 480451.35 | 1346749.275 | Aluminum | 17300 | - | 10103 | mg/kg | NORMAL |

000515



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000516

# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11104 | 122592 | 19930728 | 1 | 1.5 | 480440.862 | 1349327.557 | Aluminum | 17300 | - | 10103 | mg/kg | NORMAL |
| 11102 | 122850 | 19930810 | 6 | 6.5 | 480736.289 | 1348918.995 | Aluminum | 17300 | - | 10103 | mg/kg | NORMAL |
| NAR-3-9C-M | NAR-3-9C-M | 9 March 1997 | 1.75 | 2.25 | 482303.076404 | 1350927.56257 | Aluminum | 17300 | - | 10103 | mg/kg | NORMAL |
| NAR-2-15C-M | NAR-2-15C-M | 8 March 1997 | | | 484408.767836 | 1351959.05693 | Aluminum | 17300 | - | 10103 | mg/kg | NORMAL |
| ASI-13 | 103736 | 19921001 | 0.33 | 0.5 | 480107.59 | 1351672.383 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-19H | 40192 | 19920427 | 0 | 0.5 | 481399.047 | 1348521.208 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| WP-SS-15 | 123269 | 19930709 | 0 | 0.5 | 481135.509 | 1346953.496 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-3-MP | OSB-3C-3-MP | 15 April 1997 | 0.5 | 0.83 | 480749 | 1350679 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| P18-13C-640506 | P18-13C-640506 | 18 December 1996 | | | 482506.64 | 1350640.26 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| P18-13C-640506 | P18-13C-640506 | 18 December 1996 | | | 482506.64 | 1350640.26 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| P17-32C-876808 | P17-32C-876808 | 18 December 1996 | 0 | 0.33 | 481808 | 1350876 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| P20-00C-5-M | P20-00C-5-M | 29 January 1997 | 0 | 0.33 | 484081.27 | 1350676.89 | Aluminum | 17200 | - | 10103 | mg/kg | NORMAL |
| 1966 | 112859 | 19930421 | 4.5 | 6.5 | 477269.346 | 1348031.368 | Aluminum | 17100 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-15-MP | OSB-3C-15-MP | 14 April 1997 | 0.5 | 0.83 | 480888 | 1350680 | Aluminum | 17100 | - | 10103 | mg/kg | NORMAL |
| P20-00C-7-M | P20-00C-7-M | 29 January 1997 | 0 | 0.33 | 484113.88 | 1351071.95 | Aluminum | 17100 | J | 10103 | mg/kg | NORMAL |
| 11165 | 121391 | 19930710 | 3 | 4.5 | 480487.412 | 1346872.154 | Aluminum | 17000 | - | 10103 | mg/kg | NORMAL |
| ASI-19 | 103657 | 19920929 | 0.17 | 0.33 | 479988.014 | 1351529.085 | Aluminum | 17000 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-48 | 40270 | 19920428 | 0 | 0.5 | 481454.872 | 1348580.177 | Aluminum | 17000 | - | 10103 | mg/kg | NORMAL |
| 1577 | 56939 | 19901106 | 4 | 4.5 | 481636.566 | 1349583.052 | Aluminum | 17000 | - | 10103 | mg/kg | NORMAL |
| 11370 | 200043 | 19940710 | 0 | 0.17 | 478963.245 | 1347929.618 | Aluminum | 17000 | - | 10103 | mg/kg | NORMAL |
| NAR-4-9C-M | NAR-4-9C-M | 12 March 1997 | 1.17 | 1.5 | 483704.32 | 1351514.61 | Aluminum | 17000 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-16-MP | OSB-4C-16-MP | 7 April 1997 | 0.5 | 0.83 | 481126 | 1350850 | Aluminum | 17000 | - | 10103 | mg/kg | NORMAL |
| 1991 | 115321 | 19930506 | 12 | 15 | 482225.495 | 1348220.339 | Aluminum | 16900 | - | 10103 | mg/kg | NORMAL |
| NAR-2-11C-M | NAR-2-11C-M | 12 March 1997 | 2 | 2.33 | 483938.193787 | 1351639.16622 | Aluminum | 16900 | - | 10103 | mg/kg | NORMAL |
| P18-32C2-M-3 | P18-32C2-M-3 | 14 March 1997 | 0 | 0.33 | 482734.02 | 1350818.43 | Aluminum | 16900 | - | 10103 | mg/kg | NORMAL |
| 11159 | 121802 | 19930714 | 4.5 | 6 | 480481.062 | 1346863.194 | Aluminum | 16800 | J | 10103 | mg/kg | NORMAL |
| 1514 | 53782 | 19900206 | 2 | 2.5 | 482570.174 | 1349504.922 | Aluminum | 16800 | - | 10103 | mg/kg | NORMAL |
| P18-14C-889465 | P18-14C-889465 | 10 February 1997 | 0 | 0.33 | 482465.32 | 1350889.71 | Aluminum | 16800 | - | 10103 | mg/kg | NORMAL |
| NAR-4-1C-M | NAR-4-1C-M | 11 March 1997 | 1.33 | 1.67 | 482790.508697 | 1350966.69715 | Aluminum | 16800 | - | 10103 | mg/kg | NORMAL |
| 11105 | 122412 | 19930730 | 0 | 0.5 | 480250.656 | 1349861.207 | Aluminum | 16700 | - | 10103 | mg/kg | NORMAL |
| PA-SS-08 | 122253 | 19930724 | 0 | 0.5 | 480809.317 | 1349477.132 | Aluminum | 16700 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-6-MP | PUMP1-C-6-MP | 7 March 1997 | 0 | 0.33 | 479480 | 1350600 | Aluminum | 16700 | J | 10103 | mg/kg | NORMAL |
| O20-00C-7-M | O20-00C-7-M | 27 January 1997 | 0 | 0.33 | 483934 | 1350362 | Aluminum | 16700 | - | 10103 | mg/kg | NORMAL |
| NAR-5-7C-M | NAR-5-7C-M | 19 March 1997 | | | 482211.489959 | 1350950.32049 | Aluminum | 16700 | - | 10103 | mg/kg | NORMAL |
| 1510 | 54059 | 19900204 | 2 | 2.5 | 482549.033 | 1349408.862 | Aluminum | 16600 | - | 10103 | mg/kg | NORMAL |
| 1975 | 112545 | 19930413 | 4 | 5 | 477898.365 | 1348315.08 | Aluminum | 16600 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-14-MP | PUMP1-C-14-MP | 9 March 1997 | 0 | 0.33 | 479541 | 1350596 | Aluminum | 16600 | J | 10103 | mg/kg | NORMAL |
| NAR-2-13C-M | NAR-2-13C-M | 12 March 1997 | 2.08 | 2.42 | 484215.387043 | 1351829.08436 | Aluminum | 16600 | - | 10103 | mg/kg | NORMAL |
| NAR-1-12C-MP | NAR-1-12C-MP | 9 March 1997 | 0.58 | 0.92 | 482465.371331 | 1350917.54475 | Aluminum | 16600 | - | 10103 | mg/kg | NORMAL |
| P20-00C-8-M | P20-00C-8-M | 29 January 1997 | 0 | 0.33 | 484144.61 | 1351229.48 | Aluminum | 16600 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11367 | 200001 | 19940711 | 0 | 0.17 | 482839.871 | 1346631.007 | Aluminum | 16400 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-9-MP | PUMP1-C-9-MP | 9 March 1997 | 0 | 0.33 | 479503 | 1350581 | Aluminum | 16400 | J | 10103 | mg/kg | NORMAL |
| P17-32C2-M-3 | P17-32C2-M-3 | 21 March 1997 | 0 | 0.33 | 481978.48 | 1350867.59 | Aluminum | 16400 | - | 10103 | mg/kg | NORMAL |
| O19-00C-16-M | O19-00C-16-M | 23 January 1997 | 0 | 0.33 | 483779 | 1350548 | Aluminum | 16400 | - | 10103 | mg/kg | NORMAL |
| O19-00C-16-M | O19-00C-16-M | 23 January 1997 | 0 | 0.33 | 483779 | 1350548 | Aluminum | 16400 | - | 10103 | mg/kg | NORMAL |
| N19-00C-14-M | N19-00C-14-M | 27 February 1997 | | | 483885.364 | 1349693.167 | Aluminum | 16400 | - | 10103 | mg/kg | NORMAL |
| NAR-4-14C6-M | NAR-4-14C6-M | 20 March 1997 | 3.17 | 3.67 | 484364.1 | 1351962.772 | Aluminum | 16400 | - | 10103 | mg/kg | NORMAL |
| 1987 | 115357 | 19930513 | 5 | 7.5 | 482177.013 | 1348148.93 | Aluminum | 16300 | - | 10103 | mg/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Aluminum | 16300 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-4-MP | PUMP1-C-4-MP | 7 March 1997 | 0 | 0.33 | 479451 | 1350629 | Aluminum | 16300 | J | 10103 | mg/kg | NORMAL |
| P17-22C2-M-1 | P17-22C2-M-1 | 24 March 1997 | 0 | 0.33 | 481565.63 | 1351332.6 | Aluminum | 16300 | - | 10103 | mg/kg | NORMAL |
| 11140 | 70411 | 19930807 | 1 | 1.5 | 480481.961 | 1346796.294 | Aluminum | 16200 | - | 10103 | mg/kg | NORMAL |
| WP-SS-05 | 123212 | 19930707 | 0 | 0.5 | 482342.468 | 1347557.71 | Aluminum | 16200 | J | 10103 | mg/kg | NORMAL |
| NAR-2-10C-M | NAR-2-10C-M | 11 March 1997 | 1.83 | 2.17 | 483799.563295 | 1351553.22097 | Aluminum | 16200 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-10-MP | OSB-3C-10-MP | 14 April 1997 | 0.5 | 0.83 | 480838 | 1350651 | Aluminum | 16200 | - | 10103 | mg/kg | NORMAL |
| P20-00C-6-M | P20-00C-6-M | 29 January 1997 | 0 | 0.33 | 484085.79 | 1350967.33 | Aluminum | 16200 | - | 10103 | mg/kg | NORMAL |
| 11091 | 70545 | 19930809 | 6 | 6.5 | 480583.929 | 1348987.876 | Aluminum | 16100 | - | 10103 | mg/kg | NORMAL |
| 11200 | 122474 | 19930725 | 1 | 1.5 | 479642.49 | 1348979.987 | Aluminum | 16100 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-2-MP | OSB-2C-2-MP | 1 April 1997 | 0.5 | 0.83 | 480649 | 1350776 | Aluminum | 16100 | - | 10103 | mg/kg | NORMAL |
| SS-52 | 121015 | 19930630 | 0 | 0.5 | 481267.506 | 1350647.123 | Aluminum | 16000 | J | 10103 | mg/kg | NORMAL |
| 1984 | 111468 | 19930501 | 12.5 | 15 | 482125.544 | 1348197.441 | Aluminum | 16000 | - | 10103 | mg/kg | NORMAL |
| NAR-6-14C-M | NAR-6-14C-M | 12 March 1997 | 2 | 2.33 | 484359.624074 | 1351973.01726 | Aluminum | 16000 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-5-MP | PUMP-C-5-MP | 21 January 1997 | 0.5 | 0.83 | 479478 | 1350577.08 | Aluminum | 16000 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-5-MP | PUMP-C-5-MP | 21 January 1997 | 0.5 | 0.83 | 479478 | 1350577.08 | Aluminum | 16000 | - | 10103 | mg/kg | NORMAL |
| P18-32C-844724 | P18-32C-844724 | 31 December 1996 | | | 482724.27 | 1350844.62 | Aluminum | 16000 | J | 10103 | mg/kg | NORMAL |
| P18-32C-844724 | P18-32C-844724 | 31 December 1996 | | | 482724.27 | 1350844.62 | Aluminum | 16000 | J | 10103 | mg/kg | NORMAL |
| Q16-34C-604230 | Q16-34C-604230 | 15 November 1996 | 0 | 0.33 | 481230.33 | 1351604.91 | Aluminum | 16000 | J | 10103 | mg/kg | NORMAL |
| Q16-34C-604230 | Q16-34C-604230 | 15 November 1996 | 0 | 0.33 | 481230.33 | 1351604.91 | Aluminum | 16000 | J | 10103 | mg/kg | NORMAL |
| NAR-4-14C8-M | NAR-4-14C8-M | 20 March 1997 | 4.17 | 4.67 | 484364.1 | 1351962.772 | Aluminum | 16000 | - | 10103 | mg/kg | NORMAL |
| SWL-SS-09 | 111307 | 19930402 | 0 | 0.5 | 482260.995 | 1348173.729 | Aluminum | 15900 | J | 10103 | mg/kg | NORMAL |
| NAR-6-13C-M | NAR-6-13C-M | 12 March 1997 | 2.08 | 2.42 | 484216.884417 | 1351873.46632 | Aluminum | 15900 | - | 10103 | mg/kg | NORMAL |
| NAR-2-9C-M | NAR-2-9C-M | 11 March 1997 | 1.58 | 1.92 | 483748.364338 | 1351523.6293 | Aluminum | 15900 | - | 10103 | mg/kg | NORMAL |
| P18-31C-731719 | P18-31C-731719 | 30 December 1996 | 0 | 0.33 | 482719.53 | 1350731.64 | Aluminum | 15900 | - | 10103 | mg/kg | NORMAL |
| NAR-1-1C-MP | NAR-1-1C-MP | 8 March 1997 | 0.75 | 1.08 | 481949.600586 | 1350901.8751 | Aluminum | 15900 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-39 | 40289 | 19920428 | 0 | 0.5 | 481490.359 | 1348482.687 | Aluminum | 15800 | - | 10103 | mg/kg | NORMAL |
| 11109 | 122466 | 19930724 | 0 | 0.5 | 479750.119 | 1349623.424 | Aluminum | 15800 | - | 10103 | mg/kg | NORMAL |
| 11372 | 200071 | 19940706 | 0 | 0.17 | 478106.921 | 1349859.682 | Aluminum | 15800 | - | 10103 | mg/kg | NORMAL |
| O20-00C-4-M | O20-00C-4-M-D | 23 January 1997 | 0 | 0.33 | 483822 | 1350582 | Aluminum | 15800 | - | 10103 | mg/kg | DUPLICATE |
| NAR-4-11C-M | NAR-4-11C-M | 12 March 1997 | 3.25 | 3.58 | 484001.407466 | 1351719.00375 | Aluminum | 15800 | - | 10103 | mg/kg | NORMAL |
| 11143 | 70776 | 19930728 | 4.5 | 5 | 480451.961 | 1346796.294 | Aluminum | 15700 | - | 10103 | mg/kg | NORMAL |



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000518

# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11104 | 122593 | 19930728 | 1 | 1.5 | 480440.862 | 1349327.557 | Aluminum | 15700 | - | 10103 | mg/kg | NORMAL |
| P19C2-M-5 | P19C2-M-5 | 14 March 1997 | 0 | 0.33 | 483598.46 | 1350910.36 | Aluminum | 15700 | - | 10103 | mg/kg | NORMAL |
| Q20C-567281 | Q20C-567281 | 11 February 1997 | | | 484281.15 | 1351567.93 | Aluminum | 15700 | R | 10103 | mg/kg | NORMAL |
| NAR-4-14C2-M | NAR-4-14C2-M | 12 March 1997 | 1.17 | 1.67 | 484364.1002 | 1351962.772 | Aluminum | 15700 | - | 10103 | mg/kg | NORMAL |
| NAR-4-12C-M | NAR-4-12C-M | 12 March 1997 | 1.92 | 2.25 | 484033.830107 | 1351726.33671 | Aluminum | 15700 | - | 10103 | mg/kg | NORMAL |
| 1980 | 112153 | 19930512 | 20 | 22 | 477309.732 | 1348528.816 | Aluminum | 15600 | - | 10103 | mg/kg | NORMAL |
| 1971 | 112536 | 19930415 | 4.5 | 6.5 | 477738.361 | 1348097.062 | Aluminum | 15600 | - | 10103 | mg/kg | NORMAL |
| 11377 | 200142 | 19940708 | 0 | 0.17 | 480734.608 | 1351699.766 | Aluminum | 15600 | - | 10103 | mg/kg | NORMAL |
| NAR-3-6C-M | NAR-3-6C-M | 8 March 1997 | 2.42 | 2.75 | 482194.31 | 1350929.88 | Aluminum | 15600 | - | 10103 | mg/kg | NORMAL |
| Q17C-750121 | Q17C-750121 | 14 November 1996 | | | 482121.72 | 1351750.66 | Aluminum | 15600 | J | 10103 | mg/kg | NORMAL |
| NAR-5-5C-M | NAR-5-5C-M | 19 March 1997 | | | 482108.521017 | 1350947.79129 | Aluminum | 15600 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-8-MP | PUMP1-C-8-MP | 9 March 1997 | 0 | 0.33 | 479486 | 1350640 | Aluminum | 15500 | J | 10103 | mg/kg | NORMAL |
| OSB-3C-6-MP | OSB-3C-6-MP | 14 April 1997 | 0.5 | 0.83 | 480800 | 1350631 | Aluminum | 15500 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-4-MP | PUMP-C-4-MP | 21 January 1997 | 0.5 | 0.83 | 479467.03 | 1350637.17 | Aluminum | 15500 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-4-MP | PUMP-C-4-MP | 21 January 1997 | 0.5 | 0.83 | 479467.03 | 1350637.17 | Aluminum | 15500 | - | 10103 | mg/kg | NORMAL |
| P19C-866450 | P19C-866450 | 8 January 1997 | 0 | 0.33 | 483450 | 1350866 | Aluminum | 15500 | - | 10103 | mg/kg | NORMAL |
| NAR-1-6C-MP | NAR-1-6C-MP | 8 March 1997 | 0.5 | 0.83 | 482154.784326 | 1350896.91196 | Aluminum | 15500 | - | 10103 | mg/kg | NORMAL |
| NAR-5-3C-M | NAR-5-3C-M | 19 March 1997 | 0.83 | 1.17 | 482019.621519 | 1350942.60677 | Aluminum | 15500 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-7C-M | A1P1ST1-7C-M | 11 March 1997 | 0.25 | 0.58 | 482751 | 1351117 | Aluminum | 15500 | - | 10103 | mg/kg | NORMAL |
| ASI-8 | 103683 | 19920930 | 0.33 | 0.5 | 480249.58 | 1351462.542 | Aluminum | 15400 | - | 10103 | mg/kg | NORMAL |
| ASI-8 | 103680 | 19920930 | 0.17 | 0.33 | 480249.58 | 1351462.542 | Aluminum | 15400 | - | 10103 | mg/kg | NORMAL |
| 11037 | 115371 | 19930515 | 5 | 7.5 | 482162.725 | 1348253.89 | Aluminum | 15400 | J | 10103 | mg/kg | NORMAL |
| 11186 | 112507 | 19930412 | 4.5 | 6.5 | 478039.594 | 1348118.929 | Aluminum | 15400 | - | 10103 | mg/kg | NORMAL |
| Q17C2-M-2 | Q17C2-M-2 | 24 March 1997 | 0 | 0.33 | 481220 | 1351606 | Aluminum | 15400 | - | 10103 | mg/kg | NORMAL |
| 11109 | 122000 | 19930724 | 6 | 6.5 | 479750.119 | 1349623.424 | Aluminum | 15300 | - | 10103 | mg/kg | NORMAL |
| P1P51 | 61373 | 19910515 | 0 | 0.5 | 481388.291 | 1348553.978 | Aluminum | 15300 | - | 10103 | mg/kg | NORMAL |
| 11380 | 200185 | 19940709 | 0 | 0.17 | 482461.511 | 1348047.947 | Aluminum | 15300 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-10-MP | PUMP1-C-10-MP | 9 March 1997 | 0 | 0.33 | 479499 | 1350598 | Aluminum | 15300 | J | 10103 | mg/kg | NORMAL |
| P20-00C-12-M | P20-00C-12-M | 29 January 1997 | 0 | 0.33 | 484213.49 | 1351334.26 | Aluminum | 15300 | - | 10103 | mg/kg | NORMAL |
| NAR-4-14C7-M | NAR-4-14C7-M | 20 March 1997 | 3.67 | 4.17 | 484364.1 | 1351962.772 | Aluminum | 15300 | - | 10103 | mg/kg | NORMAL |
| 1982 | 111484 | 19930506 | 0 | 2.5 | 482252.694 | 1348126.169 | Aluminum | 15200 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-16-MP | PUMP1-C-16-MP | 9 March 1997 | 0 | 0.33 | 479541 | 1350624 | Aluminum | 15200 | J | 10103 | mg/kg | NORMAL |
| PUMP1-C-2-MP | PUMP1-C-2-MP | 7 March 1997 | 0 | 0.33 | 479452 | 1350600 | Aluminum | 15200 | J | 10103 | mg/kg | NORMAL |
| OSB-3C-4-MP | OSB-3C-4-MP | 15 April 1997 | 0.5 | 0.83 | 480724 | 1350698 | Aluminum | 15200 | - | 10103 | mg/kg | NORMAL |
| NAR-5-9C-M | NAR-5-9C-M | 17 March 1997 | 0.75 | 1.08 | 482337.550188 | 1350949.41567 | Aluminum | 15200 | - | 10103 | mg/kg | NORMAL |
| 11219 | 70603 | 19930809 | 5.5 | 6 | 480456.68 | 1346755.654 | Aluminum | 15100 | - | 10103 | mg/kg | NORMAL |
| 11093 | 122171 | 19930723 | 6 | 6.5 | 480445.887 | 1349025.74 | Aluminum | 15100 | - | 10103 | mg/kg | NORMAL |
| 11147 | 122326 | 19930723 | 6 | 6.5 | 480468.361 | 1346815.294 | Aluminum | 15100 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-11-MP | PUMP1-C-11-MP-D | 9 March 1997 | 0 | 0.33 | 479516 | 1350616 | Aluminum | 15100 | J | 10103 | mg/kg | DUPLICATE |
| P18-31C-699708 | P18-31C-699708 | 31 December 1996 | 0 | 0.33 | 482708.95 | 1350699.56 | Aluminum | 15100 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A1P1ST1-12C-M | A1P1ST1-12C-M | 11 March 1997 | 0 | 0.33 | 482786 | 1351160 | Aluminum | 15100 | - | 10103 | mg/kg | NORMAL |
| 1579 | 56958 | 19901102 | 4 | 4.5 | 481705.077 | 1349576.061 | Aluminum | 15000 | - | 10103 | mg/kg | NORMAL |
| NAR-6-11C-M | NAR-6-11C-M | 12 March 1997 | 2.25 | 2.58 | 483949.365002 | 1351692.45979 | Aluminum | 15000 | - | 10103 | mg/kg | NORMAL |
| NAR-2-2C-M | NAR-2-2C-M | 10 March 1997 | 0.83 | 1.17 | 482960.440288 | 1351017.58455 | Aluminum | 15000 | - | 10103 | mg/kg | NORMAL |
| Q20C-966823 | Q20C-966823 | 5 November 1996 | 0 | 0.33 | 483823.4 | 1351966.09 | Aluminum | 15000 | - | 10103 | mg/kg | NORMAL |
| Q20C-966823 | Q20C-966823 | 5 November 1996 | 0 | 0.33 | 483823.4 | 1351966.09 | Aluminum | 15000 | - | 10103 | mg/kg | NORMAL |
| OSB-1C-16-MP | OSB-1C-16-MP | 15 April 1997 | 0.5 | 0.83 | 480689 | 1350697 | Aluminum | 15000 | J | 10103 | mg/kg | NORMAL |
| P18-14C-891521 | P18-14C-891521 | 16 January 1997 | 0 | 0.33 | 482521.66 | 1350891.27 | Aluminum | 15000 | - | 10103 | mg/kg | NORMAL |
| 11153 | 121637 | 19930715 | 4.5 | 6 | 480474.661 | 1346834.194 | Aluminum | 14900 | - | 10103 | mg/kg | NORMAL |
| ASI-13 | 103730 | 19921001 | 0 | 0.17 | 480107.59 | 1351672.383 | Aluminum | 14900 | - | 10103 | mg/kg | NORMAL |
| ASI-13 | 103739 | 19921001 | 0.5 | 1 | 480107.59 | 1351672.383 | Aluminum | 14900 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-37 | 40277 | 19920428 | 0 | 0.5 | 481492.155 | 1348417.087 | Aluminum | 14900 | - | 10103 | mg/kg | NORMAL |
| 1977 | 110571 | 19930406 | 8.5 | 10 | 477856.149 | 1347853.522 | Aluminum | 14900 | - | 10103 | mg/kg | NORMAL |
| 1666 | 57023 | 19901218 | 0 | 0.5 | 480614.682 | 1348442.577 | Aluminum | 14900 | - | 10103 | mg/kg | NORMAL |
| 1969 | 110338 | 19930322 | 0 | 0.5 | 477662.362 | 1348231.073 | Aluminum | 14900 | - | 10103 | mg/kg | NORMAL |
| Q20C-509996 | Q20C-509996 | 11 February 1997 | | | 483996.58 | 1351509.91 | Aluminum | 14900 | R | 10103 | mg/kg | NORMAL |
| PLANT1PAD-59 | 40200 | 19920427 | 0 | 0.5 | 481390.177 | 1348545.588 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| 1573 | 56905 | 19901031 | 0.5 | 1 | 481621.035 | 1349517.533 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-2-MP | PUMP-C-2-MP | 21 January 1997 | 0.5 | 0.83 | 479449.2 | 1350588.36 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-2-MP | PUMP-C-2-MP | 21 January 1997 | 0.5 | 0.83 | 479449.2 | 1350588.36 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| P17-32C-829914 | P17-32C-829914 | 18 December 1996 | 0 | 0.33 | 481914.84 | 1350829.58 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-6C-M | A1P1ST1-6C-M | 11 March 1997 | 0.25 | 0.58 | 482739 | 1351045 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| NAR-4-16C2-M | NAR-4-16C2-M | 12 March 1997 | 1.08 | 1.58 | 484528.9902 | 1352072.391 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| NAR-4-15C-M | NAR-4-15C-M | 12 March 1997 | 5.83 | 6.17 | 484455.123712 | 1352022.74471 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| NAR-4-14C3-M | NAR-4-14C3-M | 20 March 1997 | 1.67 | 2.17 | 484364.1 | 1351962.772 | Aluminum | 14800 | - | 10103 | mg/kg | NORMAL |
| NAR-3-3C-M | NAR-3-3C-M-D | 11 March 1997 | 2.42 | 2.92 | 482018.064118 | 1350924.56309 | Aluminum | 14800 | - | 10103 | mg/kg | DUPLICATE |
| 11100 | 121937 | 19930722 | 2.5 | 3 | 479666.408 | 1348782.927 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| ASI-16 | 103814 | 19921006 | 1 | 1.5 | 480032.518 | 1351803.984 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| 11137 | 70790 | 19930726 | 1.5 | 2 | 480455.661 | 1346777.394 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| 11091 | 70536 | 19930809 | 2.5 | 3 | 480583.929 | 1348987.876 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| 1574 | 56974 | 19901104 | 2 | 2.5 | 481695.198 | 1349694.301 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| 1578 | 56944 | 19901106 | 2 | 2.5 | 481705.457 | 1349575.901 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| 1966 | 112883 | 19930422 | 24 | 25 | 477269.346 | 1348031.368 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| NAR-6-10C-M | NAR-6-10C-M | 25 March 1997 | | | 483859.702179 | 1351639.42604 | Aluminum | 14700 | - | 10103 | mg/kg | NORMAL |
| 11201 | 121660 | 19930712 | 2.5 | 3 | 480527.276 | 1350433.352 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| SS-50 | 121009 | 19930629 | 0 | 0.5 | 480756.052 | 1350740.369 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| 11094 | 70586 | 19930809 | 6 | 6.5 | 480433.78 | 1349162.447 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| 1607 | 57232 | 19910202 | 4 | 4.5 | 480333.171 | 1350167.745 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| 1978 | 112584 | 19930416 | 9.5 | 11 | 477424.369 | 1348170.076 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-11-MP | OSB-3C-11-MP | 14 April 1997 | 0.5 | 0.83 | 480815 | 1350673 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |

000549



1621

000520

# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P18C-086216 | P18C-086216 | 27 November 1996 | 0 | 0.33 | 482216.27 | 1351086.3 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-4-MP | OSB-5C-4-MP | 9 April 1997 | 0.5 | 0.83 | 480935 | 1350697 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| P18-14C-801415 | P18-14C-801415 | 15 January 1997 | 0 | 0.33 | 482415 | 1350801 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| P18-14C-810450 | P18-14C-810450 | 15 January 1997 | 0 | 0.33 | 482450 | 1350810 | Aluminum | 14600 | - | 10103 | mg/kg | NORMAL |
| 11164 | 121383 | 19930710 | 3 | 4.5 | 480497.412 | 1346872.154 | Aluminum | 14500 | - | 10103 | mg/kg | NORMAL |
| 11194 | 122072 | 19930723 | 0 | 0.5 | 481671.306 | 1348699.774 | Aluminum | 14500 | - | 10103 | mg/kg | NORMAL |
| 1988 | 115350 | 19930512 | 2.5 | 5 | 482147.545 | 1348298.14 | Aluminum | 14500 | - | 10103 | mg/kg | NORMAL |
| OSB-1C-2-MP | OSB-1C-2-MP | 15 April 1997 | 0.5 | 0.83 | 480424 | 1350636 | Aluminum | 14500 | - | 10103 | mg/kg | NORMAL |
| O20-00C-4-M | O20-00C-4-M | 23 January 1997 | 0 | 0.33 | 483822 | 1350582 | Aluminum | 14500 | - | 10103 | mg/kg | NORMAL |
| P18C-150499 | P18C-150499 | 27 November 1996 | 0 | 0.33 | 482499.62 | 1351150.8 | Aluminum | 14500 | - | 10103 | mg/kg | NORMAL |
| NAR-5-13C-M | NAR-5-13C-M | 17 March 1997 | 1.08 | 1.42 | 482512.44831 | 1350955.71226 | Aluminum | 14500 | - | 10103 | mg/kg | NORMAL |
| 1513 | 53519 | 19900206 | 2 | 2.5 | 482578.884 | 1349482.362 | Aluminum | 14400 | - | 10103 | mg/kg | NORMAL |
| P1P2 | 99155 | 19930112 | 2 | 3 | 481213.216 | 1349102.938 | Aluminum | 14400 | - | 10103 | mg/kg | NORMAL |
| LSP-SB-06 | 114602 | 19930510 | 0.5 | 1 | 480749.991 | 1348206.437 | Aluminum | 14400 | - | 10103 | mg/kg | NORMAL |
| 11375 | 200113 | 19940707 | 0 | 0.17 | 478904.115 | 1351253.389 | Aluminum | 14400 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-14-MP | OSB-3C-14-MP | 14 April 1997 | 0.5 | 0.83 | 480898 | 1350625 | Aluminum | 14400 | - | 10103 | mg/kg | NORMAL |
| ASI-13 | 103745 | 19921001 | 1.5 | 2 | 480107.59 | 1351672.383 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| 1511 | 54439 | 19900205 | 2 | 2.5 | 482592.983 | 1349412.702 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-41 | 40301 | 19920428 | 0 | 0.5 | 481488.567 | 1348548.277 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| 1720 | 67307 | 19910810 | 3 | 4.5 | 482245.116 | 1348314.239 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| P1P12 | 99173 | 19930115 | 0 | 1 | 481667.177 | 1348812.624 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| LSP-SB-05 | 114600 | 19930510 | 0.5 | 1 | 480681.992 | 1348326.937 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| 1970 | 112893 | 19930418 | 9 | 10.5 | 477642.649 | 1347975.814 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-04 | 114476 | 19930502 | 0.5 | 1 | 480466.127 | 1348110.35 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| OSB-1C-15-MP | OSB-1C-15-MP | 15 April 1997 | 0.5 | 0.83 | 480671 | 1350680 | Aluminum | 14300 | J | 10103 | mg/kg | NORMAL |
| P19C2-M-2 | P19C2-M-2 | 14 March 1997 | 0 | 0.33 | 483780.45 | 1351030.82 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-14C-M | A1P1ST1-14C-M | 11 March 1997 | 0 | 0.33 | 482792 | 1351052 | Aluminum | 14300 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-55 | 40176 | 19920427 | 0 | 0.5 | 481393.765 | 1348414.398 | Aluminum | 14200 | NV | 10103 | mg/kg | NORMAL |
| 1992 | 115343 | 19930511 | 7.5 | 10 | 482272.486 | 1348301.818 | Aluminum | 14200 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-9-MP | OSB-3C-9-MP | 14 April 1997 | 0.5 | 0.83 | 480834 | 1350603 | Aluminum | 14200 | - | 10103 | mg/kg | NORMAL |
| OSB-1C-11-MP | OSB-1C-11-MP | 15 April 1997 | 0.5 | 0.83 | 480641 | 1350679 | Aluminum | 14200 | J | 10103 | mg/kg | NORMAL |
| P18-32C-801699 | P18-32C-801699 | 31 December 1996 | 0 | 0.33 | 482699.91 | 1350801.15 | Aluminum | 14200 | - | 10103 | mg/kg | NORMAL |
| P18-32C-801699 | P18-32C-801699 | 31 December 1996 | 0 | 0.33 | 482699.91 | 1350801.15 | Aluminum | 14200 | - | 10103 | mg/kg | NORMAL |
| 11040 | 115392 | 19930520 | 2.5 | 5 | 482210.825 | 1348249.909 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |
| 1412 | 55089 | 19890630 | 5.5 | 6 | 480731.76 | 1348929.095 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |
| 1720 | 67312 | 19910810 | 9 | 10.5 | 482245.116 | 1348314.239 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |
| 1618 | 64102 | 19910729 | 47.5 | 48.5 | 480336.434 | 1347106.325 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |
| P18-32C-835773 | P18-32C-835773 | 31 December 1996 | 0 | 0.33 | 482773.62 | 1350835.21 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |
| P18-32C-835773 | P18-32C-835773 | 31 December 1996 | 0 | 0.33 | 482773.62 | 1350835.21 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |
| O19-00C-15-M | O19-00C-15-M | 28 January 1997 | 0 | 0.33 | 483740 | 1350271 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O19-00C-15-M | O19-00C-15-M | 28 January 1997 | 0 | 0.33 | 483740 | 1350271 | Aluminum | 14100 | - | 10103 | mg/kg | NORMAL |
| Q20C-714120 | Q20C-714120 | 11 February 1997 | | | 484120.22 | 1351714.61 | Aluminum | 14100 | R | 10103 | mg/kg | NORMAL |
| PA-SS-12 | 122215 | 19930721 | 1 | 1.5 | 480357.62 | 1348415.951 | Aluminum | 14000 | - | 10103 | mg/kg | NORMAL |
| 11038 | 115377 | 19930516 | 12.5 | 15 | 482144.675 | 1348277.52 | Aluminum | 14000 | - | 10103 | mg/kg | NORMAL |
| P17-22C-332565 | P17-22C-332565 | 6 December 1996 | 0 | 0.33 | 481565.63 | 1351332.63 | Aluminum | 14000 | - | 10103 | mg/kg | NORMAL |
| P17-22C-332565 | P17-22C-332565 | 6 December 1996 | 0 | 0.33 | 481565.63 | 1351332.63 | Aluminum | 14000 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-15-MP | PUMP-C-15-MP | 21 January 1997 | 0.5 | 0.83 | 479522.17 | 1350611.17 | Aluminum | 14000 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-15-MP | PUMP-C-15-MP | 21 January 1997 | 0.5 | 0.83 | 479522.17 | 1350611.17 | Aluminum | 14000 | - | 10103 | mg/kg | NORMAL |
| P17-22C2-M-7 | P17-22C2-M-7 | 24 March 1997 | 0 | 0.33 | 481255.76 | 1351377.6 | Aluminum | 14000 | - | 10103 | mg/kg | NORMAL |
| ASI-19 | 103660 | 19920929 | 0.33 | 0.5 | 479988.014 | 1351529.085 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| 11052 | 116427 | 19930525 | 19 | 21 | 478041.847 | 1347538.43 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-60 | 40206 | 19920427 | 0 | 0.5 | 481389.278 | 1348578.378 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| 1983 | 111477 | 19930503 | 2.5 | 5 | 482202.713 | 1348124.69 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| 1608 | 57276 | 19910225 | 4 | 4.5 | 480278.82 | 1350167.236 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| PA-SS-18 | 122242 | 19930723 | 1 | 1.5 | 480350.098 | 1349938.406 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| P1P4 | 99202 | 19930201 | 0 | 1 | 481503.563 | 1348618.127 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| 1577 | 56932 | 19901106 | 0.5 | 1 | 481636.566 | 1349583.052 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| 1968 | 112849 | 19930420 | 15.5 | 16.5 | 477394.328 | 1348121.576 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| NAR-4-11C2-M | NAR-4-11C2-M | 12 March 1997 | 1.08 | 1.58 | 484001.4075 | 1351719.004 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| NAR-4-10C-M | NAR-4-10C-M | 11 March 1997 | 2.25 | 2.58 | 483888.042746 | 1351625.94227 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| Q20C2-M-5 | Q20C2-M-5 | 14 March 1997 | 0 | 0.33 | 484426.38 | 1352121.05 | Aluminum | 13900 | - | 10103 | mg/kg | NORMAL |
| 11097 | 121449 | 19930713 | 0 | 0.5 | 479875.939 | 1348734.945 | Aluminum | 13800 | - | 10103 | mg/kg | NORMAL |
| SWL-SS-04 | 111300 | 19930401 | 0 | 0.5 | 482192.773 | 1348105.11 | Aluminum | 13800 | J | 10103 | mg/kg | NORMAL |
| 11148 | 122302 | 19930723 | 5 | 5.5 | 480458.361 | 1346815.294 | Aluminum | 13800 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-1-MP | PUMP1-C-1-MP | 7 March 1997 | 0 | 0.33 | 479461 | 1350576 | Aluminum | 13800 | J | 10103 | mg/kg | NORMAL |
| NAR-6-12C-M | NAR-6-12C-M | 12 March 1997 | 2 | 2.33 | 484086.812122 | 1351798.09259 | Aluminum | 13800 | - | 10103 | mg/kg | NORMAL |
| NAR-1-9C-MP | NAR-1-9C-MP | 9 March 1997 | 0.67 | 1 | 482343.55545 | 1350908.55081 | Aluminum | 13800 | - | 10103 | mg/kg | NORMAL |
| 11040 | 115393 | 19930520 | 12.5 | 15 | 482210.825 | 1348249.909 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| 36 | 20105 | 19880315 | 1 | 2.5 | 481829.419 | 1350480.967 | Aluminum | 13700 | NV | 10103 | mg/kg | NORMAL |
| 36 | 20104 | 19880315 | 1 | 2.5 | 481829.419 | 1350480.967 | Aluminum | 13700 | NV | 10103 | mg/kg | NORMAL |
| PLANT1PAD-52 | 40228 | 19920427 | 0 | 0.5 | 481423.87 | 1348513.688 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| 11088 | 121169 | 19930710 | 6 | 6.5 | 481688.606 | 1349539.452 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| ESA-8 | 99254 | 19930128 | 0 | 0.5 | 479762.478 | 1350348.582 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| LSP-SB-07 | 114576 | 19930506 | 0.5 | 1 | 480608.989 | 1348199.438 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| LSP-SB-04 | 114570 | 19930506 | 0.5 | 1 | 480538.74 | 1348321.439 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| WP-SS-10 | 123226 | 19930708 | 0 | 0.5 | 481516.99 | 1347563.94 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-7-MP | OSB-3C-7-MP | 14 April 1997 | 0.5 | 0.83 | 480768 | 1350654 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-6-MP | OSB-5C-6-MP | 9 April 1997 | 0.5 | 0.83 | 480974 | 1350628 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| P20-00C-3-M | P20-00C-3-M | 29 January 1997 | 0 | 0.33 | 483825.59 | 1351082.01 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |
| NAR-2-14C-M | NAR-2-14C-M | 8 March 1997 | | | 484369.786784 | 1351925.62824 | Aluminum | 13700 | - | 10103 | mg/kg | NORMAL |

000522

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASI-8 | 103686 | 19920930 | 0.5 | 1 | 480249.58 | 1351462.542 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| 1345 | 50159 | 19890829 | 1 | 1.5 | 481269.872 | 1348675.479 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| 1666 | 57024 | 19901218 | 0.5 | 1 | 480614.682 | 1348442.577 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| 11096 | 122985 | 19930805 | 2.5 | 3 | 479963.416 | 1348447.695 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P17-22C-377255 | P17-22C-377255 | 6 December 1996 | 0 | 0.33 | 481255.76 | 1351377.58 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P17-22C-377255 | P17-22C-377255 | 6 December 1996 | 0 | 0.33 | 481255.76 | 1351377.58 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| O20-00C-8B-M | O20-00C-8B-M | 27 January 1997 | 0 | 0.33 | 483974 | 1350487 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P18-12C-873323 | P18-12C-873323 | 26 December 1996 | 0 | 0.33 | 482323.4 | 1350873.73 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P18-31C-642718 | P18-31C-642718 | 31 December 1996 | 0 | 0.33 | 482718.27 | 1350642.63 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P18-13C-604590 | P18-13C-604590 | 18 December 1996 | | | 482590 | 1350604.8 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P17-34C-824125 | P17-34C-824125 | 30 December 1996 | 0 | 0.33 | 482125.34 | 1350824.35 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P17-34C-824125 | P17-34C-824125 | 30 December 1996 | 0 | 0.33 | 482125.34 | 1350824.35 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| P19C-267676 | P19C-267676 | 15 January 1997 | 0 | 0.33 | 483676.1 | 1351267.69 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| Q20C2-M-4 | Q20C2-M-4 | 14 March 1997 | 0 | 0.33 | 484534.77 | 1351979.18 | Aluminum | 13600 | - | 10103 | mg/kg | NORMAL |
| PA-SS-09 | 121702 | 19930714 | 1 | 1.5 | 481234.184 | 1349713.116 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-68 | 40130 | 19920408 | 0 | 0.5 | 481326.377 | 1348478.199 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| 11219 | 70604 | 19930809 | 0.5 | 1 | 480456.68 | 1346755.654 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| WPA16 | 61107 | 19910425 | 0 | 0.5 | 481157.772 | 1347165.485 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| PA-SS-15 | 122261 | 19930725 | 1 | 1.5 | 479850.531 | 1348118.217 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| 1792 | 67343 | 19910821 | 1.5 | 3 | 477309.495 | 1347903.568 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| P1P12 | 99176 | 19930115 | 2 | 3 | 481667.177 | 1348812.624 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-12-MP | PUMP1-C-12-MP | 9 March 1997 | 0 | 0.33 | 479511 | 1350630 | Aluminum | 13500 | J | 10103 | mg/kg | NORMAL |
| NAR-2-5C-M | NAR-2-5C-M-D | 11 March 1997 | 0.58 | 0.92 | 483266.470072 | 1351190.10582 | Aluminum | 13500 | - | 10103 | mg/kg | DUPLICATE |
| O20-00C-10-M | O20-00C-10-M | 27 January 1997 | 0 | 0.33 | 484013 | 1350165 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| OSB-1C-8-MP | OSB-1C-8-MP | 15 April 1997 | 0.5 | 0.83 | 480574 | 1350653 | Aluminum | 13500 | J | 10103 | mg/kg | NORMAL |
| NAR-3-3C-M | NAR-3-3C-M | 11 March 1997 | 2.42 | 2.92 | 482018.064118 | 1350924.56309 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-7-MP | OSB-2C-7-MP | 1 April 1997 | 0.5 | 0.83 | 480684 | 1350811 | Aluminum | 13500 | - | 10103 | mg/kg | NORMAL |
| ASI-19 | 103663 | 19920929 | 0.5 | 1 | 479988.014 | 1351529.085 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-21 | 121139 | 19930702 | 0 | 0.5 | 483012.247 | 1347815.001 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| 11094 | 70594 | 19930809 | 9 | 9.5 | 480433.78 | 1349162.447 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| WP-SS-23 | 123287 | 19930711 | 0 | 0.5 | 481901.991 | 1346538.938 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| WP-SS-07 | 123219 | 19930707 | 0 | 0.5 | 482023.989 | 1347938.932 | Aluminum | 13400 | J | 10103 | mg/kg | NORMAL |
| NAR-1-4C-MP | NAR-1-4C-MP | 10 March 1997 | 1 | 1.33 | 482060.542561 | 1350905.60044 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-12-MP | OSB-3C-12-MP-D | 15 April 1997 | 0.5 | 0.83 | 480825 | 1350704 | Aluminum | 13400 | - | 10103 | mg/kg | DUPLICATE |
| Q18C-845776 | Q18C-845776 | 13 November 1996 | 0 | 0.33 | 482776.59 | 1351845.42 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| P18-14C-855515 | P18-14C-855515 | 15 January 1997 | 0 | 0.33 | 482515 | 1350855 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| Q20C2-M-1 | Q20C2-M-1 | 17 March 1997 | 0 | 0.33 | 484289.89 | 1351454.5 | Aluminum | 13400 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-4-MP | OSB-4C-4-MP-D | 7 April 1997 | 0.5 | 0.83 | 480898 | 1350835 | Aluminum | 13400 | J | 10103 | mg/kg | DUPLICATE |
| 11201 | 121651 | 19930712 | 0 | 0.5 | 480527.276 | 1350433.352 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-83 | 40051 | 19920408 | 0 | 0.5 | 481227.988 | 1348475.51 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1512 | 51679 | 19900206 | 2 | 2.5 | 482570.973 | 1349457.062 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| 11088 | 121160 | 19930709 | 2.5 | 3 | 481688.606 | 1349539.452 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| 11143 | 122594 | 19930728 | 5.5 | 6 | 480451.961 | 1346796.294 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| 1661 | 57014 | 19901218 | 0.5 | 1 | 480291.014 | 1350475.895 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| 11378 | 200157 | 19940708 | 0 | 0.17 | 484405.821 | 1352071.963 | Aluminum | 13300 | J | 10103 | mg/kg | NORMAL |
| PUMP1-C-7-MP | PUMP1-C-7-MP | 9 March 1997 | 0 | 0.33 | 479484 | 1350617 | Aluminum | 13300 | J | 10103 | mg/kg | NORMAL |
| OSB-1C-4-MP | OSB-1C-4-MP | 15 April 1997 | 0.5 | 0.83 | 480497 | 1350644 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| P17-32C-841737 | P17-32C-841737 | 18 December 1996 | 0 | 0.33 | 481737 | 1350841 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| NAR-2-16C-M | NAR-2-16C-M | 8 March 1997 | | | 484539.330224 | 1352051.62832 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-5C-M | A1P1ST1-5C-M | 11 March 1997 | 0.42 | 0.75 | 482761 | 1351024 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| P18-14C2-1-M | P18-14C2-1-M | 11 March 1997 | 0 | 0.33 | 482588 | 1350805 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| Q20C2-M-3 | Q20C2-M-3 | 14 March 1997 | 0 | 0.33 | 484157.41 | 1351993.9 | Aluminum | 13300 | - | 10103 | mg/kg | NORMAL |
| ASI-16 | 103811 | 19921006 | 0.5 | 1 | 480032.518 | 1351803.984 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 1471 | 55972 | 19891116 | 5 | 5.25 | 477424.349 | 1348170.026 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| SS-32 | 121093 | 19930708 | 0 | 0.5 | 480974.666 | 1346789.288 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 11091 | 70564 | 19930809 | 12 | 12.5 | 480583.929 | 1348987.876 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 11103 | 122603 | 19930727 | 6 | 6.5 | 480729.83 | 1348966.965 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 1613 | 57407 | 19910129 | 4 | 4.5 | 480312.562 | 1350244.775 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 11103 | 122186 | 19930727 | 1 | 1.5 | 480729.83 | 1348966.965 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 1793 | 67333 | 19910815 | 3 | 4.5 | 477494.328 | 1347977.785 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 1574 | 56977 | 19901104 | 3.5 | 4 | 481695.198 | 1349694.301 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 1579 | 56954 | 19901102 | 2 | 2.5 | 481705.077 | 1349576.061 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-3-MP | PUMP1-C-3-MP | 7 March 1997 | 0 | 0.33 | 479460 | 1350617 | Aluminum | 13200 | J | 10103 | mg/kg | NORMAL |
| OSB-5C-10-MP | OSB-5C-10-MP-D | 8 April 1997 | 0.5 | 0.83 | 481027 | 1350640 | Aluminum | 13200 | - | 10103 | mg/kg | DUPLICATE |
| PUMP-C-6-MP | PUMP-C-6-MP | 21 January 1997 | 0.5 | 0.83 | 479484.1 | 1350602.14 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-6-MP | PUMP-C-6-MP | 21 January 1997 | 0.5 | 0.83 | 479484.1 | 1350602.14 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| P17-32C-824828 | P17-32C-824828 | 18 December 1996 | 0 | 0.33 | 481828.87 | 1350824.7 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-2-MP | OSB-5C-2-MP | 9 April 1997 | 0.5 | 0.83 | 480959 | 1350651 | Aluminum | 13200 | - | 10103 | mg/kg | NORMAL |
| 11163 | 121620 | 19930711 | 3 | 4.5 | 480507.412 | 1346872.154 | Aluminum | 13100 | - | 10103 | mg/kg | NORMAL |
| 11109 | 121991 | 19930724 | 2.5 | 3 | 479750.119 | 1349623.424 | Aluminum | 13100 | - | 10103 | mg/kg | NORMAL |
| P1P2 | 99154 | 19930112 | 0 | 1 | 481213.216 | 1349102.938 | Aluminum | 13100 | - | 10103 | mg/kg | NORMAL |
| Q19C-890780 | Q19C-890780 | 5 November 1996 | 0 | 0.33 | 483780.719 | 1351890.339 | Aluminum | 13100 | - | 10103 | mg/kg | NORMAL |
| Q17C-556087 | Q17C-556087 | 14 November 1996 | 0 | 0.33 | 482087.31 | 1351556.73 | Aluminum | 13100 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-8-MP | PUMP-C-8-MP | 21 January 1997 | 0.5 | 0.83 | 479474.03 | 1350633.35 | Aluminum | 13100 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-8-MP | PUMP-C-8-MP | 21 January 1997 | 0.5 | 0.83 | 479474.03 | 1350633.35 | Aluminum | 13100 | - | 10103 | mg/kg | NORMAL |
| 11163 | 121616 | 19930711 | 4.5 | 6 | 480507.412 | 1346872.154 | Aluminum | 13000 | - | 10103 | mg/kg | NORMAL |
| 1346 | 54616 | 19900107 | 1.5 | 2 | 481275.062 | 1348709.879 | Aluminum | 13000 | - | 10103 | mg/kg | NORMAL |
| 11221 | 70635 | 19930810 | 0 | 0.5 | 480448.63 | 1346771.825 | Aluminum | 13000 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-08 | 114490 | 19930503 | 0.5 | 1 | 480635.278 | 1348066.798 | Aluminum | 13000 | - | 10103 | mg/kg | NORMAL |
| WP-SS-08 | 123220 | 19930707 | 0 | 0.5 | 481929.989 | 1347939.934 | Aluminum | 13000 | J | 10103 | mg/kg | NORMAL |

000523



1621

000524

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P17-40C-034144 | P17-40C-034144 | 21 March 1997 | 0 | 0.33 | 482144.68 | 1351034.77 | Aluminum | 13000 | - | 10103 | mg/kg | NORMAL |
| P17-40C-034144 | P17-40C-034144 | 21 March 1997 | 0 | 0.33 | 482144.68 | 1351034.77 | Aluminum | 13000 | - | 10103 | mg/kg | NORMAL |
| P19C-037553 | P19C-037553 | 28 January 1997 | 0 | 0.33 | 483553 | 1351037 | Aluminum | 13000 | - | 10103 | mg/kg | NORMAL |
| 11153 | 121633 | 19930715 | 2.5 | 3.5 | 480474.661 | 1346834.194 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| ASI-19 | 103654 | 19920929 | 0 | 0.17 | 479988.014 | 1351529.085 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| WPA31 | 61212 | 19910424 | 0 | 0.5 | 480503.267 | 1347281.192 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| 1613 | 57408 | 19910129 | 4.5 | 5 | 480312.562 | 1350244.775 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| NAR-2-8C-M | NAR-2-8C-M | 11 March 1997 | 0.83 | 1.17 | 483611.135174 | 1351433.80638 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| P18-32C-885708 | P18-32C-885708 | 31 December 1996 | 0 | 0.33 | 482708.08 | 1350885.24 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| P18-32C-885708 | P18-32C-885708 | 31 December 1996 | 0 | 0.33 | 482708.08 | 1350885.24 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| P18-11C-685205 | P18-11C-685205 | 17 December 1996 | | | 482205.16 | 1350685.59 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-13C-M | A1P1ST1-13C-M | 11 March 1997 | 0 | 0.33 | 482810 | 1351050 | Aluminum | 12900 | - | 10103 | mg/kg | NORMAL |
| 11200 | 122479 | 19930725 | 2.5 | 3 | 479642.49 | 1348979.987 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| P1P61 | 61450 | 19910517 | 0 | 0.5 | 481689.294 | 1348519.375 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| 1573 | 56908 | 19901101 | 2 | 2.5 | 481621.035 | 1349517.533 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-07 | 114477 | 19930502 | 0 | 0.5 | 480618.091 | 1348323.908 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| 11187 | 112526 | 19930413 | 9 | 10.5 | 477934.364 | 1348161.27 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| 11096 | 122969 | 19930805 | 6 | 6.5 | 479963.416 | 1348447.695 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| P18-32C2-M-1 | P18-32C2-M-1 | 14 March 1997 | 0 | 0.33 | 482790.16 | 1350811.83 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| NAR-4-16C3-M | NAR-4-16C3-M | 20 March 1997 | 1.58 | 2.08 | 484528.99 | 1352072.391 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| NAR-4-16C11-M | NAR-4-16C11-M | 20 March 1997 | 5.58 | 5.82 | 484528.99 | 1352072.391 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-14-MP | OSB-5C-14-MP | 8 April 1997 | 0.5 | 0.83 | 481123 | 1350646 | Aluminum | 12800 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-31 | 121254 | 19930710 | 0 | 0.5 | 481078.499 | 1347816.474 | Aluminum | 12700 | J | 10103 | mg/kg | NORMAL |
| 1737 | 101358 | 19920106 | 0 | 0.5 | 483335.434 | 1350487.95 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| 1288 | 53474 | 19890618 | 0.5 | 1 | 481673.348 | 1349719.421 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| 11108 | 122094 | 19930724 | 1 | 1.5 | 479873.665 | 1350027.391 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-14 | 114516 | 19930505 | 0 | 0.5 | 480781.92 | 1348108.497 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-03 | 114469 | 19930501 | 0.5 | 1 | 480463.999 | 1348267.02 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| 11374 | 200099 | 19940707 | 0 | 0.17 | 478230.275 | 1350480.989 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-11-MP | OSB-5C-11-MP | 8 April 1997 | 0.5 | 0.83 | 481046 | 1350665 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| P17-40C-242116 | P17-40C-242116 | 4 December 1996 | 0 | 0.33 | 482116.91 | 1351242.49 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| P17-40C-242116 | P17-40C-242116 | 4 December 1996 | 0 | 0.33 | 482116.91 | 1351242.49 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| P18-31C-771742 | P18-31C-771742 | 31 December 1996 | 0 | 0.33 | 482742.45 | 1350771.07 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| NAR-4-15C2-M | NAR-4-15C2-M | 12 March 1997 | 1 | 1.5 | 484455.1237 | 1352022.745 | Aluminum | 12700 | - | 10103 | mg/kg | NORMAL |
| 11201 | 121655 | 19930712 | 1 | 1.5 | 480527.276 | 1350433.352 | Aluminum | 12600 | - | 10103 | mg/kg | NORMAL |
| 11104 | 122634 | 19930728 | 6 | 6.5 | 480440.862 | 1349327.557 | Aluminum | 12600 | - | 10103 | mg/kg | NORMAL |
| NAR-4-14C3-M | NAR-4-14C3-M-D | 20 March 1997 | 1.67 | 2.17 | 484364.1 | 1351962.772 | Aluminum | 12600 | - | 10103 | mg/kg | DUPLICATE |
| A1P1ST1-16C-M | A1P1ST1-16C-M | 11 March 1997 | 0 | 0.33 | 482806 | 1351131 | Aluminum | 12600 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-8-MP | OSB-2C-8-MP-D | 1 April 1997 | 0.5 | 0.83 | 480702 | 1350837 | Aluminum | 12600 | - | 10103 | mg/kg | DUPLICATE |
| 11203 | 121501 | 19930711 | 0 | 0.5 | 482395.817 | 1348273.787 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11188 | 110547 | 19930402 | 4.5 | 6 | 477872.992 | 1348010.891 | Aluminum | 12500 | J | 10103 | mg/kg | NORMAL |
| WPA41 | 61282 | 19910422 | 0 | 0.5 | 481932.79 | 1348086.973 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |
| 11142 | 122274 | 19930806 | 5.5 | 6 | 480461.961 | 1346796.294 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |
| 1721 | 67237 | 19910727 | 13.5 | 15 | 482165.795 | 1348316.31 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |
| FT-1 | 99236 | 19921229 | 1 | 1.5 | 482281.552 | 1348729.117 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |
| 11371 | 200057 | 19940710 | 0 | 0.17 | 478098.33 | 1348126.018 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |
| NAR-3-14C-M | NAR-3-14C-M | 11 March 1997 | 2.08 | 2.42 | 482597.051949 | 1350935.27073 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |
| P18C-173868 | P18C-173868 | 27 November 1996 | 0 | 0.33 | 482868.9 | 1351173.52 | Aluminum | 12500 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-84 | 40058 | 19920408 | 0 | 0.5 | 481227.09 | 1348508.3 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| 1252 | 52754 | 19890615 | 0.5 | 1 | 479834.395 | 1348442.497 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| 1515 | 52259 | 19900207 | 2 | 2.5 | 482561.514 | 1349480.272 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-23 | 40397 | 19920609 | 0 | 0.5 | 481586.953 | 1348550.966 | Aluminum | 12400 | J | 10103 | mg/kg | NORMAL |
| 11103 | 122191 | 19930727 | 2.5 | 3 | 480729.83 | 1348966.965 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| FT-4 | 99233 | 19921217 | 1 | 1.5 | 482228.89 | 1349428.556 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| 1661 | 57013 | 19901218 | 0 | 0.5 | 480291.014 | 1350475.895 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| WP-SS-13 | 123247 | 19930709 | 0 | 0.5 | 481231.992 | 1347146.934 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| P18-13C-766516 | P18-13C-766516 | 19 December 1996 | | | 482520.97 | 1350766.91 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| P18-13C-766516 | P18-13C-766516 | 19 December 1996 | | | 482520.97 | 1350766.91 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| P20-00C-2-M | P20-00C-2-M | 29 January 1997 | 0 | 0.33 | 483934.38 | 1350965.04 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| NAR-5-6C-M | NAR-5-6C-M | 19 March 1997 | | | 482194.814305 | 1350936.90697 | Aluminum | 12400 | - | 10103 | mg/kg | NORMAL |
| 1735 | 101372 | 19920107 | 0 | 0.5 | 483329.415 | 1349030.954 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| 1997 | 116177 | 19930505 | 0 | 1.5 | 477900.476 | 1347491.522 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| 11151 | 122032 | 19930716 | 0.5 | 1 | 480494.662 | 1346834.194 | Aluminum | 12300 | J | 10103 | mg/kg | NORMAL |
| 500318/SS-08 | 121109 | 19930629 | 0 | 0.5 | 482714.208 | 1350482.487 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| SS-39 | 121089 | 19930707 | 0 | 0.5 | 479207.638 | 1348310.314 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| 1983 | 111476 | 19930503 | 1.5 | 2.5 | 482202.713 | 1348124.69 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| 11086 | 122655 | 19930726 | 1 | 1.5 | 482295.759 | 1350084.253 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| 1571 | 56878 | 19901018 | 0.5 | 1 | 481706.916 | 1349526.441 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-04 | 114474 | 19930502 | 0 | 0.5 | 480466.127 | 1348110.35 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| P18-32C2-M-5 | P18-32C2-M-5 | 14 March 1997 | 0 | 0.33 | 482695.39 | 1350863.02 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| O19-00C-10-M | O19-00C-10-M | 23 January 1997 | 0 | 0.33 | 483546 | 1350022 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| O19-00C-10-M | O19-00C-10-M | 23 January 1997 | 0 | 0.33 | 483546 | 1350022 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| O19-00C-9-M | O19-00C-9-M | 23 January 1997 | 0 | 0.33 | 483485 | 1349966 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| O19-00C-9-M | O19-00C-9-M | 23 January 1997 | 0 | 0.33 | 483485 | 1349966 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| NAR-5-16C-M | NAR-5-16C-M | 19 March 1997 | | | 482664.302582 | 1350965.62586 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| NAR-4-8C2-M | NAR-4-8C2-M | 11 March 1997 | 1.25 | 1.75 | 483599.5022 | 1351429.602 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| P17-22C2-M-3 | P17-22C2-M-3 | 24 March 1997 | 0 | 0.33 | 481438.69 | 1351345.5 | Aluminum | 12300 | - | 10103 | mg/kg | NORMAL |
| 11051 | 116441 | 19930527 | 22 | 24 | 478014.937 | 1347557.381 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| 1995 | 116172 | 19930502 | 30 | 31.5 | 477799.526 | 1347585.783 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-86 | 40014 | 19920408 | 0 | 0.5 | 481196.986 | 1348409.021 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |

000525



1621

000526

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| PA-SS-11 | 122202 | 19930716 | 1 | 1.5 | 480762.184 | 1348449.296 | Aluminum | 12200 | J | 10103 | mg/kg | NORMAL |
| 1795 | 67370 | 19910823 | 3 | 4 | 477970.784 | 1348179.509 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| 1974 | 56917 | 19901025 | 2 | 2.5 | 481697.198 | 1349694.301 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-08 | 114488 | 19930503 | 0 | 0.5 | 480635.278 | 1348066.798 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-11 | 114500 | 19930504 | 0.5 | 1 | 480753.09 | 1348121.227 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| 1971 | 112593 | 19930415 | 9.5 | 11 | 477738.361 | 1348097.062 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| 11368 | 200015 | 19940709 | 0 | 0.17 | 482322.659 | 1346379.424 | Aluminum | 12200 | J | 10103 | mg/kg | NORMAL |
| 11098 | 122794 | 19930806 | 2.5 | 3 | 479780.865 | 1348460.627 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| P17-31C-672873 | P17-31C-672873 | 10 December 1996 | 0 | 0.33 | 481873.83 | 1350672.47 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| P17-31C-672873 | P17-31C-672873 | 10 December 1996 | 0 | 0.33 | 481873.83 | 1350672.47 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| P18-11C-635269 | P18-11C-635269 | 17 December 1996 | | | 482269.59 | 1350635.59 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| P19C-033360 | P19C-033360 | 8 January 1997 | 0 | 0.33 | 483360 | 1351033 | Aluminum | 12200 | - | 10103 | mg/kg | NORMAL |
| 1620 | 99469 | 19910515 | 4 | 5 | 480432.193 | 1346971.704 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| P1P5 | 99177 | 19930119 | 0 | 1 | 481532.915 | 1348785.056 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| 1965 | 110351 | 19930322 | 0 | 0.5 | 477376.357 | 1348005.637 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-10-MP | OSB-5C-10-MP | 8 April 1997 | 0.5 | 0.83 | 481027 | 1350640 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| Q20C-006313 | Q20C-006313 | 10 February 1997 | 0 | 0.33 | 484313.74 | 1352006.2 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| O20-00C-6-M | O20-00C-6-M | 27 January 1997 | 0 | 0.33 | 483970 | 1350144 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| P17-33C-628166 | P17-33C-628166 | 11 December 1996 | | | 482166.72 | 1350628.54 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| P17-33C-628166 | P17-33C-628166 | 11 December 1996 | | | 482166.72 | 1350628.54 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| P18-11C-678297 | P18-11C-678297 | 17 December 1996 | | | 482297.19 | 1350678.27 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| NAR-6-16C-M | NAR-6-16C-M | 20 March 1997 | 1 | 1.33 | 484508.15991 | 1352080.07848 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| N19-00C-11-M | N19-00C-11-M | 27 February 1997 | | | 483728.448 | 1349586.1 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-6-MP | OSB-4C-6-MP | 7 April 1997 | 0.5 | 0.83 | 480973 | 1350759 | Aluminum | 12100 | - | 10103 | mg/kg | NORMAL |
| PA-SS-05 | 121716 | 19930715 | 1 | 1.5 | 480989.483 | 1348224.434 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| 11099 | 121405 | 19930710 | 1 | 1.5 | 479770.905 | 1348509.817 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| PA-SS-18 | 122243 | 19930723 | 0 | 0.5 | 480350.098 | 1349938.406 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| P1P8 | 99168 | 19930114 | 2 | 3 | 481538.018 | 1349024.425 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| 1975 | 112550 | 19930413 | 8.5 | 10.5 | 477898.365 | 1348315.08 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| NAR-3-12C-M | NAR-3-12C-M | 11 March 1997 | 1.83 | 2.17 | 482499.189192 | 1350925.37753 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-15-MP | PUMP1-C-15-MP | 9 March 1997 | 0 | 0.33 | 479520 | 1350607 | Aluminum | 12000 | J | 10103 | mg/kg | NORMAL |
| PUMP-C-14-MP | PUMP-C-14-MP | 21 January 1997 | 0.5 | 0.83 | 479536.09 | 1350592.02 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-14-MP | PUMP-C-14-MP | 21 January 1997 | 0.5 | 0.83 | 479536.09 | 1350592.02 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| P17-34C-877017 | P17-34C-877017 | 19 December 1996 | 0 | 0.33 | 482017.59 | 1350877.54 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| P17-34C-877017 | P17-34C-877017 | 19 December 1996 | 0 | 0.33 | 482017.59 | 1350877.54 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| NAR-6-15C-M | NAR-6-15C-M | 20 March 1997 | 1 | 1.33 | 484487.397352 | 1352069.73845 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-3-MP | OSB-2C-3-MP | 1 April 1997 | 0.5 | 0.83 | 480639 | 1350792 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| P17-22C2-M-6 | P17-22C2-M-6 | 24 March 1997 | 0 | 0.33 | 481464.29 | 1351374.9 | Aluminum | 12000 | - | 10103 | mg/kg | NORMAL |
| 1679 | 100422 | 19920127 | 0 | 0.5 | 483953.923 | 1346795.563 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1288 | 53473 | 19890618 | 0 | 0.5 | 481673.348 | 1349719.421 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| 1266 | 18421 | 19890613 | 0 | 0.5 | 479743.008 | 1348744.487 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| 1979 | 112123 | 19930511 | 25.5 | 27.5 | 477270.891 | 1348424.387 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| 11220 | 70633 | 19930810 | 0.5 | 1 | 480451.35 | 1346749.275 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| ESA-9 | 99255 | 19920128 | 0 | 0.5 | 479757.118 | 1350348.372 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-12 | 114501 | 19930504 | 0 | 0.5 | 480748.682 | 1348275.506 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-12 | 114503 | 19930504 | 0.5 | 1 | 480748.682 | 1348275.506 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| WP-SS-05 | 123214 | 19930707 | 0 | 0.5 | 482342.468 | 1347557.71 | Aluminum | 11900 | J | 10103 | mg/kg | NORMAL |
| P17-32C2-M-2 | P17-32C2-M-2 | 21 March 1997 | 0 | 0.33 | 481969.69 | 1350837.79 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| Q20C-870102 | Q20C-870102 | 10 February 1997 | 0 | 0.33 | 484102.32 | 1351870.44 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| P18-14C-803468 | P18-14C-803468 | 15 January 1997 | 0 | 0.33 | 482468 | 1350803 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| N19-00C-15-M | N19-00C-15-M | 27 February 1997 | | | 484014.634 | 1349584.372 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| NAR-5-1C-M | NAR-5-1C-M | 19 March 1997 | 0.67 | 1 | 481905.557672 | 1350943.80625 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| NAR-4-13C2-M | NAR-4-13C2-M | 12 March 1997 | 1.5 | 2 | 484251.0076 | 1351871.098 | Aluminum | 11900 | - | 10103 | mg/kg | NORMAL |
| SMA-5 | 99268 | 19930204 | 0 | 0.5 | 481858.57 | 1350499.577 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| 1621 | 99580 | 19910523 | 5 | 6 | 480547.164 | 1346973.953 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| FT-3 | 99229 | 19921216 | 1 | 1.5 | 482281.931 | 1349514.095 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| 1575 | 56894 | 19901024 | 4 | 4.5 | 481640.888 | 1349732.572 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| WP-SS-04 | 123208 | 19930702 | 0 | 0.5 | 482334.995 | 1347380.94 | Aluminum | 11800 | J | 10103 | mg/kg | NORMAL |
| P18-32C-989652 | P18-32C-989652 | 6 December 1996 | 0 | 0.33 | 482652 | 1350989 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| P17-33C-725110 | P17-33C-725110 | 11 December 1996 | | | 482110.92 | 1350725.12 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| P17-33C-725110 | P17-33C-725110 | 11 December 1996 | | | 482110.92 | 1350725.12 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-13C-M | A1P1ST1-13C-M-D | 11 March 1997 | 0 | 0.33 | 482810 | 1351050 | Aluminum | 11800 | - | 10103 | mg/kg | DUPLICATE |
| NAR-4-7C-M | NAR-4-7C-M | 13 March 1997 | 1.08 | 1.42 | 483454.21846 | 1351342.80009 | Aluminum | 11800 | - | 10103 | mg/kg | NORMAL |
| 11202 | 121523 | 19930713 | 0 | 0.5 | 482383.356 | 1348187.888 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| 1587 | 56639 | 19901016 | 0.5 | 1 | 481091.72 | 1349498.369 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| 1585 | 56602 | 19900926 | 4 | 4.5 | 481133.832 | 1349644.528 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| WPA14 | 61093 | 19910425 | 0 | 0.5 | 481063.268 | 1346962.887 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| P1P14 | 99192 | 19930126 | 2 | 3 | 481185.119 | 1348506.981 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| 1974 | 56914 | 19901024 | 0.5 | 1 | 481697.198 | 1349694.301 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| 11102 | 122839 | 19930809 | 2.5 | 3 | 480736.289 | 1348918.995 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| 11368 | 200016 | 19940709 | 2 | 2.5 | 482322.659 | 1346379.424 | Aluminum | 11700 | J | 10103 | mg/kg | NORMAL |
| O18-00C-6-MP | O18-00C-6-MP | 20 February 1997 | | | 482797 | 1350360 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-5-MP | OSB-4C-5-MP | 7 April 1997 | 0.5 | 0.83 | 480955 | 1350738 | Aluminum | 11700 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-49 | 121054 | 19930629 | 0 | 0.5 | 480228.243 | 1351216.953 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-45 | 121018 | 19930630 | 0 | 0.5 | 476603.205 | 1348502.724 | Aluminum | 11600 | J | 10103 | mg/kg | NORMAL |
| 11135 | 70795 | 19930727 | 5.5 | 6 | 480475.661 | 1346777.394 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| P1P64 | 61472 | 19910519 | 0 | 0.5 | 481891.995 | 1348503.772 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| 11092 | 122442 | 19930805 | 2.5 | 3 | 480498.004 | 1348682.648 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| P1[illegible] | 99181 | 19930122 | 0 | 1 | 481266.063 | 1348795.459 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |

000527



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000528

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | 112731 | 19930419 | 29.5 | 31 | 477323.245 | 1347924.878 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| 1971 | 110327 | 19930322 | 0.5 | 1 | 477738.361 | 1348097.062 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| OSB-1C-6-MP | OSB-1C-6-MP | 15 April 1997 | 0.5 | 0.83 | 480527 | 1350664 | Aluminum | 11600 | J | 10103 | mg/kg | NORMAL |
| OSB-2C-10-MP | OSB-2C-10-MP | 2 April 1997 | 0.5 | 0.83 | 480781 | 1350780 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| P18-12C-891258 | P18-12C-891258 | 26 December 1996 | 0 | 0.33 | 482258.64 | 1350891.58 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| NAR-6-16C-M | NAR-6-16C-M-D | 20 March 1997 | 1 | 1.33 | 484508.15991 | 1352080.07848 | Aluminum | 11600 | - | 10103 | mg/kg | DUPLICATE |
| P20-00C-4-M | P20-00C-4-M | 30 January 1997 | 0 | 0.33 | 483958.82 | 1351302.77 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| NAR-4-12C2-M | NAR-4-12C2-M | 12 March 1997 | 1 | 1.5 | 484033.8301 | 1351726.337 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| Q17C2-M-1 | Q17C2-M-1 | 24 March 1997 | 0 | 0.33 | 481230 | 1351604 | Aluminum | 11600 | - | 10103 | mg/kg | NORMAL |
| 11201 | 121666 | 19930712 | 4.5 | 5 | 480527.276 | 1350433.352 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-03 | 121114 | 19930630 | 0 | 0.5 | 483730.656 | 1349569.288 | Aluminum | 11500 | J | 10103 | mg/kg | NORMAL |
| 11106 | 70505 | 19930807 | 1 | 1.5 | 480473.624 | 1350273.514 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| ESA-7 | 99253 | 19920127 | 0 | 0.5 | 479767.898 | 1350348.681 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| 11039 | 115385 | 19930519 | 12 | 14 | 482175.435 | 1348303.82 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| 11376 | 200128 | 19940708 | 0 | 0.17 | 480126.482 | 1351027.005 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-16-MP | OSB-3C-16-MP | 14 April 1997 | 0.5 | 0.83 | 480891 | 1350714 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| P17-32C-847827 | P17-32C-847827 | 18 December 1996 | 0 | 0.33 | 481827.36 | 1350847.33 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-16-MP | OSB-5C-16-MP | 8 April 1997 | 0.5 | 0.83 | 481085 | 1350690 | Aluminum | 11500 | - | 10103 | mg/kg | NORMAL |
| 11101 | 121549 | 19930722 | 6 | 6.5 | 480805.45 | 1348893.694 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| 11157 | 121751 | 19930714 | 2 | 2.5 | 480501.062 | 1346863.194 | Aluminum | 11400 | J | 10103 | mg/kg | NORMAL |
| 11099 | 121427 | 19930710 | 9 | 9.5 | 479770.905 | 1348509.817 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| 11151 | 122036 | 19930716 | 5.5 | 6 | 480494.662 | 1346834.194 | Aluminum | 11400 | J | 10103 | mg/kg | NORMAL |
| 1998 | 112054 | 19930428 | 8 | 9.5 | 478120.948 | 1347563.899 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| 11103 | 122611 | 19930727 | 9 | 9.5 | 480729.83 | 1348966.965 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| 11093 | 122179 | 19930723 | 9 | 9.5 | 480445.887 | 1349025.74 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| 1989 | 115362 | 19930514 | 2.5 | 5 | 482226.984 | 1348150.399 | Aluminum | 11400 | J | 10103 | mg/kg | NORMAL |
| 11098 | 122803 | 19930806 | 6 | 6.5 | 479780.865 | 1348460.627 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| NAR-3-11C-M | NAR-3-11C-M | 9 March 1997 | 1.92 | 2.42 | 482424.892286 | 1350936.55651 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| NAR-4-5C-M | NAR-4-5C-M | 13 March 1997 | 1.17 | 1.5 | 483244.769189 | 1351205 | Aluminum | 11400 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-25 | 121301 | 19930709 | 0 | 0.5 | 481580.501 | 1345960.334 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| 11109 | 122458 | 19930724 | 9 | 9.5 | 479750.119 | 1349623.424 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| 1665 | 57021 | 19901218 | 0 | 0.5 | 480666.063 | 1348478.377 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| 1577 | 56935 | 19901106 | 2 | 2.5 | 481636.566 | 1349583.052 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| LSP-SS-03 | 114467 | 19930501 | 0 | 0.5 | 480463.999 | 1348267.02 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| 1967 | 112696 | 19930418 | 4.5 | 7.5 | 477323.245 | 1347924.878 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| 11096 | 122977 | 19930805 | 9 | 9.5 | 479963.416 | 1348447.695 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| WP-SS-26 | 123301 | 19930712 | 0 | 0.5 | 482373.126 | 1346619.482 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-11-MP | PUMP1-C-11-MP | 9 March 1997 | 0 | 0.33 | 479516 | 1350616 | Aluminum | 11300 | J | 10103 | mg/kg | NORMAL |
| NAR-3-1C-M | NAR-3-1C-M | 8 March 1997 | 2.92 | 3.42 | 481901.503176 | 1350911.32327 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-12-MP | OSB-4C-12-MP | 7 April 1997 | 0.5 | 0.83 | 481015 | 1350835 | Aluminum | 11300 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11100 | 121932 | 19930722 | 1 | 1.5 | 479666.408 | 1348782.927 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| 11152 | 122021 | 19930716 | 5 | 5.5 | 480484.662 | 1346834.194 | Aluminum | 11200 | J | 10103 | mg/kg | NORMAL |
| 11221 | 70636 | 19930810 | 5.5 | 6 | 480448.63 | 1346771.825 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| 11091 | 70553 | 19930809 | 9 | 9.5 | 480583.929 | 1348987.876 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| 1674 | 57497 | 19901216 | 6 | 6.5 | 479929.216 | 1348461.965 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| 1674 | 57493 | 19901216 | 4 | 4.5 | 479929.216 | 1348461.965 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| 1606 | 57189 | 19910218 | 4 | 4.5 | 480404.272 | 1350161.215 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| 1660 | 57011 | 19901218 | 0 | 0.5 | 480324.744 | 1350452.055 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| LSP-K65-TR-5 | 114776 | 19930607 | 0 | 6 | 480449.379 | 1348269.99 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| P17-40C-376703 | P17-40C-376703 | 6 December 1996 | 0 | 0.33 | 481703.26 | 1351376.29 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| P17-40C-376703 | P17-40C-376703 | 6 December 1996 | 0 | 0.33 | 481703.26 | 1351376.29 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| O18-00C-5-MP | O18-00C-5-MP | 20 February 1997 | | | 482783 | 1350299 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| O19-00C-14-M | O19-00C-14-M | 28 January 1997 | 0 | 0.33 | 483742 | 1350195 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| O19-00C-14-M | O19-00C-14-M | 28 January 1997 | 0 | 0.33 | 483742 | 1350195 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| O19-00C-7-M | O19-00C-7-M | 20 January 1997 | 0 | 0.33 | 483282 | 1350240 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| O19-00C-7-M | O19-00C-7-M | 20 January 1997 | 0 | 0.33 | 483282 | 1350240 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| O19-00C-6-M | O19-00C-6-M | 20 January 1997 | 0 | 0.33 | 483289 | 1350026 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| O19-00C-6-M | O19-00C-6-M | 20 January 1997 | 0 | 0.33 | 483289 | 1350026 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-10C-M | A1P1ST1-10C-M | 11 March 1997 | 0.17 | 0.5 | 482766 | 1351075 | Aluminum | 11200 | - | 10103 | mg/kg | NORMAL |
| 11100 | 121946 | 19930722 | 6 | 6.5 | 479666.408 | 1348782.927 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 1994 | 116301 | 19930513 | 26 | 27.5 | 477771.737 | 1347731.113 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 1287 | 18884 | 19890717 | 0.5 | 1 | 481664.326 | 1349523.242 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 1605 | 18203 | 19900918 | 4 | 4.5 | 480796.852 | 1349924.351 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 11110 | 122144 | 19930727 | 2.5 | 3 | 479770.742 | 1349911.203 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 1585 | 56595 | 19900925 | 0.5 | 1 | 481133.832 | 1349644.528 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 11101 | 121242 | 19930716 | 2.5 | 3 | 480805.45 | 1348893.694 | Aluminum | 11100 | J | 10103 | mg/kg | NORMAL |
| 1989 | 115363 | 19930514 | 12.5 | 15 | 482226.984 | 1348150.399 | Aluminum | 11100 | J | 10103 | mg/kg | NORMAL |
| AFP-SS-03 | 112255 | 19930514 | 0 | 0.5 | 477265.393 | 1348609.726 | Aluminum | 11100 | J | 10103 | mg/kg | NORMAL |
| 1978 | 110335 | 19930322 | 0 | 0.5 | 477424.369 | 1348170.076 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 11367 | 200002 | 19940711 | 2 | 2.5 | 482839.871 | 1346631.007 | Aluminum | 11100 | J | 10103 | mg/kg | NORMAL |
| NAR-2-5C-M | NAR-2-5C-M | 11 March 1997 | 0.5 | 0.83 | 483266.470072 | 1351190.10582 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| P17-32C2-M-1 | P17-32C2-M-1 | 21 March 1997 | 0 | 0.33 | 481996.38 | 1350807.74 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| P18-11C-792394 | P18-11C-792394 | 17 December 1996 | | | 482394.6 | 1350792.7 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| P18-31C-776776 | P18-31C-776776 | 31 December 1996 | 0 | 0.33 | 482776.06 | 1350776.25 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| NAR-4-16C4-M | NAR-4-16C4-M | 20 March 1997 | 2.08 | 2.58 | 484528.99 | 1352072.391 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| NAR-4-4C-M | NAR-4-4C-M | 13 March 1997 | 1.17 | 1.5 | 483181.3 | 1351160.27 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-14-MP | OSB-4C-14-MP | 7 April 1997 | 0.5 | 0.83 | 481073 | 1350784 | Aluminum | 11100 | - | 10103 | mg/kg | NORMAL |
| 11159 | 121803 | 19930714 | 1.5 | 3 | 480481.062 | 1346863.194 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| 5[illegible]8/SS-01 | 121128 | 19930701 | 0 | 0.5 | 483921.004 | 1348519.869 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| 5003[illegible]-17 | 121126 | 19930701 | 0 | 0.5 | 483041.658 | 1348624.339 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |

006529



1621

000530

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SWL-SS-06 | 111303 | 19930401 | 0 | 0.5 | 482185.055 | 1348290.39 | Aluminum | 11000 | J | 10103 | mg/kg | NORMAL |
| 1978 | 110406 | 19930324 | 0.5 | 1 | 477424.369 | 1348170.076 | Aluminum | 11000 | J | 10103 | mg/kg | NORMAL |
| 11086 | 122651 | 19930726 | 0 | 0.5 | 482295.759 | 1350084.253 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| 1664 | 57020 | 19901218 | 0.5 | 1 | 480705.103 | 1348436.626 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| 11186 | 112514 | 19930412 | 9.5 | 11 | 478039.594 | 1348118.929 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| 1969 | 112563 | 19930415 | 9 | 10.5 | 477662.362 | 1348231.073 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| TRENCH 1 | 113718 | 19930603 | 2 | 2 | 482244.395 | 1348211.969 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| Q19C-413672 | Q19C-413672 | 24 March 1997 | 0 | 0.33 | 483672 | 1351413 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-1-MP | OSB-4C-1-MP | 3 April 1997 | 0.5 | 0.83 | 480884 | 1350749 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| P18-13C-740481 | P18-13C-740481 | 18 December 1996 | | | 482481.2 | 1350740.8 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| P18-13C-740481 | P18-13C-740481 | 18 December 1996 | | | 482481.2 | 1350740.8 | Aluminum | 11000 | - | 10103 | mg/kg | NORMAL |
| Q17C2-M-2 | Q17C2-M-2-D | 24 March 1997 | 0 | 0.33 | 481220 | 1351606 | Aluminum | 11000 | - | 10103 | mg/kg | DUPLICATE |
| 11145 | 121881 | 19930721 | 4.5 | 5 | 480488.361 | 1346815.294 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| ASI-8 | 103677 | 19920930 | 0 | 0.17 | 480249.58 | 1351462.542 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-38 | 121086 | 19930707 | 0 | 0.5 | 478395.211 | 1347549.786 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| WPA15 | 61100 | 19910425 | 0 | 0.5 | 481057.871 | 1347162.786 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| 1608 | 57277 | 19910225 | 4.5 | 5 | 480278.82 | 1350167.236 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| PA-SS-14 | 122204 | 19930716 | 1 | 1.5 | 480296.196 | 1348168.172 | Aluminum | 10900 | J | 10103 | mg/kg | NORMAL |
| 1795 | 67367 | 19910823 | 0 | 1 | 477970.784 | 1348179.509 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| 1792 | 67356 | 19910822 | 21.5 | 23 | 477309.495 | 1347903.568 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| SF-SS-21 | 110307 | 19930318 | 0 | 0.5 | 478153.07 | 1347702.769 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| WP-SS-16 | 123268 | 19930709 | 0 | 0.5 | 481131.797 | 1346770.376 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-8-MP | OSB-3C-8-MP | 15 April 1997 | 0.5 | 0.83 | 480779 | 1350689 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| NAR-3-2C-M | NAR-3-2C-M | 8 March 1997 | 3.5 | 3.83 | 481998.340258 | 1350913.0753 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| P19C2-M-4 | P19C2-M-4 | 14 March 1997 | 0 | 0.33 | 483415.13 | 1350631.96 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| P18-14C-845544 | P18-14C-845544 | 15 January 1997 | 0 | 0.33 | 482544.89 | 1350845.29 | Aluminum | 10900 | - | 10103 | mg/kg | NORMAL |
| PA-SS-09 | 121701 | 19930714 | 0 | 0.5 | 481234.184 | 1349713.116 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 11095 | 121905 | 19930715 | 6 | 6.5 | 480059.402 | 1348858.143 | Aluminum | 10800 | J | 10103 | mg/kg | NORMAL |
| 1623 | 99661 | 19910604 | 15 | 16 | 480544.465 | 1347063.062 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 1287 | 18883 | 19890717 | 0 | 0.5 | 481664.326 | 1349523.242 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 1587 | 56642 | 19901016 | 2 | 2.5 | 481091.72 | 1349498.369 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| SS-12 | 121060 | 19930630 | 0 | 0.5 | 482372.165 | 1350519.401 | Aluminum | 10800 | J | 10103 | mg/kg | NORMAL |
| 11094 | 70572 | 19930809 | 1 | 1.5 | 480433.78 | 1349162.447 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 1676 | 57532 | 19910308 | 0.5 | 1 | 481216.911 | 1349510.387 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 1721 | 67234 | 19910726 | 9 | 10.5 | 482165.795 | 1348316.31 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 1580 | 56967 | 19901107 | 4 | 4.5 | 481705.407 | 1349632.841 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 11373 | 200085 | 19940706 | 0 | 0.17 | 476875.594 | 1351355.031 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| SS-12 | 121060 | 30 June 1993 | 0 | 0.5 | 481580.56 | 1351645.434 | Aluminum | 10800 | J | 10103 | mg/kg | NORMAL |
| Q20C-891879 | Q20C-891879 | 5 November 1996 | 0 | 0.33 | 483879.149 | 1351891.563 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| Q20C-891879 | Q20C-891879 | 5 November 1996 | 0 | 0.33 | 483879.149 | 1351891.563 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q17C-687220 | Q17C-687220 | 15 November 1996 | 0 | 0.33 | 481220 | 1351687 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| Q17C-687220 | Q17C-687220 | 15 November 1996 | 0 | 0.33 | 481220 | 1351687 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| O18-00C-7-MP | O18-00C-7-MP | 20 February 1997 | | | 482754 | 1350531 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| OSB-1C-14-MP | OSB-1C-14-MP | 15 April 1997 | 0.5 | 0.83 | 480675 | 1350635 | Aluminum | 10800 | J | 10103 | mg/kg | NORMAL |
| P17-34C-824051 | P17-34C-824051 | 30 December 1996 | | | 482051.85 | 1350824.21 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| P17-34C-824051 | P17-34C-824051 | 30 December 1996 | | | 482051.85 | 1350824.21 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| NAR-4-10C2-M | NAR-4-10C2-M | 11 March 1997 | 1.25 | 1.75 | 483888.0427 | 1351625.942 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| OSB-4C-3-MP | OSB-4C-3-MP | 7 April 1997 | 0.5 | 0.83 | 480933 | 1350801 | Aluminum | 10800 | - | 10103 | mg/kg | NORMAL |
| 11141 | 70410 | 19930807 | 5.5 | 6 | 480471.961 | 1346796.294 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| 1964 | 110331 | 19930322 | 0 | 0.5 | 477448.237 | 1347949.306 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| SF-SS-16 | 110343 | 19930322 | 0 | 0.5 | 477765.001 | 1348012.032 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| 11188 | 110340 | 19930322 | 0 | 0.5 | 477872.992 | 1348010.891 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| Q18C-609538 | Q18C-609538 | 14 November 1996 | 0 | 0.33 | 482538.66 | 1351609.25 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| NAR-3-5C-M | NAR-3-5C-M | 8 March 1997 | 2.25 | 2.58 | 482129.006093 | 1350928.28843 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| O19-00C-8-M | O19-00C-8-M | 20 January 1997 | 0 | 0.33 | 483207 | 1350471 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| O19-00C-8-M | O19-00C-8-M | 20 January 1997 | 0 | 0.33 | 483207 | 1350471 | Aluminum | 10700 | - | 10103 | mg/kg | NORMAL |
| Q20C2-M-2 | Q20C2-M-2 | 17 March 1997 | 0 | 0.33 | 484216.29 | 1351674.01 | Aluminum | 10700 | J | 10103 | mg/kg | NORMAL |
| PA-SS-03 | 121720 | 19930715 | 0 | 0.5 | 481608.829 | 1348188.237 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| 1508 | 51160 | 19900204 | 2 | 2.5 | 482594.983 | 1349371.022 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| SS-15 | 121118 | 19930630 | 0 | 0.5 | 482467.282 | 1349428.053 | Aluminum | 10600 | J | 10103 | mg/kg | NORMAL |
| 11218 | 70602 | 19930809 | 0 | 0.5 | 480463.991 | 1346764.554 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| 11105 | 122416 | 19930730 | 1 | 1.5 | 480250.656 | 1349861.207 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| 1575 | 56890 | 19901024 | 2 | 2.5 | 481640.888 | 1349732.572 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| 1970 | 112690 | 19930418 | 4 | 5.5 | 477642.649 | 1347975.814 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| 1971 | 110324 | 19930322 | 0 | 0.5 | 477738.361 | 1348097.062 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| 11381 | 200199 | 19940712 | 0 | 0.17 | 481345.06 | 1347767.831 | Aluminum | 10600 | J | 10103 | mg/kg | NORMAL |
| 11107 | 122921 | 19930807 | 6 | 6.5 | 480415.764 | 1350309.714 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| NAR-2-7C-M | NAR-2-7C-M | 11 March 1997 | 0.5 | 0.83 | 483494.396429 | 1351350 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| NAR-2-4C-M | NAR-2-4C-M | 10 March 1997 | 0.67 | 1 | 483202.49 | 1351147.75 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| A1P1ST1-2C-M | A1P1ST1-2C-M | 12 March 1997 | 1 | 1.33 | 482729 | 1351058 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| PUMP1-C-13-MP | PUMP1-C-13-MP | 9 March 1997 | 0 | 0.33 | 479538 | 1350583 | Aluminum | 10600 | J | 10103 | mg/kg | NORMAL |
| SS-15 | 121118 | 30 June 1993 | 0 | 0.5 | 481728.252 | 1351180.967 | Aluminum | 10600 | J | 10103 | mg/kg | NORMAL |
| OSB-1C-12-MP | OSB-1C-12-MP | 15 April 1997 | 0.5 | 0.83 | 480596 | 1350699 | Aluminum | 10600 | J | 10103 | mg/kg | NORMAL |
| Q18C-676337 | Q18C-676337 | 14 November 1996 | 0 | 0.33 | 482337.92 | 1351676.53 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| NAR-4-16C10-M | NAR-4-16C10-M | 20 March 1997 | 5.08 | 5.58 | 484528.99 | 1352072.391 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| NAR-1-5C-MP | NAR-1-5C-MP | 8 March 1997 | 0.5 | 0.83 | 482142.787945 | 1350896.6173 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| NAR-4-14C5-M | NAR-4-14C5-M | 20 March 1997 | 2.67 | 3.17 | 484364.1 | 1351962.772 | Aluminum | 10600 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-26 | 121251 | 19930709 | 0 | 0.5 | 481142.469 | 1346108.578 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-28 | 121256 | 19930710 | 0 | 0.5 | 481536.803 | 1347788.819 | Aluminum | 10500 | J | 10103 | mg/kg | NORMAL |
| [illegible]60 | 121759 | 19930714 | 2 | 2.5 | 480471.062 | 1346863.194 | Aluminum | 10500 | J | 10103 | mg/kg | NORMAL |

000531



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000532

# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11099 | 121436 | 19930711 | 12 | 12.5 | 479770.905 | 1348509.817 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| SMA-2 | 99266 | 19930203 | 0 | 0.5 | 482042.588 | 1350241.936 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 1620 | 99514 | 19910517 | 20 | 21 | 480432.193 | 1346971.704 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 1622 | 99626 | 19910531 | 20 | 30 | 480430.974 | 1347059.944 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-42 | 121065 | 19930630 | 0 | 0.5 | 477506.935 | 1348568.623 | Aluminum | 10500 | J | 10103 | mg/kg | NORMAL |
| 500318/SS-16 | 121124 | 19930701 | 0 | 0.5 | 483065.533 | 1349020.317 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 11141 | 70408 | 19930807 | 5 | 5.5 | 480471.961 | 1346796.294 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 11090 | 122717 | 19930728 | 6 | 6.5 | 480857.227 | 1350276.189 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 1674 | 57498 | 19901217 | 6.5 | 7 | 479929.216 | 1348461.965 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 1606 | 57190 | 19910218 | 4.5 | 5 | 480404.272 | 1350161.215 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| FT-2 | 99227 | 19921214 | 1 | 1.5 | 482279.86 | 1349368.755 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 1991 | 115319 | 19930506 | 7.5 | 10 | 482225.495 | 1348220.339 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-9-MP | PUMP-C-9-MP | 21 January 1997 | 0.5 | 0.83 | 479508.16 | 1350580.14 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| PUMP-C-9-MP | PUMP-C-9-MP | 21 January 1997 | 0.5 | 0.83 | 479508.16 | 1350580.14 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| NAR-4-15C3-M | NAR-4-15C3-M | 20 March 1997 | 1.5 | 2 | 484455.124 | 1352022.745 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| NAR-4-14C4-M | NAR-4-14C4-M | 20 March 1997 | 2.17 | 2.67 | 484364.1 | 1351962.772 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| P18C-642957 | P18C-642957 | 24 March 1997 | 0 | 0.33 | 482957 | 1350642 | Aluminum | 10500 | - | 10103 | mg/kg | NORMAL |
| 500318/SS-29 | 121305 | 19930710 | 0 | 0.5 | 481405.411 | 1347695.84 | Aluminum | 10400 | J | 10103 | mg/kg | NORMAL |
| 2731 | 100577 | 19920109 | 0 | 0.5 | 484184.454 | 1351425.938 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 1581 | 56487 | 19901002 | 2 | 2.5 | 481139.24 | 1349502.788 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 1970 | 110372 | 19920322 | 0 | 0.5 | 477642.649 | 1347975.814 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| AFP-SD-03 | 112248 | 19930513 | 0 | 0.5 | 477224.313 | 1348641.616 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 11086 | 122677 | 19930726 | 9 | 9.5 | 482295.759 | 1350084.253 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| WPA30 | 61205 | 19910424 | 0 | 0.5 | 480452.668 | 1347346.293 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 1664 | 57019 | 19901218 | 0 | 0.5 | 480705.103 | 1348436.626 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 1968 | 112835 | 19930420 | 4.5 | 6.5 | 477394.328 | 1348121.576 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 11092 | 122901 | 19930806 | 6 | 6.5 | 480498.004 | 1348682.648 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 11098 | 122819 | 19930806 | 12 | 12.5 | 479780.865 | 1348460.627 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| O20-00C-5-M | O20-00C-5-M | 27 January 1997 | 0 | 0.33 | 483914 | 1349827 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| NAR-6-7C-M | NAR-6-7C-M | 17 March 1997 | 1 | 1.33 | 483465.198811 | 1351373.07272 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-8-MP | OSB-2C-8-MP | 1 April 1997 | 0.5 | 0.83 | 480702 | 1350837 | Aluminum | 10400 | - | 10103 | mg/kg | NORMAL |
| 11095 | 121913 | 19930715 | 9 | 9.5 | 480059.402 | 1348858.143 | Aluminum | 10300 | J | 10103 | mg/kg | NORMAL |
| 11165 | 121395 | 19930710 | 4.5 | 6 | 480487.412 | 1346872.154 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |
| 1797 | 39083 | 19911022 | 0 | 0.5 | 480238.546 | 1348991.7 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |
| P1P7 | 99185 | 19930125 | 0 | 1 | 481259.574 | 1348890.219 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |
| WP-SS-21 | 123276 | 19930710 | 0 | 0.5 | 481480.994 | 1346306.934 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-2-MP | OSB-3C-2-MP | 15 April 1997 | 0.5 | 0.83 | 480709 | 1350652 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |
| OSB-2C-15-MP | OSB-2C-15-MP | 2 April 1997 | 0.5 | 0.83 | 480851 | 1350791 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |
| OSB-5C-3-MP | OSB-5C-3-MP | 9 April 1997 | 0.5 | 0.83 | 480931 | 1350663 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N19-00C-12-M | N19-00C-12-M-D | 27 February 1997 | | | 483628.242 | 1349737.667 | Aluminum | 10300 | J | 10103 | mg/kg | DUPLICATE |
| NAR-5-8C-M | NAR-5-8C-M | 19 March 1997 | | | 482258.574009 | 1350947.4758 | Aluminum | 10300 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-9 | 40451 | 19920610 | 0 | 0.5 | 481654.342 | 1348487.165 | Aluminum | 10200 | J | 10103 | mg/kg | NORMAL |
| SWL-SS-02 | 111297 | 19930401 | 0 | 0.5 | 482122.404 | 1348216.191 | Aluminum | 10200 | J | 10103 | mg/kg | NORMAL |
| P1P65 | 61504 | 19910602 | 0 | 0.5 | 482005.197 | 1348570.871 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| 11199 | 122380 | 19930728 | 1 | 1.5 | 481110.902 | 1350425.906 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| 1576 | 56985 | 19901104 | 2 | 2.5 | 481587.717 | 1349680.952 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| WP-SS-14 | 123249 | 19930709 | 0 | 0.5 | 481046.991 | 1347185.936 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| OSB-3C-12-MP | OSB-3C-12-MP | 15 April 1997 | 0.5 | 0.83 | 480825 | 1350704 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| O18-00C-10-MP | O18-00C-10-MP | 20 February 1997 | | | 482948 | 1349963 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| P17-22C-333541 | P17-22C-333541 | 6 December 1996 | 0 | 0.33 | 481541.7 | 1351333.8 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| P17-22C-333541 | P17-22C-333541 | 6 December 1996 | 0 | 0.33 | 481541.7 | 1351333.8 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| O18-00C-15-MP | O18-00C-15-MP | 19 February 1997 | | | 482880 | 1349523 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| P17-33C-785192 | P17-33C-785192 | 11 December 1996 | | | 482192.57 | 1350785.12 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| P17-33C-785192 | P17-33C-785192 | 11 December 1996 | | | 482192.57 | 1350785.12 | Aluminum | 10200 | - | 10103 | mg/kg | NORMAL |
| PLANT1PAD-86 | 40014 | 19920408 | 0 | 0.5 | 481196.986 | 1348409.021 | Antimony | 59.8 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-8 | 40444 | 19920610 | 0 | 0.5 | 481655.239 | 1348454.375 | Antimony | 41.7 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-20 | 40380 | 19920610 | 0 | 0.5 | 481589.647 | 1348452.576 | Antimony | 37.1 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-26 | 40348 | 19920610 | 0 | 0.5 | 481556.851 | 1348451.676 | Antimony | 33.7 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-68 | 40130 | 19920408 | 0 | 0.5 | 481326.377 | 1348478.199 | Antimony | 33.6 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-23 | 40397 | 19920609 | 0 | 0.5 | 481586.953 | 1348550.966 | Antimony | 33.3 | J | 10 | mg/kg | NORMAL |
| WPA16 | 61107 | 19910425 | 0 | 0.5 | 481157.772 | 1347165.485 | Antimony | 32.8 | J | 10 | mg/kg | NORMAL |
| WPA13 | 61086 | 19910421 | 0 | 0.5 | 481068.766 | 1346762.987 | Antimony | 32.5 | J | 10 | mg/kg | NORMAL |
| WPA21 | 61142 | 19910426 | 0 | 0.5 | 480251.06 | 1346846.897 | Antimony | 32.3 | J | 10 | mg/kg | NORMAL |
| 1723 | 67184 | 19910712 | 29 | 30.5 | 477272.522 | 1348486.906 | Antimony | 31.1 | J | 10 | mg/kg | NORMAL |
| WPA3 | 61016 | 19910419 | 0 | 0.5 | 482273.675 | 1346595.373 | Antimony | 30.8 | J | 10 | mg/kg | NORMAL |
| WPA35 | 61240 | 19910425 | 0 | 0.5 | 480755.269 | 1347254.489 | Antimony | 30.2 | J | 10 | mg/kg | NORMAL |
| WPA30 | 61205 | 19910424 | 0 | 0.5 | 480452.668 | 1347346.293 | Antimony | 30.1 | J | 10 | mg/kg | NORMAL |
| WPA20 | 61135 | 19910426 | 0 | 0.5 | 480466.362 | 1346846.494 | Antimony | 29.8 | J | 10 | mg/kg | NORMAL |
| WPA15 | 61100 | 19910425 | 0 | 0.5 | 481057.871 | 1347162.786 | Antimony | 29.7 | J | 10 | mg/kg | NORMAL |
| 1792 | 67346 | 19910821 | 6 | 7.5 | 477309.495 | 1347903.568 | Antimony | 29.7 | J | 10 | mg/kg | NORMAL |
| WPA7 | 61044 | 19910422 | 0 | 0.5 | 481479.565 | 1346374.084 | Antimony | 29.5 | J | 10 | mg/kg | NORMAL |
| WPA1 | 61002 | 19910418 | 0 | 0.5 | 482476.376 | 1346501.371 | Antimony | 28.4 | J | 10 | mg/kg | NORMAL |
| WPA17 | 61114 | 19910425 | 0 | 0.5 | 481155.073 | 1347265.485 | Antimony | 28.3 | J | 10 | mg/kg | NORMAL |
| WPA40 | 61275 | 19910422 | 0 | 0.5 | 482035.49 | 1347989.772 | Antimony | 28.2 | J | 10 | mg/kg | NORMAL |
| WPA9 | 61058 | 19910421 | 0 | 0.5 | 481176.963 | 1346465.787 | Antimony | 28 | J | 10 | mg/kg | NORMAL |
| WPA4 | 61023 | 19910420 | 0 | 0.5 | 482073.773 | 1346590.376 | Antimony | 27.8 | J | 10 | mg/kg | NORMAL |
| 1621 | 99580 | 19910523 | 5 | 6 | 480547.164 | 1346973.953 | Antimony | 27.6 | J | 10 | mg/kg | NORMAL |
| 1620 | 99490 | 19910516 | 15 | 16 | 480432.193 | 1346971.704 | Antimony | 27.4 | J | 10 | mg/kg | NORMAL |
| 1719 | 67300 | 19910808 | 18 | 19.5 | 482244.965 | 1348230.149 | Antimony | 27.3 | - | 10 | mg/kg | NORMAL |

000533



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000534

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1621 | 99542 | 19910521 | 5 | 6 | 480547.164 | 1346973.953 | Antimony | 27.1 | J | 10 | mg/kg | NORMAL |
| 1619 | 64067 | 19910720 | 57.5 | 60 | 480442.345 | 1347124.214 | Antimony | 26.5 | J | 10 | mg/kg | NORMAL |
| WPA38 | 61261 | 19910423 | 0 | 0.5 | 482138.19 | 1347892.471 | Antimony | 26.4 | J | 10 | mg/kg | NORMAL |
| WPA44 | 61303 | 19910423 | 0 | 0.5 | 481635.686 | 1347978.777 | Antimony | 26.4 | J | 10 | mg/kg | NORMAL |
| WPA31 | 61212 | 19910424 | 0 | 0.5 | 480503.267 | 1347281.192 | Antimony | 26.3 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-70 | 40142 | 19920408 | 0 | 0.5 | 481324.583 | 1348543.789 | Antimony | 26.3 | J | 10 | mg/kg | NORMAL |
| 1621 | 99559 | 19910522 | 5 | 6 | 480547.164 | 1346973.953 | Antimony | 26.3 | J | 10 | mg/kg | NORMAL |
| WPA14 | 61093 | 19910425 | 0 | 0.5 | 481063.268 | 1346962.887 | Antimony | 25.5 | J | 10 | mg/kg | NORMAL |
| WPA43 | 61295 | 19910422 | 0 | 0.5 | 481738.386 | 1347881.576 | Antimony | 25.2 | J | 10 | mg/kg | NORMAL |
| WPA10 | 61065 | 19910422 | 0 | 0.5 | 481174.165 | 1346565.787 | Antimony | 25.1 | J | 10 | mg/kg | NORMAL |
| 1620 | 99469 | 19910515 | 4 | 5 | 480432.193 | 1346971.704 | Antimony | 24.9 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-55 | 40176 | 19920427 | 0 | 0.5 | 481393.765 | 1348414.398 | Antimony | 23.4 | NV | 10 | mg/kg | NORMAL |
| WPA41 | 61282 | 19910422 | 0 | 0.5 | 481932.79 | 1348086.973 | Antimony | 23.3 | J | 10 | mg/kg | NORMAL |
| 1620 | 99514 | 19910517 | 20 | 21 | 480432.193 | 1346971.704 | Antimony | 22.9 | J | 10 | mg/kg | NORMAL |
| WPA6 | 61037 | 19910420 | 0 | 0.5 | 481679.467 | 1346379.581 | Antimony | 22.7 | J | 10 | mg/kg | NORMAL |
| 1889 | 67740 | 19920225 | 15.5 | 17.5 | 482150.755 | 1348296.83 | Antimony | 22.6 | J | 10 | mg/kg | NORMAL |
| WPA12 | 61079 | 19910421 | 0 | 0.5 | 481071.465 | 1346662.987 | Antimony | 22.6 | J | 10 | mg/kg | NORMAL |
| WPA22 | 61150 | 19910421 | 0 | 0.5 | 480066.458 | 1346835.599 | Antimony | 22.6 | J | 10 | mg/kg | NORMAL |
| WPA2 | 61009 | 19910419 | 0 | 0.5 | 482373.676 | 1346598.572 | Antimony | 22.6 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-48 | 40270 | 19920428 | 0 | 0.5 | 481454.872 | 1348580.177 | Antimony | 22.4 | J | 10 | mg/kg | NORMAL |
| 1794 | 67328 | 19910813 | 2 | 2.5 | 477983.59 | 1347812.61 | Antimony | 22.3 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-9 | 40451 | 19920610 | 0 | 0.5 | 481654.342 | 1348487.165 | Antimony | 22.2 | J | 10 | mg/kg | NORMAL |
| WPA42 | 61289 | 19910422 | 0 | 0.5 | 481835.588 | 1347984.275 | Antimony | 22.1 | J | 10 | mg/kg | NORMAL |
| 1616 | 64039 | 19910628 | 103 | 104.4 | 480498.672 | 1346846.904 | Antimony | 22.1 | J | 10 | mg/kg | NORMAL |
| 1888 | 67714 | 19920223 | 0 | 1.5 | 482154.235 | 1348292.88 | Antimony | 22 | J | 10 | mg/kg | NORMAL |
| WPA39 | 61268 | 19910423 | 0 | 0.5 | 482135.491 | 1347992.471 | Antimony | 22 | J | 10 | mg/kg | NORMAL |
| 1610 | 57365 | 19910119 | 4 | 4.5 | 480309.601 | 1350204.156 | Antimony | 22 | J | 10 | mg/kg | NORMAL |
| LSP-K65-TR-5 | 114776 | 19930607 | 0 | 6 | 480449.379 | 1348269.99 | Antimony | 21.8 | J | 10 | mg/kg | NORMAL |
| 1820 | 67506 | 19911016 | 9.5 | 12 | 477443.682 | 1348419.225 | Antimony | 21.7 | J | 10 | mg/kg | NORMAL |
| WPA34 | 61233 | 19910425 | 0 | 0.5 | 480632.769 | 1347367.691 | Antimony | 21.7 | J | 10 | mg/kg | NORMAL |
| ASI-8 | 103680 | 19920930 | 0.17 | 0.33 | 480249.58 | 1351462.542 | Antimony | 21.5 | J | 10 | mg/kg | NORMAL |
| 1792 | 67350 | 19910821 | 12 | 13.5 | 477309.495 | 1347903.568 | Antimony | 21.4 | J | 10 | mg/kg | NORMAL |
| WPA5 | 61030 | 19910420 | 0 | 0.5 | 481873.871 | 1346584.878 | Antimony | 21.3 | J | 10 | mg/kg | NORMAL |
| 1616 | 64030 | 19910626 | 83 | 85.2 | 480498.672 | 1346846.904 | Antimony | 21.2 | J | 10 | mg/kg | NORMAL |
| 1796 | 39001 | 19910921 | 0 | 0.5 | 480324.036 | 1348946.579 | Antimony | 21.2 | J | 10 | mg/kg | NORMAL |
| WPA37 | 61254 | 19910423 | 0 | 0.5 | 480857.969 | 1347157.289 | Antimony | 20.6 | J | 10 | mg/kg | NORMAL |
| 1790 | 99686 | 19910617 | 4 | 5 | 480543.115 | 1347063.483 | Antimony | 20.6 | J | 10 | mg/kg | NORMAL |
| WPA11 | 61072 | 19910421 | 0 | 0.5 | 481074.264 | 1346563.088 | Antimony | 20.3 | J | 10 | mg/kg | NORMAL |
| 1609 | 57320 | 19910122 | 4 | 4.5 | 480342.572 | 1350207.075 | Antimony | 20.2 | J | 10 | mg/kg | NORMAL |
| 1808 | 67401 | 19910827 | 15 | 16.5 | 482172.304 | 1348153.53 | Antimony | 20 | J | 10 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WPA8 | 61050 | 19910422 | 0 | 0.5 | 481504.866 | 1346468.583 | Antimony | 19.6 | J | 10 | mg/kg | NORMAL |
| 1610 | 57366 | 19910119 | 4.5 | 5 | 480309.601 | 1350204.156 | Antimony | 19.5 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-39 | 40289 | 19920428 | 0 | 0.5 | 481490.359 | 1348482.687 | Antimony | 19.5 | J | 10 | mg/kg | NORMAL |
| ASI-13 | 103736 | 19921001 | 0.33 | 0.5 | 480107.59 | 1351672.383 | Antimony | 19.3 | J | 10 | mg/kg | NORMAL |
| 1622 | 99595 | 19910529 | 0 | 10 | 480430.974 | 1347059.944 | Antimony | 19.1 | J | 10 | mg/kg | NORMAL |
| 1792 | 67353 | 19910822 | 16.5 | 18 | 477309.495 | 1347903.568 | Antimony | 18.7 | J | 10 | mg/kg | NORMAL |
| 1622 | 99626 | 19910531 | 20 | 30 | 480430.974 | 1347059.944 | Antimony | 18.6 | J | 10 | mg/kg | NORMAL |
| WPA36 | 61247 | 19910423 | 0 | 0.5 | 480724.771 | 1347453.689 | Antimony | 18.2 | J | 10 | mg/kg | NORMAL |
| PLANT1PAD-83 | 40051 | 19920408 | 0 | 0.5 | 481227.988 | 1348475.51 | Antimony | 18.1 | J | 10 | mg/kg | NORMAL |
| 1609 | 57321 | 19910122 | 4.5 | 5 | 480342.572 | 1350207.075 | Antimony | 18 | J | 10 | mg/kg | NORMAL |
| 1720 | 67311 | 19910810 | 7.5 | 9 | 482245.116 | 1348314.239 | Antimony | 16.4 | J | 10 | mg/kg | NORMAL |
| 1711 | 67020 | 19910529 | 18 | 19.5 | 478155.868 | 1347499.899 | Antimony | 16.3 | J | 10 | mg/kg | NORMAL |
| 1613 | 57407 | 19910129 | 4 | 4.5 | 480312.562 | 1350244.775 | Antimony | 16.2 | J | 10 | mg/kg | NORMAL |
| ASI-13 | 103733 | 19921001 | 0.17 | 0.33 | 480107.59 | 1351672.383 | Antimony | 15.8 | J | 10 | mg/kg | NORMAL |
| 1710 | 67047 | 19910601 | 28.5 | 30 | 477960.837 | 1347524.351 | Antimony | 15 | J | 10 | mg/kg | NORMAL |
| 1794 | 67324 | 19910813 | 0 | 1 | 477983.59 | 1347812.61 | Antimony | 14.9 | J | 10 | mg/kg | NORMAL |
| 1613 | 57408 | 19910129 | 4.5 | 5 | 480312.562 | 1350244.775 | Antimony | 14.9 | J | 10 | mg/kg | NORMAL |
| 1888 | 67717 | 19920223 | 5 | 6 | 482154.235 | 1348292.88 | Antimony | 14.8 | J | 10 | mg/kg | NORMAL |
| 1623 | 99661 | 19910604 | 15 | 16 | 480544.465 | 1347063.062 | Antimony | 14.6 | J | 10 | mg/kg | NORMAL |
| 1792 | 67356 | 19910822 | 21.5 | 23 | 477309.495 | 1347903.568 | Antimony | 13.8 | J | 10 | mg/kg | NORMAL |
| WPA32 | 61221 | 19910423 | 0 | 0.5 | 480549.87 | 1347448.991 | Antimony | 12.8 | J | 10 | mg/kg | NORMAL |
| 1720 | 67312 | 19910810 | 9 | 10.5 | 482245.116 | 1348314.239 | Antimony | 11.9 | J | 10 | mg/kg | NORMAL |
| 1808 | 67394 | 19910827 | 3 | 4.5 | 482172.304 | 1348153.53 | Antimony | 10.6 | J | 10 | mg/kg | NORMAL |
| 2733 | 100318 | 19920124 | 0 | 0.5 | 477100.058 | 1351692.048 | Antimony | 10.6 | J | 10 | mg/kg | NORMAL |
| 1808 | 67396 | 19910827 | 7.5 | 9 | 482172.304 | 1348153.53 | Antimony | 10.4 | J | 10 | mg/kg | NORMAL |
| 1711 | 67015 | 19910529 | 9 | 10.5 | 478155.868 | 1347499.899 | Antimony | 10.4 | J | 10 | mg/kg | NORMAL |
| 1795 | 67367 | 19910823 | 0 | 1 | 477970.784 | 1348179.509 | Antimony | 10.2 | J | 10 | mg/kg | NORMAL |
| 1411 | 54996 | 19890620 | 10 | 10.5 | 479830.335 | 1348445.907 | Barium | 3610 | J | 500 | mg/kg | NORMAL |
| 11111 | 122574 | 19930725 | 12 | 12.5 | 481014.642 | 1349713.479 | Barium | 1200 | - | 500 | mg/kg | NORMAL |
| 1997 | 116192 | 19930505 | 10 | 11.5 | 477900.476 | 1347491.522 | Barium | 1080 | J | 500 | mg/kg | NORMAL |
| P1PSMS-27 | P1PSMS-SYSGEN-27-0 | 19121212 | 0 | 0.5 | 481272.39 | 1348573.979 | Barium | 1080 | NV | 500 | mg/kg | NORMAL |
| 1710 | 67032 | 19910531 | 9 | 10.5 | 477960.837 | 1347524.351 | Barium | 892 | - | 500 | mg/kg | NORMAL |
| 11138 | 70487 | 19930808 | 5.5 | 6 | 480501.961 | 1346796.294 | Barium | 872 | J | 500 | mg/kg | NORMAL |
| 1996 | 112084 | 19930429 | 14 | 15 | 477849.197 | 1347645.922 | Barium | 727 | J | 500 | mg/kg | NORMAL |
| 1996 | 112077 | 19930429 | 8 | 9.5 | 477849.197 | 1347645.922 | Barium | 639 | J | 500 | mg/kg | NORMAL |
| 1710 | 67029 | 19910531 | 4.5 | 5 | 477960.837 | 1347524.351 | Barium | 637 | - | 500 | mg/kg | NORMAL |
| 1998 | 112045 | 19930428 | 2 | 3.5 | 478120.948 | 1347563.899 | Barium | 621 | - | 500 | mg/kg | NORMAL |
| 1994 | 116283 | 19930512 | 14 | 15.5 | 477771.737 | 1347731.113 | Barium | 612 | - | 500 | mg/kg | NORMAL |
| 1266 | 18422 | 19890613 | 0.5 | 1 | 479743.008 | 1348744.487 | Barium | 587 | J | 500 | mg/kg | NORMAL |
| [illegible] | 18421 | 19890613 | 0 | 0.5 | 479743.008 | 1348744.487 | Barium | 561 | J | 500 | mg/kg | NORMAL |



000535

1621

000536

# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1287 | 18884 | 19890717 | 0.5 | 1 | 481664.326 | 1349523.242 | Barium | 523 | - | 500 | mg/kg | NORMAL |
| 1288 | 53473 | 19890618 | 0 | 0.5 | 481673.348 | 1349719.421 | Barium | 512 | J | 500 | mg/kg | NORMAL |
| 1723 | 67167 | 19910711 | 4.5 | 6 | 477272.522 | 1348486.906 | Barium | 508 | - | 500 | mg/kg | NORMAL |
| 1579 | 56951 | 19901102 | 0.5 | 1 | 481705.077 | 1349576.061 | Cadmium | 12.4 | - | 5 | mg/kg | NORMAL |
| 1582 | 56513 | 19901003 | 4 | 4.5 | 481137.291 | 1349541.068 | Cadmium | 8 | J | 5 | mg/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Cadmium | 8 | - | 5 | mg/kg | NORMAL |
| 1674 | 57512 | 19901218 | 13.5 | 14 | 479929.216 | 1348461.965 | Cadmium | 7.9 | - | 5 | mg/kg | NORMAL |
| 1580 | 56963 | 19901107 | 2 | 2.5 | 481705.407 | 1349632.841 | Cadmium | 7.7 | - | 5 | mg/kg | NORMAL |
| WPA3 | 61016 | 19910419 | 0 | 0.5 | 482273.675 | 1346595.373 | Cadmium | 7.7 | J | 5 | mg/kg | NORMAL |
| 1572 | 56903 | 19901102 | 4 | 4.5 | 481666.295 | 1349483.482 | Cadmium | 7.6 | - | 5 | mg/kg | NORMAL |
| 1672 | 57008 | 19901204 | 0 | 0.5 | 482619.532 | 1349268.192 | Cadmium | 7.6 | J | 5 | mg/kg | NORMAL |
| T5/6SP-1 | 92-138A-3461 | 19920107 | 1 | 2 | 479883.375 | 1348392.996 | Cadmium | 7.51 | NV | 5 | mg/kg | NORMAL |
| 1622 | 99609 | 19910530 | 10 | 20 | 480430.974 | 1347059.944 | Cadmium | 7.5 | - | 5 | mg/kg | NORMAL |
| WPA13 | 61086 | 19910421 | 0 | 0.5 | 481068.766 | 1346762.987 | Cadmium | 7.5 | - | 5 | mg/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Cadmium | 7.2 | - | 5 | mg/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Cadmium | 7.1 | - | 5 | mg/kg | NORMAL |
| 1599 | 56815 | 19901018 | 1.5 | 2 | 481000 | 1349564.68 | Cadmium | 7 | - | 5 | mg/kg | NORMAL |
| 1778 | 57452 | 19910205 | 4.5 | 5 | 480334.591 | 1350203.295 | Cadmium | 7 | - | 5 | mg/kg | NORMAL |
| 1610 | 57365 | 19910119 | 4 | 4.5 | 480309.601 | 1350204.156 | Cadmium | 7 | - | 5 | mg/kg | NORMAL |
| 1183 | 16595 | 19891023 | 0 | 0.5 | 480733.399 | 1348886.285 | Cadmium | 6.9 | - | 5 | mg/kg | NORMAL |
| 1599 | 56823 | 19901023 | 5.5 | 6 | 481000 | 1349564.68 | Cadmium | 6.9 | - | 5 | mg/kg | NORMAL |
| WPA33 | 61219 | 19910426 | 0 | 0.5 | 480638.667 | 1347131.091 | Cadmium | 6.9 | - | 5 | mg/kg | NORMAL |
| 1583 | 56569 | 19901002 | 9.5 | 10 | 481138.111 | 1349580.598 | Cadmium | 6.7 | J | 5 | mg/kg | NORMAL |
| 1307 | 19323 | 19890718 | 0 | 0.5 | 481031.51 | 1349532.099 | Cadmium | 6.7 | J | 5 | mg/kg | NORMAL |
| P1P66 | 61506 | 19910602 | 0 | 0.5 | 482006.896 | 1348506.971 | Cadmium | 6.7 | - | 5 | mg/kg | NORMAL |
| WPA26 | 61177 | 19910427 | 0 | 0.5 | 480252.766 | 1347340.795 | Cadmium | 6.7 | - | 5 | mg/kg | NORMAL |
| WPA38 | 61261 | 19910423 | 0 | 0.5 | 482138.19 | 1347892.471 | Cadmium | 6.6 | - | 5 | mg/kg | NORMAL |
| 1676 | 57560 | 19910310 | 14.5 | 15 | 481216.911 | 1349510.387 | Cadmium | 6.5 | - | 5 | mg/kg | NORMAL |
| 1888 | 67714 | 19920223 | 0 | 1.5 | 482154.235 | 1348292.88 | Cadmium | 6.5 | - | 5 | mg/kg | NORMAL |
| 1345 | 50160 | 19890829 | 1.5 | 2 | 481269.872 | 1348675.479 | Cadmium | 6.4 | - | 5 | mg/kg | NORMAL |
| 1563 | 56337 | 19901129 | 1 | 1.5 | 480869.077 | 1350251.569 | Cadmium | 6.3 | J | 5 | mg/kg | NORMAL |
| 1327 | 19764 | 19891023 | 0.5 | 1 | 480781.132 | 1349887.841 | Cadmium | 6.3 | - | 5 | mg/kg | NORMAL |
| 1283 | 18795 | 19890718 | 0 | 0.5 | 481733.108 | 1349618.881 | Cadmium | 6.2 | J | 5 | mg/kg | NORMAL |
| 1667 | 57026 | 19901218 | 0.5 | 1 | 480663.862 | 1348402.267 | Cadmium | 6.2 | - | 5 | mg/kg | NORMAL |
| 1609 | 57320 | 19910122 | 4 | 4.5 | 480342.572 | 1350207.075 | Cadmium | 6.2 | - | 5 | mg/kg | NORMAL |
| WPA21 | 61142 | 19910426 | 0 | 0.5 | 480251.06 | 1346846.897 | Cadmium | 6.2 | - | 5 | mg/kg | NORMAL |
| WPA23 | 61310 | 19910427 | 0 | 0.5 | 480269.461 | 1346937.996 | Cadmium | 6.1 | - | 5 | mg/kg | NORMAL |
| 1586 | 56635 | 19900926 | 9.5 | 10 | 481134.683 | 1349677.988 | Cadmium | 6 | - | 5 | mg/kg | NORMAL |
| 1571 | 56885 | 19901023 | 4 | 4.5 | 481706.916 | 1349526.441 | Cadmium | 6 | - | 5 | mg/kg | NORMAL |
| 1673 | 57010 | 19901204 | 0 | 0.5 | 482613.822 | 1349288.172 | Cadmium | 5.9 | J | 5 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WPA7 | 61044 | 19910422 | 0 | 0.5 | 481479.565 | 1346374.084 | Cadmium | 5.9 | - | 5 | mg/kg | NORMAL |
| 1674 | 57508 | 19901217 | 11.5 | 12 | 479929.216 | 1348461.965 | Cadmium | 5.9 | - | 5 | mg/kg | NORMAL |
| 1676 | 57550 | 19910309 | 9.5 | 10 | 481216.911 | 1349510.387 | Cadmium | 5.9 | - | 5 | mg/kg | NORMAL |
| P1P62 | 61465 | 19910518 | 0 | 0.5 | 481691.393 | 1348444.475 | Cadmium | 5.9 | - | 5 | mg/kg | NORMAL |
| 1621 | 99559 | 19910522 | 5 | 6 | 480547.164 | 1346973.953 | Cadmium | 5.8 | - | 5 | mg/kg | NORMAL |
| 1583 | 56551 | 19900927 | 0.5 | 1 | 481138.111 | 1349580.598 | Cadmium | 5.8 | - | 5 | mg/kg | NORMAL |
| 1601 | 52781 | 19900913 | 0.5 | 1 | 480804.182 | 1349889.941 | Cadmium | 5.8 | - | 5 | mg/kg | NORMAL |
| 1600 | 56840 | 19901024 | 6 | 6.5 | 480997.97 | 1349611.139 | Cadmium | 5.8 | - | 5 | mg/kg | NORMAL |
| WPA1 | 61002 | 19910418 | 0 | 0.5 | 482476.376 | 1346501.371 | Cadmium | 5.8 | J | 5 | mg/kg | NORMAL |
| 1676 | 57535 | 19910308 | 2 | 2.5 | 481216.911 | 1349510.387 | Cadmium | 5.8 | - | 5 | mg/kg | NORMAL |
| WPA22 | 61150 | 19910421 | 0 | 0.5 | 480066.458 | 1346835.599 | Cadmium | 5.8 | - | 5 | mg/kg | NORMAL |
| P1P61 | 61450 | 19910517 | 0 | 0.5 | 481689.294 | 1348519.375 | Cadmium | 5.8 | - | 5 | mg/kg | NORMAL |
| 1582 | 56509 | 19901003 | 2 | 2.5 | 481137.291 | 1349541.068 | Cadmium | 5.7 | J | 5 | mg/kg | NORMAL |
| 1610 | 57366 | 19910119 | 4.5 | 5 | 480309.601 | 1350204.156 | Cadmium | 5.7 | - | 5 | mg/kg | NORMAL |
| WPA4 | 61023 | 19910420 | 0 | 0.5 | 482073.773 | 1346590.376 | Cadmium | 5.7 | J | 5 | mg/kg | NORMAL |
| WPA9 | 61058 | 19910421 | 0 | 0.5 | 481176.963 | 1346465.787 | Cadmium | 5.7 | J | 5 | mg/kg | NORMAL |
| 1562 | 56064 | 19900809 | 1 | 1.5 | 480872.617 | 1350215.779 | Cadmium | 5.6 | J | 5 | mg/kg | NORMAL |
| 1597 | 56778 | 19901004 | 4 | 4.5 | 481034.751 | 1349639.509 | Cadmium | 5.6 | J | 5 | mg/kg | NORMAL |
| 1597 | 56774 | 19901004 | 2 | 2.5 | 481034.751 | 1349639.509 | Cadmium | 5.6 | J | 5 | mg/kg | NORMAL |
| 1572 | 56899 | 19901102 | 2 | 2.5 | 481666.295 | 1349483.482 | Cadmium | 5.6 | - | 5 | mg/kg | NORMAL |
| 1600 | 56837 | 19901024 | 4.5 | 5 | 480997.97 | 1349611.139 | Cadmium | 5.6 | - | 5 | mg/kg | NORMAL |
| 1888 | 67717 | 19920223 | 5 | 6 | 482154.235 | 1348292.88 | Cadmium | 5.6 | - | 5 | mg/kg | NORMAL |
| WPA17 | 61114 | 19910425 | 0 | 0.5 | 481155.073 | 1347265.485 | Cadmium | 5.6 | - | 5 | mg/kg | NORMAL |
| P1P63 | 61479 | 19910519 | 0 | 0.5 | 481890.196 | 1348567.772 | Cadmium | 5.6 | - | 5 | mg/kg | NORMAL |
| WPA18 | 61121 | 19910427 | 0 | 0.5 | 480866.165 | 1346857.389 | Cadmium | 5.6 | - | 5 | mg/kg | NORMAL |
| 1474 | 55988 | 19891117 | 9.9 | 10 | 478400.024 | 1347786.605 | Cadmium | 5.5 | NV | 5 | mg/kg | NORMAL |
| 1600 | 56843 | 19901025 | 7.5 | 8 | 480997.97 | 1349611.139 | Cadmium | 5.5 | - | 5 | mg/kg | NORMAL |
| WPA10 | 61065 | 19910422 | 0 | 0.5 | 481174.165 | 1346565.787 | Cadmium | 5.5 | - | 5 | mg/kg | NORMAL |
| WPA44 | 61303 | 19910423 | 0 | 0.5 | 481635.686 | 1347978.777 | Cadmium | 5.5 | - | 5 | mg/kg | NORMAL |
| P1P64 | 61472 | 19910519 | 0 | 0.5 | 481891.995 | 1348503.772 | Cadmium | 5.5 | - | 5 | mg/kg | NORMAL |
| 1620 | 99490 | 19910516 | 15 | 16 | 480432.193 | 1346971.704 | Cadmium | 5.4 | - | 5 | mg/kg | NORMAL |
| 1307 | 19324 | 19890718 | 0.5 | 1 | 481031.51 | 1349532.099 | Cadmium | 5.4 | J | 5 | mg/kg | NORMAL |
| 1260 | 18289 | 19890615 | 0 | 0.5 | 479784.965 | 1348446.707 | Cadmium | 5.4 | - | 5 | mg/kg | NORMAL |
| 1600 | 56847 | 19901025 | 9.5 | 10 | 480997.97 | 1349611.139 | Cadmium | 5.4 | - | 5 | mg/kg | NORMAL |
| 1572 | 56896 | 19901102 | 0.5 | 1 | 481666.295 | 1349483.482 | Cadmium | 5.4 | - | 5 | mg/kg | NORMAL |
| 1671 | 57006 | 19901204 | 0 | 0.5 | 482640.692 | 1349267.871 | Cadmium | 5.4 | J | 5 | mg/kg | NORMAL |
| 1665 | 57022 | 19901218 | 0.5 | 1 | 480666.063 | 1348478.377 | Cadmium | 5.4 | - | 5 | mg/kg | NORMAL |
| WPA40 | 61275 | 19910422 | 0 | 0.5 | 482035.49 | 1347989.772 | Cadmium | 5.4 | - | 5 | mg/kg | NORMAL |
| 1581 | 56484 | 19900927 | 0.5 | 1 | 481139.24 | 1349502.788 | Cadmium | 5.3 | - | 5 | mg/kg | NORMAL |
| 1592 | 56661 | 19900924 | 0.5 | 1 | 481107.942 | 1349670.738 | Cadmium | 5.3 | - | 5 | mg/kg | NORMAL |

000537

1621

000538

# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1571 | 56881 | 19901023 | 2 | 2.5 | 481706.916 | 1349526.441 | Cadmium | 5.3 | - | 5 | mg/kg | NORMAL |
| 1676 | 57539 | 19910309 | 4 | 4.5 | 481216.911 | 1349510.387 | Cadmium | 5.3 | - | 5 | mg/kg | NORMAL |
| WPA19 | 61128 | 19910427 | 0 | 0.5 | 480666.263 | 1346851.992 | Cadmium | 5.3 | - | 5 | mg/kg | NORMAL |
| WPA35 | 61240 | 19910425 | 0 | 0.5 | 480755.269 | 1347254.489 | Cadmium | 5.3 | - | 5 | mg/kg | NORMAL |
| WPA12 | 61079 | 19910421 | 0 | 0.5 | 481071.465 | 1346662.987 | Cadmium | 5.3 | - | 5 | mg/kg | NORMAL |
| 1584 | 56580 | 19900924 | 4 | 4.5 | 481135.552 | 1349611.448 | Cadmium | 5.2 | - | 5 | mg/kg | NORMAL |
| 1183 | 16597 | 19891023 | 0.5 | 1 | 480733.399 | 1348886.285 | Cadmium | 5.2 | - | 5 | mg/kg | NORMAL |
| 1597 | 56789 | 19901005 | 9.5 | 10 | 481034.751 | 1349639.509 | Cadmium | 5.2 | J | 5 | mg/kg | NORMAL |
| 1670 | 57004 | 19901204 | 0 | 0.5 | 482662.802 | 1349267.571 | Cadmium | 5.2 | J | 5 | mg/kg | NORMAL |
| 1576 | 56985 | 19901104 | 2 | 2.5 | 481587.717 | 1349680.952 | Cadmium | 5.2 | - | 5 | mg/kg | NORMAL |
| 1609 | 57321 | 19910122 | 4.5 | 5 | 480342.572 | 1350207.075 | Cadmium | 5.2 | - | 5 | mg/kg | NORMAL |
| 1723 | 67184 | 19910712 | 29 | 30.5 | 477272.522 | 1348486.906 | Cadmium | 5.2 | J | 5 | mg/kg | NORMAL |
| 1588 | 56417 | 19900919 | 0 | 0.5 | 481089.16 | 1349540.289 | Cadmium | 5.1 | - | 5 | mg/kg | NORMAL |
| 1317 | 54053 | 19891114 | 1 | 1.5 | 480976.942 | 1349777.889 | Cadmium | 5.1 | - | 5 | mg/kg | NORMAL |
| 1599 | 56830 | 19901023 | 9 | 9.5 | 481000 | 1349564.68 | Cadmium | 5.1 | - | 5 | mg/kg | NORMAL |
| 1593 | 56690 | 19901101 | 4 | 4.5 | 481035.34 | 1349506.449 | Cadmium | 5.1 | - | 5 | mg/kg | NORMAL |
| 1674 | 57518 | 19901218 | 16.5 | 17 | 479929.216 | 1348461.965 | Cadmium | 5.1 | - | 5 | mg/kg | NORMAL |
| 1820 | 67506 | 19911016 | 9.5 | 12 | 477443.682 | 1348419.225 | Cadmium | 5.1 | J | 5 | mg/kg | NORMAL |
| 11138 | 70487 | 19930808 | 5.5 | 6 | 480501.961 | 1346796.294 | Cobalt | 105 | J | 50 | mg/kg | NORMAL |
| SMA-5 | 99268 | 19930204 | 0 | 0.5 | 481858.57 | 1350499.577 | Copper | 695 | - | 100 | mg/kg | NORMAL |
| 11051 | 116441 | 19930527 | 22 | 24 | 478014.937 | 1347557.381 | Copper | 258 | - | 100 | mg/kg | NORMAL |
| 11006 | 113492 | 19930426 | 22.5 | 24 | 478042.968 | 1347561.43 | Copper | 249 | J | 100 | mg/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Copper | 207 | - | 100 | mg/kg | NORMAL |
| ESA-7 | 99253 | 19920127 | 0 | 0.5 | 479767.898 | 1350348.681 | Copper | 184 | - | 100 | mg/kg | NORMAL |
| 11138 | 70487 | 19930808 | 5.5 | 6 | 480501.961 | 1346796.294 | Copper | 171 | J | 100 | mg/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Copper | 167 | - | 100 | mg/kg | NORMAL |
| ESA-4 | 99250 | 19930127 | 0 | 0.5 | 479846.489 | 1350350.701 | Copper | 104 | - | 100 | mg/kg | NORMAL |
| A2PIPB-17A | A2PIPB-17A-2-M | 25 November 1997 | 0.5 | 1 | 477498.1 | 1347924 | Lead | 9790 | NV | 200 | mg/kg | facts |
| A2PIPB-22 | A2PIPB-22-1-TM-Y | 2 December 1997 | 0 | 1 | 477492.79 | 1347922.48 | Lead | 6260 | J | 200 | mg/kg | NORMAL |
| A2PIPB-22 | A2PIPB-22-1-TM-Y | 2 December 1997 | 0 | 1 | 477492.79 | 1347922.48 | Lead | 6260 | J | 200 | mg/kg | NORMAL |
| A2PIPB-17A | A2PIPB-17A-1-M | 25 November 1997 | 0 | 0.5 | 477498.1 | 1347924 | Lead | 6126 | NV | 200 | mg/kg | facts |
| A2PIPB-13 | A2PIPB-13-1-M | 26 November 1997 | 0 | 0.5 | 477467.47 | 1347908.37 | Lead | 5390 | NV | 200 | mg/kg | facts |
| A2PIPB-12 | A2PIPB-12-1-M | 25 November 1997 | 0 | 0.5 | 477457.54 | 1347906.8 | Lead | 4990 | NV | 200 | mg/kg | facts |
| A2PIPB-11 | A2PIPB-11-3-M | 26 November 1997 | 1 | 1.5 | 477451.58 | 1347910 | Lead | 4920 | NV | 200 | mg/kg | facts |
| A2PIPB-19 | A2PIPB-19-7-M | 24 November 1997 | 3 | 3.5 | 477478.04 | 1347922.28 | Lead | 3720 | NV | 200 | mg/kg | facts |
| A2PIPB-2 | A2PIPB-2-1-M | 25 November 1997 | 0 | 0.5 | 477508.78 | 1347925 | Lead | 3623 | NV | 200 | mg/kg | facts |
| A2PIPB-22 | A2PIPB-22-1-TM | 2 December 1997 | 0 | 1 | 477492.79 | 1347922.48 | Lead | 3590 | J | 200 | mg/kg | NORMAL |
| A2PIPB-22 | A2PIPB-22-1-TM | 2 December 1997 | 0 | 1 | 477492.79 | 1347922.48 | Lead | 3590 | J | 200 | mg/kg | NORMAL |
| A2PIPB-14 | A2PIPB-14-1-M | 26 November 1997 | 0 | 0.5 | 477477.39 | 1347909.88 | Lead | 2260 | NV | 200 | mg/kg | facts |
| TR-12N | 30917UTR12N-13 | 19930917 | 0 | 0.33 | 478713.433 | 1351053.678 | Lead | 2180 | - | 200 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TR-12M | 30917UTR12M-12 | 19930917 | 0 | 0.33 | 478691.632 | 1351006.978 | Lead | 2160 | - | 200 | mg/kg | NORMAL |
| TR-9M | 30917UTR9M-08 | 19930917 | 0 | 0.33 | 478555.395 | 1351060.303 | Lead | 2020 | - | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-3-TM-Y | 2 December 1997 | 2 | 3 | 477475.49 | 1347914.38 | Lead | 1930 | J | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-3-TM-Y | 2 December 1997 | 2 | 3 | 477475.49 | 1347914.38 | Lead | 1930 | J | 200 | mg/kg | NORMAL |
| A2PIPB-18A | A2PIPB-18A-2-M | 25 November 1997 | 0.5 | 1 | 477488 | 1347923 | Lead | 1165 | NV | 200 | mg/kg | facts |
| A1PII-S1-19-10 | A1PII-S1-19-10M | 29 January 1998 | 0 | 0.5 | 478473 | 1351444 | Lead | 1152 | NV | 200 | mg/kg | facts |
| TR-11J | 30917UTR11J-14 | 19930917 | 0 | 0.33 | 478595.431 | 1350884.579 | Lead | 1150 | - | 200 | mg/kg | NORMAL |
| 1792 | 67350 | 19910821 | 12 | 13.5 | 477309.495 | 1347903.568 | Lead | 1140 | - | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-2-TM | 2 December 1997 | 1 | 2 | 477475.49 | 1347914.38 | Lead | 1100 | J | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-2-TM | 2 December 1997 | 1 | 2 | 477475.49 | 1347914.38 | Lead | 1100 | J | 200 | mg/kg | NORMAL |
| A1P2TRAP-20 | A1P2TRAP-20-1-M | 12 September 1997 | 0 | 0.5 | 478692.332 | 1351007.659 | Lead | 1079 | NV | 200 | mg/kg | facts |
| A2PIPB-14 | A2PIPB-14-2-M | 26 November 1997 | 0.5 | 1 | 477477.39 | 1347909.88 | Lead | 1043 | NV | 200 | mg/kg | facts |
| A2PIPB-11 | A2PIPB-11-2-M | 26 November 1997 | 0.5 | 1 | 477451.58 | 1347910 | Lead | 984 | NV | 200 | mg/kg | facts |
| A2PIPB-23 | A2PIPB-23-3-TM | 2 December 1997 | 2 | 3 | 477475.49 | 1347914.38 | Lead | 793 | J | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-3-TM | 2 December 1997 | 2 | 3 | 477475.49 | 1347914.38 | Lead | 793 | J | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-2-TM-Y | 2 December 1997 | 1 | 2 | 477475.49 | 1347914.38 | Lead | 788 | J | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-2-TM-Y | 2 December 1997 | 1 | 2 | 477475.49 | 1347914.38 | Lead | 788 | J | 200 | mg/kg | NORMAL |
| A1P2TRAP-33 | A1P2TRAP-33-1-M | 11 September 1997 | 0 | 0.5 | 478500.577 | 1350950.566 | Lead | 784.9 | NV | 200 | mg/kg | facts |
| A2PIPB-18A | A2PIPB-18A-1-M | 25 November 1997 | 0 | 0.5 | 477488 | 1347923 | Lead | 751 | NV | 200 | mg/kg | facts |
| A2PIPB-13 | A2PIPB-13-2-M | 26 November 1997 | 0.5 | 1 | 477467.47 | 1347908.37 | Lead | 744 | NV | 200 | mg/kg | facts |
| A2PIPB-12 | A2PIPB-12-2-M | 26 November 1997 | 0.5 | 1 | 477457.54 | 1347906.8 | Lead | 714 | NV | 200 | mg/kg | facts |
| TRAP BOX SOUTH | 126519 | 19930730 | 0 | 0.33 | 479044.068 | 1350944.208 | Lead | 693 | J | 200 | mg/kg | NORMAL |
| A2PIPB-20A | A2PIPB-20A-2-M | 25 November 1997 | 0.5 | 1 | 477468 | 1347921 | Lead | 626 | NV | 200 | mg/kg | facts |
| A2PIPB-19A | A2PIPB-19A-1-M | 25 November 1997 | 0 | 0.5 | 477478 | 1347922 | Lead | 616 | NV | 200 | mg/kg | facts |
| A2PIPB-13 | A2PIPB-13-3-M | 26 November 1997 | 1 | 1.5 | 477467.47 | 1347908.37 | Lead | 606 | NV | 200 | mg/kg | facts |
| ASI-13 | 103736 | 19921001 | 0.33 | 0.5 | 480107.59 | 1351672.383 | Lead | 570 | - | 200 | mg/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Lead | 569 | - | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-1-TM-Y | 2 December 1997 | 0 | 1 | 477475.49 | 1347914.38 | Lead | 546 | J | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-1-TM-Y | 2 December 1997 | 0 | 1 | 477475.49 | 1347914.38 | Lead | 546 | J | 200 | mg/kg | NORMAL |
| ESA-4 | 99250 | 19930127 | 0 | 0.5 | 479846.489 | 1350350.701 | Lead | 543 | - | 200 | mg/kg | NORMAL |
| A2PIPB-20A | A2PIPB-20A-3-M | 25 November 1997 | 1 | 1.5 | 477468 | 1347921 | Lead | 510 | NV | 200 | mg/kg | facts |
| A2PIPB-20A | A2PIPB-20A-1-M | 25 November 1997 | 0 | 0.5 | 477468 | 1347921 | Lead | 505 | NV | 200 | mg/kg | facts |
| A2PIPB-17 | A2PIPB-17-4-M | 24 November 1997 | 1.5 | 2 | 477498.08 | 1347924.06 | Lead | 503 | NV | 200 | mg/kg | facts |
| 1183 | 16597 | 19891023 | 0.5 | 1 | 480733.399 | 1348886.285 | Lead | 440 | - | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-1-TM | 2 December 1997 | 0 | 1 | 477475.49 | 1347914.38 | Lead | 435 | J | 200 | mg/kg | NORMAL |
| A2PIPB-23 | A2PIPB-23-1-TM | 2 December 1997 | 0 | 1 | 477475.49 | 1347914.38 | Lead | 435 | J | 200 | mg/kg | NORMAL |
| A2PIPB-10 | A2PIPB-10-1-M | 2 December 1997 | 0 | 0.5 | 477451.51 | 1347919.98 | Lead | 427 | J | 200 | mg/kg | NORMAL |
| A2PIPB-10 | A2PIPB-10-1-M | 2 December 1997 | 0 | 0.5 | 477451.51 | 1347919.98 | Lead | 427 | J | 200 | mg/kg | NORMAL |
| 11051 | 116441 | 19930527 | 22 | 24 | 478014.937 | 1347557.381 | Lead | 400 | - | 200 | mg/kg | NORMAL |
| A2PIPB-10 | A2PIPB-10-2-M | 2 December 1997 | 0.5 | 1 | 477451.51 | 1347919.98 | Lead | 353 | J | 200 | mg/kg | NORMAL |



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# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A2PIPB-10 | A2PIPB-10-2-M | 2 December 1997 | 0.5 | 1 | 477451.51 | 1347919.98 | Lead | 353 | J | 200 | mg/kg | NORMAL |
| 1307 | 19323 | 19890718 | 0 | 0.5 | 481031.51 | 1349532.099 | Lead | 334 | J | 200 | mg/kg | NORMAL |
| 1183 | 16595 | 19891023 | 0 | 0.5 | 480733.399 | 1348886.285 | Lead | 334 | - | 200 | mg/kg | NORMAL |
| A2PIPB-11 | A2PIPB-11-4-M | 26 November 1997 | 1.5 | 2 | 477451.58 | 1347910 | Lead | 332 | NV | 200 | mg/kg | facts |
| A2PIPB-22 | A2PIPB-22-2-TM | 2 December 1997 | 1 | 2 | 477492.79 | 1347922.48 | Lead | 300 | J | 200 | mg/kg | NORMAL |
| A2PIPB-22 | A2PIPB-22-2-TM | 2 December 1997 | 1 | 2 | 477492.79 | 1347922.48 | Lead | 300 | J | 200 | mg/kg | NORMAL |
| A2PIPB-13 | A2PIPB-13-5-M | 26 November 1997 | 2 | 2.5 | 477467.47 | 1347908.37 | Lead | 288 | NV | 200 | mg/kg | facts |
| LSP-SS-02 | 114591 | 19930516 | 0 | 0.5 | 480454.439 | 1348278.18 | Lead | 240 | - | 200 | mg/kg | NORMAL |
| A2PIPB-22 | A2PIPB-22-2-TM-Y | 2 December 1997 | 1 | 2 | 477492.79 | 1347922.48 | Lead | 231 | J | 200 | mg/kg | NORMAL |
| A2PIPB-22 | A2PIPB-22-2-TM-Y | 2 December 1997 | 1 | 2 | 477492.79 | 1347922.48 | Lead | 231 | J | 200 | mg/kg | NORMAL |
| P6PSP-7 | 91-137C-3385 | 19920113 | 0 | 0.5 | 480703.404 | 1350139.981 | Lead | 226 | NV | 200 | mg/kg | NORMAL |
| A2PIPB-21 | A2PIPB-21-5-M | 2 December 1997 | 2 | 2.5 | 477458.09 | 1347920.52 | Lead | 223 | J | 200 | mg/kg | NORMAL |
| A2PIPB-21 | A2PIPB-21-5-M | 2 December 1997 | 2 | 2.5 | 477458.09 | 1347920.52 | Lead | 223 | J | 200 | mg/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Lead | 220 | - | 200 | mg/kg | NORMAL |
| 11138 | 70487 | 19930808 | 5.5 | 6 | 480501.961 | 1346796.294 | Manganese | 12200 | J | 1500 | mg/kg | NORMAL |
| WPA29 | 61198 | 19910428 | 0 | 0.5 | 480457.665 | 1347161.393 | Manganese | 7740 | J | 1500 | mg/kg | NORMAL |
| P18C-384451 | P18C-384451 | 27 November 1996 | 0 | 0.33 | 482451.51 | 1351384.92 | Manganese | 5470 | J | 1500 | mg/kg | NORMAL |
| 500318/SS-54 | 121051 | 19930629 | 0 | 0.5 | 481218.59 | 1351843.76 | Manganese | 4400 | J | 1500 | mg/kg | NORMAL |
| 1577 | 56935 | 19901106 | 2 | 2.5 | 481636.566 | 1349583.052 | Manganese | 4200 | J | 1500 | mg/kg | NORMAL |
| 11099 | 121410 | 19930710 | 2.5 | 3 | 479770.905 | 1348509.817 | Manganese | 3890 | J | 1500 | mg/kg | NORMAL |
| Q19C-564505 | Q19C-564505 | 5 November 1996 | 0 | 0.33 | 483502.33 | 1351564.2 | Manganese | 3220 | J | 1500 | mg/kg | NORMAL |
| 11088 | 121155 | 19930709 | 1 | 1.5 | 481688.606 | 1349539.452 | Manganese | 2700 | J | 1500 | mg/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Manganese | 2650 | - | 1500 | mg/kg | NORMAL |
| 11101 | 121549 | 19930722 | 6 | 6.5 | 480805.45 | 1348893.694 | Manganese | 2620 | J | 1500 | mg/kg | NORMAL |
| 11201 | 121660 | 19930712 | 2.5 | 3 | 480527.276 | 1350433.352 | Manganese | 2540 | - | 1500 | mg/kg | NORMAL |
| NAR-4-2C-M | NAR-4-2C-M | 12 March 1997 | 1.25 | 1.58 | 482863.193465 | 1351002.28344 | Manganese | 2470 | - | 1500 | mg/kg | NORMAL |
| Q17C-556087 | Q17C-556087 | 14 November 1996 | 0 | 0.33 | 482087.31 | 1351556.73 | Manganese | 2430 | J | 1500 | mg/kg | NORMAL |
| 1575 | 56890 | 19901024 | 2 | 2.5 | 481640.888 | 1349732.572 | Manganese | 2280 | - | 1500 | mg/kg | NORMAL |
| P17-22C2-M-2 | P17-22C2-M-2 | 24 March 1997 | 0 | 0.33 | 481541.7 | 1351333.8 | Manganese | 2190 | J | 1500 | mg/kg | NORMAL |
| 500318/SS-09 | 121101 | 19930629 | 0 | 0.5 | 482549.441 | 1350889.578 | Manganese | 2150 | J | 1500 | mg/kg | NORMAL |
| P18-32C2-2-MP | P18-32C2-2-MP | 11 March 1997 | 0 | 0.33 | 482640.1 | 1350874.5 | Manganese | 2110 | - | 1500 | mg/kg | NORMAL |
| P17-32C-866935 | P17-32C-866935 | 18 December 1996 | 0 | 0.33 | 481935.76 | 1350866.23 | Manganese | 2080 | - | 1500 | mg/kg | NORMAL |
| 11110 | 122144 | 19930727 | 2.5 | 3 | 479770.742 | 1349911.203 | Manganese | 2050 | - | 1500 | mg/kg | NORMAL |
| P17-40C-376703 | P17-40C-376703-D | 6 December 1996 | 0 | 0.33 | 481703.26 | 1351376.29 | Manganese | 2050 | J | 1500 | mg/kg | DUPLICATE |
| P17-40C-376703 | P17-40C-376703-D | 6 December 1996 | 0 | 0.33 | 481703.26 | 1351376.29 | Manganese | 2050 | J | 1500 | mg/kg | DUPLICATE |
| P17-34C-856128 | P17-34C-856128 | 30 December 1996 | | | 482128.28 | 1350856.37 | Manganese | 2050 | - | 1500 | mg/kg | NORMAL |
| P17-34C-856128 | P17-34C-856128 | 30 December 1996 | | | 482128.28 | 1350856.37 | Manganese | 2050 | - | 1500 | mg/kg | NORMAL |
| 500318/SS-48 | 121008 | 19930629 | 0 | 0.5 | 480369.102 | 1351832.68 | Manganese | 2040 | J | 1500 | mg/kg | NORMAL |
| ASI-16 | 103805 | 19921006 | 0.17 | 0.33 | 480032.518 | 1351803.984 | Manganese | 2010 | J | 1500 | mg/kg | NORMAL |
| 11088 | 121160 | 19930709 | 2.5 | 3 | 481688.606 | 1349539.452 | Manganese | 1960 | J | 1500 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 112181 | 19930514 | 19 | 21 | 477395.523 | 1348495.355 | Manganese | 1900 | - | 1500 | mg/kg | NORMAL |
| 11103 | 122603 | 19930727 | 6 | 6.5 | 480729.83 | 1348966.965 | Manganese | 1890 | - | 1500 | mg/kg | NORMAL |
| ASI-16 | 103802 | 19921006 | 0 | 0.17 | 480032.518 | 1351803.984 | Manganese | 1880 | J | 1500 | mg/kg | NORMAL |
| NAR-2-14C-M | NAR-2-14C-M | 8 March 1997 | | | 484369.786784 | 1351925.62824 | Manganese | 1880 | - | 1500 | mg/kg | NORMAL |
| NAR-5-15C-M | NAR-5-15C-M | 13 March 1997 | 1 | 1.5 | 482627.448148 | 1350967.63927 | Manganese | 1860 | J | 1500 | mg/kg | NORMAL |
| NAR-4-14C3-M | NAR-4-14C3-M | 20 March 1997 | 1.67 | 2.17 | 484364.1 | 1351962.772 | Manganese | 1860 | J | 1500 | mg/kg | NORMAL |
| NAR-1-13C-MP | NAR-1-13C-MP | 8 March 1997 | 0.5 | 0.83 | 482537.990705 | 1350907.43141 | Manganese | 1810 | - | 1500 | mg/kg | NORMAL |
| 11103 | 122611 | 19930727 | 9 | 9.5 | 480729.83 | 1348966.965 | Manganese | 1800 | - | 1500 | mg/kg | NORMAL |
| SS-50 | 121009 | 19930629 | 0 | 0.5 | 480756.052 | 1350740.369 | Manganese | 1780 | J | 1500 | mg/kg | NORMAL |
| Q20C2-M-1 | Q20C2-M-1 | 17 March 1997 | 0 | 0.33 | 484289.89 | 1351454.5 | Manganese | 1780 | - | 1500 | mg/kg | NORMAL |
| 1346 | 54616 | 19900107 | 1.5 | 2 | 481275.062 | 1348709.879 | Manganese | 1770 | - | 1500 | mg/kg | NORMAL |
| NAR-1-15C-MP | NAR-1-15C-MP | 8 March 1997 | 0.5 | 0.83 | 482628.04614 | 1350911.32156 | Manganese | 1770 | - | 1500 | mg/kg | NORMAL |
| 11369 | 200029 | 19940711 | 0 | 0.17 | 479915.53 | 1347209.139 | Manganese | 1750 | J | 1500 | mg/kg | NORMAL |
| ASI-16 | 103808 | 19921006 | 0.33 | 0.5 | 480032.518 | 1351803.984 | Manganese | 1750 | - | 1500 | mg/kg | NORMAL |
| Q17C2-M-3 | Q17C2-M-3-D | 24 March 1997 | 0 | 0.33 | 481220 | 1351687 | Manganese | 1750 | J | 1500 | mg/kg | DUPLICATE |
| 11109 | 122466 | 19930724 | 0 | 0.5 | 479750.119 | 1349623.424 | Manganese | 1720 | - | 1500 | mg/kg | NORMAL |
| 1720 | 67312 | 19910810 | 9 | 10.5 | 482245.116 | 1348314.239 | Manganese | 1690 | - | 1500 | mg/kg | NORMAL |
| NAR-4-14C2-M | NAR-4-14C2-M | 12 March 1997 | 1.17 | 1.67 | 484364.1002 | 1351962.772 | Manganese | 1630 | J | 1500 | mg/kg | NORMAL |
| 11158 | 122102 | 19930722 | 7 | 7.5 | 480491.062 | 1346863.194 | Manganese | 1620 | J | 1500 | mg/kg | NORMAL |
| 1574 | 56977 | 19901104 | 3.5 | 4 | 481695.198 | 1349694.301 | Manganese | 1610 | - | 1500 | mg/kg | NORMAL |
| P20-00C-7-M | P20-00C-7-M | 29 January 1997 | 0 | 0.33 | 484113.88 | 1351071.95 | Manganese | 1610 | J | 1500 | mg/kg | NORMAL |
| Q20C2-M-3 | Q20C2-M-3 | 14 March 1997 | 0 | 0.33 | 484157.41 | 1351993.9 | Manganese | 1610 | - | 1500 | mg/kg | NORMAL |
| P19C2-M-2 | P19C2-M-2 | 14 March 1997 | 0 | 0.33 | 483780.45 | 1351030.82 | Manganese | 1600 | - | 1500 | mg/kg | NORMAL |
| 11157 | 121755 | 19930714 | 5.5 | 6 | 480501.062 | 1346863.194 | Manganese | 1580 | J | 1500 | mg/kg | NORMAL |
| P20-00C-3-M | P20-00C-3-M | 29 January 1997 | 0 | 0.33 | 483825.59 | 1351082.01 | Manganese | 1580 | J | 1500 | mg/kg | NORMAL |
| Q20C-509996 | Q20C-509996 | 11 February 1997 | | | 483996.58 | 1351509.91 | Manganese | 1560 | R | 1500 | mg/kg | NORMAL |
| P17-22C2-M-9 | P17-22C2-M-9 | 24 March 1997 | 0 | 0.33 | 481380.87 | 1351382.2 | Manganese | 1540 | J | 1500 | mg/kg | NORMAL |
| P20-00C-12-M | P20-00C-12-M | 29 January 1997 | 0 | 0.33 | 484213.49 | 1351334.26 | Manganese | 1530 | J | 1500 | mg/kg | NORMAL |
| P17-32C2-M-5 | P17-32C2-M-5 | 21 March 1997 | 0 | 0.33 | 481859.7 | 1350881.95 | Manganese | 1530 | Z | 1500 | mg/kg | NORMAL |
| OSB-5C-14-MP | OSB-5C-14-MP | 8 April 1997 | 0.5 | 0.83 | 481123 | 1350646 | Manganese | 1530 | - | 1500 | mg/kg | NORMAL |
| P19-SP4 | 930506-077 | 16 May 1993 | 0 | 1 | 479992.07 | 1348612.25 | Mercury | 18.6 | NV | 5 | mg/kg | |
| 1618 | 64134 | 19910802 | 105 | 107.5 | 480336.434 | 1347106.325 | Molybdenum | 29.9 | - | 10 | mg/kg | NORMAL |
| 1888 | 67717 | 19920223 | 5 | 6 | 482154.235 | 1348292.88 | Molybdenum | 29.3 | - | 10 | mg/kg | NORMAL |
| 1888 | 67714 | 19920223 | 0 | 1.5 | 482154.235 | 1348292.88 | Molybdenum | 26.8 | - | 10 | mg/kg | NORMAL |
| 1618 | 64123 | 19910801 | 87.5 | 90 | 480336.434 | 1347106.325 | Molybdenum | 20.2 | - | 10 | mg/kg | NORMAL |
| 1726 | 67149 | 19910701 | 9 | 10.5 | 477346.843 | 1348570.615 | Molybdenum | 18.8 | - | 10 | mg/kg | NORMAL |
| 1720 | 67312 | 19910810 | 9 | 10.5 | 482245.116 | 1348314.239 | Molybdenum | 18.8 | - | 10 | mg/kg | NORMAL |
| 1726 | 67155 | 19910701 | 18 | 19.5 | 477346.843 | 1348570.615 | Molybdenum | 17.9 | - | 10 | mg/kg | NORMAL |
| 1720 | 67307 | 19910810 | 3 | 4.5 | 482245.116 | 1348314.239 | Molybdenum | 16 | - | 10 | mg/kg | NORMAL |
| 1792 | 67343 | 19910821 | 1.5 | 3 | 477309.495 | 1347903.568 | Molybdenum | 15.8 | - | 10 | mg/kg | NORMAL |



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# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1795 | 67370 | 19910823 | 3 | 4 | 477970.784 | 1348179.509 | Molybdenum | 15.5 | - | 10 | mg/kg | NORMAL |
| 1721 | 67237 | 19910727 | 13.5 | 15 | 482165.795 | 1348316.31 | Molybdenum | 14.9 | - | 10 | mg/kg | NORMAL |
| 1794 | 67324 | 19910813 | 0 | 1 | 477983.59 | 1347812.61 | Molybdenum | 14.9 | - | 10 | mg/kg | NORMAL |
| 1792 | 67356 | 19910822 | 21.5 | 23 | 477309.495 | 1347903.568 | Molybdenum | 14.8 | - | 10 | mg/kg | NORMAL |
| 1618 | 64102 | 19910729 | 47.5 | 48.5 | 480336.434 | 1347106.325 | Molybdenum | 14.7 | - | 10 | mg/kg | NORMAL |
| 1793 | 67333 | 19910815 | 3 | 4.5 | 477494.328 | 1347977.785 | Molybdenum | 14.6 | - | 10 | mg/kg | NORMAL |
| 1719 | 67300 | 19910808 | 18 | 19.5 | 482244.965 | 1348230.149 | Molybdenum | 14.5 | - | 10 | mg/kg | NORMAL |
| 1795 | 67367 | 19910823 | 0 | 1 | 477970.784 | 1348179.509 | Molybdenum | 14.5 | - | 10 | mg/kg | NORMAL |
| 1720 | 67311 | 19910810 | 7.5 | 9 | 482245.116 | 1348314.239 | Molybdenum | 14.2 | - | 10 | mg/kg | NORMAL |
| 1792 | 67353 | 19910822 | 16.5 | 18 | 477309.495 | 1347903.568 | Molybdenum | 14.1 | J | 10 | mg/kg | NORMAL |
| 1808 | 67401 | 19910827 | 15 | 16.5 | 482172.304 | 1348153.53 | Molybdenum | 14 | - | 10 | mg/kg | NORMAL |
| 1808 | 67396 | 19910827 | 7.5 | 9 | 482172.304 | 1348153.53 | Molybdenum | 13.7 | - | 10 | mg/kg | NORMAL |
| 1981 | 112181 | 19930514 | 19 | 21 | 477395.523 | 1348495.355 | Molybdenum | 13.5 | - | 10 | mg/kg | NORMAL |
| 1792 | 67350 | 19910821 | 12 | 13.5 | 477309.495 | 1347903.568 | Molybdenum | 13.4 | J | 10 | mg/kg | NORMAL |
| 1735 | 101372 | 19920107 | 0 | 0.5 | 483329.415 | 1349030.954 | Molybdenum | 13.3 | - | 10 | mg/kg | NORMAL |
| 1790 | 99686 | 19910617 | 4 | 5 | 480543.115 | 1347063.483 | Molybdenum | 13.3 | - | 10 | mg/kg | NORMAL |
| 1889 | 67740 | 19920225 | 15.5 | 17.5 | 482150.755 | 1348296.83 | Molybdenum | 13.2 | J | 10 | mg/kg | NORMAL |
| 1724 | 67218 | 19910716 | 41.5 | 43 | 477269.05 | 1348361.987 | Molybdenum | 13.2 | - | 10 | mg/kg | NORMAL |
| 1619 | 64067 | 19910720 | 57.5 | 60 | 480442.345 | 1347124.214 | Molybdenum | 13.1 | - | 10 | mg/kg | NORMAL |
| 1796 | 39001 | 19910921 | 0 | 0.5 | 480324.036 | 1348946.579 | Molybdenum | 13.1 | - | 10 | mg/kg | NORMAL |
| 1792 | 67346 | 19910821 | 6 | 7.5 | 477309.495 | 1347903.568 | Molybdenum | 13 | J | 10 | mg/kg | NORMAL |
| 1797 | 39083 | 19911022 | 0 | 0.5 | 480238.546 | 1348991.7 | Molybdenum | 12.8 | - | 10 | mg/kg | NORMAL |
| AFP-SS-06 | 112259 | 19930514 | 0 | 0.5 | 477350.821 | 1348368.176 | Molybdenum | 12.5 | - | 10 | mg/kg | NORMAL |
| 1723 | 67184 | 19910712 | 29 | 30.5 | 477272.522 | 1348486.906 | Molybdenum | 12.5 | J | 10 | mg/kg | NORMAL |
| 1723 | 67173 | 19910711 | 13.5 | 15 | 477272.522 | 1348486.906 | Molybdenum | 12.5 | - | 10 | mg/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Molybdenum | 12.4 | - | 10 | mg/kg | NORMAL |
| 1737 | 101358 | 19920106 | 0 | 0.5 | 483335.434 | 1350487.95 | Molybdenum | 12.4 | - | 10 | mg/kg | NORMAL |
| 1794 | 67328 | 19910813 | 2 | 2.5 | 477983.59 | 1347812.61 | Molybdenum | 12.3 | - | 10 | mg/kg | NORMAL |
| AFP-SS-02 | 112254 | 19930514 | 0 | 0.5 | 477229.941 | 1348473.907 | Molybdenum | 11.9 | - | 10 | mg/kg | NORMAL |
| 1721 | 67234 | 19910726 | 9 | 10.5 | 482165.795 | 1348316.31 | Molybdenum | 11.8 | - | 10 | mg/kg | NORMAL |
| 1808 | 67394 | 19910827 | 3 | 4.5 | 482172.304 | 1348153.53 | Molybdenum | 11.7 | - | 10 | mg/kg | NORMAL |
| 1679 | 100422 | 19920127 | 0 | 0.5 | 483953.923 | 1346795.563 | Molybdenum | 11.7 | - | 10 | mg/kg | NORMAL |
| 1979 | 112091 | 19930510 | 0 | 1.5 | 477270.891 | 1348424.387 | Molybdenum | 11.4 | - | 10 | mg/kg | NORMAL |
| 2731 | 100577 | 19920109 | 0 | 0.5 | 484184.454 | 1351425.938 | Molybdenum | 11.3 | - | 10 | mg/kg | NORMAL |
| 1722 | 67259 | 19910730 | 14 | 16.5 | 482144.205 | 1348270.42 | Molybdenum | 11.2 | - | 10 | mg/kg | NORMAL |
| 1616 | 64030 | 19910626 | 83 | 85.2 | 480498.672 | 1346846.904 | Molybdenum | 11.1 | J | 10 | mg/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Molybdenum | 11.1 | - | 10 | mg/kg | NORMAL |
| 1734 | 100841 | 19920108 | 0 | 0.5 | 483329.409 | 1348530.955 | Molybdenum | 10.8 | - | 10 | mg/kg | NORMAL |
| 1616 | 64039 | 19910628 | 103 | 104.4 | 480498.672 | 1346846.904 | Molybdenum | 10.6 | J | 10 | mg/kg | NORMAL |
| 1618 | 64112 | 19910730 | 67.5 | 70 | 480336.434 | 1347106.325 | Molybdenum | 10.5 | - | 10 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1981 | 112160 | 19930513 | 0 | 2 | 477395.523 | 1348495.355 | Molybdenum | 10.4 | - | 10 | mg/kg | NORMAL |
| 1724 | 67201 | 19910714 | 16 | 17.5 | 477269.05 | 1348361.987 | Molybdenum | 10.3 | - | 10 | mg/kg | NORMAL |
| 1722 | 67250 | 19910729 | 1.5 | 3 | 482144.205 | 1348270.42 | Molybdenum | 10.2 | J | 10 | mg/kg | NORMAL |
| 11138 | 70487 | 19930808 | 5.5 | 6 | 480501.961 | 1346796.294 | Nickel | 186 | J | 100 | mg/kg | NORMAL |
| 1618 | 64123 | 19910801 | 87.5 | 90 | 480336.434 | 1347106.325 | Selenium | 16.1 | - | 3 | mg/kg | NORMAL |
| 1981 | 112167 | 19930513 | 8 | 10 | 477395.523 | 1348495.355 | Selenium | 11.4 | - | 3 | mg/kg | NORMAL |
| 1994 | 116264 | 19930512 | 2 | 3.5 | 477771.737 | 1347731.113 | Selenium | 11.1 | - | 3 | mg/kg | NORMAL |
| 1979 | 112091 | 19930510 | 0 | 1.5 | 477270.891 | 1348424.387 | Selenium | 10.3 | - | 3 | mg/kg | NORMAL |
| 1726 | 67149 | 19910701 | 9 | 10.5 | 477346.843 | 1348570.615 | Selenium | 10.2 | J | 3 | mg/kg | NORMAL |
| IFP-SS-01 | 111790 | 19930416 | 0 | 0.5 | 477729.578 | 1347819.173 | Selenium | 8.2 | - | 3 | mg/kg | NORMAL |
| AFP-SS-02 | 112254 | 19930514 | 0 | 0.5 | 477229.941 | 1348473.907 | Selenium | 7.8 | - | 3 | mg/kg | NORMAL |
| 1576 | 56982 | 19901104 | 0.5 | 1 | 481587.717 | 1349680.952 | Selenium | 7.7 | - | 3 | mg/kg | NORMAL |
| AFP-SS-03 | 112255 | 19930514 | 0 | 0.5 | 477265.393 | 1348609.726 | Selenium | 6.7 | - | 3 | mg/kg | NORMAL |
| P19-SP2 | 930511-088 | 11 May 1993 | 0 | 5 | 480002.96 | 1348639.82 | Selenium | 6.6 | NV | 3 | mg/kg | |
| P19-SP1 | 930511-087 | 11 May 1993 | 0 | 3 | 480003.42 | 1348602.4 | Selenium | 6.26 | NV | 3 | mg/kg | |
| P19-SP4 | 930511-090 | 11 May 1993 | 0 | 4 | 479992.07 | 1348612.25 | Selenium | 5.89 | NV | 3 | mg/kg | |
| P19-SP5 | 930511-091 | 11 May 1993 | 0 | 1 | 479991.91 | 1348669.18 | Selenium | 5.89 | NV | 3 | mg/kg | |
| 1723 | 67167 | 19910711 | 4.5 | 6 | 477272.522 | 1348486.906 | Selenium | 5.5 | - | 3 | mg/kg | NORMAL |
| 1998 | 112045 | 19930428 | 2 | 3.5 | 478120.948 | 1347563.899 | Selenium | 5.4 | J | 3 | mg/kg | NORMAL |
| 1994 | 116283 | 19930512 | 14 | 15.5 | 477771.737 | 1347731.113 | Selenium | 5.1 | - | 3 | mg/kg | NORMAL |
| P19-SP3 | 930511-089 | 11 May 1993 | 0 | 1 | 479999.23 | 1348674.78 | Selenium | 4.98 | NV | 3 | mg/kg | |
| AFP-SS-06 | 112259 | 19930514 | 0 | 0.5 | 477350.821 | 1348368.176 | Selenium | 4.9 | - | 3 | mg/kg | NORMAL |
| AFP-SS-04 | 112257 | 19930514 | 0 | 0.5 | 477312.854 | 1348636.065 | Selenium | 4.4 | - | 3 | mg/kg | NORMAL |
| AFP-SS-05 | 112258 | 19930514 | 0 | 0.5 | 477384.724 | 1348571.845 | Selenium | 4.1 | - | 3 | mg/kg | NORMAL |
| 1709 | 67071 | 19910606 | 13.5 | 15 | 477843.575 | 1347500.453 | Selenium | 4.1 | - | 3 | mg/kg | NORMAL |
| 1995 | 116090 | 19930501 | 8 | 9 | 477799.526 | 1347585.783 | Selenium | 4.1 | J | 3 | mg/kg | NORMAL |
| 1979 | 112123 | 19930511 | 25.5 | 27.5 | 477270.891 | 1348424.387 | Selenium | 3.7 | - | 3 | mg/kg | NORMAL |
| PA-SS-12 | 122214 | 19930721 | 0 | 0.5 | 480357.62 | 1348415.951 | Selenium | 3.7 | J | 3 | mg/kg | NORMAL |
| AFP-SD-05 | 112251 | 19930513 | 0 | 0.5 | 477414.664 | 1348588.224 | Selenium | 3.6 | J | 3 | mg/kg | NORMAL |
| AFP-SS-01 | 112252 | 19930514 | 0 | 0.5 | 477251.95 | 1348341.097 | Selenium | 3.5 | - | 3 | mg/kg | NORMAL |
| 1723 | 67173 | 19910711 | 13.5 | 15 | 477272.522 | 1348486.906 | Selenium | 3.4 | - | 3 | mg/kg | NORMAL |
| 1980 | 112145 | 19930512 | 13 | 15 | 477309.732 | 1348528.816 | Selenium | 3.3 | J | 3 | mg/kg | NORMAL |
| 1980 | 112129 | 19930512 | 0 | 2 | 477309.732 | 1348528.816 | Selenium | 3.3 | J | 3 | mg/kg | NORMAL |
| 11144 | 121860 | 19930721 | 1.5 | 2 | 480498.361 | 1346815.294 | Selenium | 3.3 | J | 3 | mg/kg | NORMAL |
| 1979 | 112117 | 19930510 | 20 | 22 | 477270.891 | 1348424.387 | Selenium | 3.2 | - | 3 | mg/kg | NORMAL |
| 1710 | 67032 | 19910531 | 9 | 10.5 | 477960.837 | 1347524.351 | Selenium | 3.1 | J | 3 | mg/kg | NORMAL |
| 1579 | 56951 | 19901102 | 0.5 | 1 | 481705.077 | 1349576.061 | Silver | 36.4 | - | 10 | mg/kg | NORMAL |
| WPA33 | 61219 | 19910426 | 0 | 0.5 | 480638.667 | 1347131.091 | Silver | 31.1 | - | 10 | mg/kg | NORMAL |
| 1674 | 57512 | 19901218 | 13.5 | 14 | 479929.216 | 1348461.965 | Silver | 31.1 | J | 10 | mg/kg | NORMAL |
| 1580 | 56963 | 19901107 | 2 | 2.5 | 481705.407 | 1349632.841 | Silver | 30.5 | - | 10 | mg/kg | NORMAL |

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000544

# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1599 | 56815 | 19901018 | 1.5 | 2 | 481000 | 1349564.68 | Silver | 25.3 | J | 10 | mg/kg | NORMAL |
| 1599 | 56823 | 19901023 | 5.5 | 6 | 481000 | 1349564.68 | Silver | 25 | - | 10 | mg/kg | NORMAL |
| 1572 | 56903 | 19901102 | 4 | 4.5 | 481666.295 | 1349483.482 | Silver | 23.7 | - | 10 | mg/kg | NORMAL |
| 1888 | 67714 | 19920223 | 0 | 1.5 | 482154.235 | 1348292.88 | Silver | 19.7 | J | 10 | mg/kg | NORMAL |
| 1622 | 99609 | 19910530 | 10 | 20 | 480430.974 | 1347059.944 | Silver | 19.2 | - | 10 | mg/kg | NORMAL |
| 1723 | 67184 | 19910712 | 29 | 30.5 | 477272.522 | 1348486.906 | Silver | 18.5 | - | 10 | mg/kg | NORMAL |
| 1616 | 64030 | 19910626 | 83 | 85.2 | 480498.672 | 1346846.904 | Silver | 17.6 | - | 10 | mg/kg | NORMAL |
| 1183 | 16595 | 19891023 | 0 | 0.5 | 480733.399 | 1348886.285 | Silver | 17.2 | - | 10 | mg/kg | NORMAL |
| 1616 | 64039 | 19910628 | 103 | 104.4 | 480498.672 | 1346846.904 | Silver | 17.1 | J | 10 | mg/kg | NORMAL |
| 1792 | 67346 | 19910821 | 6 | 7.5 | 477309.495 | 1347903.568 | Silver | 16.2 | - | 10 | mg/kg | NORMAL |
| 1808 | 67401 | 19910827 | 15 | 16.5 | 482172.304 | 1348153.53 | Silver | 15.6 | - | 10 | mg/kg | NORMAL |
| 1719 | 67300 | 19910808 | 18 | 19.5 | 482244.965 | 1348230.149 | Silver | 15.5 | - | 10 | mg/kg | NORMAL |
| 1619 | 64067 | 19910720 | 57.5 | 60 | 480442.345 | 1347124.214 | Silver | 15.2 | - | 10 | mg/kg | NORMAL |
| 1796 | 39001 | 19910921 | 0 | 0.5 | 480324.036 | 1348946.579 | Silver | 15.2 | - | 10 | mg/kg | NORMAL |
| 1889 | 67740 | 19920225 | 15.5 | 17.5 | 482150.755 | 1348296.83 | Silver | 15 | - | 10 | mg/kg | NORMAL |
| 1720 | 67311 | 19910810 | 7.5 | 9 | 482245.116 | 1348314.239 | Silver | 14.9 | - | 10 | mg/kg | NORMAL |
| 1790 | 99686 | 19910617 | 4 | 5 | 480543.115 | 1347063.483 | Silver | 14.4 | - | 10 | mg/kg | NORMAL |
| 1981 | 112181 | 19930514 | 19 | 21 | 477395.523 | 1348495.355 | Silver | 14.1 | J | 10 | mg/kg | NORMAL |
| 1792 | 67353 | 19910822 | 16.5 | 18 | 477309.495 | 1347903.568 | Silver | 13.3 | J | 10 | mg/kg | NORMAL |
| 1792 | 67350 | 19910821 | 12 | 13.5 | 477309.495 | 1347903.568 | Silver | 13.2 | J | 10 | mg/kg | NORMAL |
| 1794 | 67328 | 19910813 | 2 | 2.5 | 477983.59 | 1347812.61 | Silver | 13.2 | - | 10 | mg/kg | NORMAL |
| 1888 | 67717 | 19920223 | 5 | 6 | 482154.235 | 1348292.88 | Silver | 12.6 | J | 10 | mg/kg | NORMAL |
| 1808 | 67396 | 19910827 | 7.5 | 9 | 482172.304 | 1348153.53 | Silver | 12.5 | - | 10 | mg/kg | NORMAL |
| 1722 | 67250 | 19910729 | 1.5 | 3 | 482144.205 | 1348270.42 | Silver | 12.5 | J | 10 | mg/kg | NORMAL |
| 1820 | 67506 | 19911016 | 9.5 | 12 | 477443.682 | 1348419.225 | Silver | 11.9 | - | 10 | mg/kg | NORMAL |
| 1618 | 64146 | 19910803 | 125 | 127.5 | 480336.434 | 1347106.325 | Silver | 11.6 | - | 10 | mg/kg | NORMAL |
| 1808 | 67394 | 19910827 | 3 | 4.5 | 482172.304 | 1348153.53 | Silver | 11 | - | 10 | mg/kg | NORMAL |
| 1618 | 64112 | 19910730 | 67.5 | 70 | 480336.434 | 1347106.325 | Silver | 11 | - | 10 | mg/kg | NORMAL |
| 1618 | 64123 | 19910801 | 87.5 | 90 | 480336.434 | 1347106.325 | Silver | 10.8 | - | 10 | mg/kg | NORMAL |
| 1802 | 39060 | 19911015 | 0 | 0.5 | 480223.854 | 1348899.071 | Silver | 10.8 | J | 10 | mg/kg | NORMAL |
| 1981 | 112180 | 19930514 | 17 | 19 | 477395.523 | 1348495.355 | Silver | 10.7 | J | 10 | mg/kg | NORMAL |
| 1964 | 112648 | 19930417 | 5 | 6.5 | 477448.237 | 1347949.306 | Silver | 10.6 | - | 10 | mg/kg | NORMAL |
| 11162 | 122520 | 19930725 | 6.5 | 7 | 480517.412 | 1346872.153 | Silver | 10.5 | - | 10 | mg/kg | NORMAL |
| 1672 | 57008 | 19901204 | 0 | 0.5 | 482619.532 | 1349268.192 | Silver | 10.4 | - | 10 | mg/kg | NORMAL |
| WPA1 | 61002 | 19910418 | 0 | 0.5 | 482476.376 | 1346501.371 | Silver | 10.4 | - | 10 | mg/kg | NORMAL |
| WPA9 | 61058 | 19910421 | 0 | 0.5 | 481176.963 | 1346465.787 | Silver | 10.3 | - | 10 | mg/kg | NORMAL |
| WPA4 | 61023 | 19910420 | 0 | 0.5 | 482073.773 | 1346590.376 | Silver | 10.3 | - | 10 | mg/kg | NORMAL |
| P1P64 | 61472 | 19910519 | 0 | 0.5 | 481891.995 | 1348503.772 | Silver | 10.2 | - | 10 | mg/kg | NORMAL |
| WPA40 | 61275 | 19910422 | 0 | 0.5 | 482035.49 | 1347989.772 | Silver | 10.2 | J | 10 | mg/kg | NORMAL |
| 1722 | 67259 | 19910730 | 14 | 16.5 | 482144.205 | 1348270.42 | Silver | 10.2 | - | 10 | mg/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P1P6 | 99183 | 19930122 | 2 | 3 | 481266.063 | 1348795.459 | Silver | 10.1 | - | 10 | mg/kg | NORMAL |
| WPA26 | 61177 | 19910427 | 0 | 0.5 | 480252.766 | 1347340.795 | Silver | 10.1 | - | 10 | mg/kg | NORMAL |
| 11374 | 200100 | 19940707 | 2 | 2.5 | 478230.275 | 1350480.989 | Thallium | 22.7 | - | 6.3 | mg/kg | NORMAL |
| 11376 | 200129 | 19940708 | 2 | 2.5 | 480126.482 | 1351027.005 | Thallium | 21.3 | - | 6.3 | mg/kg | NORMAL |
| 11380 | 200186 | 19940709 | 2 | 2.5 | 482461.511 | 1348047.947 | Thallium | 20.6 | - | 6.3 | mg/kg | NORMAL |
| 11379 | 200172 | 19940709 | 2 | 2.5 | 482586.876 | 1350587.638 | Thallium | 15.6 | - | 6.3 | mg/kg | NORMAL |
| 11370 | 200044 | 19940710 | 2 | 2.5 | 478963.245 | 1347929.618 | Thallium | 13 | - | 6.3 | mg/kg | NORMAL |
| 1889 | 67740 | 19920225 | 15.5 | 17.5 | 482150.755 | 1348296.83 | Thallium | 12.5 | - | 6.3 | mg/kg | NORMAL |
| 11377 | 200143 | 19940708 | 2 | 2.5 | 480734.608 | 1351699.766 | Thallium | 11.6 | - | 6.3 | mg/kg | NORMAL |
| 11138 | 70487 | 19930808 | 5.5 | 6 | 480501.961 | 1346796.294 | Vanadium | 190 | J | 150 | mg/kg | NORMAL |
| 1672 | 57008 | 19901204 | 0 | 0.5 | 482619.532 | 1349268.192 | Zinc | 2150 | - | 500 | mg/kg | NORMAL |
| 11194 | 122087 | 19930723 | 4.5 | 5 | 481671.306 | 1348699.774 | Zinc | 780 | J | 500 | mg/kg | NORMAL |
| 1307 | 19323 | 19890718 | 0 | 0.5 | 481031.51 | 1349532.099 | Zinc | 767 | J | 500 | mg/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Zinc | 764 | J | 500 | mg/kg | NORMAL |
| 1671 | 57006 | 19901204 | 0 | 0.5 | 482640.692 | 1349267.871 | Zinc | 707 | - | 500 | mg/kg | NORMAL |
| 11194 | 122076 | 19930723 | 1 | 1.5 | 481671.306 | 1348699.774 | Zinc | 502 | J | 500 | mg/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Benzo(a)anthracene | 310000 | - | 1000 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Benzo(a)anthracene | 61000 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Benzo(a)anthracene | 19000 | - | 1000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Benzo(a)anthracene | 18000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61511 | 19910725 | 1.5 | 1.9 | 480866.165 | 1346857.389 | Benzo(a)anthracene | 17000 | J | 1000 | ug/kg | NORMAL |
| WPA18 | 61514 | 19910725 | 1.3 | 1.8 | 480866.165 | 1346857.389 | Benzo(a)anthracene | 13000 | J | 1000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Benzo(a)anthracene | 9200 | - | 1000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Benzo(a)anthracene | 9100 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61512 | 19910724 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(a)anthracene | 6500 | - | 1000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Benzo(a)anthracene | 6300 | - | 1000 | ug/kg | NORMAL |
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Benzo(a)anthracene | 5500 | - | 1000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Benzo(a)anthracene | 5400 | - | 1000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Benzo(a)anthracene | 5100 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61126 | 19910427 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(a)anthracene | 4700 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Benzo(a)anthracene | 2900 | - | 1000 | ug/kg | NORMAL |
| 1672 | 57008 | 19901204 | 0 | 0.5 | 482619.532 | 1349268.192 | Benzo(a)anthracene | 2700 | J | 1000 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Benzo(a)anthracene | 2500 | - | 1000 | ug/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Benzo(a)anthracene | 2400 | - | 1000 | ug/kg | NORMAL |
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Benzo(a)anthracene | 2100 | - | 1000 | ug/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Benzo(a)anthracene | 2000 | J | 1000 | ug/kg | NORMAL |
| 11110 | 122142 | 19930727 | 0 | 0.5 | 479770.742 | 1349911.203 | Benzo(a)anthracene | 1800 | J | 1000 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Benzo(a)anthracene | 1600 | - | 1000 | ug/kg | NORMAL |
| PA-SS-18 | 122243 | 19930723 | 0 | 0.5 | 480350.098 | 1349938.406 | Benzo(a)anthracene | 1600 | J | 1000 | ug/kg | NORMAL |
| WPA18 | 61515 | 19910725 | 0.5 | 1 | 480866.165 | 1346857.389 | Benzo(a)anthracene | 1300 | J | 1000 | ug/kg | NORMAL |



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# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 111441 | 19930426 | 2 | 4 | 482121.864 | 1348255.63 | Benzo(a)anthracene | 1100 | J | 1000 | ug/kg | NORMAL |
| 1972 | 110382 | 19930319 | 0.5 | 1 | 477987.353 | 1348022.38 | Benzo(a)anthracene | 1100 | - | 1000 | ug/kg | NORMAL |
| 1808 | 67396 | 19910827 | 7.5 | 9 | 482172.304 | 1348153.53 | Benzo(a)anthracene | 1100 | J | 1000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Benzo(a)pyrene | 260000 | - | 1000 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Benzo(a)pyrene | 69000 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Benzo(a)pyrene | 24000 | - | 1000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Benzo(a)pyrene | 13000 | - | 1000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Benzo(a)pyrene | 12000 | - | 1000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Benzo(a)pyrene | 11000 | - | 1000 | ug/kg | NORMAL |
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Benzo(a)pyrene | 9400 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61514 | 19910725 | 1.3 | 1.8 | 480866.165 | 1346857.389 | Benzo(a)pyrene | 8600 | J | 1000 | ug/kg | NORMAL |
| WPA18 | 61512 | 19910724 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(a)pyrene | 7000 | - | 1000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Benzo(a)pyrene | 6000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61126 | 19910427 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(a)pyrene | 5200 | - | 1000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Benzo(a)pyrene | 5100 | - | 1000 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Benzo(a)pyrene | 4700 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Benzo(a)pyrene | 3700 | - | 1000 | ug/kg | NORMAL |
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Benzo(a)pyrene | 3400 | - | 1000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Benzo(a)pyrene | 3400 | - | 1000 | ug/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Benzo(a)pyrene | 3300 | - | 1000 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Benzo(a)pyrene | 2600 | - | 1000 | ug/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Benzo(a)pyrene | 2300 | J | 1000 | ug/kg | NORMAL |
| 1972 | 110382 | 19930319 | 0.5 | 1 | 477987.353 | 1348022.38 | Benzo(a)pyrene | 1800 | - | 1000 | ug/kg | NORMAL |
| 1672 | 57008 | 19901204 | 0 | 0.5 | 482619.532 | 1349268.192 | Benzo(a)pyrene | 1600 | J | 1000 | ug/kg | NORMAL |
| 11110 | 122142 | 19930727 | 0 | 0.5 | 479770.742 | 1349911.203 | Benzo(a)pyrene | 1600 | J | 1000 | ug/kg | NORMAL |
| PA-SS-18 | 122243 | 19930723 | 0 | 0.5 | 480350.098 | 1349938.406 | Benzo(a)pyrene | 1100 | J | 1000 | ug/kg | NORMAL |
| LSP-SS-14 | 114516 | 19930505 | 0 | 0.5 | 480781.92 | 1348108.497 | Benzo(a)pyrene | 1100 | - | 1000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Benzo(b)fluoranthene | 220000 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Benzo(b)fluoranthene | 39000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61511 | 19910725 | 1.5 | 1.9 | 480866.165 | 1346857.389 | Benzo(b)fluoranthene | 23000 | J | 1000 | ug/kg | NORMAL |
| WPA18 | 61514 | 19910725 | 1.3 | 1.8 | 480866.165 | 1346857.389 | Benzo(b)fluoranthene | 20000 | J | 1000 | ug/kg | NORMAL |
| WPA18 | 61512 | 19910724 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(b)fluoranthene | 16000 | - | 1000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Benzo(b)fluoranthene | 15000 | - | 1000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Benzo(b)fluoranthene | 11000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61126 | 19910427 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(b)fluoranthene | 9700 | - | 1000 | ug/kg | NORMAL |
| 1672 | 57008 | 19901204 | 0 | 0.5 | 482619.532 | 1349268.192 | Benzo(b)fluoranthene | 7700 | - | 1000 | ug/kg | NORMAL |
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Benzo(b)fluoranthene | 6200 | - | 1000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Benzo(b)fluoranthene | 6100 | - | 1000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Benzo(b)fluoranthene | 6000 | - | 1000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Benzo(b)fluoranthene | 4700 | - | 1000 | ug/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Benzo(b)fluoranthene | 4500 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Benzo(b)fluoranthene | 4200 | - | 1000 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Benzo(b)fluoranthene | 3900 | - | 1000 | ug/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Benzo(b)fluoranthene | 3500 | - | 1000 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Benzo(b)fluoranthene | 3300 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61515 | 19910725 | 0.5 | 1 | 480866.165 | 1346857.389 | Benzo(b)fluoranthene | 2400 | J | 1000 | ug/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Benzo(b)fluoranthene | 2300 | J | 1000 | ug/kg | NORMAL |
| 11110 | 122142 | 19930727 | 0 | 0.5 | 479770.742 | 1349911.203 | Benzo(b)fluoranthene | 2000 | J | 1000 | ug/kg | NORMAL |
| ASI-8 | 103683 | 19920930 | 0.33 | 0.5 | 480249.58 | 1351462.542 | Benzo(b)fluoranthene | 1800 | - | 1000 | ug/kg | NORMAL |
| 1972 | 110382 | 19930319 | 0.5 | 1 | 477987.353 | 1348022.38 | Benzo(b)fluoranthene | 1600 | - | 1000 | ug/kg | NORMAL |
| PA-SS-18 | 122243 | 19930723 | 0 | 0.5 | 480350.098 | 1349938.406 | Benzo(b)fluoranthene | 1500 | J | 1000 | ug/kg | NORMAL |
| P1P61 | 61455 | 19910517 | 1.5 | 2 | 481689.294 | 1348519.375 | Benzo(b)fluoranthene | 1400 | - | 1000 | ug/kg | NORMAL |
| 11039 | 115385 | 19930519 | 12 | 14 | 482175.435 | 1348303.82 | Benzo(b)fluoranthene | 1200 | - | 1000 | ug/kg | NORMAL |
| 1992 | 115343 | 19930511 | 7.5 | 10 | 482272.486 | 1348301.818 | Benzo(b)fluoranthene | 1200 | - | 1000 | ug/kg | NORMAL |
| 1985 | 111441 | 19930426 | 2 | 4 | 482121.864 | 1348255.63 | Benzo(b)fluoranthene | 1100 | J | 1000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Benzo(g,h,i)perylene | 150000 | - | 1000 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Benzo(g,h,i)perylene | 48000 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Benzo(g,h,i)perylene | 12000 | - | 1000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Benzo(g,h,i)perylene | 8700 | - | 1000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Benzo(g,h,i)perylene | 8200 | - | 1000 | ug/kg | NORMAL |
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Benzo(g,h,i)perylene | 6200 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61512 | 19910724 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(g,h,i)perylene | 5900 | - | 1000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Benzo(g,h,i)perylene | 5800 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61126 | 19910427 | 1.5 | 2 | 480866.165 | 1346857.389 | Benzo(g,h,i)perylene | 5300 | - | 1000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Benzo(g,h,i)perylene | 3700 | - | 1000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Benzo(g,h,i)perylene | 3500 | - | 1000 | ug/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Benzo(g,h,i)perylene | 3400 | - | 1000 | ug/kg | NORMAL |
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Benzo(g,h,i)perylene | 3200 | - | 1000 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Benzo(g,h,i)perylene | 3100 | - | 1000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Benzo(g,h,i)perylene | 2200 | - | 1000 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Benzo(g,h,i)perylene | 2000 | - | 1000 | ug/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Benzo(g,h,i)perylene | 1900 | J | 1000 | ug/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Benzo(g,h,i)perylene | 1500 | J | 1000 | ug/kg | NORMAL |
| 1972 | 110382 | 19930319 | 0.5 | 1 | 477987.353 | 1348022.38 | Benzo(g,h,i)perylene | 1200 | - | 1000 | ug/kg | NORMAL |
| ASI-8 | 103683 | 19920930 | 0.33 | 0.5 | 480249.58 | 1351462.542 | Benzo(g,h,i)perylene | 1100 | - | 1000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Benzo(k)fluoranthene | 140000 | - | 1000 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Benzo(k)fluoranthene | 69000 | - | 1000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Benzo(k)fluoranthene | 25000 | - | 1000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Benzo(k)fluoranthene | 12000 | - | 1000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Benzo(k)fluoranthene | 9500 | - | 1000 | ug/kg | NORMAL |

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# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Benzo(k)fluoranthene | 7300 | - | 1000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Benzo(k)fluoranthene | 5000 | - | 1000 | ug/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Benzo(k)fluoranthene | 3800 | - | 1000 | ug/kg | NORMAL |
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Benzo(k)fluoranthene | 3800 | - | 1000 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Benzo(k)fluoranthene | 3300 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Benzo(k)fluoranthene | 3100 | - | 1000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Benzo(k)fluoranthene | 2900 | - | 1000 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Benzo(k)fluoranthene | 2900 | - | 1000 | ug/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Benzo(k)fluoranthene | 2600 | J | 1000 | ug/kg | NORMAL |
| 1808 | 67396 | 19910827 | 7.5 | 9 | 482172.304 | 1348153.53 | Benzo(k)fluoranthene | 1800 | J | 1000 | ug/kg | NORMAL |
| 1972 | 110382 | 19930319 | 0.5 | 1 | 477987.353 | 1348022.38 | Benzo(k)fluoranthene | 1600 | - | 1000 | ug/kg | NORMAL |
| 11110 | 122142 | 19930727 | 0 | 0.5 | 479770.742 | 1349911.203 | Benzo(k)fluoranthene | 1500 | J | 1000 | ug/kg | NORMAL |
| ASI-8 | 103683 | 19920930 | 0.33 | 0.5 | 480249.58 | 1351462.542 | Benzo(k)fluoranthene | 1300 | - | 1000 | ug/kg | NORMAL |
| PA-SS-18 | 122243 | 19930723 | 0 | 0.5 | 480350.098 | 1349938.406 | Benzo(k)fluoranthene | 1200 | J | 1000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Chrysene | 310000 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Chrysene | 18000 | - | 1000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Chrysene | 18000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61511 | 19910725 | 1.5 | 1.9 | 480866.165 | 1346857.389 | Chrysene | 17000 | J | 1000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Chrysene | 12000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61514 | 19910725 | 1.3 | 1.8 | 480866.165 | 1346857.389 | Chrysene | 12000 | J | 1000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Chrysene | 11000 | - | 1000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Chrysene | 7800 | - | 1000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Chrysene | 7200 | - | 1000 | ug/kg | NORMAL |
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Chrysene | 6000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61512 | 19910724 | 1.5 | 2 | 480866.165 | 1346857.389 | Chrysene | 5500 | - | 1000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Chrysene | 5000 | - | 1000 | ug/kg | NORMAL |
| 1672 | 57008 | 19901204 | 0 | 0.5 | 482619.532 | 1349268.192 | Chrysene | 4700 | J | 1000 | ug/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Chrysene | 3600 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61126 | 19910427 | 1.5 | 2 | 480866.165 | 1346857.389 | Chrysene | 3500 | - | 1000 | ug/kg | NORMAL |
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Chrysene | 3500 | - | 1000 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Chrysene | 3200 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Chrysene | 3000 | - | 1000 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Chrysene | 2500 | - | 1000 | ug/kg | NORMAL |
| 11110 | 122142 | 19930727 | 0 | 0.5 | 479770.742 | 1349911.203 | Chrysene | 2200 | J | 1000 | ug/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Chrysene | 1900 | J | 1000 | ug/kg | NORMAL |
| PA-SS-18 | 122243 | 19930723 | 0 | 0.5 | 480350.098 | 1349938.406 | Chrysene | 1600 | J | 1000 | ug/kg | NORMAL |
| 1808 | 67396 | 19910827 | 7.5 | 9 | 482172.304 | 1348153.53 | Chrysene | 1400 | J | 1000 | ug/kg | NORMAL |
| 1972 | 110382 | 19930319 | 0.5 | 1 | 477987.353 | 1348022.38 | Chrysene | 1400 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61515 | 19910725 | 0.5 | 1 | 480866.165 | 1346857.389 | Chrysene | 1100 | J | 1000 | ug/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LSP-SS-14 | 114516 | 19930505 | 0 | 0.5 | 480781.92 | 1348108.497 | Chrysene | 1100 | - | 1000 | ug/kg | NORMAL |
| SWL-SS-01 | 111293 | 19930401 | 0 | 0.5 | 482123.692 | 1348105.541 | Chrysene | 1100 | J | 1000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Dibenzo(a,h)anthracene | 79000 | - | 880 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Dibenzo(a,h)anthracene | 23000 | - | 880 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Dibenzo(a,h)anthracene | 6900 | - | 880 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Dibenzo(a,h)anthracene | 3500 | - | 880 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Dibenzo(a,h)anthracene | 3400 | - | 880 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Dibenzo(a,h)anthracene | 3000 | J | 880 | ug/kg | NORMAL |
| IFP-SS-07 | 111796 | 19930416 | 0 | 0.5 | 478195.239 | 1347554.049 | Dibenzo(a,h)anthracene | 2200 | - | 880 | ug/kg | NORMAL |
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Dibenzo(a,h)anthracene | 1900 | J | 880 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Dibenzo(a,h)anthracene | 1500 | - | 880 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Dibenzo(a,h)anthracene | 1500 | - | 880 | ug/kg | NORMAL |
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Dibenzo(a,h)anthracene | 1400 | J | 880 | ug/kg | NORMAL |
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Dibenzo(a,h)anthracene | 1200 | - | 880 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Dibenzo(a,h)anthracene | 1100 | - | 880 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Dibenzo(a,h)anthracene | 1100 | - | 880 | ug/kg | NORMAL |
| WPA18 | 61512 | 19910724 | 1.5 | 2 | 480866.165 | 1346857.389 | Dibenzo(a,h)anthracene | 1000 | J | 880 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Dibenzo(a,h)anthracene | 920 | - | 880 | ug/kg | NORMAL |
| WPA18 | 61126 | 19910427 | 1.5 | 2 | 480866.165 | 1346857.389 | Dibenzo(a,h)anthracene | 900 | J | 880 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Fluoranthene | 790000 | - | 10000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Fluoranthene | 48000 | - | 10000 | ug/kg | NORMAL |
| WPA18 | 61511 | 19910725 | 1.5 | 1.9 | 480866.165 | 1346857.389 | Fluoranthene | 34000 | J | 10000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Fluoranthene | 33000 | - | 10000 | ug/kg | NORMAL |
| WPA18 | 61514 | 19910725 | 1.3 | 1.8 | 480866.165 | 1346857.389 | Fluoranthene | 29000 | J | 10000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Fluoranthene | 19000 | - | 10000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Fluoranthene | 18000 | - | 10000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Fluoranthene | 13000 | - | 10000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Fluoranthene | 11000 | - | 10000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Indeno(1,2,3-cd)pyrene | 150000 | - | 1000 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Indeno(1,2,3-cd)pyrene | 49000 | - | 1000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Indeno(1,2,3-cd)pyrene | 13000 | - | 1000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Indeno(1,2,3-cd)pyrene | 8700 | - | 1000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Indeno(1,2,3-cd)pyrene | 8000 | - | 1000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Indeno(1,2,3-cd)pyrene | 6500 | - | 1000 | ug/kg | NORMAL |
| 1972 | 110378 | 19930319 | 0 | 0.5 | 477987.353 | 1348022.38 | Indeno(1,2,3-cd)pyrene | 6000 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61512 | 19910724 | 1.5 | 2 | 480866.165 | 1346857.389 | Indeno(1,2,3-cd)pyrene | 4900 | - | 1000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Indeno(1,2,3-cd)pyrene | 4800 | - | 1000 | ug/kg | NORMAL |
| WPA18 | 61126 | 19910427 | 1.5 | 2 | 480866.165 | 1346857.389 | Indeno(1,2,3-cd)pyrene | 4200 | - | 1000 | ug/kg | NORMAL |
| KC2-3 | 99262 | 19930201 | 0 | 0.5 | 482089.111 | 1349607.097 | Indeno(1,2,3-cd)pyrene | 3100 | - | 1000 | ug/kg | NORMAL |



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# TABLE C-4
## (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SMA-1 | 99270 | 19930204 | 0 | 0.5 | 482046.125 | 1349968.396 | Indeno(1,2,3-cd)pyrene | 3000 | - | 1000 | ug/kg | NORMAL |
| SF-SS-17 | 110297 | 19930318 | 0 | 0.5 | 477940.162 | 1347967.79 | Indeno(1,2,3-cd)pyrene | 3000 | - | 1000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Indeno(1,2,3-cd)pyrene | 2900 | - | 1000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Indeno(1,2,3-cd)pyrene | 2200 | - | 1000 | ug/kg | NORMAL |
| KC2-4 | 99263 | 19930201 | 0 | 0.5 | 482087.102 | 1349709.607 | Indeno(1,2,3-cd)pyrene | 2000 | - | 1000 | ug/kg | NORMAL |
| 1327 | 19763 | 19891023 | 0 | 0.5 | 480781.132 | 1349887.841 | Indeno(1,2,3-cd)pyrene | 1700 | J | 1000 | ug/kg | NORMAL |
| 1308 | 19346 | 19891204 | 0.5 | 1 | 481025.692 | 1349685.459 | Indeno(1,2,3-cd)pyrene | 1500 | J | 1000 | ug/kg | NORMAL |
| ASI-8 | 103683 | 19920930 | 0.33 | 0.5 | 480249.58 | 1351462.542 | Indeno(1,2,3-cd)pyrene | 1500 | - | 1000 | ug/kg | NORMAL |
| 11110 | 122142 | 19930727 | 0 | 0.5 | 479770.742 | 1349911.203 | Indeno(1,2,3-cd)pyrene | 1300 | J | 1000 | ug/kg | NORMAL |
| SS-14 | 121116 | 30 June 1993 | 0 | 0.5 | 481736.64 | 1351181.607 | Pentachlorophenol | 1100 | Z | 100 | ug/kg | NORMAL |
| 1514 | 53782 | 19900206 | 2 | 2.5 | 482570.174 | 1349504.922 | Pentachlorophenol | 260 | J | 100 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Phenanthrene | 900000 | - | 5000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Phenanthrene | 48000 | - | 5000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Phenanthrene | 22000 | - | 5000 | ug/kg | NORMAL |
| WPA18 | 61511 | 19910725 | 1.5 | 1.9 | 480866.165 | 1346857.389 | Phenanthrene | 18000 | J | 5000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Phenanthrene | 13000 | - | 5000 | ug/kg | NORMAL |
| WPA18 | 61514 | 19910725 | 1.3 | 1.8 | 480866.165 | 1346857.389 | Phenanthrene | 12000 | J | 5000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Phenanthrene | 9900 | - | 5000 | ug/kg | NORMAL |
| 1252 | 52753 | 19890615 | 0 | 0.5 | 479834.395 | 1348442.497 | Phenanthrene | 8800 | - | 5000 | ug/kg | NORMAL |
| WPA18 | 61515 | 19910725 | 0.5 | 1 | 480866.165 | 1346857.389 | Phenanthrene | 6800 | - | 5000 | ug/kg | NORMAL |
| 1584 | 56576 | 19900924 | 2 | 2.5 | 481135.552 | 1349611.448 | Phenanthrene | 5900 | - | 5000 | ug/kg | NORMAL |
| 11039 | 115384 | 19930519 | 2.5 | 5 | 482175.435 | 1348303.82 | Pyrene | 610000 | - | 10000 | ug/kg | NORMAL |
| 11041 | 115389 | 19930519 | 0 | 2.5 | 482243.105 | 1348213.659 | Pyrene | 38000 | - | 10000 | ug/kg | NORMAL |
| WPA18 | 61511 | 19910725 | 1.5 | 1.9 | 480866.165 | 1346857.389 | Pyrene | 30000 | J | 10000 | ug/kg | NORMAL |
| WPA18 | 61514 | 19910725 | 1.3 | 1.8 | 480866.165 | 1346857.389 | Pyrene | 29000 | J | 10000 | ug/kg | NORMAL |
| 1308 | 19345 | 19891204 | 0 | 0.5 | 481025.692 | 1349685.459 | Pyrene | 22000 | - | 10000 | ug/kg | NORMAL |
| 11099 | 121401 | 19930710 | 0 | 0.5 | 479770.905 | 1348509.817 | Pyrene | 15000 | - | 10000 | ug/kg | NORMAL |
| KC2-1 | 99260 | 19930201 | 0 | 0.5 | 482094.908 | 1349393.927 | Pyrene | 14000 | - | 10000 | ug/kg | NORMAL |
| KC2-2 | 99261 | 19930201 | 0 | 0.5 | 482091.45 | 1349504.077 | Pyrene | 12000 | - | 10000 | ug/kg | NORMAL |
| UST-12-2 | UST62583 | 19901213 | 10 | 10.5 | 480862.068 | 1348900.503 | Benzene | 342 | NV | 100 | ug/kg | NORMAL |
| UST-8-1 | UST62572 | 19901213 | 10 | 10.5 | 479961.896 | 1350004.25 | Benzene | 271 | NV | 100 | ug/kg | NORMAL |
| UST-8-2 | UST62573 | 19901213 | 10 | 10.5 | 479976.83 | 1350004.26 | Benzene | 121 | NV | 100 | ug/kg | NORMAL |
| P6PSP-8 | 91-137C-3391 | 19920113 | 0 | 0.5 | 480692.404 | 1350138.981 | Carbon Tetrachloride | 1200 | NV | 300 | ug/kg | NORMAL |
| P6PSP-8 | 91-137C-3388 | 19920113 | 0 | 0.5 | 480692.404 | 1350138.981 | Carbon Tetrachloride | 1100 | NV | 300 | ug/kg | NORMAL |
| UST-8-2 | UST62573 | 19901213 | 10 | 10.5 | 479976.83 | 1350004.26 | Ethylbenzene | 4470 | NV | 100 | ug/kg | NORMAL |
| UST-12-2 | UST62583 | 19901213 | 10 | 10.5 | 480862.068 | 1348900.503 | Ethylbenzene | 2920 | NV | 100 | ug/kg | NORMAL |
| UST-8-1 | UST62572 | 19901213 | 10 | 10.5 | 479961.896 | 1350004.25 | Ethylbenzene | 1190 | NV | 100 | ug/kg | NORMAL |
| US3-5 (EM-2120) | UST60606 | 19901129 | 2 | 0 | 481136.405 | 1349866.977 | Ethylbenzene | 747 | NV | 100 | ug/kg | NORMAL |
| UST-12-1 | UST62581 | 19901213 | 10 | 10.5 | 480861.879 | 1348884.803 | Ethylbenzene | 690 | NV | 100 | ug/kg | NORMAL |

# TABLE C-4
# (CONT'D)

| Location ID | Sample ID | Sample Date | Top Depth (ft) | Bottom Depth (ft) | Northing 83 | Easting 83 | Parameter | Result | Validation Qualifier | BTV | Units | QA Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PLANT1PAD-19M | 40205 | 19920427 | 0 | 0.5 | 481397.253 | 1348586.798 | Ethylbenzene | 660 | J | 100 | ug/kg | NORMAL |
| UST-11-1 | UST62582 | 19901213 | 10 | 10.5 | 480854.8 | 1348884.753 | Ethylbenzene | 652 | NV | 100 | ug/kg | NORMAL |
| UST-9-1 | UST62575 | 19901213 | 10 | 10.5 | 479942.52 | 1350005.92 | Ethylbenzene | 528 | NV | 100 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Ethylbenzene | 290 | - | 100 | ug/kg | NORMAL |
| 1283 | 18796 | 19890718 | 0.5 | 1 | 481733.108 | 1349618.881 | Ethylbenzene | 140 | J | 100 | ug/kg | NORMAL |
| USSO-041990-2 | UST28263 | 19900418 | -99 | -99 | 479862.396 | 1350125.991 | Toluene | 2e+06 | NV | 100 | ug/kg | NORMAL |
| 1995 | 116090 | 19930501 | 8 | 9 | 477799.526 | 1347585.783 | Toluene | 1800 | J | 100 | ug/kg | NORMAL |
| 1996 | 112084 | 19930429 | 14 | 15 | 477849.197 | 1347645.922 | Toluene | 1000 | J | 100 | ug/kg | NORMAL |
| US3-5 (EM-2120) | UST60606 | 19901129 | 2 | 0 | 481136.405 | 1349866.977 | Toluene | 794 | NV | 100 | ug/kg | NORMAL |
| UST-12-2 | UST62583 | 19901213 | 10 | 10.5 | 480862.068 | 1348900.503 | Toluene | 519 | NV | 100 | ug/kg | NORMAL |
| 1980 | 112145 | 19930512 | 13 | 15 | 477309.732 | 1348528.816 | Toluene | 440 | J | 100 | ug/kg | NORMAL |
| UST-8-1 | UST62572 | 19901213 | 10 | 10.5 | 479961.896 | 1350004.25 | Toluene | 382 | NV | 100 | ug/kg | NORMAL |
| UST-8-2 | UST62573 | 19901213 | 10 | 10.5 | 479976.83 | 1350004.26 | Toluene | 379 | NV | 100 | ug/kg | NORMAL |
| UST-12-1 | UST62581 | 19901213 | 10 | 10.5 | 480861.879 | 1348884.803 | Toluene | 255 | NV | 100 | ug/kg | NORMAL |
| SMA-6 | 99273 | 19930204 | 0 | 0.5 | 481733.973 | 1350063.05 | Toluene | 200 | - | 100 | ug/kg | NORMAL |
| 1621 | 99533 | 19910521 | 5 | 6 | 480547.164 | 1346973.953 | Toluene | 200 | - | 100 | ug/kg | NORMAL |
| 1307 | 19323 | 19890718 | 0 | 0.5 | 481031.51 | 1349532.099 | Toluene | 190 | J | 100 | ug/kg | NORMAL |
| 1996 | 112077 | 19930429 | 8 | 9.5 | 477849.197 | 1347645.922 | Toluene | 180 | - | 100 | ug/kg | NORMAL |
| 1283 | 18796 | 19890718 | 0.5 | 1 | 481733.108 | 1349618.881 | Toluene | 160 | J | 100 | ug/kg | NORMAL |
| 1979 | 112091 | 19930510 | 0 | 1.5 | 477270.891 | 1348424.387 | Toluene | 160 | J | 100 | ug/kg | NORMAL |
| 1998 | 112045 | 19930428 | 2 | 3.5 | 478120.948 | 1347563.899 | Toluene | 150 | J | 100 | ug/kg | NORMAL |
| 1979 | 112117 | 19930510 | 20 | 22 | 477270.891 | 1348424.387 | Toluene | 140 | J | 100 | ug/kg | NORMAL |
| 1846 | 67706 | 19920222 | 6 | 7.5 | 477250.801 | 1348484.517 | Toluene | 130 | J | 100 | ug/kg | NORMAL |
| 1981 | 112161 | 19930513 | 2 | 4 | 477395.523 | 1348495.355 | Toluene | 130 | J | 100 | ug/kg | NORMAL |
| US3-4 (EM-2121) | UST60607 | 19901129 | 4 | 0 | 481136.405 | 1349861.977 | Toluene | 116 | NV | 100 | ug/kg | NORMAL |
| P6PSP-4 | 92-137C-3415 | 19920206 | 0 | 0.5 | 480705.404 | 1350132.981 | Toluene | 110 | NV | 100 | ug/kg | NORMAL |
| 1846 | 67711 | 19920222 | 13.5 | 15 | 477250.801 | 1348484.517 | Toluene | 110 | J | 100 | ug/kg | NORMAL |
| 1850 | 67632 | 19920223 | 13.5 | 15 | 478155.548 | 1347493.639 | Toluene | 110 | J | 100 | ug/kg | NORMAL |
| UST-10-1 | UST61671 | 19901207 | 10 | 10.5 | 479952.716 | 1350053.06 | Toluene | 106 | NV | 100 | ug/kg | NORMAL |

Validation Qualifier:
(-) = Validated, no data qualifier
J = Estimated value
NV = Not validated
R = Rejected
Z = Sample reanalyzed



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# TABLE C-5
## SURFACE WATER AND SEDIMENT COECs

| Surface Water COEC | FS Detection Limit (μg/L) | FS Background (μg/L) | | Surface Water (μg/L) | | Individual Screen | Sample IEMP |
|---|---|---|---|---|---|---|---|
| | | Paddys Run | GMR | FRL | BTV | | |
| Barium | 5.0 | 53 | 100 | 100000 | 145 | | yes |
| Cadmium | 0.4 | ND | 9.8 | 9.8 | 3.5 | | yes |
| Silver | 5.0 | ND | ND | 5 | 1.3 | | yes |
| Aluminum | NA | 640 | 115 | NA | 87 | yes | |
| Manganese | 4.0 | 35 | 82 | 1500 | 98 | yes | |
| Ammonia | NA | 39 | 110 | NA | 1000 | yes | |
| 1,2-dichloroethene | NA | ND | ND | NA | 55 | yes | |
| Trichloroethene | 1.0 | ND | ND | NA | 5 | yes | |
| Beryllium | 0.2 | ND | ND | 1.2 | 4 | | |
| Lead | 2.0 | ND | 10 | 10 | 50 | | |
| Mercury | 0.2 | ND | ND | 0.2 | 0.2 | | |
| Bis(2-ethylhexyl)phthalate | 5.0 | NA | NA | 8.4 | 8.4 | | |
| Cyanide | 5.0 | NA | NA | 12 | 12 | | |
| Di-n-octylphthalate | 5.0 | NA | NA | 5 | 47.7 | | |

| Sediment COEC | FS Detection Limits (mg/kg) | FS Background (mg/kg) | | Sediment (mg/kg) | | Individual Screen | Sample IEMP |
|---|---|---|---|---|---|---|---|
| | | Paddys Run | GMR | FRL | BTV | | |
| Barium | 2.5 | 21 | NA | NA | 40 | | yes |
| Cadmium | 0.2 | 3.7 | NA | 71 | 5 | | yes |
| Iron | NA | 6700 | NA | NA | 17000 | | yes |
| Lead | 1.0 | NA | NA | NA | 35 | | yes |
| Zinc | 2.0 | 13.5 | NA | NA | 120 | | yes |
| Manganese | 2.0 | 411 | NA | 410 | 300 | yes | |
| Phenanthrene | 0.003 | NA | NA | 0.003 | 0.3 | | |

ND = Not detected above method detection limits
NA = Not applicalbe
COEC = constituent of ecological concern
IEMP = Integrated Environmental Monitoring Plan
FS = feasibility study
GMR = Great Miami River

# TABLE C-6
## SURFACE WATER MODELING RESULTS ($\mu$g/L)

| Area | Antimony | Cadmium | Silver | Molybdenum | Manganese | Thallium | Benzo(b)-fluoranthene | Benzo(a)-pyrene | Benzo(a)-anthracene | Benzo(g,h,i)-perylene | Benzo(k)-fluoranthene | Chrysene | Dibenzo(a,h)-anthracene | Ideno(1,2,3-cd)-pyrene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 560 | 1.97e-01 | 1.70e-01 | 0.518 | 4.34 | 270 | 0.0778 | 0.0000128 | NA | NA | NA | NA | NA | NA | NA |
| 570 | 0.165 | 1.40e-01 | 0.571 | 1.52 | 247 | 0.0692 | NA | NA | NA | NA | NA | NA | NA | NA |
| 575 | 1.72e-01 | 1.03e-01 | 0.481 | 1.28 | 257 | 0.0128 | NA | NA | NA | NA | NA | NA | NA | NA |
| 580 | 0.162 | 5.68e-02 | 0.225 | 9.35 | 242 | 0.0121 | NA | NA | NA | NA | NA | NA | NA | NA |
| 581 | 0.183 | 6.41e-02 | 0.254 | 1.06 | 298 | 0.0119 | NA | NA | NA | NA | NA | NA | NA | NA |
| 582 | 0.197 | 6.46e-02 | 0.264 | 1.06 | 269 | 0.0133 | NA | NA | NA | NA | NA | NA | NA | NA |
| PDAR | 0.161 | 1.64e-01 | 0.96 | 1.66 | 241 | 0.012 | 0.00309 | 0.0455 | 0.0242 | 0.000234 | 0.000811 | 0.0226 | 0.00214 | 0 |
| WPA | 0.181 | 1.53e-01 | 0.252 | 1.29 | 271 | 0.0135 | 0.0157 | 0.0228 | 0.108 | 0.00088 | NA | 0.108 | 0.00272 | 0 |
| NEb | 0.18 | 6.30e-02 | 0.25 | 4.34 | 269 | 0.0134 | NA | NA | NA | NA | NA | NA | NA | NA |

NA = Not applicable

# TABLE C-7
## SEDIMENT MODELING RESULTS (mg/kg)

| Area | Antimony | Cadmium | Silver | Molybdenum | Manganese | Thallium | Benzo(b)-fluoranthene | Benzo(a)-pyrene | Benzo(a)-anthracene | Benzo(g,h,i)-perylene | Benzo(k)-fluoranthene | Chrysene | Dibenzo(a,h)-anthracene | Ideno(1,2,3-cd)-pyrene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 560 | 1.42e+00 | 2.45e+00 | 2.68 | 11.3 | 1400 | 3.36 | 0.01 | NA | NA | NA | NA | NA | NA | NA |
| 570 | 1.3 | 2.20e+00 | 3.24 | 4.3 | 1400 | 3.27 | NA | NA | NA | NA | NA | NA | NA | NA |
| 575 | 1.3 | 1.56e+00 | 2.61 | 3.49 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 580 | 1.3 | 9.10e-01 | 1.3 | 2.7 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| 581 | 1.3 | 9.10e-01 | 1.3 | 2.7 | 1520 | 5.08 | NA | NA | NA | NA | NA | NA | NA | NA |
| 582 | 1.42 | 9.36e-01 | 1.38 | 2.76 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |
| PDAR | 1.3 | 2.65e+00 | 5.57 | 4.83 | 1400 | 0.58 | 2.05 | 7.77 | 1.73 | 0.712 | 1 | 1.62 | 0.356 | 0.712 |
| WPA | 1.3 | 2.19e+00 | 1.3 | 3.34 | 1400 | 0.58 | 9.26 | 3.46 | 6.85 | 2.38 | NA | 6.85 | 4.03 | 1.97 |
| NEb | 1.3 | 9.10e-01 | 1.3 | 11.3 | 1400 | 0.58 | NA | NA | NA | NA | NA | NA | NA | NA |

NA = Not applicable

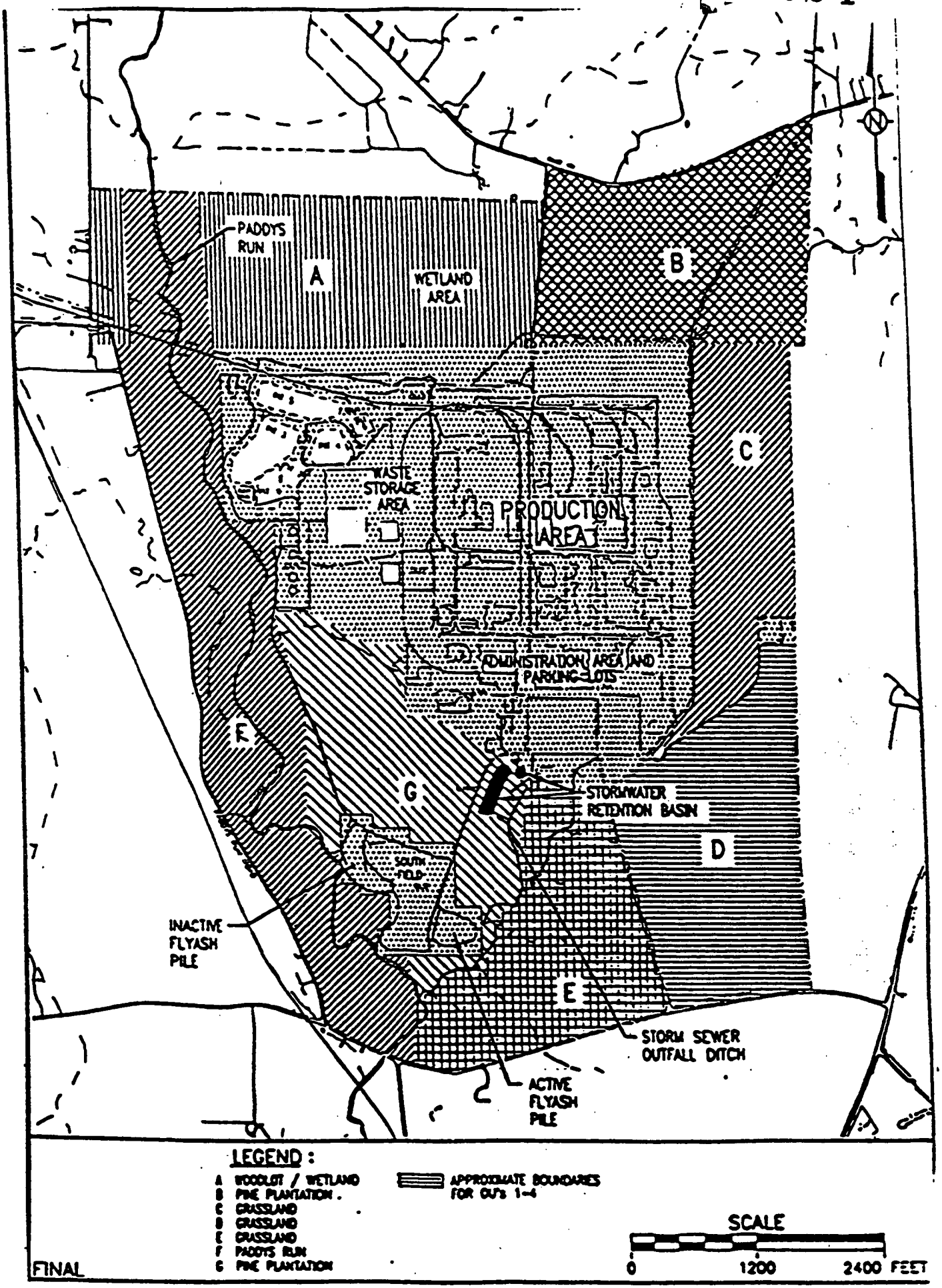


FIGURE C-1 STUDY AREAS FOR THE SITE-WIDE ECOLOGICAL RISK ASSESSMENT

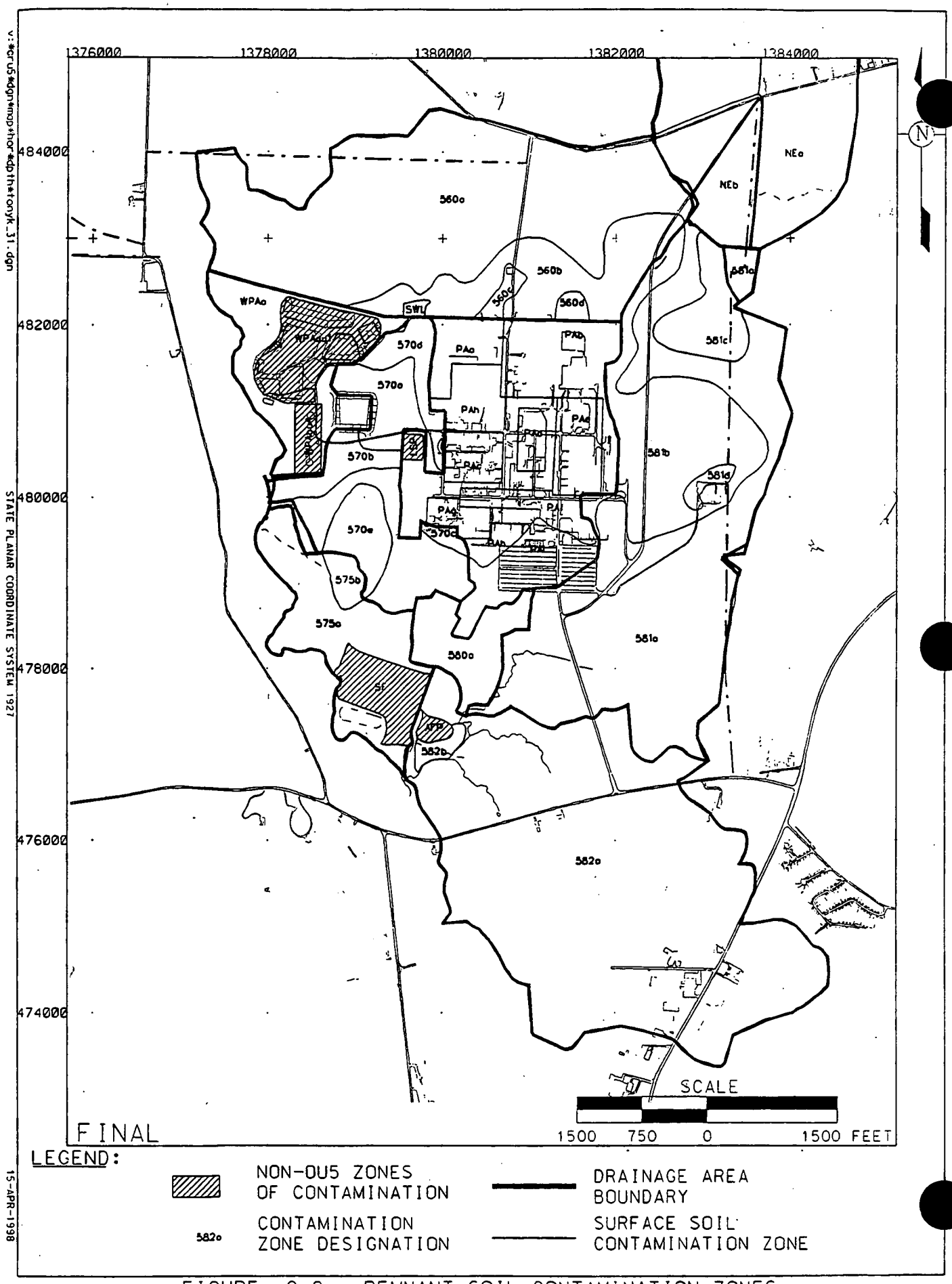


FIGURE C-2. REMNANT SOIL CONTAMINATION ZONES FOR USE IN SURFACE WATER AND SEDIMENT MODELING

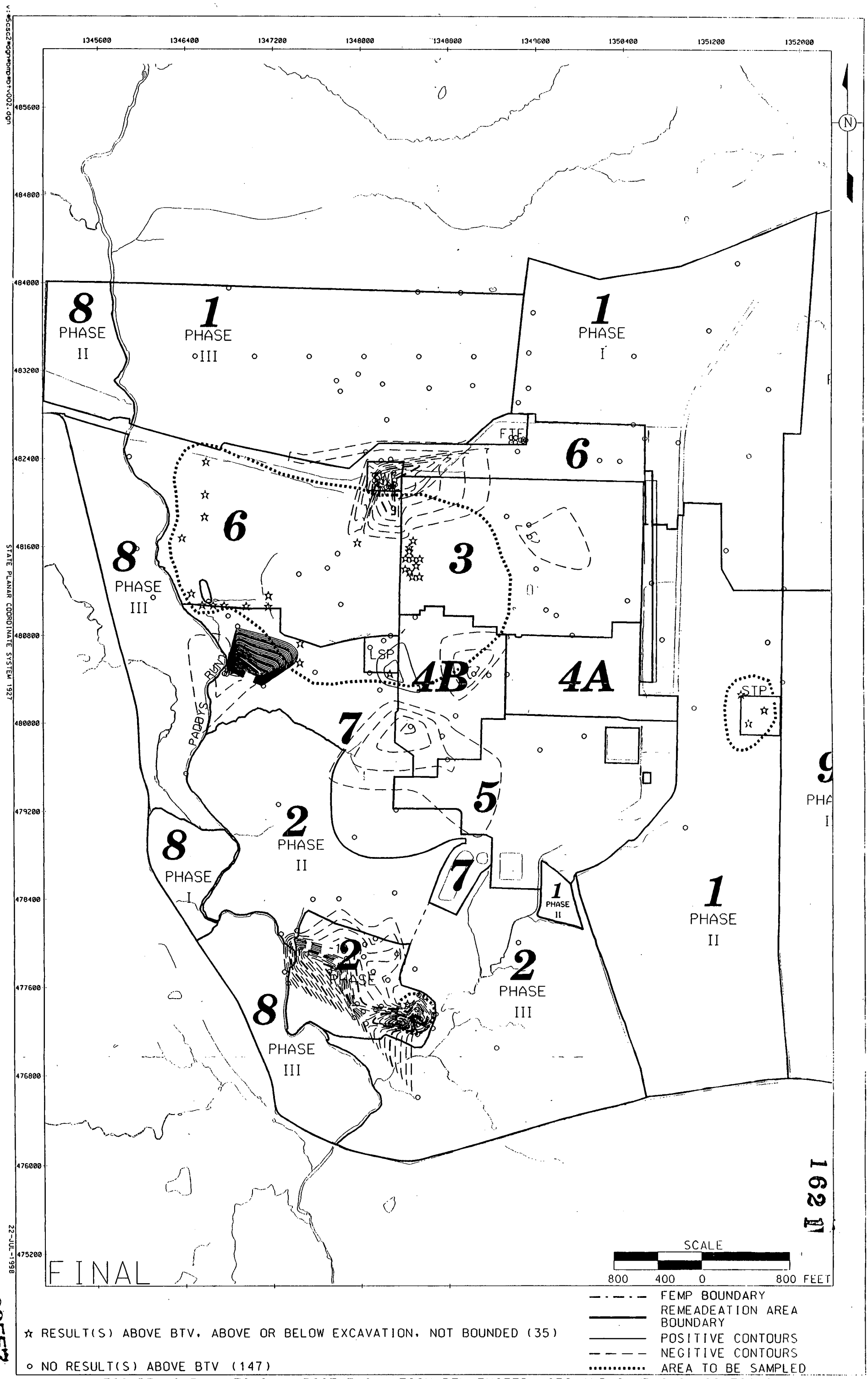


FIGURE C-3. ANTIMONY: POST-EXCAVATION BTV EXCEEDANCES AND SAMPLING LOCATIONS

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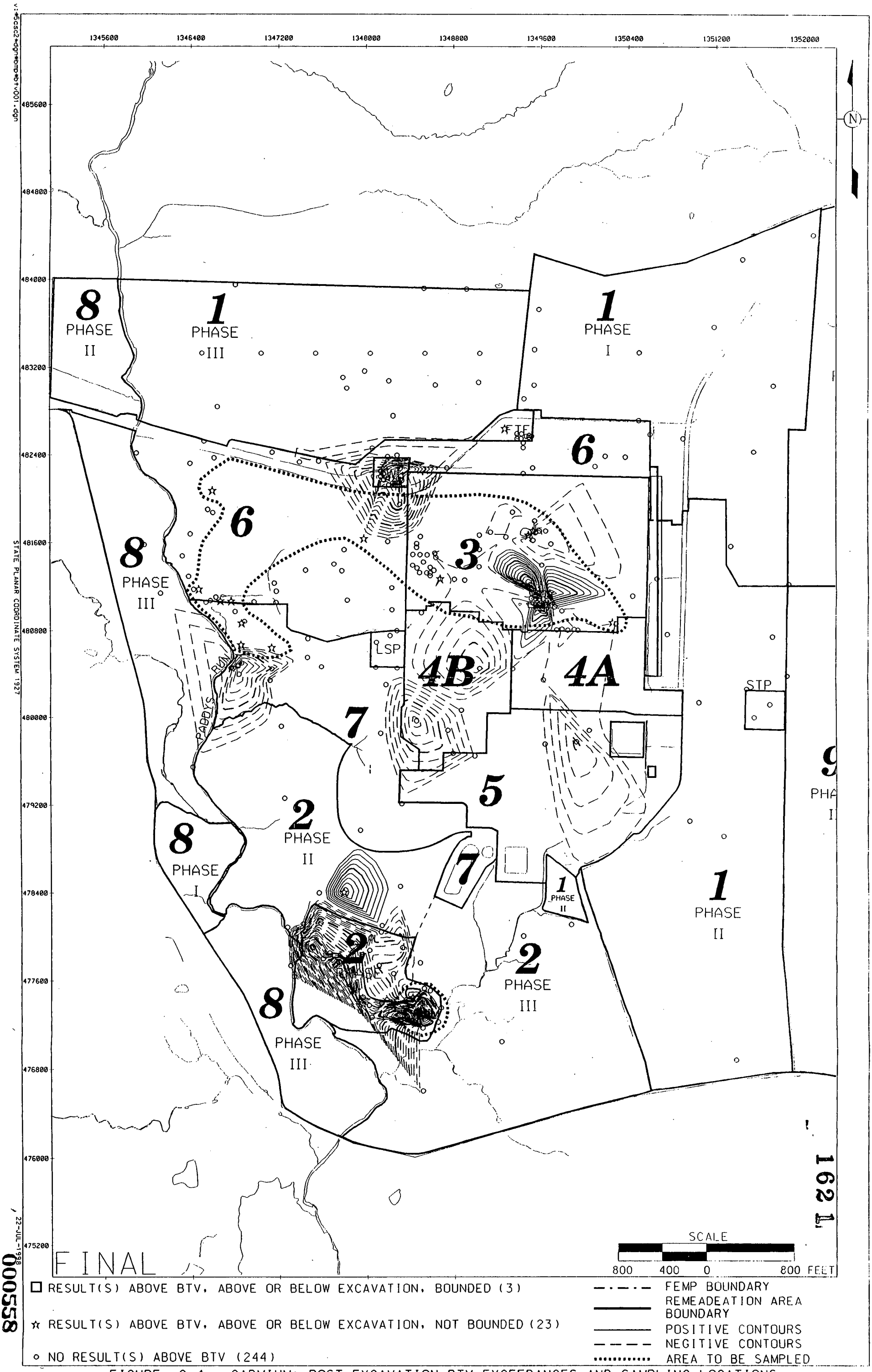


FIGURE C-4. CADMIUM: POST-EXCAVATION BTV EXCEEDANCES AND SAMPLING LOCATIONS

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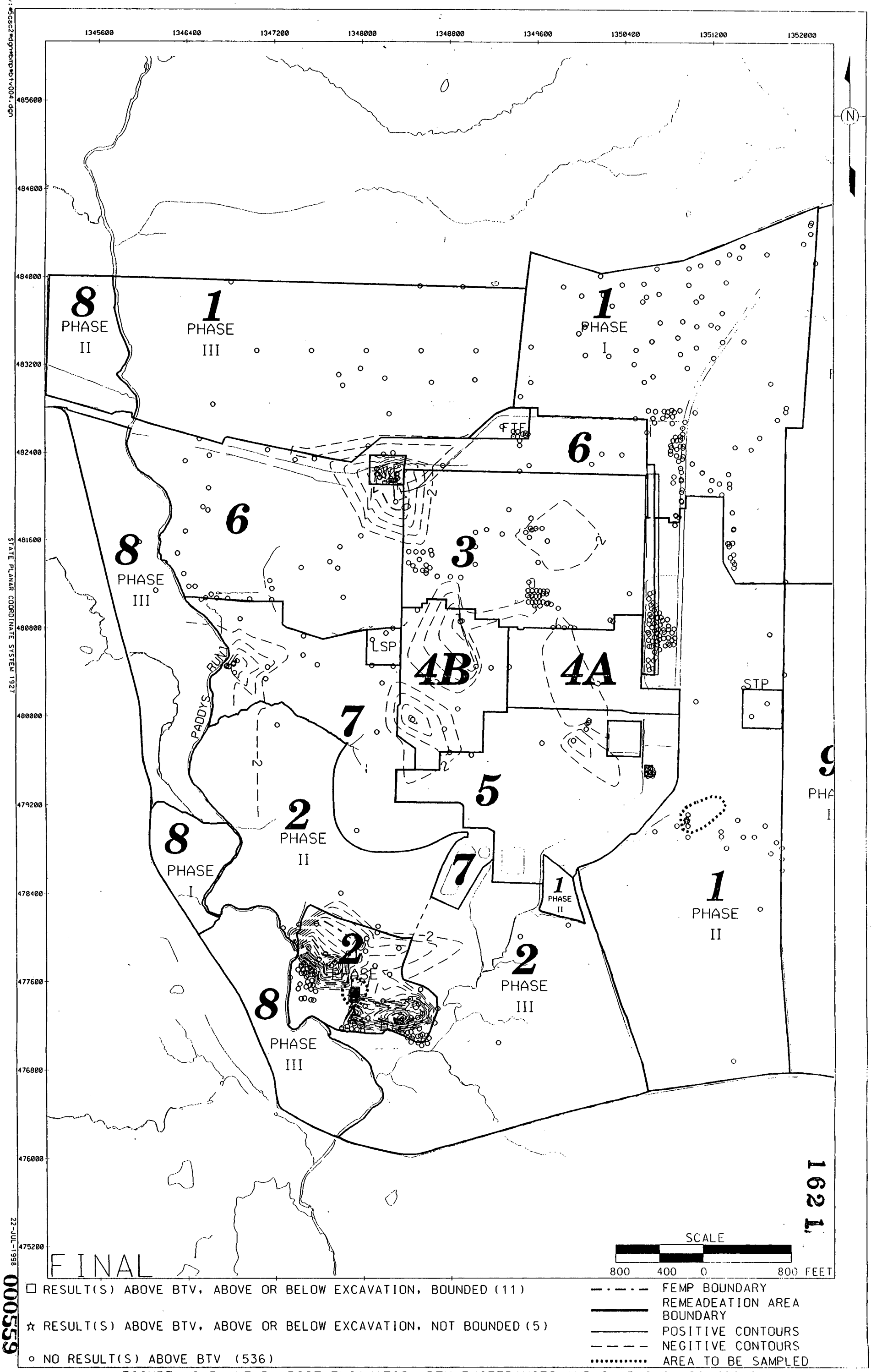


FIGURE C-5. LEAD: POST-EXCAVATION BTV EXCEEDANCES AND SAMPLING LOCATIONS

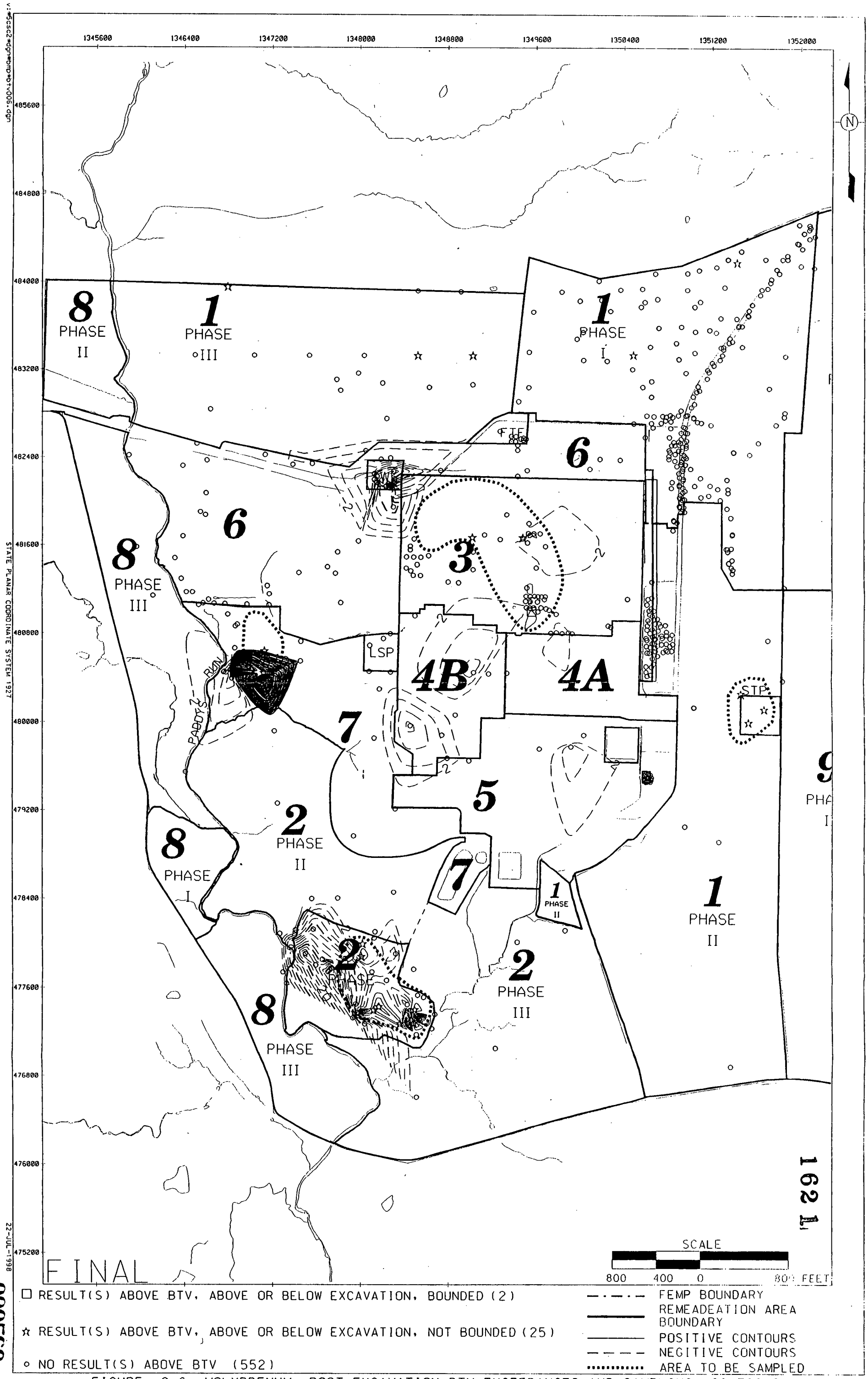


FIGURE C-6. MOLYBDENUM: POST-EXCAVATION BTV EXCEEDANCES AND SAMPLING LOCATIONS

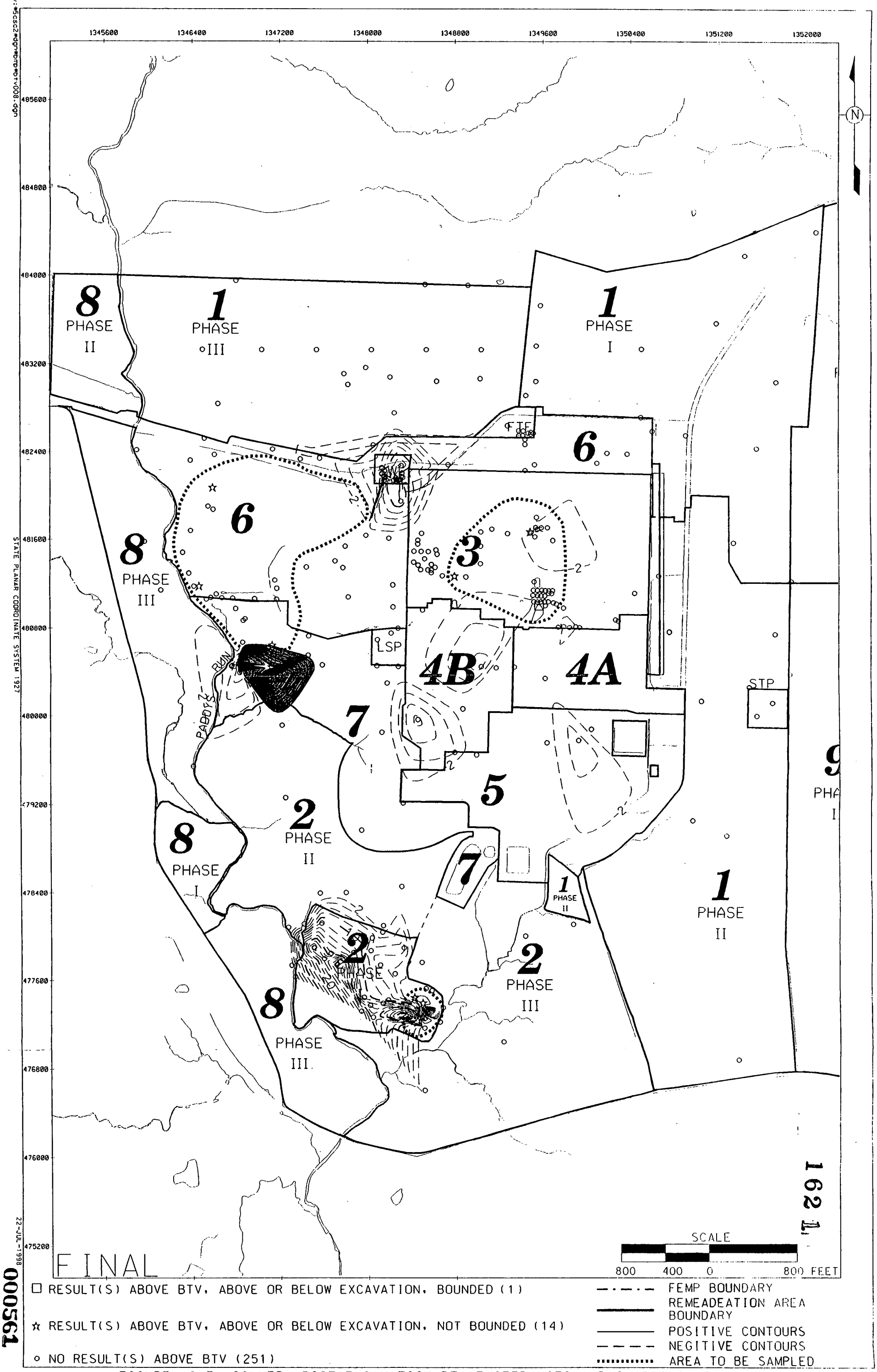


FIGURE C-7. SILVER: POST-EXCAVATION BTV EXCEEDANCES AND SAMPLING LOCATIONS

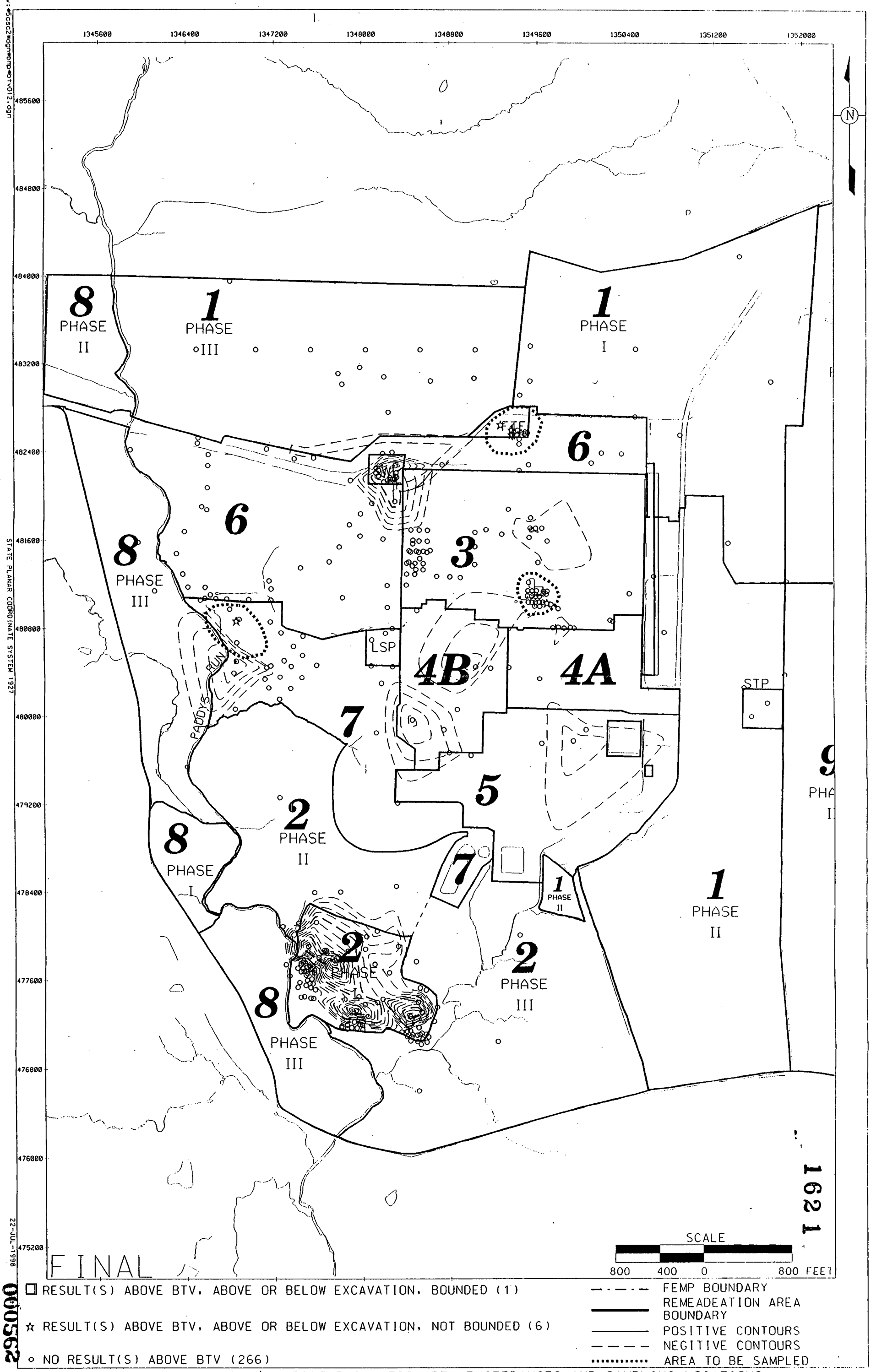


FIGURE C-8. PAH's: POST-EXCAVATION BTV EXCEEDANCES AND SAMPLING LOCATIONS

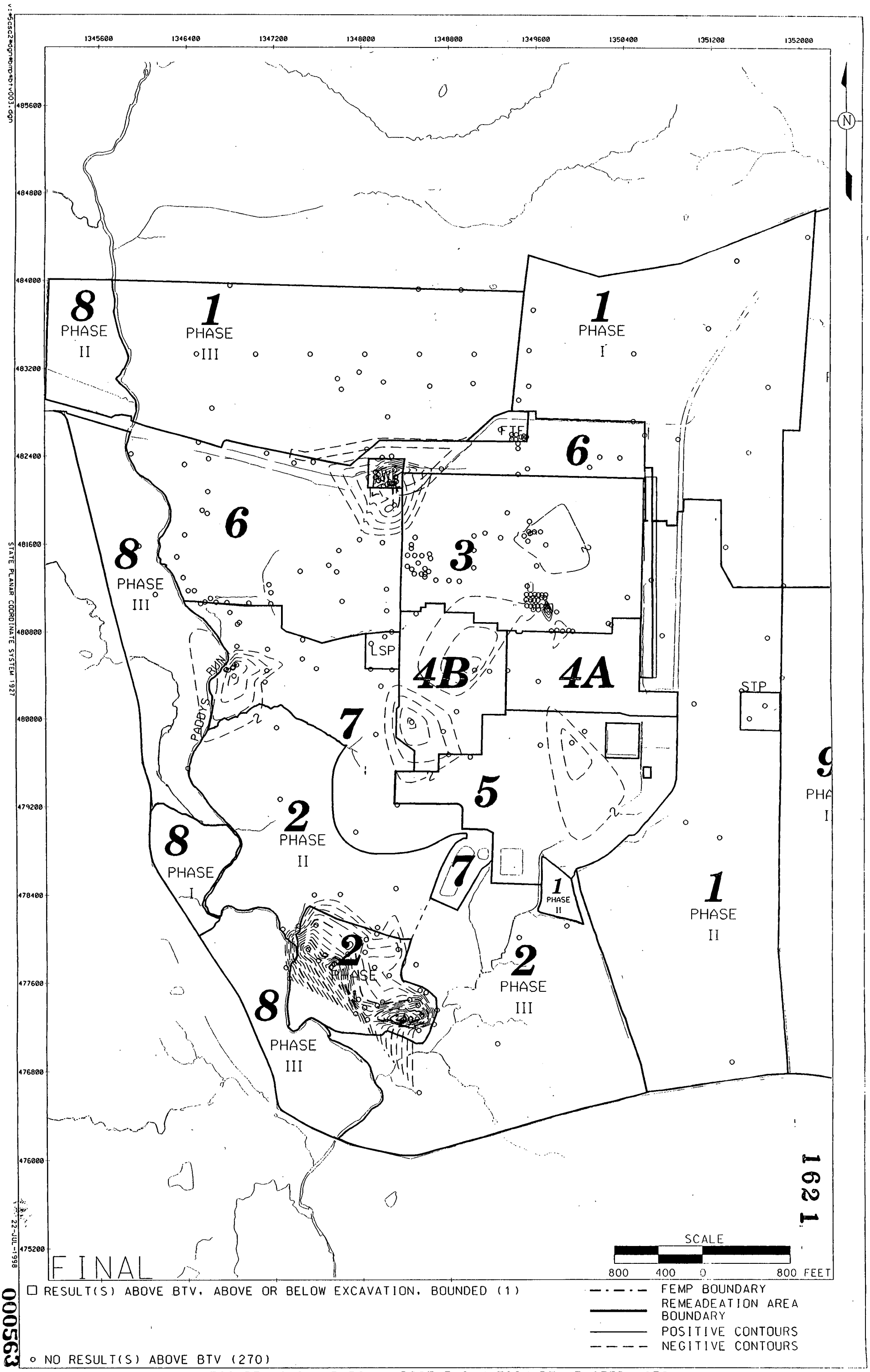


FIGURE C-9. BARIUM: POST-EXCAVATION BTV EXCEEDANCES

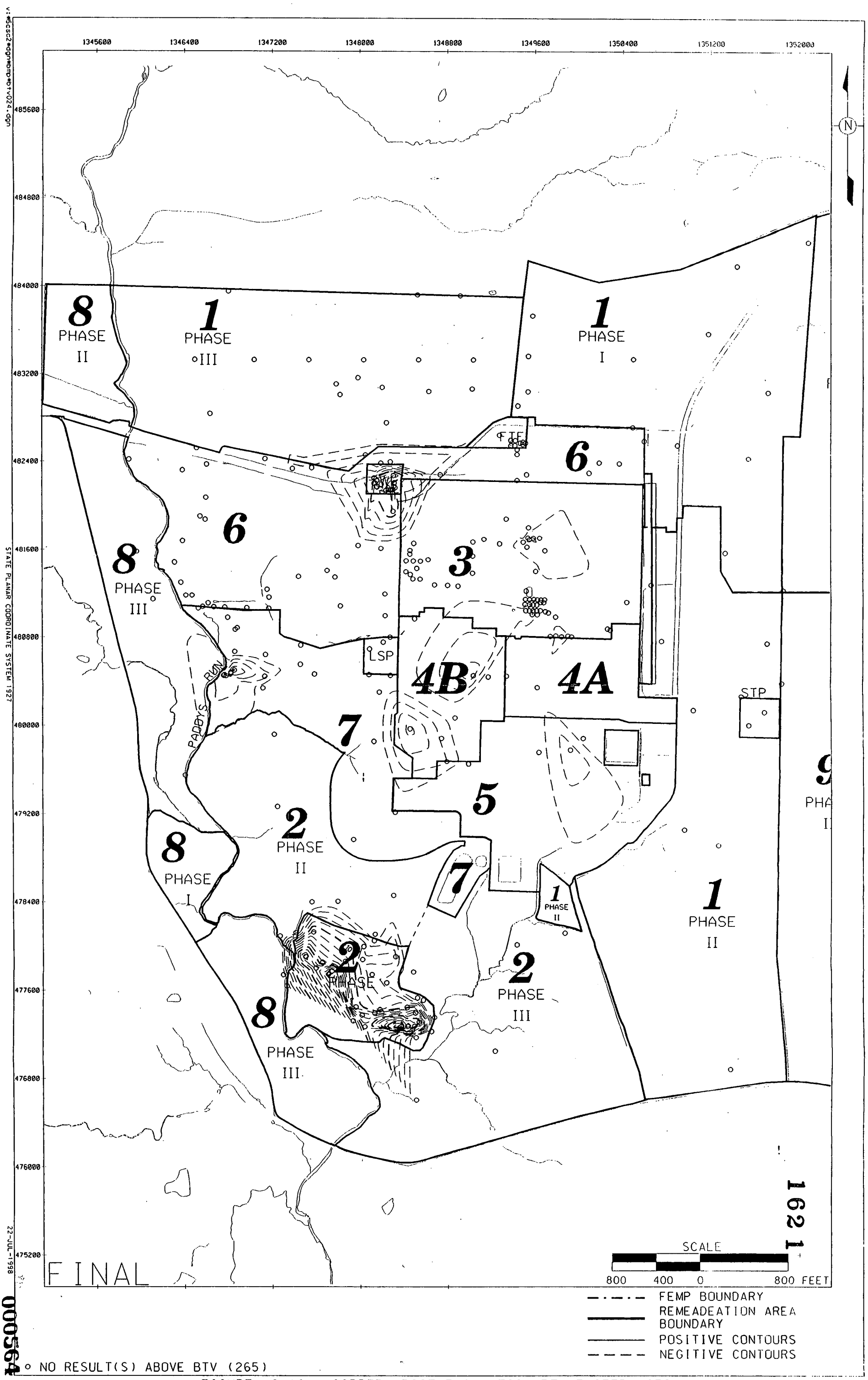


FIGURE C-10. COPPER: POST-EXCAVATION BTV EXCEEDANCES

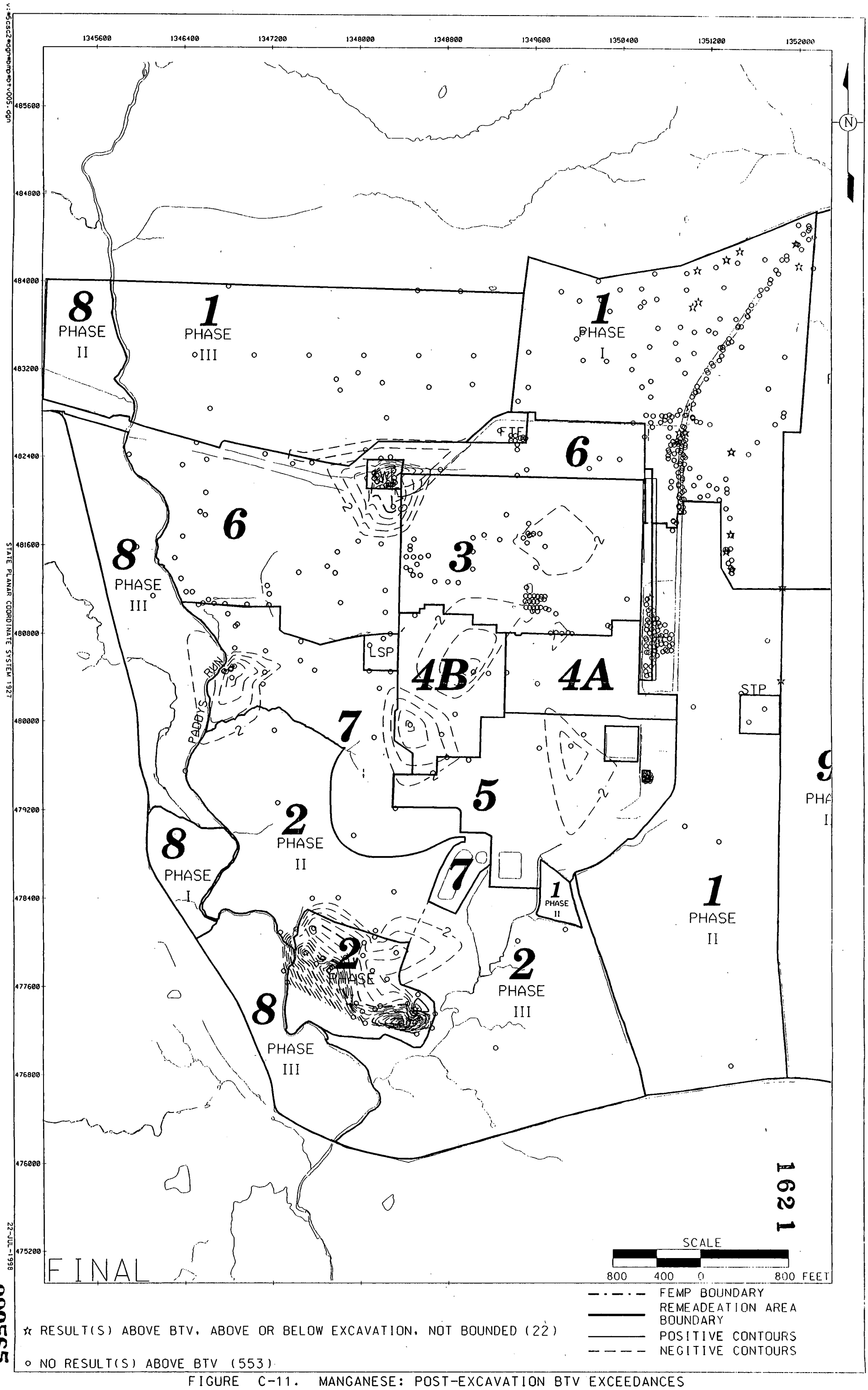


FIGURE C-11. MANGANESE: POST-EXCAVATION BTV EXCEEDANCES

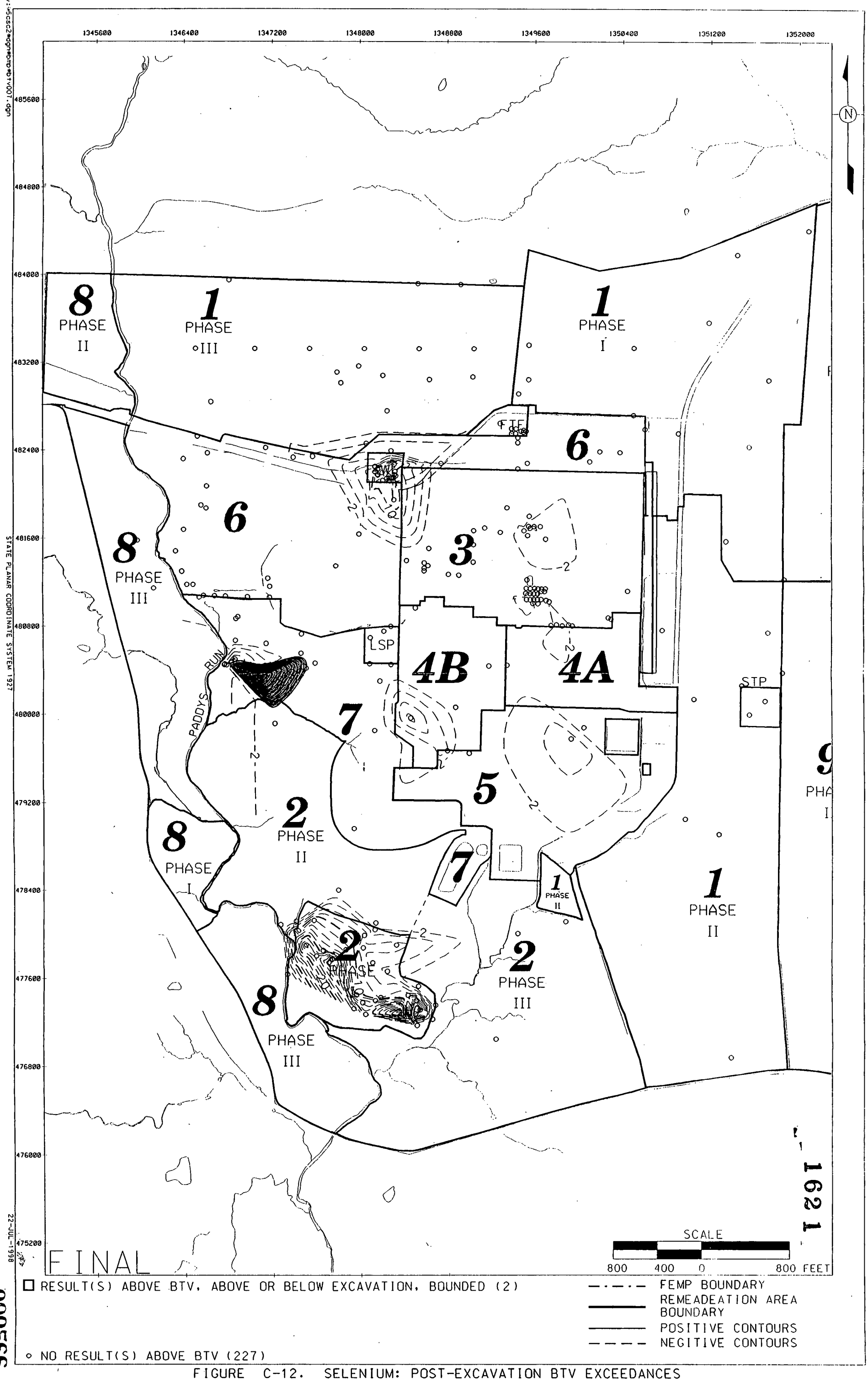


FIGURE C-12. SELENIUM: POST-EXCAVATION BTV EXCEEDANCES

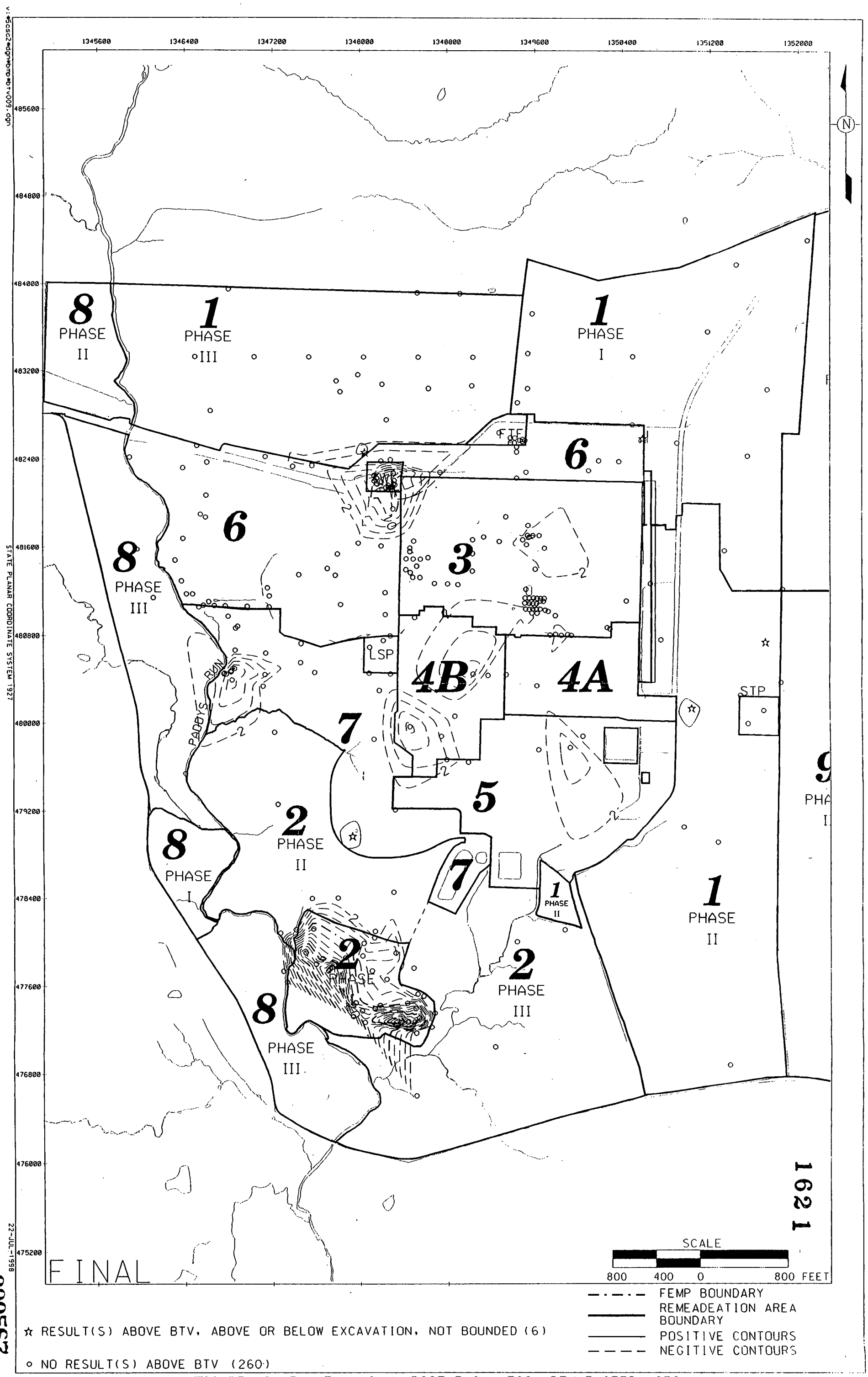


FIGURE C-13. THALLIUM: POST-EXCAVATION BTV EXCEEDANCES

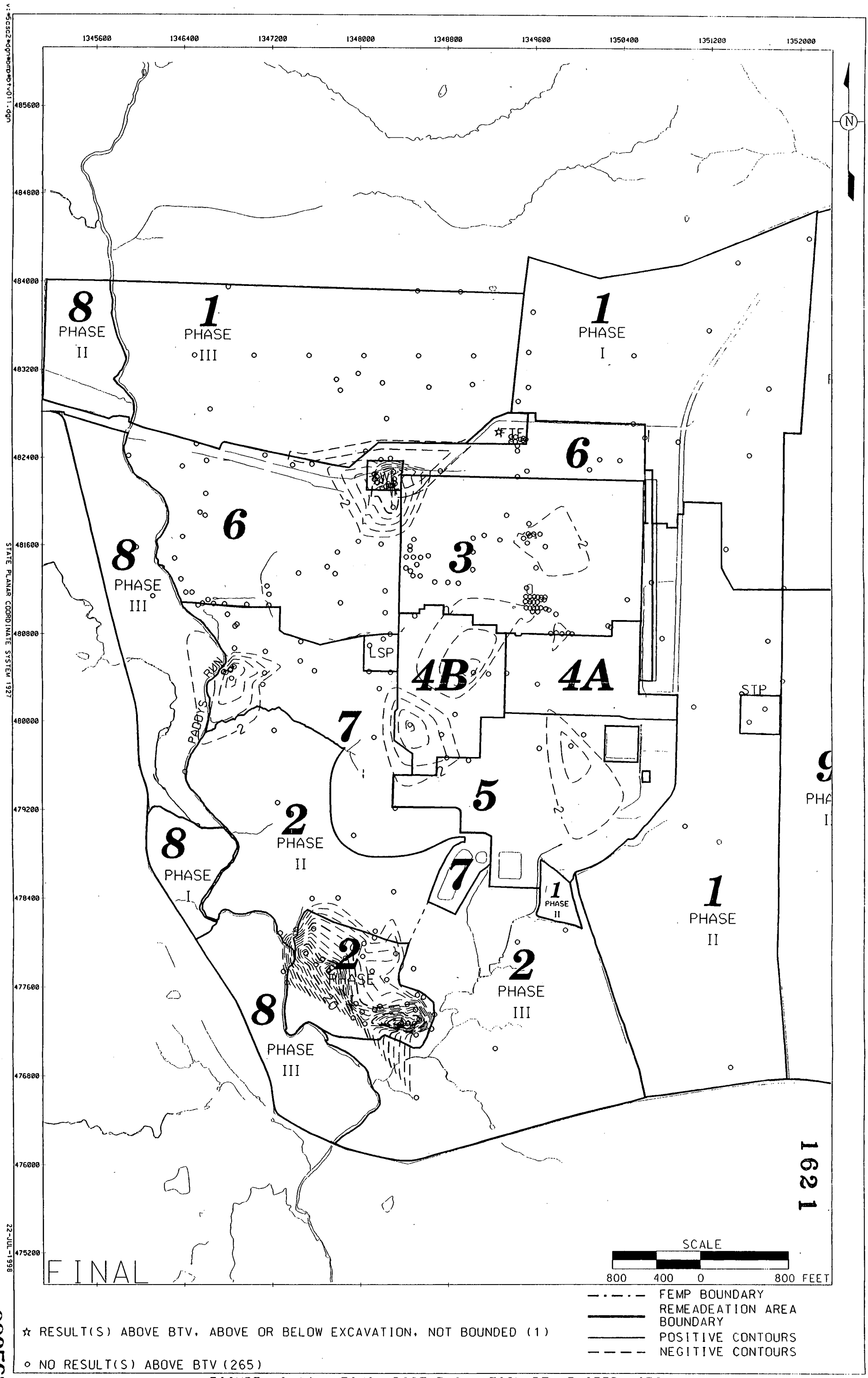


FIGURE C-14. ZINC: POST-EXCAVATION BTV EXCEEDANCES

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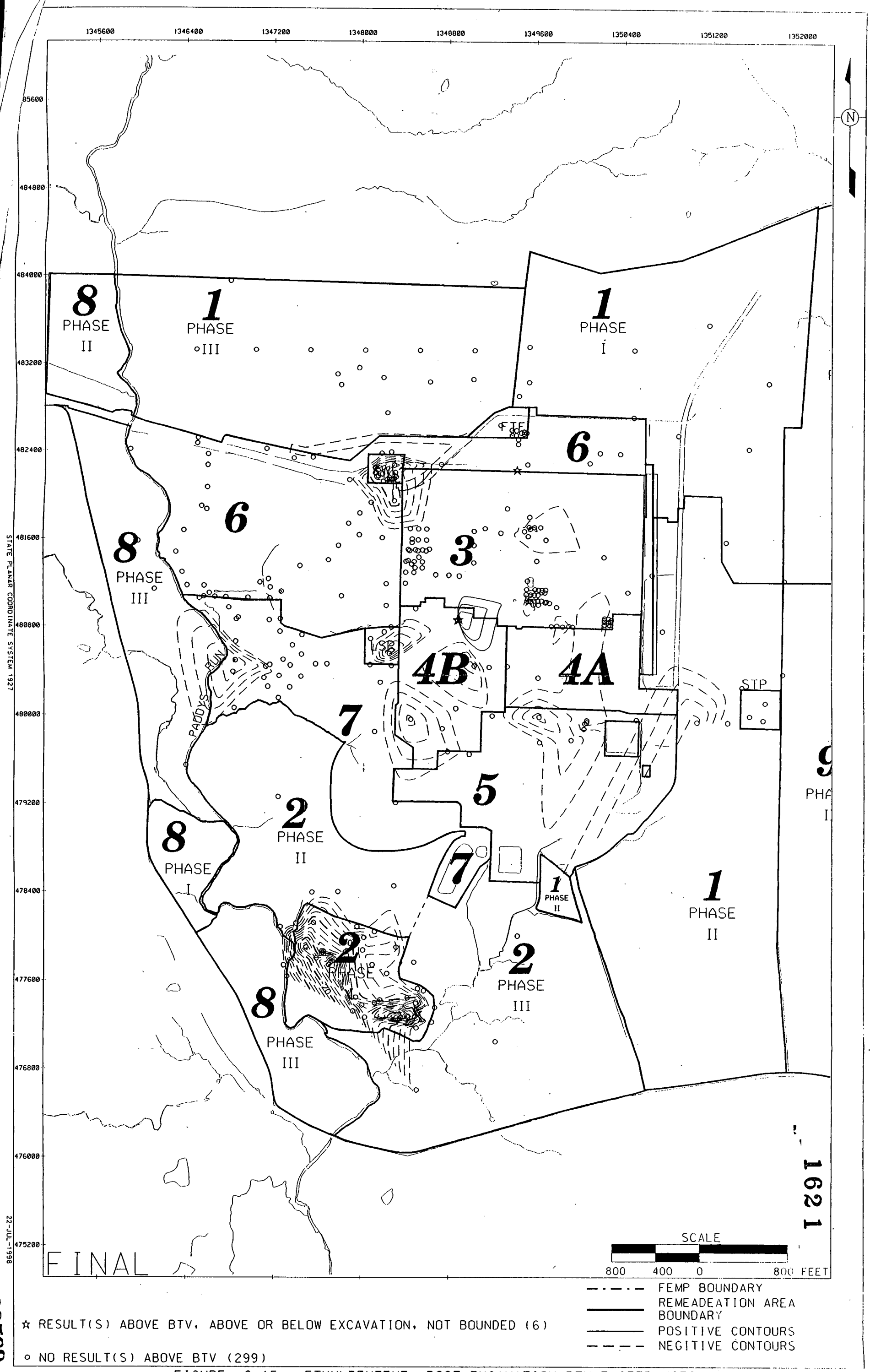


FIGURE C-15. ETHYLBENZENE: POST-EXCAVATION BTV EXCEEDANCES

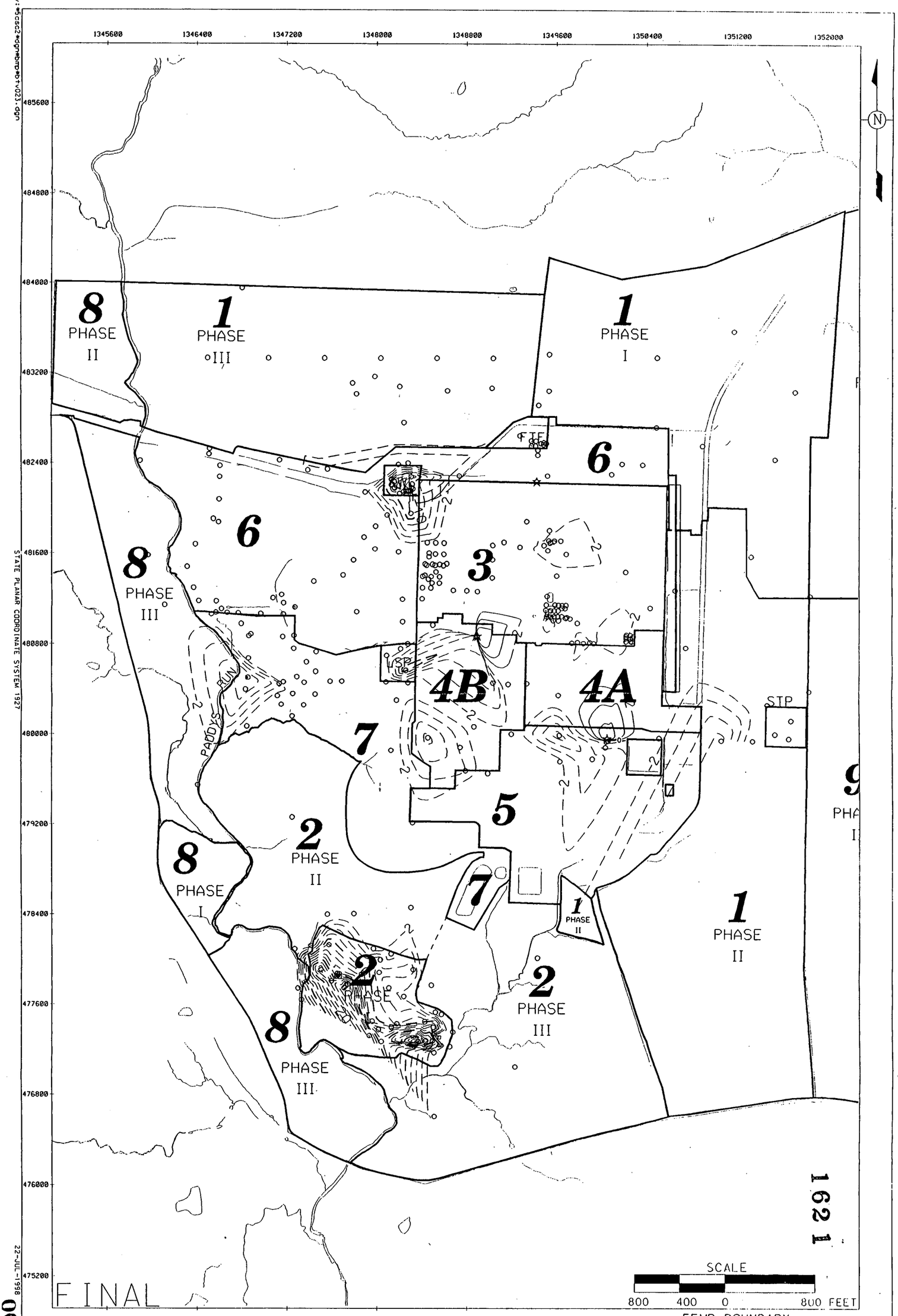


FIGURE C-16. TOLUENE: POST-EXCAVATION BTV EXCEEDANCES

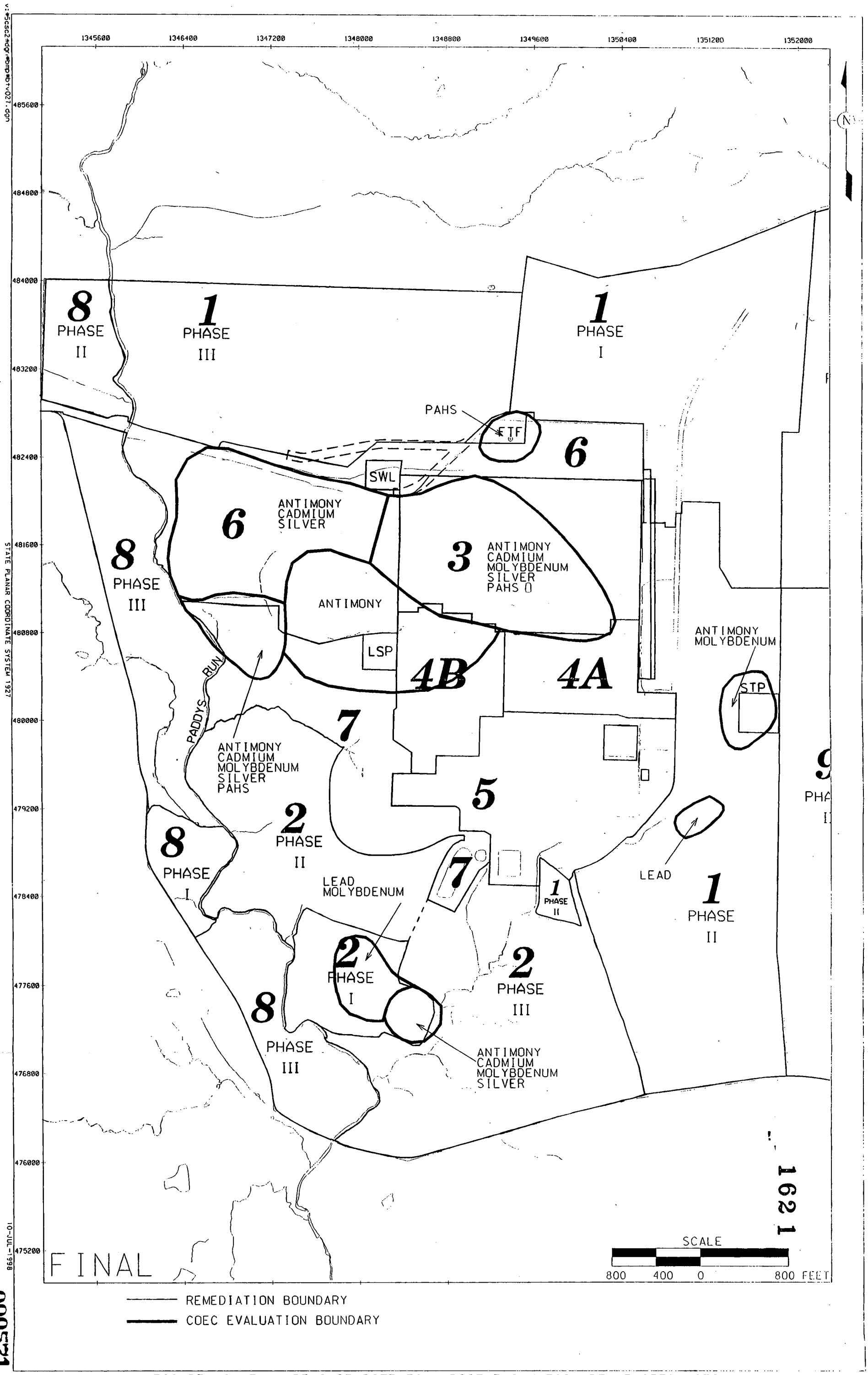


FIGURE C-17. AREAS OF POTENTIAL POST-EXCAVATION BTV EXCEEDANCES

# APPENDIX D

# WOOD SAMPLING PROGRAM

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Table D-3 Reported Concentrations of Radionuclides in Wood

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Figure D-1 Approximate Tree Tissue Sampling Locations

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ASL | analytical support level |
| BTV | benchmark toxicity value |
| COCs | constituents of concern |
| FEMP | Fernald Environmental Management Project |
| FRL | final remediation level |
| mg/kg | milligrams per kilogram |
| SCQ | Sitewide CERCLA Quality Assurance Program |
| UCL | upper confidence level |

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## D.1 INTRODUCTION

The Fernald Environmental Management Project (FEMP) is progressing into the remedial design phase, which will involve removal of saplings and mature trees as a result of construction and excavation activities. The intent is to recycle cleared trees by chipping and applying the chips as mulch cover for areas that have been excavated, to minimize waste. It is therefore necessary to provide information on the contaminant uptake of these trees before they can be used as mulch.

This sitewide tree tissue sampling program was developed to provide data on site-specific contaminant concentrations in tree tissue to support a decision to use the tree tissue for mulch application. Tree tissue concentrations were compared to soil final remediation levels (FRLs) in the Operable Unit 5 Record of Decision (DOE 1996a) to ensure that areas of mulch application would not be recontaminated if tree tissue was free-released for use as mulch on site. Soil FRLs were determined based on modeled reductions in risk to human receptors.

## D.2 SAMPLING METHODOLOGY

Thirty-six (36) live, standing trees of various species at the FEMP were sampled and analyzed by an off-site laboratory for metals and radionuclides (Table D-1) according to the criteria set forth in the Project-Specific Plan for Tree Tissue Sampling (DOE 1996b). Tree sampling locations were determined by comparing forested areas shown on aerial photographs of the site with anticipated areas of excavation. Forested areas likely to be cleared during remediation were determined by cross-referencing aerial photographs with a surface soil database. This database contained information on areas where contaminant concentrations exceeded soil FRLs. Individual trees in these areas with a minimum diameter (diameter breast height) of 10 centimeters were selected to obtain sufficient sample (Figure D-1). Tables D-2 and D-3 list tree tissue sampling locations based upon geographic proximity. Sampling points 1E-7E are designated as east; sampling points 8E-13E and 1W-6W are designated as north; and sampling points 7W-21W are designated as south.

Each tree to be sampled was identified in the field with reflective tape containing the sample number. Samples were numbered in relation to their position to the former North Entrance Road. Those samples located east of the North Entrance Road were sequentially designated with the project number and an "E" suffix, and those samples located west of the North Entrance Road were sequentially

designated with the project number and a "W" suffix (see Figure D-1). For each tree sample, additional data were recorded, such as tree type, diameter breast height, location, and general health condition.

Sampling was conducted using a portable, 18-volt drill with 1-inch carbon steel drill bits. Tree tissue was collected approximately 4.5 feet from the base of the trunk and consisted of the outer bark to the inner pith of the tree. Polyethylene sheeting was positioned in an apron formation directly below the drilling location to collect wood tissue. Each individual wood tissue sample was transferred from a plastic apron into a 12-ounce, wide-mouth, glass sample jar. To obtain adequate mass for analysis, more than one hole was drilled in each tree. A duplicate tree tissue and rinsate sample was collected for every 20 samples in accordance with the Sitewide CERCLA Quality Assurance Program (SCQ) (DOE 1993), by drilling an additional hole(s) immediately adjacent to the location of the original sample location. Approximately 330 grams of tree tissue were required from each tree for analysis. Excess wood tissue sample was placed into a waste container.

Sampling equipment was decontaminated (Level II) prior to transport to the each sampling location, before reuse, and after sampling was complete to limit the introduction of contaminants from equipment to the sampled media. Decontamination was conducted in accordance with SCQ requirements in Appendix K, Section 11.2, of the SCQ. Equipment was dried with a lint-free wipe after final rinse.

### D.2.1 Sample Analysis

All tree samples were homogenized, and each aliquot was weighted and ashed prior to analysis. Table D-1 lists the laboratory methods used to analyze the tree samples. Analyses were conducted in accordance with analytical support level (ASL) B as outlined in the SCQ. Results were reported on a dry-weight basis (mg/kg dry wt.).

### D.2.2 Results And Discussion

To determine whether chipped tree tissue from excavated areas could be applied as mulch, the representative concentrations of tree tissue were calculated. Representative concentrations were calculated using the 95 percent upper confidence limit (UCL) on the arithmetic mean for primary

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constituents of concern (COCs) (total uranium, radium-226 & 228, and thorium-228 & 232) and the 90 percent UCL on the arithmetic mean for secondary COCs (all metals and cesium-137, strontium-90, and technetium-99).

Soil FRLs for the FEMP were determined based on modeled reductions in risk to human receptors. Comparing tree tissue concentrations to soil FRLs ensured that areas would not be recontaminated if tree tissue was free-released for use as mulch on site. All area-specific tree tissue representative concentrations were at levels less than the established soil FRLs (Tables D-2 and D-3); therefore, felled trees encountered during site remediation will be chipped and used as mulch.

An additional comparison was performed to identify potential impacts on ecological receptors from possible chemical exposures. Field observations indicate that the trees which exhibited tissue concentrations at or slightly above the Benchmark Toxicity Value (BTV) for molybdenum were in good condition (no signs of disease or dying).

Some constituents of area-specific tree tissue slightly exceeded some soil BTVs, which are media concentrations considered protective of ecological receptors. The use of BTVs is a conservative screening process to indicate whether there is a potential risk to ecological receptors. BTVs are not cleanup levels that must be achieved to ensure protection of ecological receptors. BTVs are discussed in detail in Appendix C.

Specific sampling locations exhibited tree tissue concentrations of selenium and molybdenum at or slightly above the BTV for these constituents. The representative tree tissue concentrations for selenium and molybdenum were influenced from one tree sampling point in each geographic area. The representative tree tissue concentrations for selenium range from 3.23 to 3.74 milligrams per kilogram (mg/kg) compared to the selenium BTV of 3 mg/kg. The representative tree tissue concentrations for molybdenum range from 10.09 to 11.17 mg/kg compared to the molybdenum BTV of 10 mg/kg. The results of the tree tissue sampling program do not indicate an impact to the trees from molybdenum and/or selenium. Based on this information, there is no restriction for applying the tree tissue as mulch.

## REFERENCES

U.S. Department of Energy, 1993, "Sitewide CERCLA Quality Assurance Project Plan," SCQ-085, Rev. 0, Fernald Environmental Management Project, DOE, Fernald Field Office, Cincinnati, Ohio.

U.S. Department of Energy, 1996a, "Record of Decision for Remedial Actions at Operable Unit 5," Final, Fernald Environmental Management Project, DOE, Fernald Field Office, Cincinnati, Ohio.

U.S. Department of Energy, 1996b, "Project-Specific Plan for Tree Tissue Sampling," Project No. 50.03.44, Fernald Environmental Management Project, DOE, Fernald Field Office, Cincinnati, Ohio.

**TABLE D-1**
**ANALYTICAL REQUIREMENTS FOR WOOD**

| Parameter | Matrix | Container & Volume | Sample Mass | Hold Time | Preservative | Laboratory Analyses | ASL | Sample Type |
|---|---|---|---|---|---|---|---|---|
| | | | | Tree Tissue Sample | | | | |
| Total Metals[a] | S (solid) | 12-ounce glass or plastic | 30 g | 6 months (Mercury-28 days) | Cool 4° C | Inductively Coupled Plasma, Atomic Absorption | B | Grab |
| Radionuclides[b] | S (solid) | 12-ounce glass or plastic | 300 g | 6 months | None | Liquid Scintillation; Lucas Cell, Gas Flow Proportional Counter, Alpha and Gamma Spectroscopy, | B | Grab |
| | | | | Rinsate Sample | | | | |
| Metals | W (water) | 1-liter plastic | N/A[c] | 6 months (Mercury-28 days) | $HNO_3$, pH < 2, Cool 4°C | Inductively Coupled Plasma, Atomic Absorption | B | Grab |
| Radionuclides | W (water) | 6-liter plastic or glass | N/A | 6 months | $HNO_3$, pH < 2 | Kinetic Phosphorescence Analyzer, Lucas Cell, Alpha Spectroscopy Gas Flow Proportional Counter | B | Grab |

[a] Metals - Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc.
[b] Radionuclides -Total uranium, isotopic thorium, radium-226, radium-228, cesium-137, strontium-90, technetium-99.
[c] N/A - Not Applicable

**TABLE D-2**
**REPORTED CONCENTRATIONS OF METALS IN WOOD**

| | Mean Concentration (mg/kg dry wt.) | | | Soil FRL |
|---|---|---|---|---|
| Analyte | North Area | East Area | South Area | (mg/kg) |
| Aluminum | 59.9 | 27.5 | 23.6 | -[a] |
| Antimony | 0.65 | 0.4 | 0.797 | 96 |
| Arsenic | 0.135 | 0.108 | 0.119 | 12 |
| Barium | 23.5 | 33.7 | 17.7 | 68000 |
| Beryllium | 0.28 | 0.149 | 0.26 | 1.5 |
| Cadmium | 0.2 | 0.052 | 0.064 | 82 |
| Calcium | 5520 | 26289 | 20200 | -[a] |
| Chromium | 1.527 | 1.129 | 1.02 | 300 |
| Cobalt | 2.12 | 1.31 | 1.6 | 740 |
| Copper | 61.55 | 3.33 | 4.07 | 220000 |
| Iron | 20.4 | 39.5 | 36.6 | -[a] |
| Lead | 0.568 | 0.834 | 0.892 | 400 |
| Magnesium | 711 | 505 | 926 | -[a] |
| Manganese | 82.6 | 66.5 | 26.3 | 4600 |
| Molybdenum | 10.09 [b] | 11.15 | 10.4 | 2900 |
| Mercury | 0.069 | 0.043 | 0.143 | 7.5 |
| Nickel | 3.73 | 4.94 | 2.15 | 15000 |
| Potassium | 2037 | 2929 | 2420 | -[a] |
| Selenium | 3.48 | 3.74 | 3.22 | 5400 |
| Silver | 1.221 | 0.76 | 0.925 | 29000 |
| Sodium | 20 | 313 | 229 | -[a] |
| Thallium | 1.297 | 0.81 | 0.989 | 91 |
| Vanadium | 0.871 | 0.514 | 0.664 | 5100 |
| Zinc | 19.54 | 9.28 | 11.5 | 120000 |

[a] Analytes do not have soil FRLs.

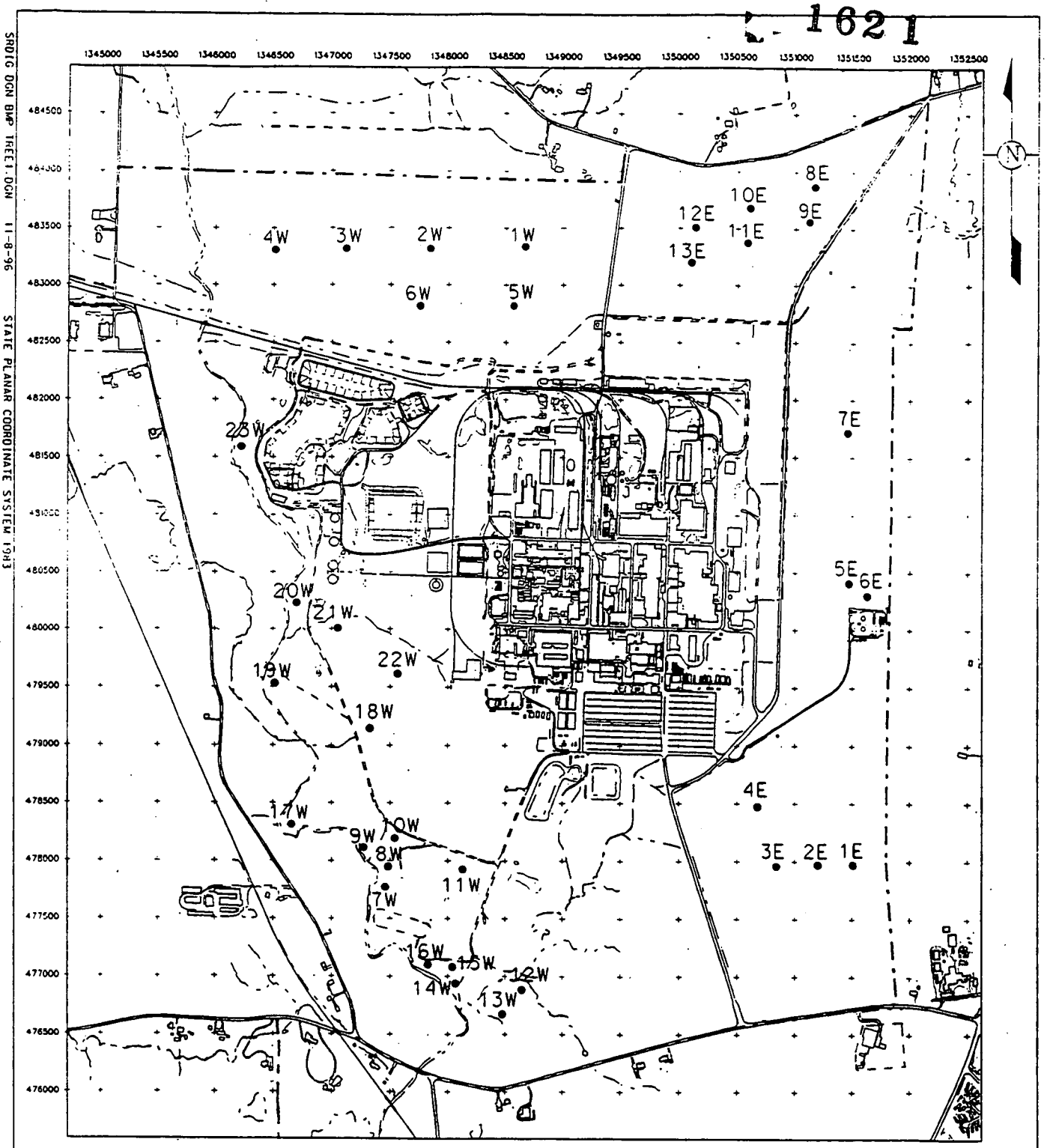
**TABLE D-3**
**REPORTED CONCENTRATIONS OF RADIONUCLIDES IN WOOD**

| | Mean Concentration (pCi/g dry wt.)[a b] | | | Soil FRL |
|---|---|---|---|---|
| Analyte | North Area | East Area | South Area | (pCi/g) |
| Thorium 228 | 0.14 | 0.05 | 0.07 | 1.7 |
| Thorium 230 | 0.10 | 0.05 | 0.05 | 280 |
| Thorium 232 | 0.04 | 0.02 | 0.03 | 1.5 |
| Radium 226 | 0.22 | 0.16 | 0.10 | 1.7 |
| Radium 228 | 0.34 | 0.27 | 0.29 | 1.8 |
| Cesium 137 | 0.08 | 0.06 | 0.06 | 1.4 |
| Strontium 90 | 0.31 | 0.19 | 0.38 | 14 |
| Technetium 99 | 4.5 | 5.5 | 4.4 | 29.1 |
| Total Uranium | 0.05 | 0.06 | 0.11 | 55 |

[a] The radiological data was assigned an "R" qualifier based on a calibration deficiency of the gamma spectrometers. The calibration deficiency was based on the difference in density between tree tissue (0.2 g/cc) and the calibration standard (1.15 g/cc). If the density differences were compensated for, the radionuclide concentrations would have been lower than those reported. Analytes were not detected and the sensitivity of the measurements was well below the final soil remediation levels (FRLs). Therefore, the data are useable for determining that wood chips from site trees can be used as cover material in excavated or disturbed areas with no concern for violating soil FRLs.

[b] Average values are representative of all samples within each area. Non-detects reported were used to calculate average values.

SRDIG DGN BMP TREE1.DGN 11-8-96 STATE PLANAR COORDINATE SYSTEM 1983




LEGEND:

— · — · — FEMP BOUNDARY

• 11W TREE TISSUE SAMPLING LOCATIONS

NOTE: 500344 is the prefix for all sampling locations noted on map (e.g., 500344-11W)

SCALE

125 65.5 0 125 FEET

FIGURE D-1. APPROXIMATE TREE TISSUE SAMPLING LOCATIONS

# APPENDIX E

## SEP QUALITY ASSURANCE JOB SPECIFIC PLAN (QajSP)

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Attachment A Construction Quality Requirements

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Figure E-1 SEP QA Program Organization

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# LIST OF ACRONYMS

| | |
|---|---|
| ANSI | American National Standards Institute |
| ASL | analytical sampling level |
| ASME | American Society for Mechanical Engineering |
| ASTM | American Society of Testing and Materials |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFC | certified for construction |
| COC | constituent of concern |
| CU | certification unit |
| DCN | Design Change Notice |
| DOE | U.S. Department of Energy |
| DQO | data quality objective |
| ECDC | Engineering/Construction Document Control |
| EPA | U.S. Environmental Protection Agency |
| FDF | Fluor Daniel Fernald |
| FEMP | Fernald Environmental Management Project |
| FRL | final remediation level |
| GET | General Employee Training |
| GPS | Global Positioning System |
| HDPE | high-density polyethylene |
| HPGe | High Purity Germanium Detector |
| IEMP | Integrated Environmental Monitoring Plan |
| IRDP | Integrated Remedial Design Package |
| NAD | North American Datum |
| NaI | sodium iodide |
| NPDES | National Pollutant Discharge Elimination System |
| OEPA | Ohio Environmental Protection Agency |
| PEP | Project Execution Plan |
| PID | photoionization detector |
| PSP | Project Specific Plan |
| QA | Quality Assurance |
| QajSP | Quality Assurance Job Specific Plan |
| QAP | Quality Assurance Program |
| QC | Quality Control |
| RCI | Request for Clarification of Information |
| RCRA | Resource Conservation and Recovery Act |
| RFP | Request for Proposal |
| RTRAK | Real Time Radiation Tracking System |
| SCQ | Sitewide CERCLA Quality |
| SED | Sitewide Environmental Database |
| SEP | Sitewide Excavation Plan |
| SOW | statement of work |
| V&V | verification and validation |
| WAC | Waste Acceptance Criteria |

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## E.1 INTRODUCTION

### E.1.1 Purpose

The goal of a quality-oriented project is to produce a product that will meet the stated or implied needs and expectations of the project. Quality Assurance (QA) is an integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that data and products are of the type, quantity, and quality needed. Quality Control (QC) is the overall system of technical activities that measure the QA attributes and how well the processes and results meet defined standards to verify that the stated objectives of the activity are met. The purpose of the Sitewide Excavation Plan (SEP) Quality Assurance Job Specific Plan (QAjSP) is to establish the necessary QA/QC framework to support SEP-related plans, design, construction, sampling, analysis, and resulting data to satisfy stated objectives. Effective implementation of detailed QA program objectives and specifications is required in management functions to effectively measure and control remediation work scopes so products and services are of the appropriate type and quality for their intended use. Activities that generate environmental data will be conducted in a manner that produces legally defensible data.

The SEP QAjSP criteria were based on the current version of the Fernald Environmental Management Project (FEMP) Quality Assurance Program Description (QAP; RM-0012) and the Sitewide CERCLA Quality Assurance Project Plan (SCQ; FD-1000). Additional considerations include QA/QC requirements relative to 10 CFR 830.120, Quality Assurance Requirements; DOE Order 5700.6C, Quality Assurance; ANSI/ASQC E4, Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs; and ASME NQA-1, Quality Assurance Requirements for Nuclear Facilities.

### E.1.2 Scope

The QAjSP covers all SEP activities carried out by contractor employees and subcontractors. Key activities covered under this QAjSP include radiological surveys, field measurements, sampling, and analysis carried out during pre-excavation investigations; preparation of the data quality objectives and project specific plans (DQOs/PSPs); engineering controls of the remedial design; preparation of the Integrated Remedial Design Packages (IRDPs); soil excavation and segregation; Waste Acceptance Criteria (WAC) attainment; preparation of the Certification Design Letter and implementation of the certification process; and preparation of the Certification Report. Should activities that implement SEP

requirements differ from established FEMP QA programs, SCQ, or the SEP QAjSP for substantive technical considerations, the SEP planning document must justify the basis for change.

This SEP QAjSP may be referenced in Project Execution Plans (PEPs) as the applicable Quality Assurance Job Specific Plan.

Construction-related QA/QC specifications will be incorporated into the design documents and relevant parts of the construction subcontracts.

## E.2 PROGRAM

General flowdown from FEMP site policies and programs regarding quality affecting requirements will be applicable in SEP planning and implementation processes. The matrix correlating SEP content to the QAP is summarized in Table E-1. Organizational structures will be established to adequately support the FEMP and SEP functions necessary to accomplish planned QA/QC objectives. The SEP QA program organization is presented in Figure E-1.

### E.2.1 Organization

SEP functional organizational interfaces with FEMP management and Department of Energy/U.S. Environmental Protection Agency (DOE/EPA) interfaces will be defined to establish roles and responsibilities for decisions directing work and certifications. This includes soil excavation activity interfaces when crossing other project work scopes.

Integrated remedial design packages, PEPs, and PSPs will define operational roles of SEP functions as they pertain to SEP implementation. Planning documents for SEP activities will describe how supporting organizations controlling work such as health and safety, industrial hygiene, radiation (rad) control, waste disposition, validation, and quality assurance applies to work activities. The extent of decision authority to stop work will be defined. The QA organization has stop-work authority.

E.2.2 Project Functional Responsibilities

EPA

DOE-FEMP submits SEP deliverables to EPA and the Ohio Environmental Protection Agency (OEPA). The EPA reviews and comments on SEP submittals. The comments and/or approvals are then presented by letter to DOE-FEMP. Deviations from the SEP, if needed, will be described in subsequent IRDPs, which require EPA review. Changes to the SEP, if needed, will be accomplished through revision to the SEP (or sections or pages as appropriate) and submittal of the revision to EPA and OEPA. As soil remediation progresses, deliverables such as IRDPs and Certification Reports will be submitted by DOE-FEMP for EPA acceptance. The EPA has access to activities, documents, and databases to assess and verify submittal compliance to SEP requirements, and to conduct audits, surveillances, and inspections.

OEPA

The OEPA provides the similar approval and oversight functions as the EPA relative to SEP submittals. Additionally, OEPA has operations oversight responsibility for regulatory agreements between OEPA and the FEMP, such as National Pollutant Discharge Elimination System (NPDES), Resource Conservation and Recovery Act (RCRA), dust control, environmental monitoring, and related split-sampling programs. The OEPA has ready access to SEP activities, documents, and databases to conduct audits, surveillances, and inspections.

DOE Fernald Field Office (DOE-FEMP)

The DOE-FEMP Remediation Program Manager reviews and concurs with FDF SEP submittals. Upon acceptance, DOE-FEMP submits SEP project documents to EPA/OEPA for approval. The Remediation Program Manager designates a DOE-FEMP SEP representative as a field oversight interface for SEP remediation design, construction, QA/QC control, and health and safety. The DOE SEP representative will immediately notify the DOE Remediation Program Manager in an effort to seek prompt resolution of any issues or problems that affect quality. The DOE Remediation Program Manager determines performance measures in attaining compliance with DOE and EPA requirements and milestones pertaining to SEP project-specific tasks.

FDF President

The FDF President is the highest FDF authority responsible for the FDF Quality Assurance Program. The authority for establishing, administering, and evaluating the effectiveness of the QA program is delegated to the FDF Director of Quality Assurance.

FDF Vice President

The FDF Vice President is the highest SEP project authority needed to approve deliverables to DOE-FEMP and EPA/OEPA. Because the SEP program impacts other FDF projects, this authority should ensure effective integration to accomplish SEP objectives.

FDF SEP Project Manager

The FDF SEP Project Manager is responsible for implementing this SEP QAjSP. This authority assures that project documents are controlled and SEP records are properly maintained until project closure. The SEP project will be accessible to internal and external assessment groups. The SEP project will allow for organizational QA independence not tied to schedule or cost, and will support evaluation and verification of IRDPs/PSPs and subsequent deliverables for subcontractors and FDF SEP tasks. The SEP Project Manager assigns SEP-specific assignments to project functional managers and determines schedule and cost considerations to stage and resource load the planning and implementation processes.

FDF SEP Project Leads

FDF SEP Project Leads are responsible for the training and qualification of personnel so technical functions can be performed in accordance with SEP requirements and professional standards. Project Leads develop DQOs, PSPs, IRDPs, construction subcontracts, implementing procedures, assessment plans, Certification Design Letters, and Certification Reports. Documents and related changes must be controlled by the respective functional Project Leads. The Project Leads interface with other FDF-related organizations needed to facilitate SEP work processes and is responsible for approving budget resource and cost allocations to execute assigned Scopes of Work.

Quality Assurance provides independent assessment verification of SEP requirements and processes, approves project plans, procedures, and purchase requisitions. WAC and certification attainment deliverables will be independently verified by the sitewide QA function. All construction QC



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inspections will be performed by QA, except where specified that the construction subcontractor will perform inspections. External SEP audits, surveillances, and other types of assessments will be facilitated by project QA. Project QA will conduct audits, surveillances, inspections, vendor qualification surveys, and other internal assessments required to verify quality in SEP-related work processes. Anticipated project support for the following functions will be addressed in project execution plans.

- Engineering
- Construction
- Characterization
- Certification
- Waste Disposition
- Environmental compliance, natural and cultural resources
- Health and Safety

Subcontractors

Subcontractors will be monitored for compliance with submitted QA/QC plans required to meet contract specifications. The subcontractor will have a QA/QC officer who conducts internal assessments and reports observations, test acceptance, and nonconformances to the FDF Construction Manager and SEP QA program lead. Subcontractor work will be performed to the requirements described in the contract, the SEP QAjSP, and QA/QC specifications in FDF contracts. The subcontractor must meet all DOE, FDF, and SEP QA/QC requirements. Expected types of subcontractors include laboratories, construction, cultural resources, waste disposition, and suppliers providing items and materials. The SEP QA function must determine prequalification requirements for subcontractor approval and the required periodic qualification assessment to measure QA/QC performance in maintaining qualification status.

E.2.3 Project Planning

Project planning should include measurement systems for schedules, resources, and costs to discrete project tasks; charge numbers, procurements, etc. Project Leads typically are Control Account Managers for project-specific scopes of work. Budget tracking and control is accomplished by the FDF Primavera project control system. Project budgets shall include funding for all required QA/QC personnel to support SEP work.

Project IRDPs, sampling plans, DQOs, and subcontract task orders are used to describe how SEP work will be accomplished in accordance with accepted standards and practices. All associated hold points, inspection criteria, and verification requirements will be specified.

## E.3 PERSONNEL TRAINING AND QUALIFICATION

All personnel performing SEP work will be trained for their function commensurate to the skill level required by assigned tasks. General Employee Training (GET) will be required for FDF employees, subcontractors, and other individuals needing access to the FDF work sites.

The IRDP, PSP, and subcontract QA plans will identify work functions requiring special training when certification is required. Training records will be maintained for skill-specific training needed to perform procedure-specific tasks that verify training, proficiency demonstration, when required, and qualification status. Training will be provided on the use of equipment, the nature of particular excavation areas, or conditions requiring special consideration (e.g., unusual hazards, motor vehicle operators, confined-space workers). Specific examples include:

1. Field sampling technicians for the Real Time Radiation Tracking System (RTRAK) and High Purity Germanium Detector (HPGe) will be trained to respective operations manuals and demonstrate ability to calibrate gamma-sensitive detectors and associated QC controls in system functions and data transfer. Sampling technicians will be trained to complete chain-of-custody and field logs in a manner that will be traceable to original work and legally defensible.

2. Personnel conducting analysis of soil and debris samples will be certified to complete analyses in accordance with established methods. Periodic requalification will be required to maintain qualification. Requalification may involve satisfactory performance sample analysis.

3. Health and safety training requirements will be met by completing site access training and job-specific radcon qualifications necessary for Radiological Work Permit compliance.

4. Subcontractor training plans will address the personnel qualification process needed to certify any nondestructive examination testing for Title III placements and inspections to those specified in IRDPs. This includes geomembrane weldments/sealing, soil construction, concrete testing, steel weldments, and HDPE manholes and associated piping. All certifications will be submitted to FDF project management upon request.

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5. Personnel handling data transfer or manipulation, data statistical treatment, data validation, and subsequent report generation will be technically capable of determining acceptance/validation and abnormal conditions necessary to control data to support precertification and certification reports from verifiable database fields.

## E.4 QUALITY IMPROVEMENT

Improvement of quality in the work to be performed is a goal of the DOE throughout remediation. FDF and DOE encourage a policy of "no fault" attitude toward the identification of nonconformances.

### E.4.1 Nonconformance

Tracking of internal and external deficiencies with respect to SEP work processes and deliverables will follow established FEMP QA nonconformance reporting and corrective action procedures. Process controls will be established to identify nonconforming conditions that apply to procedure noncompliant field practices, field samples, analytical method QC failure, incomplete data packages, off-specification materials and services, and deviations resulting from construction inspections. Items, activities, and processes that do not meet specified requirements are to be identified, controlled, and corrected to prevent their inadvertent use. Project QA will have the authority to place hold tags on nonconforming items. Documentation of nonconformances will be in the respective project records.

### E.4.2 Lessons Learned

A lessons-learned survey should be completed at the end of each IRDP to assess the effectiveness of implementing SEP programmatic requirements. The survey should include effectiveness of corrective action implementation for nonconformances. Recommendations identifying strengths and weaknesses should be incorporated into subsequent project plans.

## E.5 DOCUMENTS AND RECORDS

The SEP Functional Project Leads will prepare, review, approve, distribute, and revise project-specific plans, procedures, drawings, specifications, instructions, and other work affecting documents in accordance with FEMP document control, engineering, and construction procedures. Project QA will review work-affecting documents to verify compliance to established site policies and procedures.

Documents and records pertaining to SEP soil remediation that provide work instruction will be controlled, and all records documenting work implementation will be placed in

Engineering/Construction Document Control (ECDC) designated project files. Identified SEP documents include PSPs and geotechnical plans for remedial design planning in IRDP development, waste characterization plans and related soil-tracking records, Certification Design Letter, Certification Report, Certified for Construction specifications and drawings, and final construction turnover documents such as-built drawings. Data collected during SEP implementation will be traceable to the planning and operating documents actually used and to the personnel collecting the data.

E.5.1 Document Control

1. Centralization and Indexing will include a master index of project-specific documents. ECDC will assign document numbers and distribution where applicable. Copies of this index will be distributed to design, construction, and quality engineers and other impacted personnel within the project.

2. Document issuance and distribution will include the project manager authority, and when required, QA approval prior to controlled distribution. Project-related plans will be routed to internally affected organizations for review prior to approval such that affected external organizations such as subcontractors may provide comments. Planning documents will include titles, unique project numbers, effective date, revision number, approval signatures, and a unique document control number.

   A partial list of documents to be controlled includes:

   - Design Specifications
   - Design and Work Drawings, Certified for Construction and As-Built Drawings
   - Subcontractor Submittals
   - Spreadsheet/Database Revisions and V&V Calculations
   - Test Reports
   - Field Change Requests and Design Change Notices
   - IRDPs, DQOs, PSPs, Procedures
   - Field Logs

3. Electronic information such as photos, spreadsheets, databases, access, custodians, backups and hard copies pertaining to PSPs, IRDP, and certification will be controlled by instructions or procedures to ensure retrieveability and traceability.

4. Document revisions will be approved by the same level of approval as the original document. PSPs may be amended in accordance with the SCQ. Engineering and construction revisions will follow engineering and construction change-control processes.

5. Revisions to electronic media, such as software, spreadsheets, and databases, will require change controls, such as software validation criteria NQA-1 11-S2.

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6. Construction, engineering, and environmental document control will be centralized in ECDC. Engineering and construction drawings will be controlled in the field. "For Information" drawings will not be used to perform field work.

7. SEP agency reports: Certification Reports, Remedial Action Report, Site Closeout Report will have established reviews to effectively control deliverable reporting between SEP project and agency interfaces and subsequent distribution.

E.5.2 SEP Changes and Revisions

Agency agreements, project work process improvements, and organization functional changes may result in changes to the SEP. Affected SEP sections will be modified using change pages, which will include the change page revision number, issue date, and text changes identified by shading, print or some style different from the original text. Deleted text may be removed from the change page. Typically, the change pages are on colored pages different from the original revision pages. A revision record of change pages will be placed at the front of controlled SEPs and will accompany change page distribution. The revision record should include a brief description for the basis of changes.

The change page revision number will be identified with sequential two-decimal numbering after the current revision number (i.e., Revision 0.01 is the first change page of Revision 0). All change pages will be incorporated into complete subsequent revisions of the SEP.

All change pages are reviewed, approved, and controlled in the same manner as the distribution of full revisions. This involves getting DOE, EPA, and OEPA approvals for SEP change pages.

This method of change and revision control may be applied to other SEP project, program, or procedural documents.

E.5.3 Records

1. ECDC will maintain documents in a manner conducive to FDF records archiving requirements.

2. For SEP activities, QA records must be retained in ECDC-designated project files. Project personnel will maintain active records until task completion. Upon completion of PSP and IRDP work scopes, active records are considered to be complete and will

be placed in ECDC custody. Typical examples of records are IRDPs, DQO/PSPs, construction as-built drawings and associated field logs, subcontractor submittals, contracts, analytical data, sample field logs, geotechnical data, waste manifests, waste disposition logs, WAC/Certification reports, and all QA/QC oversight documentation and inspection reports.

## E.6 WORK PROCESSES

SEP environmental and engineering work processes that will be controlled to ensure that tasks performed meet the QA/QC objectives of the QAjSP include collection and recording of field data, sampling and analysis, engineering design, construction controls, document preparation and review, database management and control, and project management controls.

### E.6.1 Procedures and Instructions

Procedures will be developed, documented, and implemented for appropriate routine, standardized, special, or critical operations. Procedures that specify technical requirements will be reviewed for adequacy and approved by qualified personnel before use. During implementation, the need for expedited changes to established plans should be addressed. When expedited changes are made, prior verbal authorization is always required, and approval by normal review and approval will be conducted within a subsequent time frame. Planning documents, such as IRDPs and PSPs, must contain sufficient description for field use and may be considered as instructions.

### E.6.2 QA/QC Objectives for Environmental Work Processes

During the predesign investigation (Section 3.1), field data will be collected and recorded, and sampling and analysis will be implemented to define above-WAC and above-final remediation level (FRL) boundaries of the constituents of concern (COCs). The geotechnical properties of the soil in the defined excavation volumes will be considered. Environmental activities will be planned using accepted EPA protocols, such as DQOs and PSPs. The content and execution of environmental planning is described in the EPA-approved SCQ. All environmental activities supporting the SEP will be in compliance with SCQ requirements. The SCQ is the principal environmental QAjSP for the FEMP, which has been developed to cover the EPA QAMS-005/80 requirements for environmental sampling and analysis to support ultimate remediation of the site. Table E-2 lists typical sampling functions and correlating reference documents.

E.6.3 Collection and Recording of Field Data

Field data will be recorded in accordance with the performance criteria outlined in SCQ. Instruments used to characterize gamma radiation in the field [sodium iodide (NaI) and HPGe detectors] will undergo performance testing of their gamma detector systems to document that the systems perform within acceptable bounds. Portable instruments used to record field information on organic vapors [e.g., photoionization detectors (PID)] will be maintained and operated in accordance with procedures and operator's manuals. Performance criteria for the HPGe instrument are presented in the User's Manual (DOE 1998).

E.6.4 Field Sampling

Sample collection, containers, preservatives, handling, and analytical protocols for radionuclides, metals, and organic constituents will conform to the performance criteria defined in the SCQ. When PSPs specify, field QC samples, trip blanks, equipment rinsates, and field duplicates will be collected at a minimum rate of one each per 20 samples for analytical sampling level (ASL) D data. In-place sampling for combinations of WAC, precertification, and certification will include the required QC samples and field control of the highest ASL level. Field personnel will record sampling location and date on the chain-of-custody forms, and laboratory services will follow chain-of-custody requirements in demonstrating sample traceability from sampling events to analytical data package transmittal for validation. If analytical results cannot be related to a date and location, the data are unusable for quantitative decisions for SEP report deliverables.

Field QC Samples

The requirements for field QC samples are stated in the SCQ with respect to assigned ASLs. The DQO/PSP may specify additional QC samples when required. In general, a field QC sample is taken at a frequency of 1 in 20, per every PSP sampling event, or per every certification unit (CU), whichever is more frequent. Typically, field blanks, trip blanks and container blanks are not taken with soil samples unless field conditions are conducive to cross-contamination. Additionally, field QC samples such as field blanks, trip blanks and container blanks are not to be used by the laboratory to perform laboratory quality control analyses.

E.6.5 Sample Analysis

Sample analysis for investigative characterization, WAC attainment, precertification, waste characterization, and certification sampling will be conducted at either off-site or on-site laboratories for ASL A, B, and D, as specified in IRDP, DQO, and PSP planning documents.

Certification analysis will be to ASL D for all primary and secondary COCs. Certification analysis for COCs will report detection limits at one-tenth the value of the COC FRL or the ASL D detection level stated in the SCQ, whichever is higher. On-site ASL D analyses will be performed only if the resulting data packages are equivalent to off-site data packages meeting data validation criteria. Typically, all non-certification analyses should be to ASL B, unless otherwise specified in IRDPs or DQOs. Only laboratory services that qualify with SCQ requirements will be placed on the laboratory Approved Vendor List.

Independent data verification and validation will be performed on all analytical data and real-time measurements commensurate to the ASL level required in planning documents (e.g., ASL B or ASL D). The assessment of data quality will determine data usability. Quality indicators to be evaluated include completeness, comparability, representativeness, precision, and accuracy.

Analytical Validation Requirements

For ASL A, no validation is required. Data collected to ASL B will require all data packages to include a Certificate of Analysis with associated method QCs. A minimum of 10 percent of the field and analytical data will be validated to ASL B criteria. Data collected to ASL D will require all data packages to be reported to the respective ASL D criteria. All ASL D field data packages will be validated and a minimum of 10 percent of associated analytical data packages will be validated to SCQ requirements.

Field and analytical validation for all ASL B and D packages will be independent of the project and will be performed by the QA validation function.

Geotechnical sampling is generally considered to be ASL E and is used to support engineering design and construction placements.

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E.6.6 Document Preparation and Review

Documents prepared as milestone deliverables for work performed under the SEP (Section 7.0) will be reviewed by project management and appropriate QA personnel to ensure completeness and quality have been met. Appropriate document review forms will be routed and signed by the designated reviewers. Document control will be implemented as discussed in Section E.4.

Work processes resulting in records/reports will be reviewed to check validity of information as inputs to post-remediation documents, such as Certification Reports.

E.6.7 Computer Hardware, Software, and Database Management

Computer hardware/software configurations will be tested prior to actual use, and the results will be documented and maintained. Computer hardware/software configurations that are commercial grade and are configured or calibrated for a specific purpose do not require further testing unless the scope of the software usage changes; or modifications are made to the configuration. If any components/software are changed or modified and a new configuration results, the configuration must be retested and redocumented.

The database integrity for the SEP is maintained in accordance with the FEMP Computer Software Management Plan. Database access will be controlled and access will be granted on an as-needed basis using the standard FDF Computer Access process. In general, users will be granted access to read-only operations, with entry and edit privileges restricted to the database custodian and/or his/her designee.

Data change control for SEP data entered into the Sitewide Environmental Database (SED) will be documented by the data user requesting changes. Each database custodian and/or the custodian's designee will record additions, updates, and deletions through the use of a "history" table, which maintains the original data prior to each change. The date of the change, the user requesting the change, and the individual who makes the change will be recorded to provide a means of tracking all changes made to the database. Records that have been added, changed, or deleted will be summarized in a database change report.

Before new data packages or transmittals are placed in the database, a QC hold point will be established where each data set will be verified and validated. The database custodian and/or a designee will confirm which records in the database have had adequate QC control and will flag these records as "verified". Records which are not initially flagged as verified because of missing documentation and/or analytical problems will be updated to indicate QC verification if the necessary documentation and/or analytical information is provided.

Data sets used in statistical calculations will be controlled from the SED in a manner that can be traced from the Certification Report back to the SED CU data set. All associated calculations and spreadsheets will be tied to the proper data in the SED.

E.6.8 Access Control

Certified clean areas must be posted and access to posted areas must be controlled to prevent recontamination. Impacted soil stockpiles are fenced and secured for authorized access. Access documentation and traceability will be a part of access control measures used. Movement of impacted materials to stockpiles around certified clean areas, and from stockpiles to the On-Site Disposal Facility, will be monitored for compliance to waste disposition programmatic controls established to track clean areas, impacted material volumes, and the associated decontamination to prevent cross-contamination during SEP remediation. Inspections will be performed by waste disposition functions and SEP QA to verify cross-contamination control systems.

E.6.9 Project Management Controls

Project management controls will include measurement systems for schedules, resources, and cost tracking as well as procedures for implementing nonconformance and change-order policies. The Project Lead will be responsible for executing these controls and dealing with personnel issues that affect quality-related objectives of the SEP. Section E.2.3 provides additional information on project management responsibilities.

E.6.10 QA/QC Objectives for Engineering and Construction Work Processes

During the preparation of the remedial design and performance of the remedial actions, a variety of work processes will be carried out that require QA review. Examples include issuing a statement of work (SOW) for area-specific excavation; preparation of engineering drawings, specifications, and the

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IRDP; preparation of construction quality control plans, measurement tests, and equipment; and technical review of documents. Each of these areas must be reviewed with respect to attainment of QA objectives to demonstrate that soil excavation was carried out as designed.

E.6.10.1 Statement of Work

The SOW will be prepared and reviewed with the appropriate project manager, engineers, and procurement individual to ensure the successful solicitation of contractor services. The quality control provisions for excavation activities are specified in remediation subcontracts. The remediation subcontractor is responsible for developing a QA/QC plan that will be approved by the SEP QA representative. An example of QA elements associated with a subcontract SOW request for proposal (RFP) is described in Attachment A. Additionally, the remediation subcontractor will be required to submit, in conjunction with or separately from the QA elements, a detailed Construction Quality Control Plan. The subcontractor will also prepare a Safe Work Plan which will detail plans and instructions necessary for project workers to determine the tools and equipment needed to perform work in a safe manner.

E.6.10.2 Construction Quality Control Plan

Prior to initiating construction activities, a construction quality control plan will be prepared by the subcontractor with input from FDF. This plan must address, as a minimum, access controls, attainment of excavation design specifications, and reporting of survey and field test information used to demonstrate attainment of the design specifications. All construction testing and inspection methods will be specified. Any QC hold points necessary for construction staging will be identified with applicable acceptance criteria. This plan will be reviewed by FDF to ensure all applicable FEMP QA and construction specification criteria are satisfied.

E.6.10.3 Engineering Drawings, Specifications, and the IRDP

The area-specific remedial design will be presented in the IRDP. All engineering drawings and specifications specified in the IRDP will meet FDF engineering drawing and specification protocols. Appropriate independent verification of QC design criteria will be completed prior to regulatory agency review of the IRDP. Technical specifications include the ASTM, EPA, and other national standards/methods required to demonstrate acceptability of design criteria (e.g., Standards/Requirements Identification Document).

E.6.10.4 Measurement Tests and Equipment

Measuring tests and equipment used during construction tasks will be of the proper type, range, and accuracy and will be properly calibrated, maintained, and used according to design specifications and other planning documents. Equipment found unsatisfactory for its prescribed use will be recalibrated and certified within tolerances before being used. The validity of any measurements and tests performed with out-of-calibration equipment will be evaluated, and such measurements and tests will be repeated, as required, at the contractors expense. All measuring and test equipment used in construction and fabrication work that affects the quality of the final product will be calibrated. The basis for calibration will be documented and maintained as a record that is traceable to the equipment. Traceability of calibrated equipment to nationally recognized performance standards will be required. All analytical methods and equipment used to demonstrate attainment of the design specifications will be calibrated to National Institute of Science and Technology traceable standards or applicable national standards. Calibration and control measures may not be required for some devices (e.g., rulers, tape measures, levels) if normal commercial equipment provides adequate accuracy.

E.6.10.5 Technical Review of Documents

All engineering design documents and final survey records that establish the attainment of the design specifications will be reviewed by the appropriate registered engineer to ensure QA protocols are met. A document review form will be circulated and signed by the designated individuals to establish a record of the review process. The review form will become a formal project record and will be controlled with the document as discussed in Section E.5.2. Final construction punchlist walkdown will require QA participation, and the QA representative will approve the Final Acceptance Form for completed turnover punchlists.

E.7 DESIGN

Engineering design for SEP tasks will provide control of design of items and processes to appropriate standards necessary for project support functions and subcontractors to accomplish IRDP objectives.

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E.7.1 Design Document Preparation

The results of the final design will be appropriately documented in specifications and/or drawings that define design baseline. Design documents will specify the necessary technical and quality acceptance criteria and detail the required inspections and tests to verify acceptable construction.

E.7.2 Technical Review, Verification, Validation, and Readiness

E.7.2.1 Review

Design documents will be peer reviewed by technically qualified discipline experts to verify compliance with SEP program criteria. The project manager will assure that all relevant interfaces to design implementation are involved in the design review process. Quality Assurance will be part of the design review.

External independent reviews by DOE-FEMP and/or EPA may be performed upon request. In project planning, it should be determined whether the DOE field office may wish to conduct Management Reviews on any given project.

Typical design review stages are Title I (30 percent), Title II (60 percent), Title III (90 percent), and final CFC, which readies the design package for the IRDP and the procurement bid package when subcontractors are utilized.

E.7.2.2 Verification and Validation

At appropriate stages of design, independent design review will be performed to verify and validate systems, structures, components, computer programs, calculations, and tests. Designs must be verified for adequacy as early as practical, but in all cases, prior to dependence upon the design to perform its intended function. All V&V will be documented.

E.7.2.3 Readiness Assessment

Required readiness assessments will be conducted on systems requiring formal start-up evaluations in accordance with Conduct of Operations criteria. The necessity of Standard Startup Reviews, Readiness Assessments, and Operational Readiness Reviews will be determined by the appropriate level of quality as specified in 10 CFR 830.120. Engineering will specify Performance Grade of structures, systems, or components. Health and Safety will determine the Nuclear Hazard Category.

Quality Assurance will determine the Quality Level associated with Performance Grades and Hazard Categories. Quality Level 4 applies to work processes, purchased services, or commercial-grade items, which are not safety-significant. QA requirements for Quality Level 4 items and services are listed in PSPs or the purchase order.

E.7.3 Design Change Control

Changes affecting approved design documents will be standardized. A Request for Clarification of Information (RCI) formally documents additional information which does not affect approved documents or configuration. A Design Change Notice (DCN) provides a method for requesting a change to CFC design documents, existing installations, or modifications to SSCs. DCNs may also change the project scope to meet additional design basis performance requirements. All previous DCNs and related design documents are to be considered when evaluating the proposed change. When DCNs affect requirements established by documents such as Records of Decision, Remedial Work Plans, SEP, SCQ, or other EPA and OEPA and approved documents, annotation will be provided showing that the effects of the change have been reviewed and will be incorporated. The same levels of review that were imposed during the initial design will also be rendered for subsequent changes.

The RCIs and DCNs will be controlled in the same manner as original design documents by ECDC. Project QA receives copies of completed RCIs and DCNs.

E.7.4 Procurement Requirements

Design documents will identify acceptability criteria for purchased items, initial conditions, intermediate and end products.

E.7.5 Required Hold Points

Design documents will specify QC hold points and provide inspection and/or acceptance testing criteria to verify conformity to design specifications.

E.8 PROCUREMENT

Evaluation of SEP quality criteria in procurement documents is part of the selection and award function. When required, subcontractors will submit QA plans supporting work scopes.

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Subcontractors will pass down SEP quality elements to the lowest-tier subcontractor. QA review signatures are required on all procurement ordering documents.

E.8.1 Vendor Qualification, Selection, and Award

Engineering and construction will develop procurement documents, which include Purchase Requisitions, Invitation for Bid, Request for Quote, or RFP, in accordance with FDF engineering, construction and procurement procedures. Procurement documents will identify systems, structures, and components requiring inspection and/or acceptance testing. Associated quality verification of design specifications will be clearly defined in subcontractor deliverables. Title II pre-award teams will include QA on the planning and bidding teams, and QA will finalize the QA plan. Potential subcontractors will submit a QA plan and be prequalified prior to contract award to verify ability to perform to contract requirements. Environmental procurements relating to field sampling, sample analysis and validation will be performed in accordance with the SCQ.

E.9 INSPECTION AND ACCEPTANCE TESTING

Inspections and testing may involve survey, surveillance, and other assessment evaluations commensurate to establishing verification of specifications, operability, and performance of components and systems. Results of these activities will be documented and retained as project records. Inspection and testing used to evaluate and verify design will be planned, controlled, and documented.

Work that is nonconforming to design specifications or good practice will be identified, documented, and corrected by the appropriate project lead. Corrective measures will be completed in a timely manner. Items rejected by inspection will be tagged, segregated, and dispositioned in accordance with FEMP QA procedures.

E.9.1 Engineering and Construction

All Title III inspections will be performed by the appropriate FDF QA qualified and/or subcontractor QA certified inspector. Punch list and final turnover acceptance activities will include the project FDF QA representative who signs the Final Acceptance Form verifying construction subcontractor closure for completed construction tasks.

E.9.1.1 Welding

Welding inspections consist of welder certifications, weld filler materials, and welded joints performed to AWS standards. Welding inspections will be performed by FDF QA and/or the QA subcontractor representative.

E.9.1.2 Geomembrane Liner

Geomembrane liner installation will satisfy the requirements of OAC 3745-27-08(C)(2). The liners will be manufactured of high-density polyethylene or other material as approved via the design; be negligibly permeable to fluid migration; be physically and chemically resistant to attack by solid waste, leachate, or other materials which may come in contact with the geomembrane; be seamed to allow no more than negligible amounts of leakage with the seaming material physically and chemically resistant to attack. Geomembrane seaming apparatus will be tested each day of use by peel and shear tests on scrap pieces at the beginning of each seaming period and every 4 hours thereafter. Nondestructive testing will be performed on 100 percent of the geomembrane seams. Destructive testing for peel and shear will be performed at least once every 500 ft of seam length.

E.9.1.3 Geotechnical

Geotechnical investigative sampling will be conducted to determine the geotechnical properties of soils within areas of excavation, including the coarse- and fine-grained materials for use in design and evaluation of excavation, dewatering, grading, borrow fill materials and site restoration. Penetration/resistance testing performed in the field will be used to correlate strength and consistency (or density) of soils. Geotechnical testing required to determine soil classification, moisture content, strength, and permeability will be performed on samples obtained from test borings for subgrade characterization. Typical QA/QC measures associated with geotechnical analysis are described in respective ASTM methods and are presented in Table E-3. Geotechnical physical soil testing is considered to be ASL E. Geotechnical laboratories will be prequalified by FEMP QA.

E.9.1.4 Earthwork

SEP project QA will monitor the subcontractor earthwork activities to verify compliance to technical specifications. During construction, conformance and performance testing of the subgrade soil materials will be performed. Only qualified borrow and fill materials will be used and approved by the Construction Manager. For soil materials obtained from on-site borrow areas or stockpiles, visual

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inspections and conformance tests will be performed by construction QC prior to material excavation. For off-site borrow material sources, the visual inspection and conformance testing may be performed at the source location or as the borrow materials arrive at the FEMP. Initial evaluation of various soil types by construction QC personnel may be largely visual. Compacted fill materials placed to achieve grades will be tested by construction QC to specified test methods and frequencies. Areas of proofrolling or compacted fill that do not meet technical specifications will be delineated and reported to the Construction Manager. The areas will be retested after any reworking by the subcontractor. The proofrolling and testing will be repeated until passing results are achieved. QC will monitor the repair and rework of subgrade that is damaged by moisture (causing softening) and insufficient moisture (causing desiccation and shrinkage), or by freezing. If such conditions are determined to exist, the suitability of the subgrade will be evaluated by moisture/density testing, continuous visual inspection during proofrolling, and checking consistency of cohesive soils using a penetrometer or other suitable field-expedient measurement device in suspect weak soil areas.

E.9.1.5 Surveying

Land surveying will be performed at all locations using the 1983 North American Datum (NAD) coordinate system. Surveying results for construction process and final as-builts will be approved and certified by a State of Ohio Registered Professional Land Surveyor. All surveyed benchmarks/monuments will be accurate to the nearest 0.01 ft elevation accuracy. Survey points will be located to within 0.5 ft horizontal accuracy and integrated into the existing FEMP Geographic Information System, and incorporated into the site Geotechnical Database and the SED. Periodically, the construction subcontractor will submit as-built surveys to indicate compliance of excavation lifts, residual contours, lines, and grades. The SEP QA representative will review the information in a timely manner and notify the construction manager of any noncompliance.

The Global Positioning System (GPS) may be used during surveying to mark locations for in-process and as-built topographic contours. Additionally, the GPS will be used extensively to mark sampling locations, extent of surface impacted areas, hot spots, and Geoprobe® or other borings to determine depth of contamination. The use of GPS must be proceduralized with the necessary calibration program that will periodically verify GPS unit accuracy.

E.9.2 Environmental

The SCQ contains the acceptance requirements for field sampling, analytical analysis, and data validation. Special considerations outside the SCQ must be defined, technically justified, and the appropriate QA/QC specifications established.

E.9.2.1 In Situ Gamma Technology

Quality Control performance specifications for gamma-sensitive detectors such as used in RTRAK and HPGe systems will be commensurate to the intended field application. Details of the use of in situ gamma systems at the FEMP are provided in the In Situ Gamma Users Manual (DOE 1998), which includes related performance QC criteria required for acceptable field use and in the RTRAK and HPGe comparability studies (DOE 1997a, 1997b). GPS readings should accompany in situ gamma readings related to RTRAK and HPGe. The in situ data must meet analytical validation requirements of the SCQ for requested ASLs including associated field data packages.

RTRAK

RTRAK performance criteria will be specified in operations documents to meet the ASL data requirements identified in PSPs. The appropriate QC checks of RTRAK data will be completed to verify measurement defensibility.

HPGe

The HPGe system is capable of scanning for isotopic uranium, thorium and radium at their respective FRL. Calibration will be required at the beginning of a scanning event, at the beginning of the day and at the end of the same day. Acceptable calibration criteria are described in the HPGe calibration procedure. The applicable ASL level (i.e., A or B) will depend on the area specific application and the respective performance criteria.

E.9.2.2 Sediment Basin

Sediment basin monitoring will be monitored in accordance with the IEMP and Stormwater Pollution Prevention Program. The IRDP will specify maximum acceptable sediment and uranium loadings before corrective actions must commence. The frequency and conditions for sampling will be specified in the IRDP.

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E.9.2.3 Waste Characterization

Waste characterization for waste disposition materials will meet the SCQ requirements for sampling and analysis. Appropriate DQOs and PSPs will describe acceptable QC performance criteria.

E.9.2.4 Dust Monitoring

Dust control management will follow requirements specified in 40 CFR Part 60, Appendix A, Method 9, Visual Determination of the Opacity of Emissions From Stationary Sources, and 40 CFR Part 60, Appendix A, Method 22, Visual Determination of Fugitive Emissions From Material Sources and Smoke Emissions From Flares. Method 9 observers must be EPA certified opacity readers and must recertify every 6 months in order to retain certification. As a minimum, Method 22 observers must be trained and knowledgeable regarding the effects on the visibility of emissions caused by background contrast, ambient lighting, observer position relative to lighting, wind, and the presence of condensing water vapor; this training can be obtained from the lecture portion of the Method 9 certification course. However, Method 22 observers do not require certification or re-certification.

## E.10 MANAGEMENT ASSESSMENT

SEP Project Leads will assess effectiveness of IRDP implementation. The SEP management assessment plan will encompass SEP activities. At a minimum, an annual management assessment report will summarize project specific self-assessments, management surveys, and effectiveness of corrective action implementation. Process improvement actions should be applied to subsequent SEP planning and operations.

## E.11 INDEPENDENT ASSESSMENT

Planned and periodic independent assessments will be conducted on SEP activities to measure item quality and process implementation to established plans, procedures, and standards.

E.11.1 Assessments

Assessments include inspection, surveillance, audit, peer review, and readiness review and should be performed at a frequency commensurate to the activity and as required by planning documents. Planning documents such as PSPs and IRDPs will designate a QA representative to conduct independent assessments. The QA representative will be responsible for verifying subcontractor quality performance to contract requirements. Assessments conducted by outside organizations will be

facilitated by the QA representative. Personnel performing independent QA assessment should have no direct responsibilities in the area they are assessing. Results of assessments will be documented, reported to, and reviewed by management.

E.11.2 Corrective Action

Nonconforming conditions will be identified and addressed promptly. Appropriate corrective actions will be taken and their adequacy verified and documented in response to the findings of the assessments.

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## REFERENCES

U.S. Department of Energy, 1997a, "RTRAK Applicability Study," July Draft, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Department of Energy, 1997b, "Comparability Study of In Situ Gamma Spectroscopy and Laboratory Data," July Draft, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Department of Energy, 1998, "User Guidelines, Measurement Strategies and Operational Factors for Deployment of In Situ Gamma Spectrometry at the Fernald Site," April Draft, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

**TABLE E-1**
**QUALITY ASSURANCE CRITERIA CROSSWALK**

| Sitewide Excavation Plan | Quality Assurance Criterion - RM-0012 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Introduction | | | | | | | | | | |
| Purpose & Scope | ✔ | | | | ✔ | | | | ✔ | |
| Key Components of the Selected Remedy (SR) | | | | | | ✔ | | | ✔ | |
| Remedial Management Strategy | | | | | | | | | | |
| Contracting During RD & RA | | | | ✔ | | | ✔ | | | |
| Application of the SR | | | | | ✔ | ✔ | | | | |
| Application of New Technologies | ✔ | ✔ | | | ✔ | | | | | |
| Regulations, Permits, and Enforceable Agreements | ✔ | | | | | | | | | |
| ARARs (Appendix) | ✔ | | | | ✔ | | | | ✔ | |
| Permits | ✔ | | | ✔ | ✔ | | | | | |
| Enforceable Agreements | ✔ | | | | ✔ | | ✔ | | | |
| Natural Resource Trustees | | | | | | | | | | |
| RA Implementation | | | | | | | | | | |
| Contracting and Preparation | | ✔ | | ✔ | ✔ | ✔ | ✔ | | | ✔ |
| Existing and Anticipated Site-wide Conditions for At-and Below-Grade Features | | | | | | ✔ | | | | |
| Area-Specific Excavation Control | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | | | | ✔ |
| Environmental Monitoring | | ✔ | ✔ | ✔ | ✔ | | | ✔ | | ✔ |
| Excavation Material Management | | | | ✔ | ✔ | | | ✔ | | ✔ |
| Remediation Maintenance Procedures | | | | ✔ | ✔ | | | | | ✔ |
| Encounters with Threatened and Endangered Species, Artifacts, and Historical Landmarks | | | ✔ | | ✔ | | | | | |
| Criteria for Implementation of the SR | | | | | | ✔ | | | | |
| Application of Selected Remedy Terminology | ✔ | | | | | ✔ | | | | |
| Precertification Sampling and Analysis (Environmental Reference Document) | ✔ | | | ✔ | ✔ | ✔ | | ✔ | | ✔ |

**TABLE E-1**
**(CONT'D)**

| Sitewide Excavation Plan | Quality Assurance Criterion - RM-0012 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Certification Sampling and Analysis | ✔ | ✔ | | ✔ | ✔ | | | ✔ | | ✔ |
| Project Health and Safety | | ✔ | | | | | | | ✔ | |
| Sitewide Health and Safety Matrix (appendix) | ✔ | | | | | ✔ | | | | |
| Remediation Access Controls | | ✔ | | | | | | | | |
| Emergency Preparedness | | | | ✔ | ✔ | | | | | |

QA Criterion 1 - Program/Organization
QA Criterion 2 - Personnel Training and Qualification
QA Criterion 3 - Quality Improvement
QA Criterion 4 - Documents and Records
QA Criterion 5 - Work Processes
QA Criterion 6 - Design
QA Criterion 7 - Procurement
QA Criterion 8 - Inspection and Acceptance Testing
QA Criterion 9 - Management Assessment
QA Criterion 10 - Independent Assessment

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# TABLE E-2

## SAMPLING REFERENCE GUIDELINES

| Administrative Procedures | Reference Documents |
|---|---|
| QA/QC | SCQ Sections 4, 5, 10, and 11; Appendix A/Table 2-2; Appendix D; Appendix J |
| Chain of Custody | SCQ Volume I, Section 7.1;<br>RI/FS Fernald Project Policy and Procedures Manual, FPP-401, Section 5.1.12 |
| Corrective Action | SCQ Volume I, Section 15.2;<br>RI/FS Fernald Project Policy and Procedures Manual, FPP-210 |
| Daily Logs | SCQ Appendix J, Subsection J.4.1 |
| Document Change Request | SCQ Volume I, Section 4.4.3.2;<br>RI/FS Fernald Project Policy and Procedures Manual, FPP-200 |
| **Field Procedures** | **Reference Documents** |
| General Drilling Practices | SCQ Section 5.2.1; Appendix J, Subsection J.4.2 |
| Subsurface Sampling | SCQ Appendix K, Section K.5.3 |
| Surface Sampling | SCQ Appendix K, Section K.5.1 |
| Abandonment | ASTM D5299-42 "Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes and Other Devices for Environmental Activities";<br>OAC 3745-9-10 "Abandonment of Test Holes and Wells";<br>ASTM C150-92 "Standard Specification for Portland Cement" |
| Field Screening of Samples for Radioactive Contamination | SCQ Appendix K, Subsection K.5.3.2;<br>RI/FS Fernald Project Policy and Procedures Manual, FPP-600 |
| Decontamination | SCQ Appendix K, Subsection K.11 |
| **Sample Handling/ Laboratory Procedures** | **Reference Documents** |
| Classification, Transportation, and Shipment of FEMP RI/FS Samples | RI/FS Fernald Project Policy and Procedures Manual, FPP-601;<br>SCQ Appendix K, Subsection K.10; Volume I, Subsection 6.7;<br>Compendium of Superfund Field Operations Methods, Section 6.0 |
| Geotechnical Sampling and Testing Methods | ASTM reference standards as shown in Table E-4 |

QA/QC - Quality Assurance/Quality Control
RI/FS - Remedial Investigation/Feasibility Study
SCQ - Sitewide CERCLA Quality Assurance Plan
ASTM - American Society of Testing and Materials
OAC - Ohio Administrative Code
FEMP - Fernald Environmental Management Project

# TABLE E-3

## SUMMARY OF ASTM GEOTECHNICAL PROCEDURES

| ASTM Test No. | Title |
|---|---|
| D 420 | Standard Guide for Investigating and Sampling Soil and Rock |
| D 421 | Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis Determination of Soil Constants |
| D 422 | Standard Test Method for Particle Size Analysis for Soils |
| D 698 | Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort |
| D 854 | Standard Test Method for Specific Gravity of Soils |
| D 1452 | Standard Practice for Soil Investigation and Sampling by Auger Borings |
| D 1586 | Standard Test method for Penetration Test and Split-Barrel Sampling of Soils |
| D 1587 | Standard Practice for Thin-Walled Tube Sampling of Soils |
| D 2166 | Standard Test Method for Unconfined Compressive Strength of Cohesive Soil |
| D 2216 | Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock |
| D 2217 | Standard Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soi Constants |
| D 2434 | Standard Test Method of Permeability of Granular Soils (Constant Head) |
| D 2487 | Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System) |
| D 2488 | Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) |
| D 3080 | Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions |
| D 3550 | Standard Practice for Ring-Lines Barrel Sampling of Soils |
| D 4220 | Standard Practices for Preserving and Transporting Soil Samples |
| D 4318 | Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| D 4767 | Standard Test Method for Consolidated-Undrained Triaxial Compressive Test on Cohesive Soils |
| D 5084 | Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall |
| D 5299 | Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities |

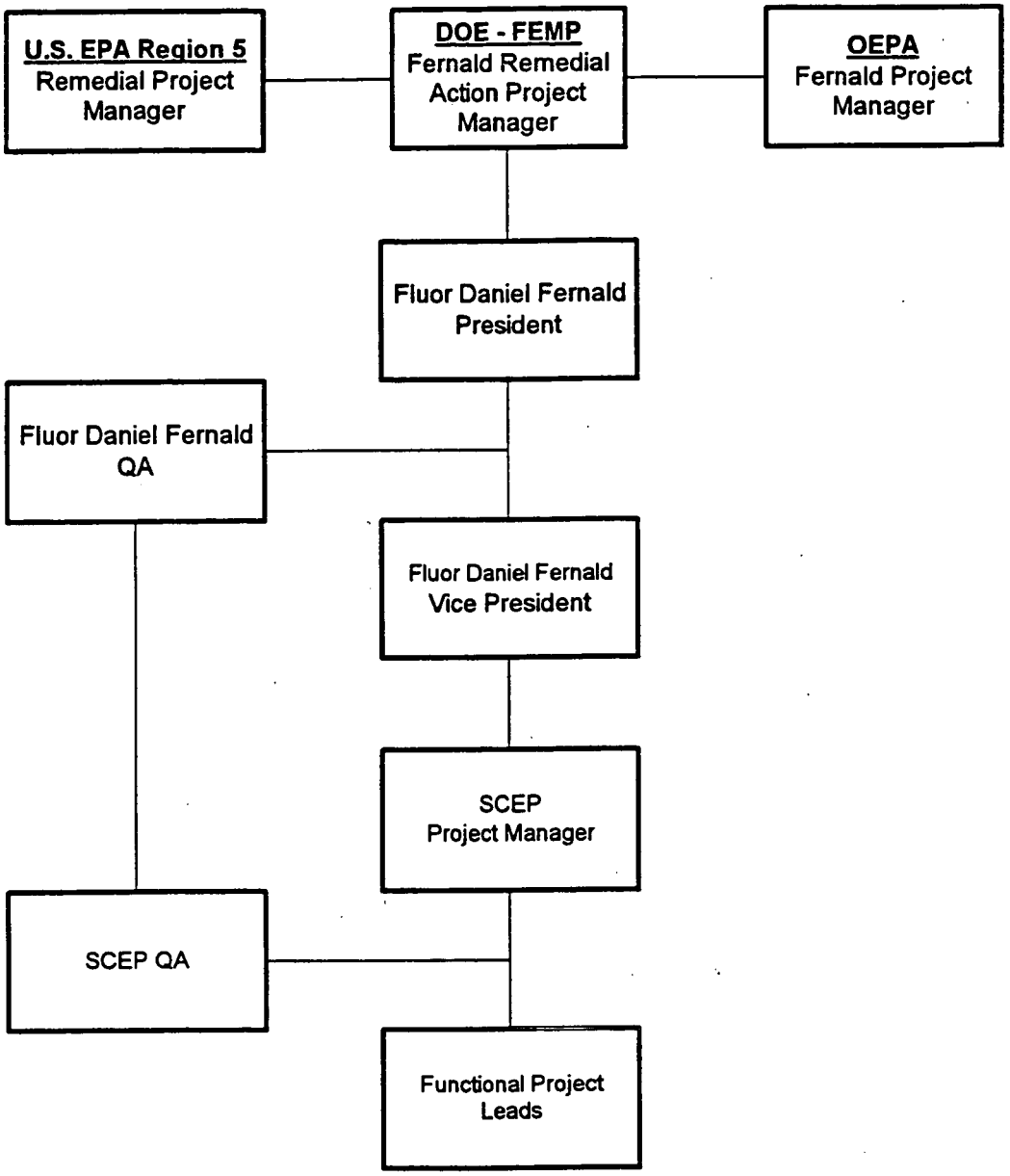


FIGURE E-1 SEP QA PROGRAM ORGANIZATION

# ATTACHMENT A

# CONSTRUCTION QUALITY REQUIREMENTS

# PART 9

## QUALITY REQUIREMENTS
## CONTRACT NUMBER _____

A. General Information

The Contractor shall develop a written supplemental Quality Assurance Plan (QAP) addressing the quality elements outlined in this Part 9.

These supplemental quality requirements will fulfill the requirements of Fluor Daniel Fernald (FDF) Quality Assurance Program Description (RM-0012), which satisfies the requirements of ANSI/ASME NQA-1, EPA QAMS-005/80, DOE Order 5700-6C, and 10 CFR Part 830.120. Those quality assurance elements not specified in other parts of the contract documents are included in this Part 9.

B. Within (15) calender days from Notice to Proceed, the contractor shall submit a QAP to the Construction Contracts Manager for review and approval. Work shall not begin till this plan is approved. The following quality elements shall be included in the QAP:

### 1.0 ORGANIZATION

1.1 Describe, and show with an organization chart, the contractor's organizational structure from the Contractor's home office support staff through key field management personnel who are specified in Part 6 of this contract. The functional titles and names of personnel shall be included in this chart.

1.2 Subtiers are part of the Contractor's organization and shall be included in the organizational structure as well as describing functional responsibilities and levels of authority.

1.3 Provide an outline for an orientation/training to be given by the contractor to employees and subcontractors on the necessity and expectation of performing quality work as addressed in the QAP. Attendance records of personnel attending orientation shall be maintained on-site as Quality Records.

### 2.0 PERSONNEL TRAINING AND QUALIFICATIONS

2.1 Describe in the QAP how the contractor shall assure project personnel receive the required specified FDF site training before performing work in the field. The contractor shall document necessary training, and a copy of training records shall be kept in the contractor's field office.

2.2 Describe how the contractor shall assure personnel and sub-tier Subcontractors performing the work are suitably qualified to accomplish their assigned task. The contractor shall document qualification records and file these records in the Subcontractor's field office.

2.3 Show with a resume, the Q/A manager has a minimum of ___ years experience in construction, and also show with a resume, the Q/C inspector has a minimum of ___ years

experience in construction. These resumes are not considered part of the QAP, but shall be an attachment to the document.

## 3.0 QUALITY IMPROVEMENTS

3.1 When the contractor's Quality Inspector verifies the subcontract material and workmanship does not meet the specified requirements, describe how these nonconformances will be documented on an approved NONCONFORMANCE Report form.

3.2 Describe how the contractor shall distribute NONCONFORMANCE Reports to FDF.

3.3 Describe how FDF shall be integrated in the approval process when evaluating the corrective actions required to close a NONCONFORMANCE report.

3.4 Describe how nonconforming materials and workmanship shall be controlled to prevent inadvertent use.

## 4.0 DOCUMENTS AND RECORDS

4.1 Control of FDF issued Controlled Documents

4.1.1 Describe how FDF Controlled Documents will be managed to assure the following requirements are met:

A. Assure controlled documents issued by FDF are controlled by the contractor when reproduced and issued to sub-tier subcontractors and Contractor employees such that only current, controlled revisions are used for the work.

B. FDF transmittal forms shall be signed, indicating receipt of documents, and returned to FDF Engineering and Construction Document Control (ECDC) with a copy sent to the Construction Manager.

C. Certified for Construction documents received by the Contractor which do not have a "ECDC/Controlled Copy" stamp with red control numbers shall be returned to (ECDC) with a copy of transmittal sent to the Construction Manager.

D. Superseded and canceled controlled documents shall be marked "VOID" and removed from the field work area. "VOID" drawings shall only be maintained in the Subcontractors field office.

E. Controlled documents reproduced by the Contractor shall have a Contractor control number designated on the document in red. The Contractor shall maintain a log of their control numbers showing to whom they were issued.

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F. Work shall be performed from current documents marked "ECDC/Controlled".

G. Upon receipt of a FDF transmittal of controlled documents, the Contractor shall verify that the document numbers and revision numbers correspond with those on the transmittal. Deviations shall be reported to ECDC and a copy of the transmittal sent to the Construction Manager.

H. Approved Design Change Notices (DCNs), containing the "ECDC/Controlled" stamp shall be annotated by the Contractor on the affected controlled construction drawings and technical specifications. The annotated construction drawings are not considered red lined drawings.

I. The Contractor shall routinely review documents used in the work to assure that current controlled documents are in use, that DCNs are properly noted on the affected documents, and that work is performed in compliance with applicable subcontract documents.

4.2 Control of Contractor Submittals

4.2.1 Describe how and by which Contractor organizational position the following requirements will be met.

A. Submittals are made in accordance with the "Contractor Submittal Requirements" from Part 7 - Drawings & Technical Specifications.

B. Submittals are reviewed for accuracy, completeness and compliance with the subcontract requirements and so marked in accordance with Part 3 - General Provisions, "Specifications and Drawings for Construction".

C. Do not erase or obliterate Quality Records when revised. Quality Records are inspection reports, test reports, NONCONFORMANCE reports, and material certificates. Revisions shall be made using a line through the error or items deleted and initialed and dated by the person making the revision.

4.3 Maintenance of Subcontract Documents

4.3.1 Describe how subcontract documents will be maintained.

## 5.0 WORK PROCESSES

5.1 Describe how work procedures shall be developed for special work processes such as welding High Density Polyethylene (HDPE) pipe, geomembrane seam welding, continuity and tensiometer testing of geomembrane, hydrostatic testing of HDPE pipe, HDPE pipe inspection by video camera, and repair procedures for HDPE pipe and geomembrane liner. Special work processes that are not in this listing but are in the technical specifications of this contract shall be addressed with a procedure.

## 6.0 DESIGN

6.1 Describe how and by whom As-built drawings shall be maintained for Contractor issued drawings to meet the following requirements.

6.1.1 Provisions of Part 4, Special Conditions, As-Built Redline drawings, applies.

6.1.2 The redlined documents shall be clearly identified as containing as-built information. they shall be clear, concise, up-to-date, legible representation of Contract changes.

## 7.0 PROCUREMENT

7.1 Describe the Contractor procurement program which shall address the following:

7.1.1 Show how contract requirements are invoked for procurement of items and services within the Contractor's and any subtler organization.

7.1.2 Describe the method and documentation process for accepting purchased items.

7.1.3 Describe how nonconforming items shall be tagged and segregated from acceptable items.

## 8.0 INSPECTION AND ACCEPTANCE TESTING

8.1 Describe how the Q/C Inspector maintains independence from field supervision.

8.2 Describe how inspections are planned, performed, and documented to assure work is in compliance with the acceptance criteria specified in this contract.

## 9.0 MANAGEMENT ASSESSMENT

9.1 Describe how contractor senior management shall conduct periodic overviews of this contract to assure it is in compliance with their QA Program and contract requirements.

## 10.0 INDEPENDENT ASSESSMENT

10.1 FDF Quality Assurance will conduct periodic oversight of the Contractor's Quality Program. The Contractor shall cooperate with FDF in the identification, control, correction, and reporting of material and process deficiencies.

10.2 The Contractor shall provide FDF personnel access to work being done and to project documentation. FDF QA/QC monitoring may include, but not limited to; inspection of materials, inspection of work in progress, and programmatic surveillances.

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# APPENDIX F

# IMPLEMENTATION OF CONSTRUCTION

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# LIST OF ACRONYMS

| | |
|---|---|
| ACM | asbestos-containing materials |
| AWWT | Advanced Wastewater Treatment Facility |
| FEMP | Fernald Environmental Management Project |
| CFC | certified for construction |
| COC | constituent of concern |
| D&D | decontamination and dismantlement |
| DOE | U.S. Department of Energy |
| FRL | final remediation levels |
| FTL | Field Tracking Log |
| IEMP | Integrated Environmental Monitoring Plan |
| IIMS | Integrated Information Management System |
| IMPP | Impacted Materials Placement Plan |
| IRDP | Integrated Remedial Design Package |
| MEF | Material Evaluation Form |
| mrem | millirem |
| MTL | material tracking location |
| NAGPRA | Native American Graves Protection and Repatriation Act |
| NHPA | National Historic Preservation Act |
| NRRDP | Natural Resource Restoration Design Package |
| NRRP | Natural Resource Restoration Plan |
| ODNR | Ohio Department of Natural Resources |
| ODOT | Ohio Department of Transportation |
| OEPA | Ohio Environmental Protection Agency |
| OSDF | On-Site Disposal Facility |
| OSHA | Occupational Safety and Health Act |
| pls | pure live seed |
| PPE | personal protective equipment |
| PWID | Project Waste Identification and Disposition |
| RI/FS | remedial investigation/feasibility study |
| SCEP | Soil Characterization and Excavation Project |
| SCQ | Sitewide CERCLA Quality Assurance Plan |
| SED | Sitewide Environmental Database |
| SEP | Sitewide Excavation Plan |
| SSP | Sitewide Sequencing Plan |
| SWIFTS | Sitewide Waste Information Forecasting and Tracking System |
| SWRB | Stormwater Retention Basins |
| WAC | waste acceptance criteria |
| WAO | Waste Acceptance Operations |
| WPM | Waste Programs Management |

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## F.1 INTRODUCTION

As described within the Sitewide Excavation Plan (SEP), the Fernald Environmental Management Project (FEMP) is divided into remediation areas that will be excavated in a sequential and logical manner. Generally, separate Integrated Remedial Design Packages (IRDPs), and corresponding construction packages, will be prepared for each area. Area-specific details will be developed and presented in each IRDP. The drawings and specifications from each IRDP will be used for construction procurement and execution.

### F.1.1 Purpose

This appendix presents the general approach to implementing construction activities to achieve soil remediation objectives at the FEMP. It presents the overall approach to soil remediation that will serve as a general guide for construction remediation activities.

### F.1.2 Construction Activities

Construction activities were initially integrated into the FEMP project in the Remedial Investigation/ Feasibility Study (RI/FS). Construction will take an increasingly larger role as the individual areas move through design and into remediation. During the design phase, construction personnel will review and provide input into the specific IRDPs as they are developed. After the drawing and specification components of the IRDP are certified for construction (CFC), FEMP management will take the lead on construction activities as described in this appendix. Major construction and associated activities that will be performed to remediate the FEMP include:

- Subcontractor Procurement
- Actual Construction
  - Site Preparation
  - Excavation
- Waste Disposition
- Restoration
- Remediation Area Maintenance.

Generally, construction work will be performed by subcontractors, with FEMP management and monitoring the work to ensure compliance with approved IRDPs and other documents.

F.1.2.1 Subcontractor Procurement

Construction subcontractors will be selected in accordance with the approved FEMP acquisition system, which follows the Federal Acquisition Requirements and is designed to ensure competition. Generally, subcontractors will be prequalified prior to issuance of a solicitation. The CFC drawings and specifications prepared for the IRDP will be incorporated into the solicitation, which will either be an invitation for bid or request for proposal.

F.1.2.2 Actual Construction

The IRDP drawings and specifications will be developed based on information contained in the FEMP Sitewide Environmental Database (SED) (Section 2.5). The design will be created based on SED data, and drawings will be developed to illustrate the proposed limits of excavation. This information will be presented to the construction subcontractors in the CFC construction drawings and technical specifications of the IRDPs. Actual excavation limits will be based on field conditions and analysis during remediation.

Actual construction and remediation activities generally include site preparation and excavation. Site preparation consists of the construction activities necessary to prepare the site for actual excavation; site preparation activities are presented in more detail in Section F.2. Excavation consists of the actual excavation of soil and at- and below-grade structures; excavation activities are presented in more detail in Section F.3. Contingency plans will be developed to address unexpected conditions in the field; continency plan requirements are presented in Section F.4.

The subcontractors will be responsible for preparing detailed Safe Work Plans that describe how the construction activities described on the CFC drawings and specifications will be implemented. The plans will include a construction sequence and schedule. Safe Work Plans will be reviewed and approved by FEMP management.

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F.1.2.3 Waste Disposition

Waste disposition protocols (outlined in Section F.5) will be developed and implemented by Waste Acceptance Operations (WAO) and Waste Programs Management (WPM) to ensure proper material disposition. The subcontractor will comply with the protocols to the satisfaction of WAO and WPM.

F.1.2.4 Restoration

Restoration guidelines are addressed in Section F.6.

F.1.2.5 Remediation Area Maintenance

Maintenance activities and surveillance and inspections for remediated areas are presented in Section F.7.

F.1.3 Well Management

Monitoring wells located within each of the remediation areas will be plugged and abandoned, or excavated as appropriate, to facilitate remedial activities. The wells will be addressed based on area-specific requirements. To the extent practical, they will be addressed by FEMP management before construction subcontractors begin work in the area. If monitoring well work is required by the subcontractor, it will be incorporated into the CFC construction drawings and technical specifications.

Portions of the existing monitoring well network will be maintained as described in Section 3.0 of the Integrated Environmental Monitoring Plan (IEMP) (DOE 1997), to ensure that the appropriate groundwater monitoring data continue to be generated throughout remedial activities at the site. The location of specific wells within each of the remediation areas, and the expected status of plugging and abandonment activities, will be addressed in the area-specific IRDPs (Section 7.2).

F.1.3.1 Plugging and Abandonment

Monitoring well plugging and abandonment will be conducted in accordance with existing site procedures, Appendix J of the Sitewide CERCLA Quality Assurance Plan (SCQ) (DOE 1993), and the Ohio Environmental Protection Agency (OEPA) well abandonment standards promulgated in OAC 3745-9-10. Information on monitoring wells abandonment will be included in the appropriate area IRDP.

F.1.3.2 Monitoring Well Excavation

Soil excavation may extend to a depth where 1000 series wells can be removed intact during excavation, without implementing normal plugging and abandonment procedures. The Soil Characterization and Excavation Project (SCEP) will coordinate the removal of these wells with the Aquifer Restoration Project to maintain the integrity of the existing groundwater monitoring program.

F.1.3.3 Monitoring Well Preservation

Section 3.0 of the IEMP (DOE 1997) describes the existing groundwater monitoring program and identifies the monitoring wells that will be maintained during remedial activities. These wells will also be identified in the IRDPs, and protective measures, such as construction fencing, will be specified to ensure these wells are physically protected during field activities. New monitoring wells may be installed in some areas after the completion of excavation activities to ensure appropriate groundwater monitoring data is generated under the IEMP (DOE 1997) groundwater monitoring program.

## F.2 SITE PREPARATION

Site preparation activities will be performed for every excavation area. Depending on the size and scope of the site preparation work, it may be awarded as a separate subcontract or incorporated as the first phase of an excavation contract.

Site preparation consists of the construction activities and tasks necessary to prepare the site for actual soil excavation and at- and below-grade decontamination and dismantlement (D&D) activities. Site preparation may include, but is not limited to:

- Establishing construction boundaries and access controls
- Establishing support areas
- Installing decontamination and wash facilities
- Clearing and grubbing
- Removing surface material
- Implementing surface water management systems
- Installing erosion and sediment control measures
- Establishing survey controls
- Maintaining utilities.

Each of these activities is discussed in the following subsections.

F.2.1 Establishing Construction Boundaries and Access Controls

Initial site preparation activities will include establishing defined construction areas and access controls in the field and posting appropriate signs at construction boundaries. The purpose of this activity is to control access and ensure that appropriate safety procedures are observed. Construction areas will be established based on potential radiological exposure, the type of work to be performed (excavation, D&D, etc.), and location. Areas will be posted based on radiological requirements. The types of radiological postings that are anticipated for soil excavation areas include:

- Radiation Area: Areas in which radiation levels could result in an individual receiving a dose of radiation in excess of 5 millirem (mrem) in 1 hour at 30 centimeters from the source or from any surface that the radiation penetrates.

- Contamination Area: Areas where removable contamination levels are greater than the removable values specified in Appendix D of RM-0020, but less than or equal to 100 times those values.

- Soil Contamination Area: Area where radioactive material contamination exists in a matrix (e.g., soil) at levels exceeding natural background and which has not been released for unrestricted use in accordance with Department of Energy (DOE) Order 5400.5, Radiation Protection of the Public and the Environment.

- Controlled Area: Areas to which access is managed to protect individuals from exposure to radiation and/or radioactive material. Two categories of controlled areas are anticipated:

  - Category I (controlled area): Individuals have a potential to be exposed to low levels of radioactive contamination in Category I controlled areas. Eating, drinking, smoking, and chewing are prohibited within Category I controlled areas except for controlled break areas approved by the Manager of Radiological Control. Personnel and material monitoring are required to exit a Category I controlled area.

  - Category II (controlled area): A Category II controlled area is an area that has been surveyed and released from contamination controls. No personnel or material monitoring is required to exit.

- Radiological Buffer Area: Intermediate areas established to prevent the spread of radioactive material and to protect personnel from radiation exposure.

Fencing will be used to establish the construction boundary. The type of fencing used will be based on several factors, including location, amount of traffic in the area, expected depth of excavation, and

radiological classification. The fencing requirements will be shown on the construction drawings and will be selected based on area-specific situations. Some examples of types of boundary fencing and their typical uses are:

- Chain link fencing may be used in highly congested traffic areas and may include pedestrian and vehicle access gates.
- Perimeter rope and stakes will be placed at the boundary of remote, relatively low contamination areas. The construction area will be defined by stakes, yellow rope and signs. The perimeter rope will also define the radiological control boundary for the site. Chain link fencing and gates may be installed at vehicle access points.
- Construction fencing is a cloth, plastic or similar material used to delineate construction areas and restrict access.
- Silt fencing may be used in some locations to delineate construction boundaries and provide sediment control.
- Combination fencing is a combination of chain link fencing and rope. The rope and stakes will define the site boundary in remote areas. Fencing and gates may also be installed at the perimeter of sensitive areas such as support areas and retention basins.

F.2.2 Establishing Support Areas

Support areas will be established in the vicinity of the construction area. Access to the construction area will generally be provided through a support area. Support areas may include vehicle and personnel radiological monitoring and decontamination facilities, office and storage trailers, parking, storage yard, restroom, and other subcontractor facilities. If properly located, one support area may be used for multiple construction areas. The size, location, and complexity of each support area will vary depending upon area-specific requirements that will be identified in each IRDP (Section 7.2).

F.2.3 Installation of Decontamination and Wash Facilities

Decontamination facilities will be used to monitor and decontaminate personnel and equipment leaving a controlled area. Equipment wash facilities will be used to wash equipment before it leaves one area in order to reduce the potential spread of contamination. Each IRDP will identify specific requirements related to the construction of new, or use of existing, decontamination and wash facilities.

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Personnel decontamination facilities will generally be located in the support area at the entrance to the construction area. The facilities will typically consist of one or more trailers containing radiological monitoring equipment, emergency showers, wash basins, and change-out room(s).

Similarly, equipment decontamination and wash facilities will be located where equipment can be washed or decontaminated before it is taken out of a specific area. Depending on its location, the facility may be used to support multiple remediation areas. In addition, it may be necessary to construct a decontamination facility for construction equipment that leaves the FEMP. These facilities will be used within a controlled area to minimize the spread of soil and mud onto haul roads and other areas of the site. These facilities will typically consist of vehicle and wheel wash facilities and be constructed where haul vehicles exit excavation areas onto dedicated haul roads within contaminated areas. Their function is to remove larger pieces of soil and debris from vehicles before they leave the excavation area. These facilities will typically consist of high pressure wash equipment and a concrete pad with a trench drain and sump. Water collected in the sump will be managed in accordance with existing site procedures. Specific decontamination requirements for each phase of remediation will be identified in area-specific IRDPs.

F.2.4 Clearing and Grubbing

Clearing (i.e., cutting and removal of trees) will typically be the first step of excavation. Trees and shrubs will be cut at a level above-grade that corresponds to appropriate health and safety protocols (e.g., use of chain saws and tripping hazards).

Based on the results of the Wood Sampling Program (Appendix D), the portion of the tree above ground is considered to meet all final remediation levels (FRLs). Therefore, the tree trunks and upper branches may be chipped and stockpiled for later use as mulch. Wood chips derived from clearing trees and brush on site will only be used on site. The stumps and roots of the trees will be considered part of the surface soil and will be dispositioned in the same manner as the surface soil.

F.2.5 Removal of Surface Material

Surface material such as gravel, pavement, and railroad ties and ballast will be removed during excavation. This material will be managed in accordance with excavated material management as described in Section F.5.

F.2.6 Implementation of Surface Water Management Systems

Surface water management systems will be installed during the site preparation phase to control surface water runoff/runon, provide erosion and sedimentation control, minimize potential recontamination of remediated areas, and to minimize discharges of potentially contaminated surface water during remediation. These facilities will be monitored and may be modified during excavation. Surface water management and erosion and sediment control facilities will be designed for each specific area as the IRDPs are developed. The following documents will be used for guidance and/or reference during the development of specific plans:

- Rainwater and Land Development (ODNR 1996)
- Storm Water Pollution Prevention Plan Checklist (OEPA 1995)
- Construction and Material Specifications, State of Ohio Department of Transportation (ODOT 1995)
- FEMP Storm Water Pollution Prevention Plan (DOE 1996).

Surface water management systems and sediment and erosion control measures will be designed using the appropriate design guidance, engineering judgment and experience from earlier phases of remediation. Surface water management systems will be designed to divert stormwater runoff from upgradient areas around excavations, collect runoff from areas that will be disturbed during excavation/remediation, convey water to appropriate facilities, and provide the necessary and appropriate controlled and/or treatment facilities.

The overall approach for remediation activities and surface water management system practices will be performed to achieve, to the extent practical, the following objectives:

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- Minimize stormwater runoff from contaminated areas
- Minimize stormwater runon to remediated areas
- Minimize the disturbed area undergoing excavation at any one time
- Collect, control and provide adequate hydrologic and sedimentation wastewater/stormwater capacity for runoff from disturbed areas
- Collect and treat potentially contaminated runoff in existing FEMP treatment facilities, as appropriate.

Runon and runoff will be minimized through the installation and construction of diversion channels, diversion berms, culverts, and similar drainage control structures. The area disturbed at any one time will be minimized and disturbed areas will be stabilized in accordance with recognized design standards. Sumps, traps, basins, and/or ponds will be constructed in and near disturbed areas to provide sedimentation capacity. Collection channels will be constructed to collect and convey runoff from disturbed areas to sedimentation facilities. All stormwater runoff currently conveyed to the controlled storm sewer system (former production and waste pit areas) will continue to be collected and treated through the Advanced Wastewater Treatment (AWWT) Facility until the areas have been certified clean. Runoff from radiologically contaminated areas (above FRLs) and potentially contaminated areas located outside of the controlled storm sewer system will be controlled, monitored, and treated if degradation of runoff quality is expected. As necessary, specific details on the control, monitoring, and potential treatment of stormwater from each remediation area will be provided in area-specific IRDPs.

Surface water management systems will control runoff from disturbed areas during each phase of remediation (i.e. soil excavation). Runoff from all disturbed areas will be collected and conveyed to appropriate erosion and sedimentation control devices and/or wastewater treatment facilities prior to discharge. The Sitewide Sequencing Plan (SSP) conceptually addresses runoff for each phase of remediation.

F.2.6.1 Diversion Channels and Related Devices

Surface water runon from areas that are upgradient or adjacent to a disturbed areas will be diverted away from disturbed areas and the associated surface water collection systems to the extent possible.

Diversion devices may include but are not limited to: diversion ditches, berms, swales, and pipes. They will be used to convey stormwater runon away from undisturbed or previously remediated areas. Diversion ditches will generally be constructed on relatively flat slopes (typically 1 to 5 percent slope). Because of their relatively flat slope, the ditches will typically be stabilized with vegetation. Diversion ditches that convey large flows or are excavated with steeper grades will be designed and constructed with erosion control matting or other appropriate stabilization techniques.

F.2.6.2 Excavation Sumps

Where practical, active excavation areas may be graded to drain to collection points located within the excavation as remediation is performed. Temporary excavation sumps will be installed in these collection points. Excavation sumps will minimize the amount of runoff that may flow overland and provide sedimentation capacity near the active area of excavation. Water will be pumped out of the sumps and into sediment traps, basins, or ponds as necessary to keep the excavation area functional. Multiple excavation sumps may be used at one time. They will be continually moved as remediation progresses to keep them in close proximity to the active excavation. The excavation subcontractor may propose alternate means of controlling sediment within the excavation.

F.2.6.3 Collection Channels

Collection channels will be constructed at the downstream area of excavation to collect runoff from disturbed areas and convey it to traps, basins, ponds, or other collection points. Collection channels will be designed to handle the flow that will be generated in the upgradient areas and safely convey it to the appropriate facilities. Generally, collection channels in areas where overflow has the potential to discharge off site will be designed for the 10-year, 24-hour storm. Channels will be lined with vegetation, matting material, or other material based on the design flow. When necessary, an infiltration barrier or synthetic liner will be installed in collection channels where excavation to construct the channels extends into the sands and gravels of the Great Miami Aquifer.

F.2.6.4 Traps, Basins, and Ponds

Traps, basins, and ponds will be constructed to provide stormwater management and sedimentation control. Runoff from disturbed areas will discharge directly into these facilities, or will be collected and conveyed to them through collection channels. The decision to use traps, basins, or ponds will be

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based on area-specific conditions and presented in IRDPs. These area-specific conditions include: size of the disturbed area, existing conditions (before excavation), expected final conditions (after excavation), and location of nearby water management facilities. Traps, basins and ponds will be sited to provide both sediment and stormwater storage capacity. Each facility will have appropriate outlet devices. In general, larger basins and ponds will have both principal and emergency spillways. Principal spillways may include pumps, risers, outlet barrels, or open channels. Emergency spillways will generally consist of open channels.

F.2.6.5 Existing Water Control Facilities

Existing water handling and treatment facilities will be utilized during construction to take maximum advantage of existing FEMP infrastructure, and to minimize construction costs to the extent practical. These facilities include:

- Storm sewer (collection and conveyance) systems
- Stormwater Retention Basins (SWRB)
- AWWT Facility
- Bio-surge Lagoon
- Existing systems from other projects.

F.2.7 Installation of Erosion and Sediment Control Devices

Stormwater management system components (such as channels, basins, etc.) will also provide erosion and sediment control. However, additional measures will be used as required to provide erosion and sedimentation control. These measures may include, but are not limited to:

- Silt fence
- Temporary seeding
- Permanent seeding
- Crusting agents.

Erosion and sediment control components will be selected and utilized in general conformance with applicable ODNR, OEPA, and ODOT requirements. Specific components will be presented on the construction drawings and technical specifications of the IRDPs.

F.2.8 Establishing Survey Controls

The subcontractor will establish project site survey control points (including baselines and temporary benchmarks) in the field based on the coordinate system shown on the drawings.

F.2.9 Utility Maintenance

The FEMP will identify and address all area-specific underground utilities before excavation begins. All active utilities within areas to be excavated may be protected, permanently shut off, or rerouted. Utility lines will be shown on the drawings. The excavation subcontractor will be responsible for protecting utilities in and around the excavation areas and removing utilities within the excavation as shown on the drawings.

F.3 EXCAVATION

The IRDP drawings and specifications for excavation, including the proposed excavation limits, will be developed based on information contained in the SED. This information will include data collected during the RI/FS process as well as during predesign investigations associated with the remedial design phase (Section 3.1). The information will be presented to excavation subcontractors in CFC construction drawings and technical specifications. The excavation limits shown on the drawings will be the basis for initial excavation. When the excavation limits shown on the CFC drawings are achieved, certification sampling will be performed as described in Section 3.4.

The FEMP subcontractor will be responsible for preparing a detailed Safe Work Plan as discussed in Section F.1.2.2. The IRDP and CFC documents for each remediation area will address area-specific requirements. Below is a general list of activities that may be performed for excavation:

- Field layout of excavation
- Removal of utilities
- Shallow excavation
- Demolition of at- and below-grade walls and structures
- Deep excavation
- Excavation of special materials
- Removal of roads and water management systems.

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F.3.1 Field Layout of Excavation

Existing benchmarks and survey monuments will be provided by FEMP management and shown on the CFC drawings. All areas to be excavated will be staked in the field and approved by FEMP management before actual excavation.

F.3.2 Removal of Utilities

Utility lines include storm, sanitary, water, electric, gas, and sump lines. Excavation of utilities will include the utility lines themselves and backfill material, which typically consists of sand or gravel and extends below the utility lines.

Utilities will first be identified and located. They will then be protected, shut off, disconnected or rerouted before excavation. Excavated material will be managed according to waste disposition protocols in Section F.5.

F.3.3 Shallow Excavation

Excavation of shallow contaminated material (less than 4 feet) will be performed using standard excavation equipment, including scrapers, dozers, loaders, or similar equipment. Excavation Approaches A and E in Section 4.0 provide conceptual details regarding the procedures to be used in shallow excavation areas to meet remediation goals. Excavated material will be managed according to waste disposition protocols in Section F.5.

F.3.4 Demolition and Removal of At- and Below-Grade Walls and Structures

This work includes the demolition and removal of interior walls, slabs, and structural steel below the existing ground/slab levels. During material excavation and size reduction of slabs and foundations, water misting or other methods will be used for dust control. All material will be managed in accordance with waste disposition protocols in Section F.5.

The interior walls of basements that are not support walls will generally be removed before exterior wall and foundation removal. The type of equipment used will depend on the location and construction of the structures.

Demolition and removal of exterior walls and foundations will require excavation of sufficient material along the outside of these structures to remove them and to provide access to sub-basement slabs and sumps. Slabs and foundations will be systematically cut or broken up within each working excavation area. Excavation for foundations, slabs, and piers will be done with proper shoring techniques or will be laid back on a safe slope in accordance with the Occupational Safety and Health Act (OSHA) requirements.

F.3.5 Deep Excavations

This work involves the excavation of below-grade building footers, slabs, grade beams, piles, and deep contaminated material, including perched water and sand lenses. Deep excavation of contaminated soil may be accomplished with dozers, loaders, excavators, backhoes and other equipment as necessary. Stormwater will be contained by the installation of stormwater runon/runoff controls, such as collection ditches, berms, and basins. Excavation Approaches B, D, and F in Section 4.0 provide conceptual details regarding the procedures to be used in deep excavation areas to meet remediation goals.

As described in the Sitewide Sequencing Plan (Appendix B), surface water will generally be pumped into the existing stormwater facilities on the FEMP. Perched water will be addressed based on the specific conditions anticipated for each area. Perched water will generally be pumped to the AWWT for treatment. The IRDPs will describe the anticipated perched water conditions in the remediation areas, the conceptual requirements for dewatering systems (i.e., number and location of wells and pumping rates), and the required treatment. In addition, the IRDPs will compare the expected flow and quality to waste acceptance guidelines for the AWWT Facility. The subcontractor's Safe Work Plan will describe specific methods, equipment, and procedures that will be used for excavation dewatering.

F.3.6 Excavation of Special Materials

Special materials that are known to exist as a result of RI/FS data, pre-design data, or process knowledge will be addressed as early as possible during remediation of an area to allow for laboratory turnaround times, archaeological excavation or surveys, or to prevent potentially adverse environmental conditions. The requirements for excavation, segregation, staging, and documenting special materials will be identified in the IRDP contract specifications. The subcontractor will describe the specific methods that will be used for special materials in the Safe Work Plan and any associated

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standard operating and health and safety procedures. The subcontractor will submit this information for review and approval prior to commencing excavation activities. All special materials will be managed in accordance with waste disposition protocols described in Section F.5.

IRDP contract specifications will comply with the guidelines provided in Section F.4. The requirements will be applied to any special materials that are encountered unexpectedly as well as those known to exist through preremediation investigations. Special materials that are encountered unexpectedly during excavation activities will be managed in accordance with contingency plans that are described in Section F.4.

F.3.7 Removal of Roads and Water Management Systems

Existing roads will be used to transport impacted material from excavation areas to the On-Site Disposal Facility (OSDF) and interim storage areas whenever possible. In some cases, new haul roads will be constructed to transport material. Roads will be designed and surfaced to meet the specific needs of the area. Aggregate and pavement surfaces will be used to provide durable and reliable surfaces that will minimize dust generation. Also, to the extent practical, nonessential vehicular traffic will be minimized on haul routes.

The FEMP maintains and operates a complex water management system. The major components of this system include a stormwater collection system, SWRBs, and an AWWT facility. Excavation plans will utilize the components of the existing systems, to the extent practical, during remediation for conveyance and appropriate treatment. Proposed conveyance routes and treatment systems are described in the SSP (Appendix B). Other water management facilities will be added as required to meet the specific needs of the area.

Removal of roads and surface water management systems will be sequenced to optimize their use during remediation. They will be used to support as many areas as possible to minimize construction costs and reduce waste generation.

## F.4 CONTINGENCY PLAN REQUIREMENTS

Contingency plans are required to address special materials encountered during excavation and unexpected field conditions. Typically, these situations will require special protocols. The three general contingency plan categories include:

- Encountering materials which require special handling
- The discovery of unexpected cultural or historic resources
- Encountering contamination or soil conditions which may pose a risk to human health or the environment if standard excavation practices are used, or which are significantly different than expected, or which may affect other operations.

### F.4.1 Special Materials

The following potentially contaminated or hazardous materials are identified as special materials and will require special handling if encountered during soil excavation:

- Asbestos
- Lead acid batteries
- Medical/Infectious waste
- Miscellaneous debris
- Non-soil residues
- Nonpressurized containers
- Pressurized containers
- Piping/pumps
- Tires
- Transformers/electrical equipment
- Uranium metal
- Brick, including acid brick.

The management strategy for each type of material is provided in the following subsections. Planning for boxes, drums, bags or other containers potentially required for disposal or storage of non-conforming materials is the responsibility of each project. Each project is also responsible for recording and transferring information required for subsequent management of the discovered materials (Section F.5). All special materials will be managed in accordance with waste disposition protocols in Section F.5.

It may be determined during the development of an IRDP that a specific area has the potential to contain significant quantities of one or more of these materials. In other cases, special materials may

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be encountered unexpectedly during excavation activities. Consequently, IRDP contract specifications will include requirements for excavation, segregation, staging, and documentation of the specified materials identified above. WAO qualified field personnel will ensure that construction manages these materials in compliance with contract specifications, including movement of materials to appropriate FEMP storage and handling areas for characterization, treatment evaluation, and final disposition arrangements. Waste management facilities will be utilized for the processing of special materials.

All special materials will be managed in accordance with waste disposition protocols in Section F.5. The Impacted Materials Placement Plan (IMPP) (DOE 1998) includes further details regarding OSDF waste acceptance criteria (WAC) and impacted material categories.

F.4.1.1 Asbestos

Potential forms of regulated and non-regulated asbestos-containing materials (ACM) include, but are not limited to, transite panels, floor tile, electrical cable, and piping insulation.

In general, insulation from wrapped pipe will be segregated, optionally size-reduced, and double-bagged or equivalent. Other ACM meeting OSDF Category 5 criteria will be segregated from the soil, double-bagged for on-site disposition and, if necessary, containerized for interim storage. ACM which does not meet the OSDF WAC will be containerized and moved to a FEMP interim storage area for characterization, treatment evaluation, and final disposition.

F.4.1.2 Lead Acid Batteries

In general, intact lead acid batteries will be containerized and taken to a FEMP interim storage area for subsequent off-site recycling or disposal. Broken batteries and battery pieces will be segregated from soil as practical, containerized, and stored for subsequent off-site disposal.

F.4.1.3 Medical/Infectious Waste

Examples of medical/infectious waste include syringes and vials. In general, medical/infectious waste will be containerized and moved to a FEMP interim storage area for characterization, treatment evaluation, and off-site disposal.

F.4.1.4 Miscellaneous Debris

Miscellaneous debris includes oil/air filters, personal protective equipment (PPE), radiators, cable/wire, tools, heavy equipment, office materials and documents. In general, miscellaneous debris will require evaluation against the OSDF WAC on a case-by-case basis.

F.4.1.5 Non-Soil Residues

Examples of non-soil residues that are readily identifiable in the field include, but are not limited to, process residues such as green salt, black oxide, orange oxide, sump cake, and flyash. Veins or pockets of this material of sufficient size to excavate will be field screened and surveyed to determine radionuclide content. If field screening indicates that the material is a radionuclide-bearing residue, appropriate health and safety procedures must be implemented (Section 6.0).

In general, the non-soil residues will be excavated, evaluated for treatment, and stockpiled or containerized, based upon operational constraints. These materials will be evaluated against OSDF WAC and will be managed as appropriate. Some non-soil residues may require additional physical processing, including dewatering, compaction, or blending with impacted soil before OSDF placement. Non-soil residues which cannot be placed in the OSDF will be containerized, as appropriate, for off-site disposal.

F.4.1.6 Containers

Containers include intact drums, metal and wood boxes, tanks, cans, non-pressurized containers, and other types of vessels. In general, containers will be segregated from excavated soil and visually inspected for leaks. The contents will be assessed with a beta/gamma frisker and photoionization detector. If contamination is absent, the container will be marked for disposition to the OSDF. Containers exceeding the uranium WAC will be dispositioned for off-site disposal. If organic constituents are present above the air concentration threshold of 5 parts per million, personnel will upgrade their personnel protection equipment to remove the containers to a segregated storage area for further characterization.

When safety considerations allow, closed containers will be opened and a description of contents recorded on a Visual Inspection Form. Leaking containers will be either overpacked or repacked

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before movement from the immediate area of discovery. When these actions have been completed, containers will be moved to a FEMP interim storage area for characterization, treatment evaluation, and final disposition. Off-site disposition is expected for most containerized materials other than soil. Empty containers will be managed as OSDF Category 2 debris and staged in an approved stockpile for on-site disposition. The containers will be size-reduced as necessary to meet Category 2 criteria.

F.4.1.7 Pressurized Containers

Pressurized containers that may be encountered include aerosol cans, Freon containers, gas cylinders, propane tanks and fire extinguishers. In general, pressurized containers will be segregated from the excavated soil and container integrity evaluated. All intact pressurized containers will be handled as though they contain material under pressure. Intact containers will be overpacked and moved to a FEMP interim storage area where they will be emptied or otherwise appropriately managed. Any contents will be characterized, evaluated for treatment, and dispositioned either on or off site. The OSDF IMPP prohibits pressurizable gas cylinders; therefore all empty pressurized containers must be punctured, crushed or cut so that the interior is open to the atmosphere before OSDF disposition. Damaged pressurized containers (i.e., no longer containing material at the time of discovery) will either be disposed off site or managed as OSDF Category 2, 3, or 5 debris for on-site disposition.

F.4.1.8 Piping/Pumps

Drain lines, sewer lines and process piping and pumps are expected to be encountered during soil excavations. To the extent possible, excavations will be designed so that sections of piping are exposed intact. One end of the piping will then be elevated, cut, and any flowable material contained therein drained into a container. The length of piping may then be capped and removed.

In general, material drained and placed in containers will be moved to a FEMP storage area and evaluated for on-site treatment in the AWWT or disposal off site. Typically, the emptied piping and/or pumps will be managed as OSDF Category 2 or 3. The piping may be no more than 10 feet in length and voids greater than 1 $ft^3$ must be filled with flowable cohesionless material or a quick set grout. Characterization of impacted materials (piping, soil, others) from trenches that contain process piping will include a review of the Material Evaluation Form (MEF) files for containerized process residues/equipment that were managed in the associated plant.

F.4.1.9 Tires

In general, tires will not be placed in the OSDF. They will be containerized and moved to a FEMP interim storage area for characterization, treatment evaluation, and final off-site disposition.

F.4.1.10 Transformers/Electrical Equipment

In general, transformers and electrical equipment will be segregated from the excavated soil and evaluated to determine if they contain fluids. Empty transformers will be evaluated against the OSDF WAC and, if found to be acceptable, managed as OSDF Categories 2, 3 or 5. If an empty transformer does not meet one of these OSDF categories, it will be containerized and moved to a designated FEMP interim storage area for characterization and treatment evaluation, with arrangements for off-site disposal. Transformers containing fluid will be containerized for interim storage and management. The contents will be evaluated for treatment, drained, and containerized by WPM. After appropriate flushing (if required), emptied transformers will be filled with grout or crushed to meet the OSDF WAC and will be managed as OSDF Category 2, 3, or 5 material.

F.4.1.11 Uranium Metal

Uranium metal may be encountered in various forms, including but not limited to derbies, ingots, and irregularly shaped scrap. In general, uranium metal will be segregated and moved to a FEMP interim storage area and evaluated for disposition.

F.4.1.12 Brick and Acid Brick

Actual and/or suspected acid brick found during soil excavation activities will be segregated from other debris and sent off site for disposal. The objective is to remove the vast majority of brick that is readily identified and can be safely removed during soil excavation and OSDF placement activities. This effort is designed to minimize the chance placement of brick containing process residues into the OSDF.

F.4.2 Unexpected Discovery of Cultural or Historic Resources

DOE's proactive approach to protecting cultural resources at the FEMP site and the land impacted by remediation activities consists of identifying, avoiding (if possible), and mitigating (when necessary) any cultural resources affected by actions at the FEMP. DOE has finalized a Programmatic Agreement

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with the Advisory Council on Historic Preservation and the Ohio Historic Preservation Office that will streamline the National Historic Preservation Act (NHPA) Section 106 consultation process.

Surveys of all areas scheduled for disturbance during remediation (approximately 450 acres) have been completed. Four sites requiring additional investigation if they are scheduled for disturbance in the future have been identified. Monitoring provisions will be included within the individual IRDPs to ensure that previously identified sites are not disturbed and that any inadvertent discoveries in previously surveyed areas are managed accordingly. Additional areas of the FEMP site will only be surveyed if proposed future activities will result in a disturbance.

This plan provides a method to ensure compliance with the NHPA, Native American Graves Protection and Repatriation Act (NAGPRA), and other applicable cultural resource regulations in the event personnel, sub-contractor personnel and/or any other persons working or assisting with a project (performing any ground disturbing activity) discover a cultural resource/historic property.

F.4.2.1 Procedural Responsibilities

In the event that a remedial action affects an unidentified cultural resource, project staff will ensure safe handling by isolating the affected area until an emergency on-call contractor (within 4 hours) can perform the necessary data recovery. A contract is in place for such eventualities and has been used during installation of the public water supply. The DOE will consult with the appropriate parties, such as the State of Ohio Historic Preservation Office, pursuant to federal regulations (36 CFR Part 800) to determine an appropriate course of action as necessary. The DOE will avoid and minimize any adverse impacts to the extent practicable.

A site procedure at the FEMP (SP-0003) has been established to formalize the notification and consultation process for the unexpected discovery of cultural resources. All ground-disturbing field activities must comply with that site procedure.

F.4.2.2 Training

Subcontractors will be trained to site requirements (e.g., how to recognize a cultural resource) as needed. Additionally, the requirements to address potential cultural resource discoveries will be included in contract documents.

F.4.3 Unexpected Contamination/Soil Conditions

In the iterative process of excavating, precertifying, certifying, and re-excavating areas, some excavations may progress to a point where continued work would cause the remedial action to differ from the design. Such a difference could include:

- A contaminated area that extends outside the area of feasible stormwater control
- An encounter with soil types or depths of excavation that were not within the design parameters
- A contaminated area that extends laterally to impact site facilities that are currently active or have a planned future use.

In cases where the difference would not be considered significant, it will be addressed via the FEMP design change process. In the event the difference is significant from the design, one of the following options will be exercised in addition to the design change process:

- Revise the design within the guidelines established in this SEP, submit a letter describing the design change to the regulatory agencies, and proceed with excavation
- Stop the job at the boundary of the problem condition and address the continued excavation in a subsequent IRDP
- Discuss optional approaches with the regulatory agencies to determine if the area must be addressed as an exception to guidelines otherwise presented in this SEP.

F.5 WASTE DISPOSITION PROTOCOLS

All material that is excavated during excavation, including soil, debris, vegetation, and special materials, will be managed in accordance with the WAO and WPM protocols identified in this section. WAO personnel will determine if a material is suitable for placement in the OSDF. WPM will address and manage materials that are not acceptable for placement in the OSDF. Details for management of excavated materials will be provided in the area-specific IRDPs (Section 7.2) and will be based on the

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guidelines established in this section for staging, disposition, data-tracking, and management of impacted materials. Additionally, health and safety issues (Section 6.0) may be associated with some special materials.

F.5.1 Conceptual Waste Disposition Process

The objective of the waste disposition process is to integrate all aspects of remediation associated with the handling, excavation, removal, and disposal of soil, debris, and special materials. Four basic steps have been identified for this process (Figure F.5-1):

- Waste planning, where waste streams are identified and characterized
- Waste generation, where waste is excavated or removed from existing stockpiles
- Waste stream segregation into appropriate OSDF and off-site waste categories
- Waste storage, treatment (if applicable), and disposal.

WAO will review and approve waste planning documents, sampling plans, and project waste identification and disposition (PWID) forms. WAO qualified field personnel will ensure and document that construction generates, segregates and dispositions waste streams in compliance with the intent of planning documents. Field tracking log (FTL) reports will be used to document any changes from the original PWID that are necessitated by changing conditions.

On Figure F.5.1, the waste disposition process begins with waste identification, data review, and characterization activities to estimate excavation volumes of the waste streams. Waste planning is finalized by preparing the IRDP, which contains the remedial design to conduct the excavation. Excavation activities generate the waste and it is segregated into the appropriate OSDF and off-site categories for storage, treatment, and disposal. Excavated material that is not designated for disposal will be placed under one of the following disposition options:

- Reuse of the material on site [e.g., soil with constituents of concern (COCs) below FRLs]
- Sale of noncontaminated materials (e.g., scrap metal).

F.5.2 Waste Tracking

The Integrated Information Management System (IIMS) and a manifest system will be used to track all excavated bulk material. A PWID will be generated by the IIMS to describe the source location, waste profile, volume, and tracking number of the material. Management decisions regarding worker safety

and health, transportation, storage, treatment, and disposal of the material are made and tracked using the IIMS. Additionally, existing data from historical, RI/FS, and predesign investigations can be evaluated during the decision process because the IIMS is linked to the SED, Sitewide Waste Information Forecasting and Tracking System (SWIFTS), and FTLs. The manifest system will be used to control material movement and to ensure that all parties involved with the excavation, transportation, and disposal of bulk material comply with the relevant procedures. Decisions on disposal will consider all FRLs and on-site and off-site WAC.

### F.5.3 Off-Site Disposal

Material that exceeds the radionuclide, chemical, or physical WAC will be profiled and staged for off-site disposal as bulk or containerized material (Figure F.5-1). Bulk materials may be segregated further based on the need for treatment prior to disposal (i.e., the presence or absence of the toxicity characteristic). Containerized materials may include special materials (Section F.4.1) or material that could not be processed to meet the OSDF WAC.

The FTL will be used to document the movement of materials from the initial excavation to other locations, including use for construction or backfill, staging in stockpiles, staging in containers for transfer to interim storage, and OSDF placement. Unless the material is to be used for construction or backfill, a waste stream profile number will be identified on the FTL. Other key information on the FTL will include the source material tracking location (MTL), estimated volume, and destination MTL. FTLs will be prepared and signed by WAO qualified field personnel. Information from the FTL will be entered into the IIMS, and a hard copy will be filed in the site operating record.

FTLs are only used for material containerized for off-site shipment to document transfer to the interim storage area. Subsequent management of this material will be based on established 65-card and material evaluation form (MEF) systems, with tracking performed in SWIFTS.

### F.5.4 Placement of Material in the OSDF

Bulk and discrete placement of material in the OSDF will be in accordance with the IMPP. The IMPP describes the following five general waste-stream categories defined for the OSDF:

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- Category 1 Soil and soil-like material
- Category 2 Debris for bulk placement
- Category 3 Debris for individual placement
- Category 4 High-organic content (humus and vegetation)
- Category 5 Double-bagged asbestos, sludges and special case-by-case approval.

F.5.5 Special Materials

Special materials are listed and described in Section F.4.1, along with the plan for handling their excavation. They may be identified in pre-excavation investigations or during excavation activities as described. When present, these waste streams will require special handling due to potential health and safety concerns. Portions of these waste streams will be eligible for OSDF disposition, but may require physical processing, sampling and analysis, or interim containerization. The balance will be evaluated for off-site disposition. The general protocols for managing special materials are provided in Figures F.5-2 through F.5-14.

F.5.6 Management of Soil with COCs below FRLs

Soil with COCs below FRLs will be generated from both remedial and nonremedial (i.e., maintenance, general nonremediation construction, and removal actions) activities. In some cases, soil with COCs below FRLs will be used as borrow material for construction of the OSDF liner, for surface runon/runoff control in remediated areas, and/or for backfilling excavations in certified areas. However, no soil may be used for borrow purposes if FRLs are exceeded, and soil used as borrow material in remediated areas will be characterized sufficiently to ensure that recontamination is not occurring.

F.5.7 Stockpile Management

Stockpile management will be implemented via site procedures that establish project responsibilities for maintaining the integrity of the stockpiles. A full inventory of existing stockpiles is taken on a weekly basis and reported to the IIMS for future tracking purposes. The stockpile location map is also updated on a weekly basis. All stockpiles are color-coded (i.e., above WAC, OSDF, below WAC, etc.) to prevent mixing of materials, and the appropriate dust and runoff controls are put in place to control contamination. When stockpiles are placed on dissimilar material, the appropriate underlying geotextile or infiltration barrier will be installed to segregate the materials. After a stockpile is

removed, the underlying soil will be remediated and certified using the COC list for the stockpile, except for stockpiles placed on infiltration barriers.

## F.6 RESTORATION GRADING GUIDELINES

The DOE has made the commitment to accelerate the restoration of natural resources into the remedial design process whenever possible. This commitment will add some complexity into the restoration guidelines for design purposes, but will inevitably reduce the cost and the need for repeatedly disturbing the land. Restoration will be performed by construction subcontractors. The work will be structured as part of the excavation contracts or separate contracts based on area-specific conditions. The ability to accelerate the natural resource restoration process will also depend on the range of environmental conditions in which a proposed habitat may thrive. Developing restoration guidelines is generally a three-phase process that will end with establishing vegetation to develop the proposed habitat for the end land use. The three major phases include:

- Interim grading, to be performed after certification. It will begin after remediation/excavation is completed and will start the restoration process.
- Final grading, to include complete restoration grading including the use of borrow material, additional excavation, placement of topsoil and construction of required drainage features.
- Habitat development, to include planting the required vegetation for the proposed land use.

These phases are described below.

### F.6.1 Interim Grading

Rough or interim grading activities will be performed after each area is certified. Rough grading will be performed to flatten slopes (for stability) and to begin grading the remediated area for final restoration. The excavation design will be developed and excavation performed in accordance with the Natural Resource Restoration Plan (NRRP), which is a sitewide plan, and the area-specific Natural Resource Restoration Design Package (NRRDP). Rough grading will consist of establishing surface water drainage within the area and to begin development of the site into the restored land use type.

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F.6.2 Final Grading

Final grading will include construction of drainage features, placement of topsoil, and other steps necessary to properly grade the area. This may include bringing in additional soil from other areas to restore the site.

F.6.3 Habitat Development

Vegetation will be established for the specific habitat by seeding, tree planting and other methods as appropriate. Specific criteria for the design and development of these habitats will be identified in relevant IRDPs (Section 7.2) and updated in the NRRDP. After final grading, habitat restoration, which will consist of establishing appropriate vegetation, will be performed. The following general guidelines were developed for wetlands, open water areas, woodlands, riparian areas, and grasslands. These habitats have been identified as the feasible natural environments at the FEMP.

F.6.3.1 Wetlands

Wetlands require specific environmental conditions that are affected by saturation, slopes, water depth, and other mitigating factors. Gradual shoreline slopes of 6 (horizontal):1 (vertical) or flatter to a depth of 1 to 3 feet will encourage plant species diversity and feeding areas. Poorly drained soil types are essential to supply an impermeable substrate for holding water. For a wetland to be functional it must have adequate amounts of water during appropriate times of the year. Subsurface tile drains must be broken or removed if they are identified in a proposed wetlands location.

F.6.3.2 Open Water Areas

Open water areas require slopes of 3 (horizontal):1 (vertical) or higher to a depth of 8 to 20 feet. Soils containing textured and silty clays are most desirable.

F.6.3.3 Woodlands

A woodlands habitat may accept a range of soil conditions to thrive. They can be located in any area on the FEMP that is well drained.

F.6.3.4 Riparian Areas

Soil conditions that would support a riparian habitat would have to be located along a linear topographically low area that receives surface water runoff from the surrounding area. Paddys Run currently supports the only naturally occurring riparian environment at the FEMP.

F.6.3.5 Grasslands

Grassland habitat would require poorly drained soil conditions, and could be located in a wide range of areas on the FEMP property.

## F.7 REMEDIATION MAINTENANCE ACTIVITIES

Maintenance activities during remedial excavation include slope stabilization, sediment basin cleaning, drainage channel maintenance, and winterization. This work will be performed by the remediation contractors.

Postclosure maintenance of excavated remediation areas (other than the OSDF footprint) will be addressed within the NRRP as part of the site's restoration activities. Postclosure maintenance of the OSDF is specifically addressed within the "Post-Closure Care and Inspection Plan, On-Site Disposal Facility."

### F.7.1 Slope Stability

Unstabilized slopes may result in unnecessary erosion, and remedial construction subcontractors will be required to stabilize inactive slopes via seeding, spraying of crusting agents, or other suitable means. In general, stabilization of disturbed areas by seeding or use of a crusting agent shall be performed at completion of excavation or within seven calendar days of knowing a disturbed area will be idle for more than 45 days, whichever is sooner. However, the need and approach to stabilize a slope must be determined with regulatory concurrence on a case-by-case basis. There are three categories of commonly encountered situations which may require different approaches for stabilization.

**Category 1 -** Areas/soil piles scheduled to be significantly disturbed within 2 years, destined for the OSDF, and/or need effective erosion control immediately. Examples include:

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- Areas disturbed by site preparation that lie dormant prior to remediation (e.g., the Southern Waste Units after site preparation activities)

- Newly generated, impacted soil stockpiles in areas without runoff collection and/or treatment
- Exposed stockpiles of highly contaminated soils (e.g., above-WAC stockpile)
- Selected portions of an active construction area exposed during the winter seasonal shutdown of construction activities (e.g., open OSDF cells)

**Category 2 -** Areas/soil piles which are scheduled to, or may be, further disturbed within 2 years but have relatively lower levels of contamination (i.e., they do not have significant potential of spreading contamination via erosion) and/or have other special conditions (e.g., located within a runoff control area that is sloped significantly). Examples include:

- Non-impacted soil stockpiles (e.g., surface soil piles in the west field)
- Selected impacted soil stockpiles within a runoff control area (e.g., the Area 1, Phase I west impacted stockpile and sediment basin pile)
- Areas waiting for certification and/or final restoration (e.g., the Inactive Flyash Pile after the 1998 construction season)
- Exposed inactive portion of a borrow area (e.g., the portion of the Area 1, Phase II, Sector 1 area after the 1998 construction season)
- Other selected ditches and sloped areas

**Category 3 -** Areas/soil piles which will not be disturbed for more than 2 years. Examples include:

- Exposed portions of certified or restored areas (e.g., Area 1, Phase I)
- Exposed soil stockpiles to be excavated at a later date (e.g., the non-impacted soil stockpile associated with the Southern Waste Units)
- Exposed areas to be remediated, certified, regraded, or restored later (e.g., portions of Area 6 and Area 2, Phase II)

Category-specific guidelines for stabilization of the above listed situations are described below:

Category 1 areas will require a crusting agent. The crusting agent (e.g., pine sap emulsion) must be 100 percent organic, non-leachable, non-corrosive, non-flammable and have no offensive odor. The crusting agent shall be reapplied to eroded and bare areas as necessary, and maintained in a condition to ensure proper erosion control.

Category 2 areas will require establishment of interim habitat. The interim habitat mix would consist of 60 pounds pure live seed per acre (lbs pls/acre) of annual rye grass and 60 lbs pls/acre of perennial rye grass. This seed mix can be applied between October 15 and March 15. This application rate accounts for dormancy. If Category 2 areas become exposed during the summer season (June - September), then 60 lbs/acre of buckwheat should be applied as a cover crop to provide soil stabilization.

Category 3 areas will require a permanent seeding mixture using warm season grasses. The permanent seed mix would consist of 2 lbs pls Canada Wild Rye; 2 lbs pls Little Bluestem; 3 lbs pls Big Bluestem; 2 lbs pls Indian Grass; 0.5 lbs pls Switchgrass; 0.5 lbs pls Side Oats Gramma at an application rate of 10 lbs pls/acre, along with 20 lbs pls/acre of oats. Mid-April to Early June is the optimal planting window for the permanent seed mixture. If Category 3 areas are planted during the dormant season (October-February), then the application rate will increase to 15 lbs pls/acre of prairie grass mix and 25 lbs pls/acre of oats. If Category 3 areas become exposed during the summer season (June - September), then 60 lbs/acre of buckwheat should be applied as a cover crop to provide soil stabilization.

Seed bed preparation is recommended prior to planting. The planting of buckwheat during the summer season will be followed by either interim or permanent seeding during the next seeding window. The interim habitat seed mix is recommended for inaccessible and sloped areas. Areas which are sloped should receive coconut matting (where feasible) after seed application. A broadcast seeder or hydroseeder may be used for areas which are inaccessible. A seed drill is recommended for planting the interim habitat and permanent seed mix in accessible areas. Seeding should be followed by 2 tons/acre of straw with the exception of those sloped areas containing coconut matting. For areas planted in the summer season, the mulch application rate should increase to 3 tons/acre of straw. Straw/mulch application activities are exempt from the fugitive dust control requirements.

F.7.2 Sediment Basin Maintenance

Sediment basin cleanout levels will be determined in the design effort. Material will be removed from the basins by the subcontractor when the sediment level approaches the cleanout level. The removed material may be managed in accordance with waste disposition protocols in Section F.5, as if it were soil originating from the area that drains to the sediment basin.

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F.7.3 Drainage Channel Maintenance

Drainage channels may require mowing and occasional repairs in order to convey water in a controlled manner. The subcontractor will be required to maintain vegetation in and around designated drainage channels within the subcontractor's limits of work, and to repair channels to conform to the applicable construction specifications and drawings.

F.7.4 Winterization Activities

Winterization encompasses those activities necessary to ensure that an excavation area can be reentered and that construction can restart in minimal time following winter shutdown. Winterization activities include:

- Subcontractor observation of all exposed surfaces within the subcontractor's work limits, with follow-up stabilization as determined by that observation
- Subcontractor observation of all drainage channels and sediment and erosion control devices, with follow-up maintenance as determined by that observation
- Subcontractor identification of any liquid lines susceptible to freezing, with subsequent modification of those lines to prevent freezing or inclusion of those lines in the plan mentioned in the next activity
- Subcontractor submittal of a plan which itemizes winter maintenance actions and assigns those actions to appropriate personnel for those project systems and/or components that cannot be safely left unobserved and/or unmaintained over the winter
- Follow-up FEMP site inspection to ensure that the above winterization steps have been addressed.

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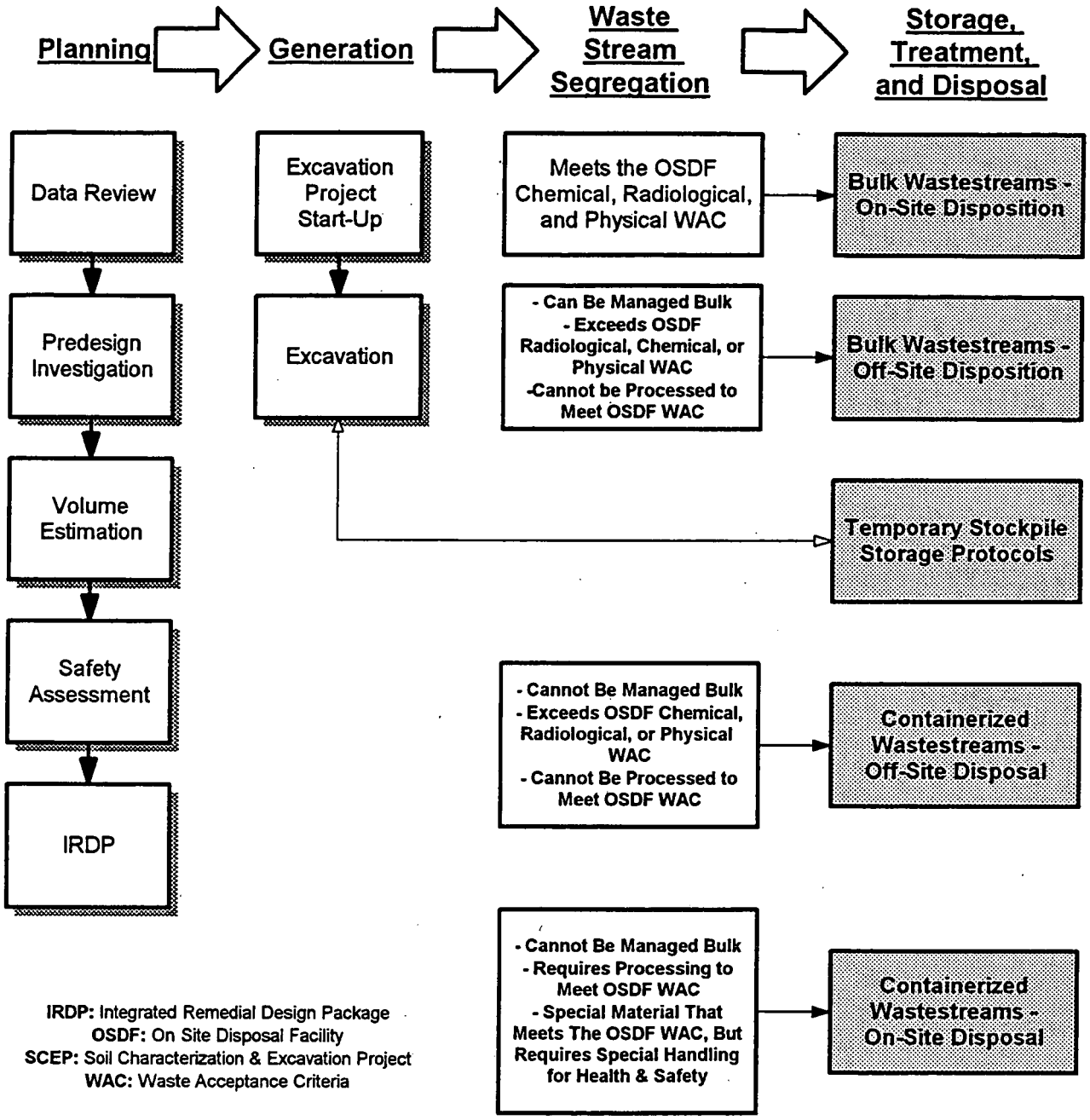
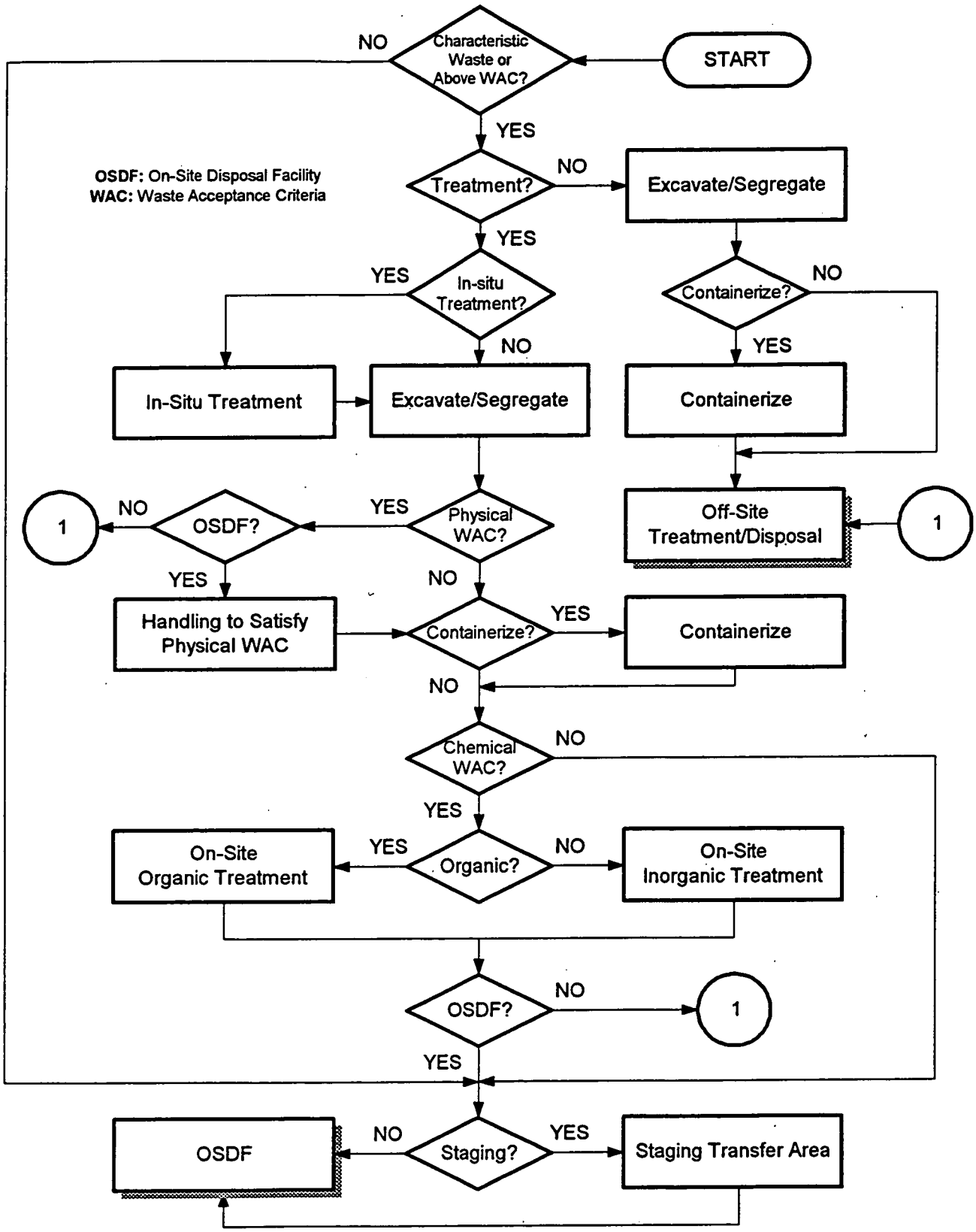



FIGURE F.5-1 CONCEPTUAL SCEP WASTE DISPOSITION PROCESS

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F.5-2 GENERAL WASTE DISPOSITION DECISIONS

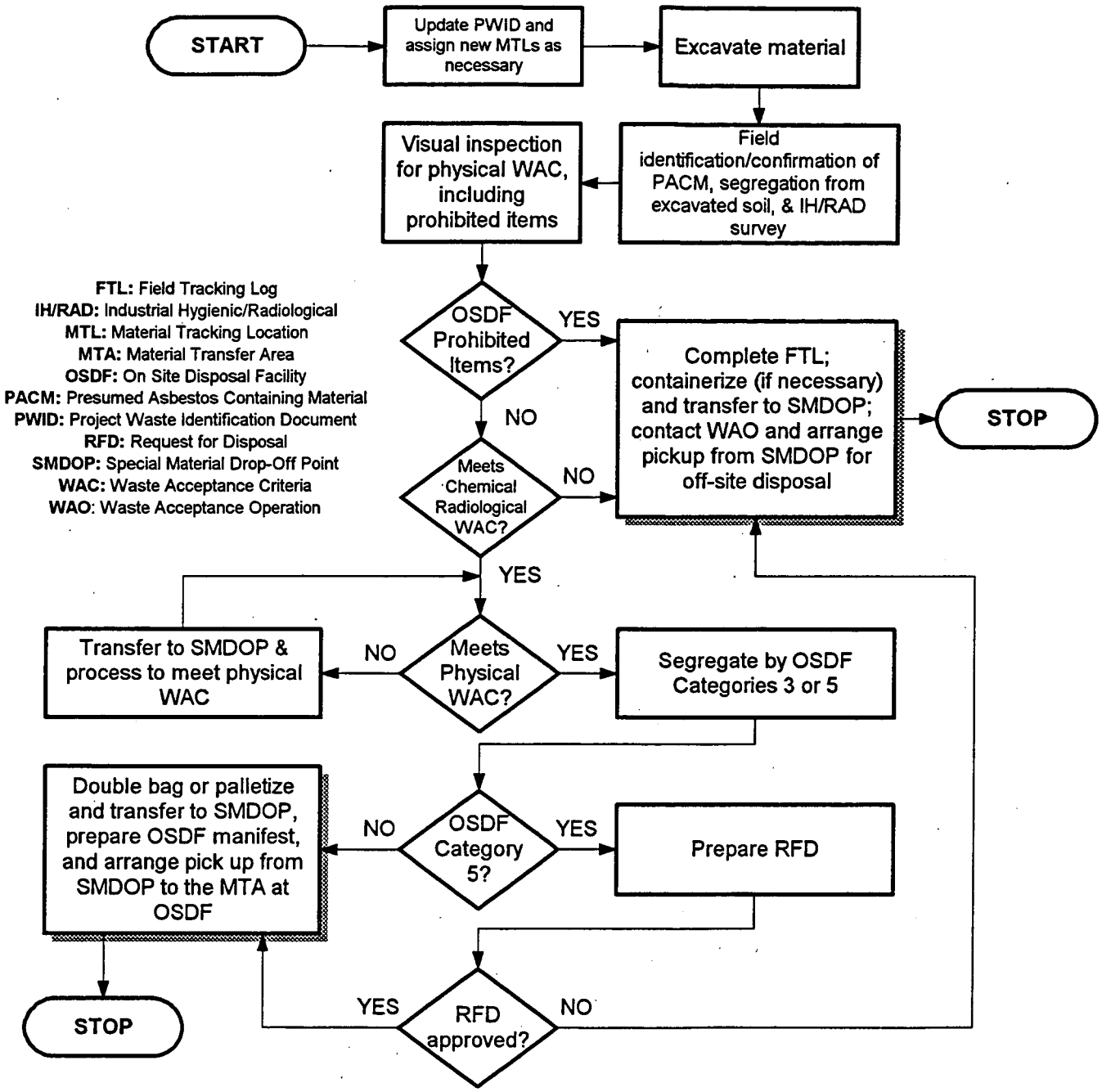


FIGURE F.5-3 ASBESTOS

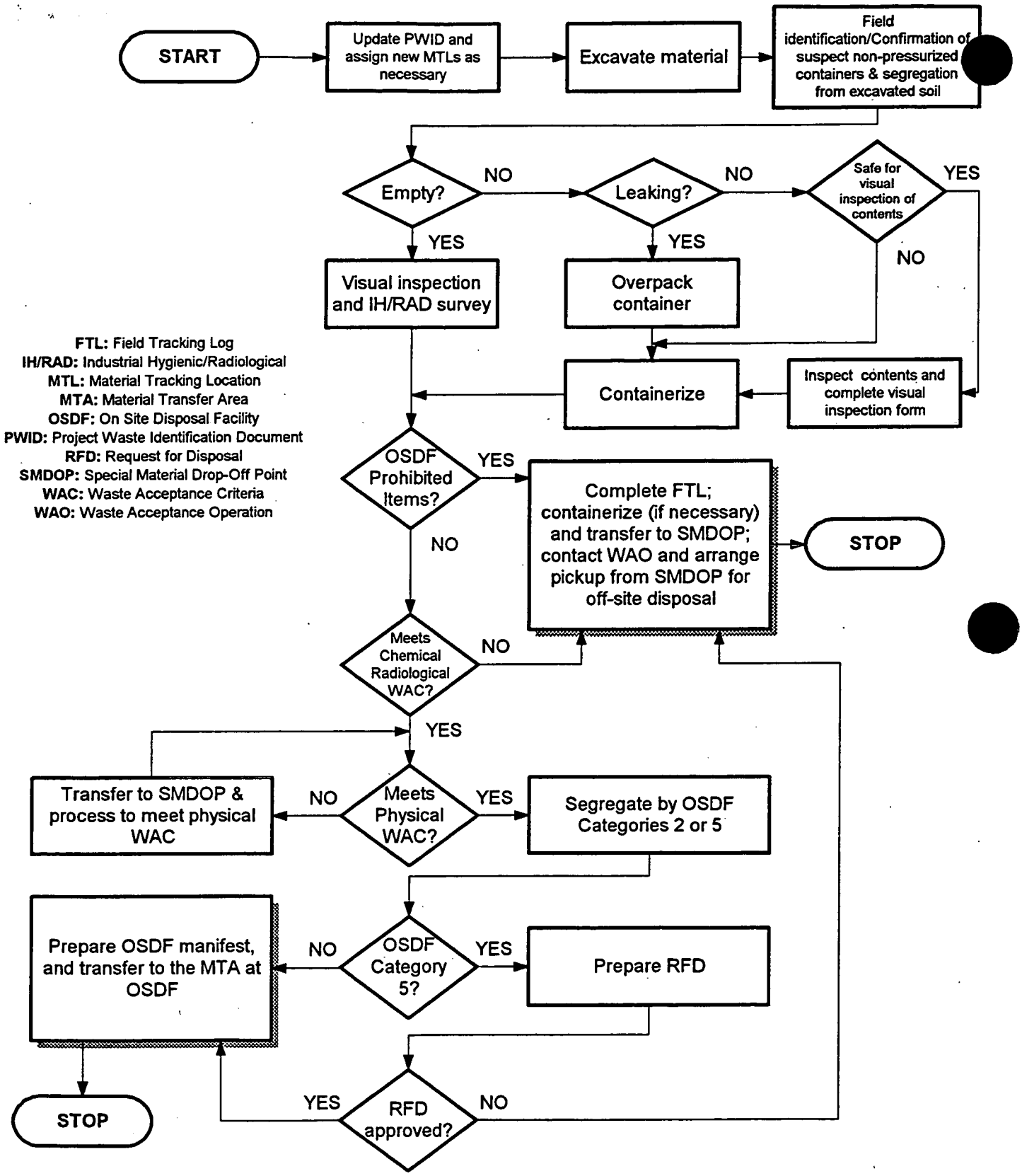


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**FIGURE F.5-4 NON-PRESSURIZED CONTAINERS**

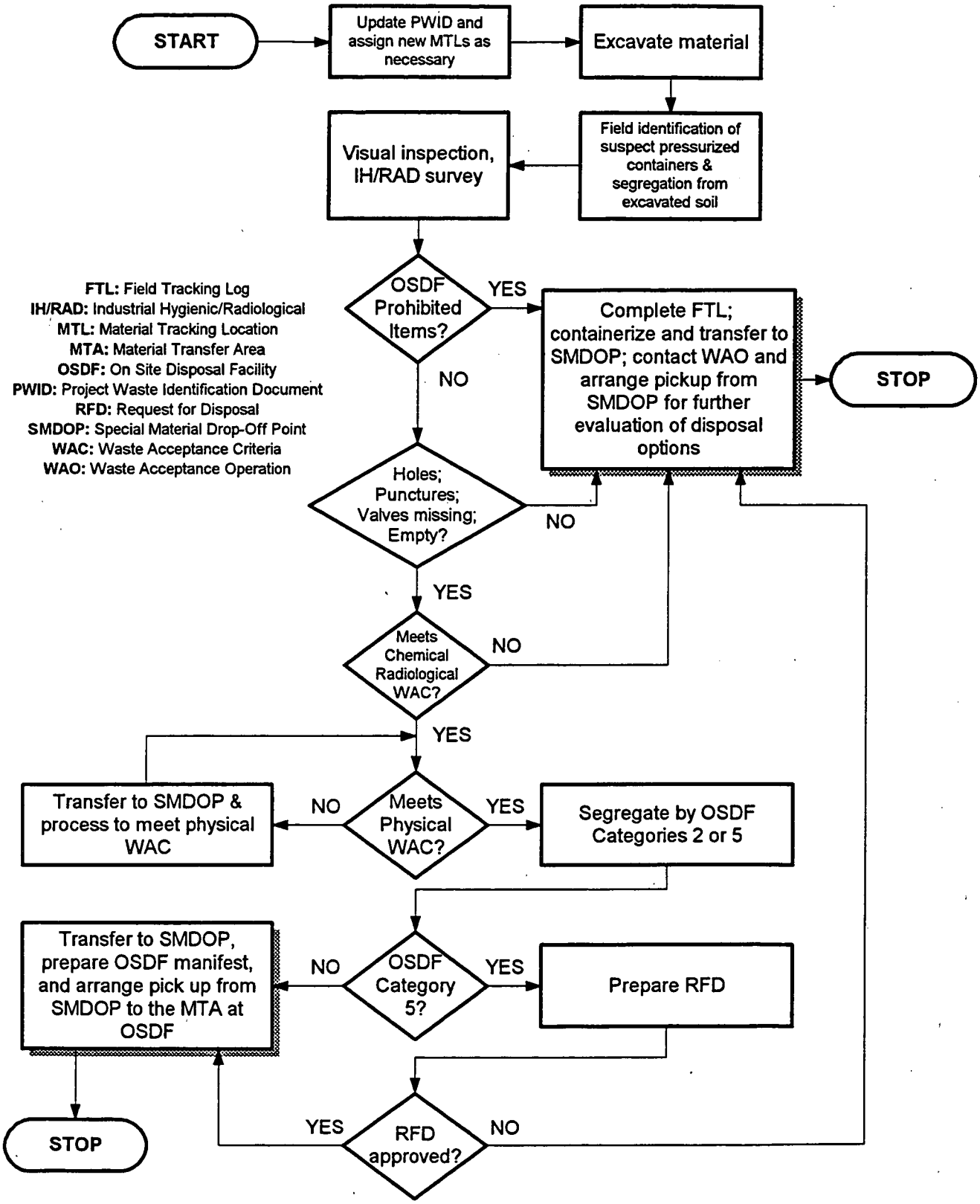
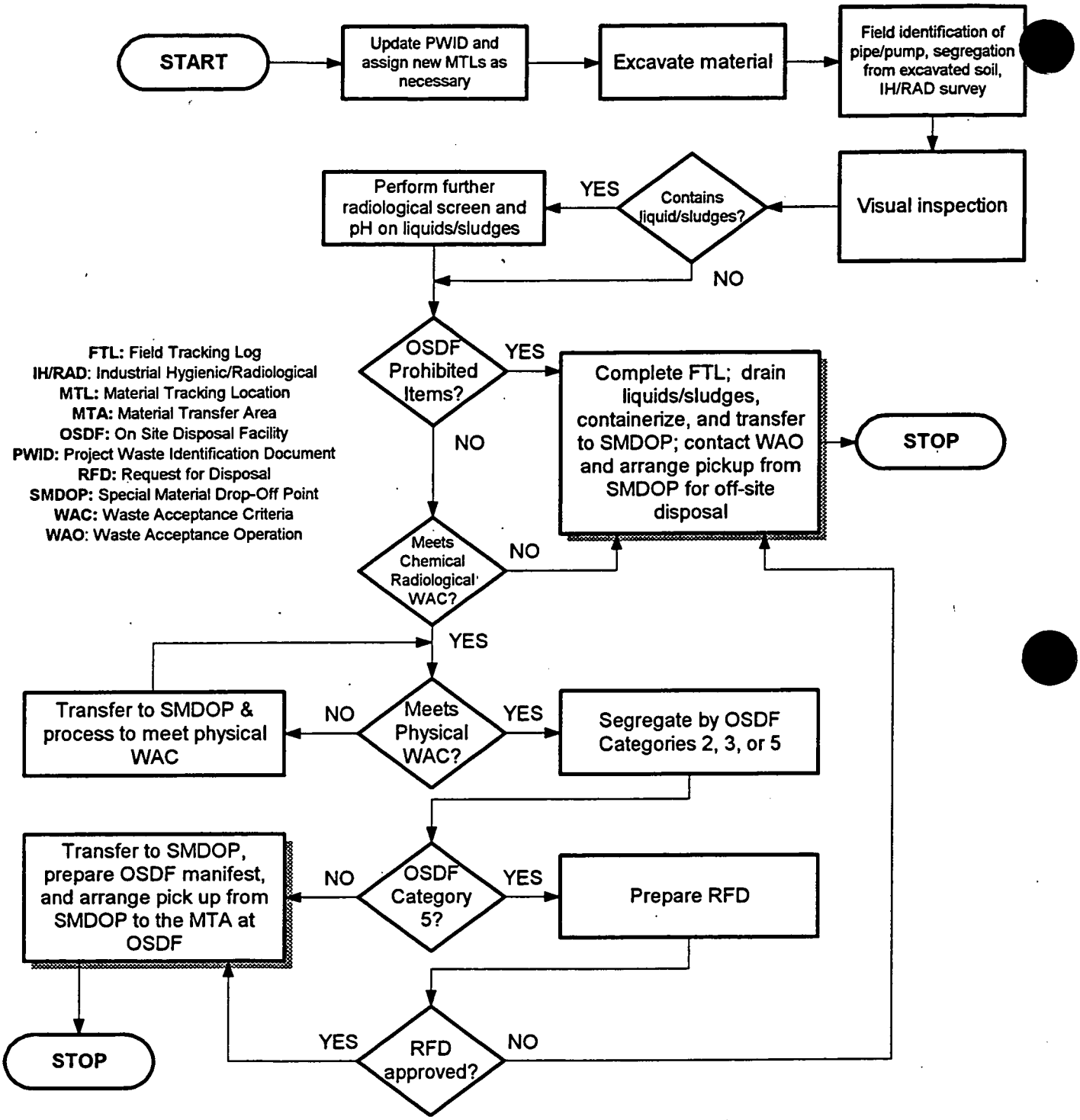
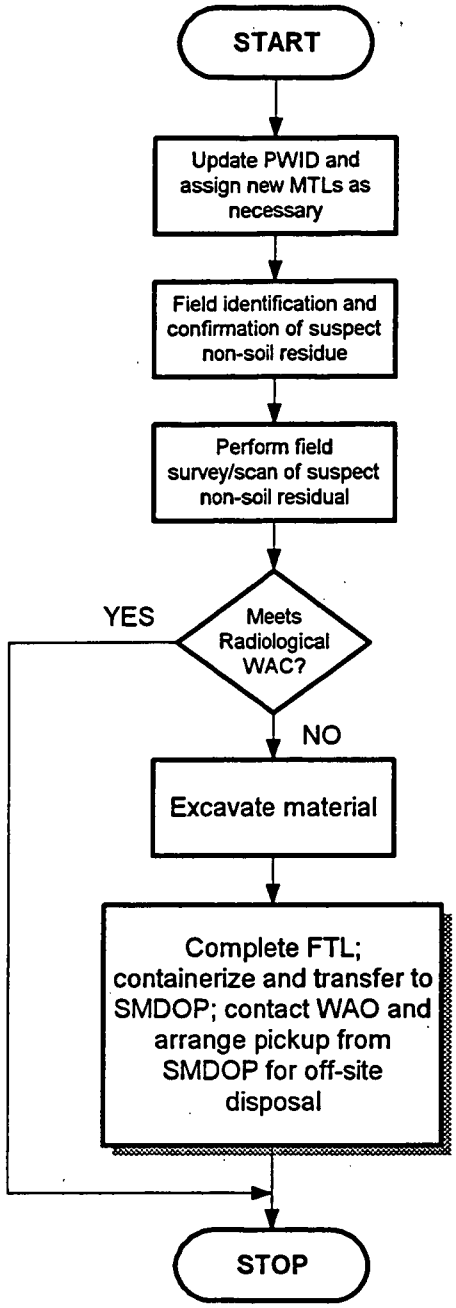



FIGURE F.5-5 PRESSURIZED CONTAINERS

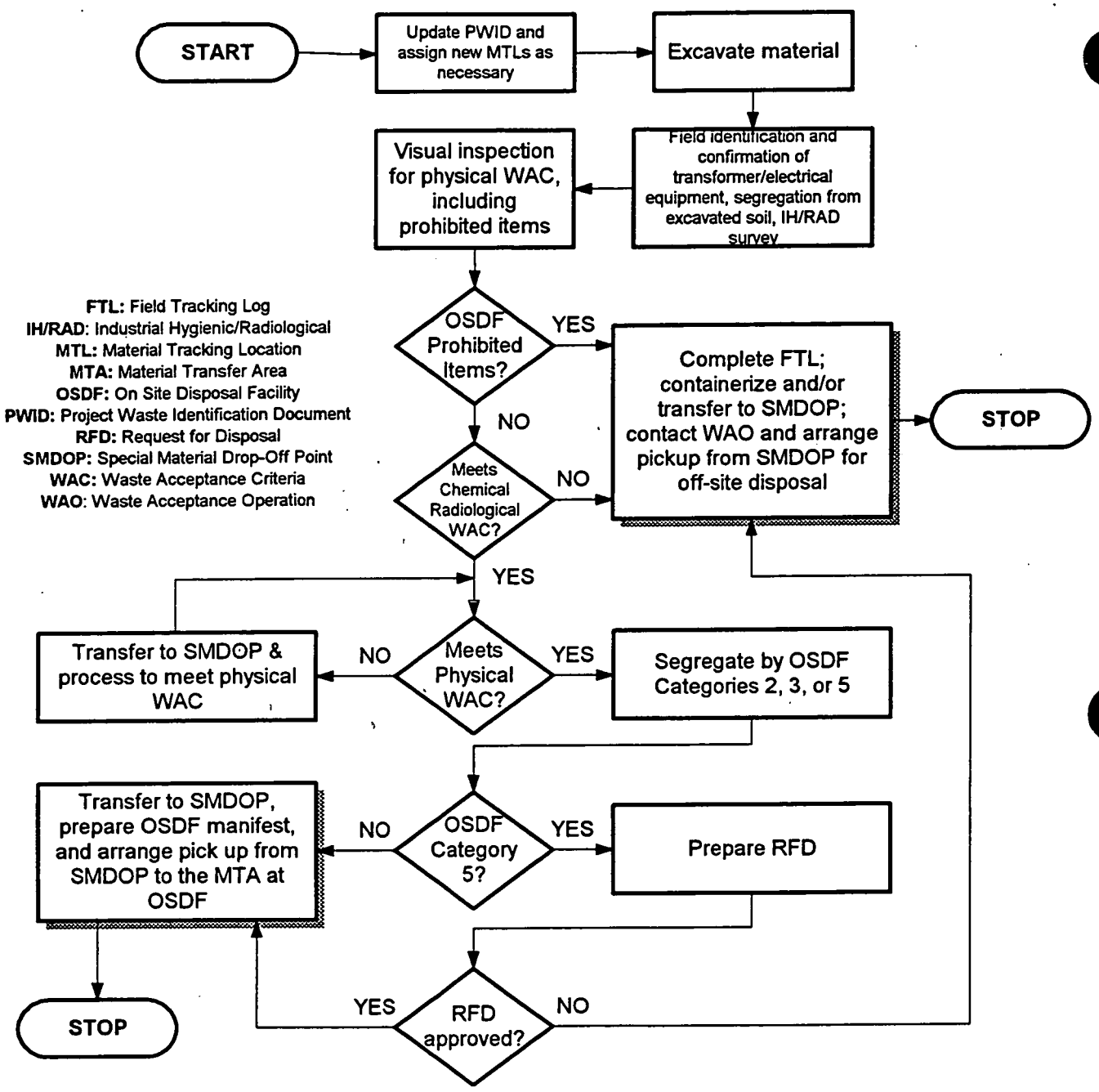



# FIGURE F.5-6 PIPING/PUMPS




**FTL:** Field Tracking Log
**IH/RAD:** Industrial Hygienic/Radiological
**MTL:** Material Tracking Location
**PWID:** Project Waste Identification Document
**SMDOP:** Special Material Drop-Off Point
**WAC:** Waste Acceptance Criteria
**WAO:** Waste Acceptance Operation

# FIGURE F.5-7 NON-SOIL RESIDUES




# FIGURE F.5-8 TRANSFORMERS/ELECTRIC EQUIPMENT

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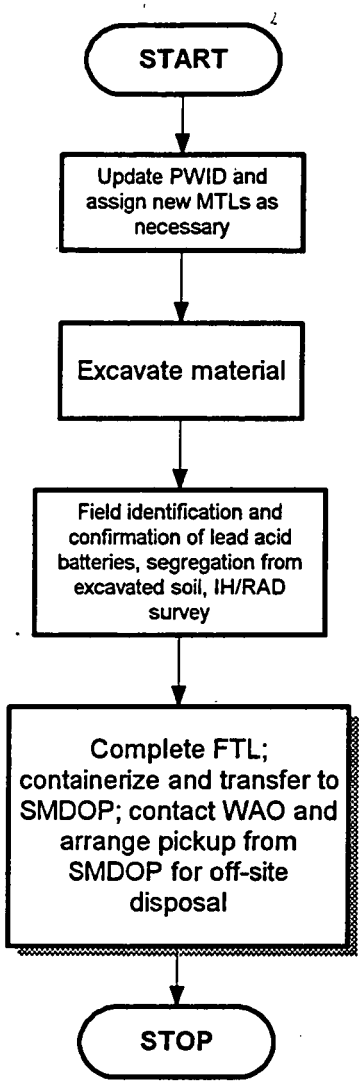
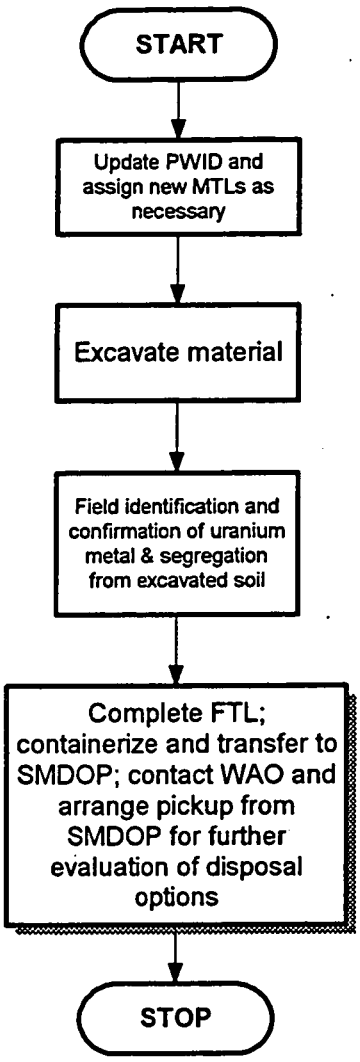



**FTL:** Field Tracking Log
**IH/RAD:** Industrial Hygienic/Radiological
**MTL:** Material Tracking Location
**PWID:** Project Waste Identification Document
**SMDOP:** Special Material Drop-Off Point
**WAO:** Waste Acceptance Operation

# FIGURE F.5-9 LEAD ACID BATTERIES




**FTL:** Field Tracking Log
**MTL:** Material Tracking Location
**PWID:** Project Waste Identification Document
**SMDOP:** Special Material Drop-Off Point
**WAO:** Waste Acceptance Operation

# FIGURE F.5-10 URANIUM METAL

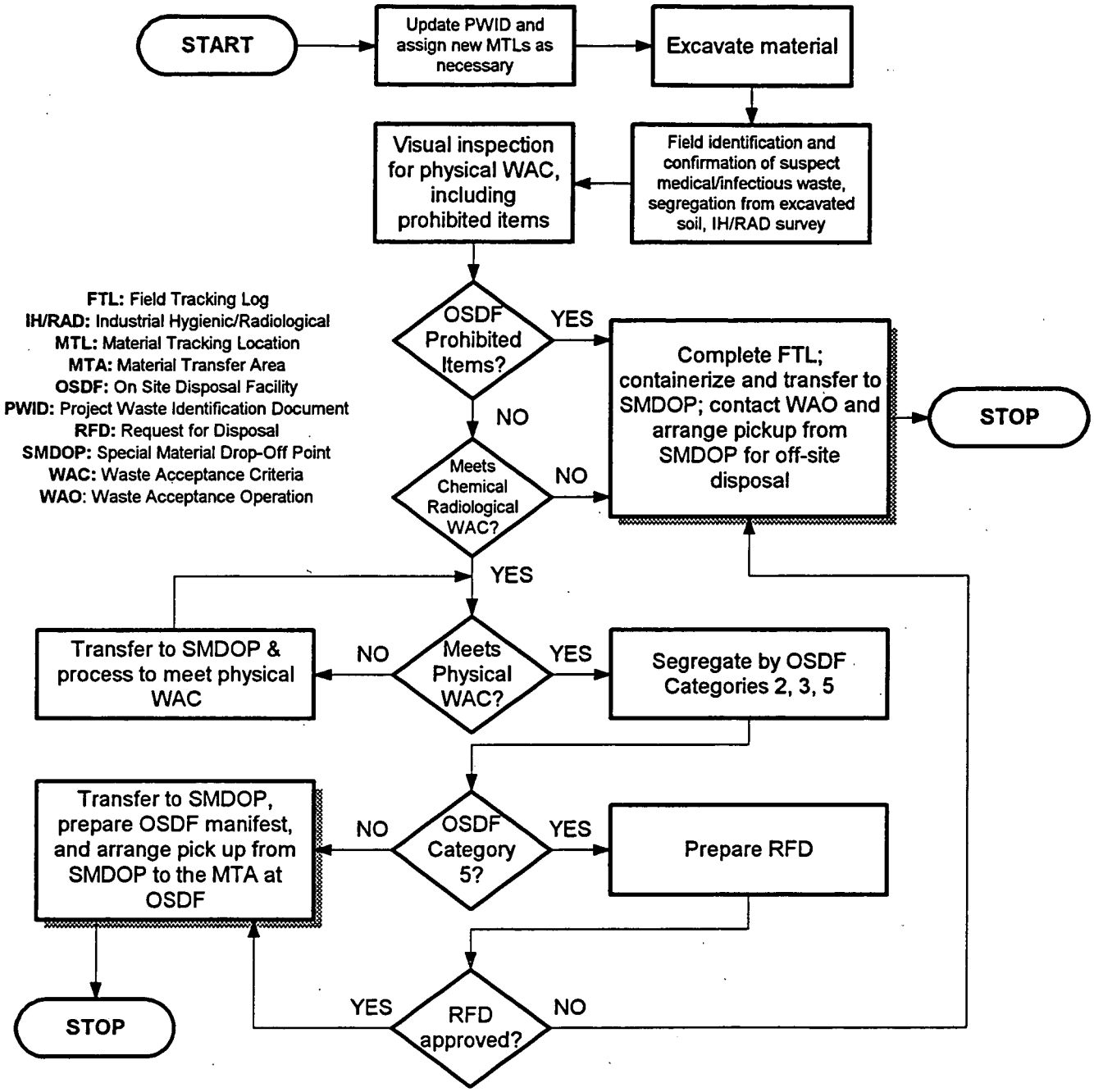
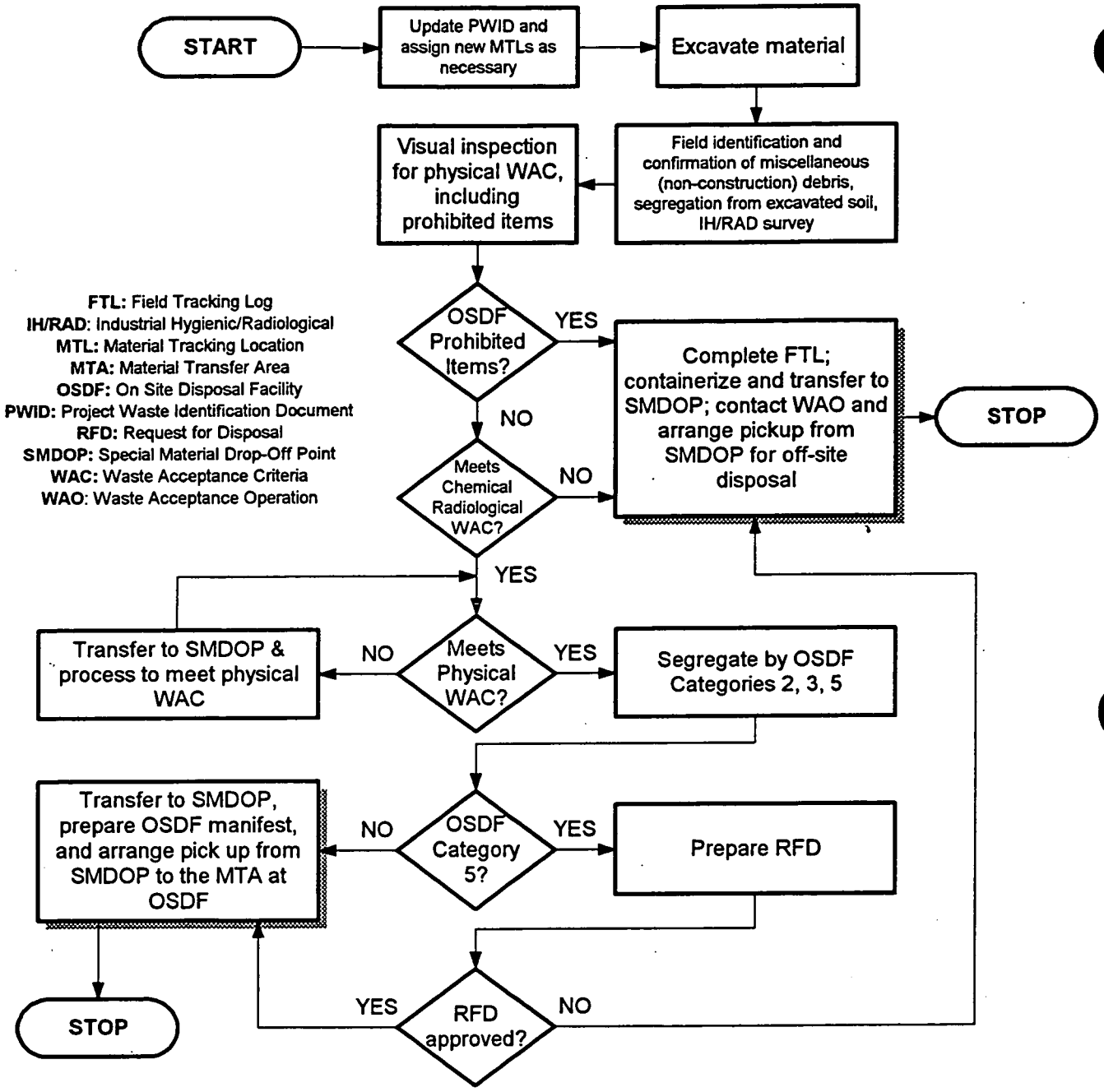
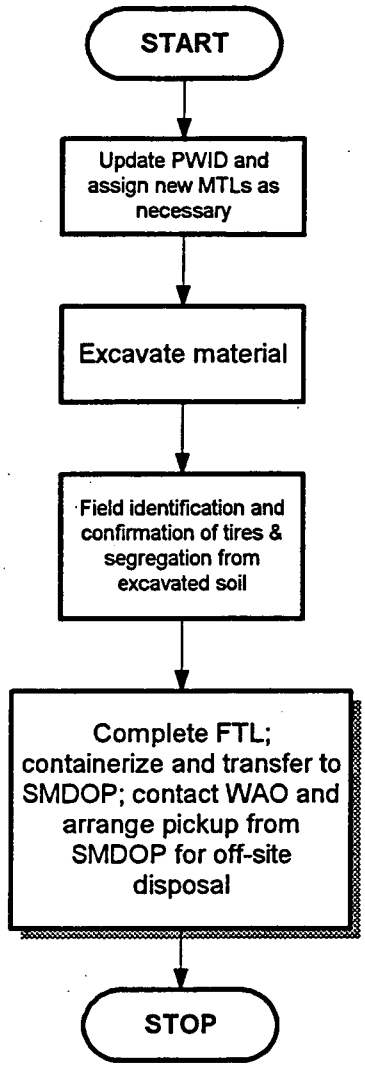



FIGURE F.5-11 MEDICAL/INFECTIOUS WASTE

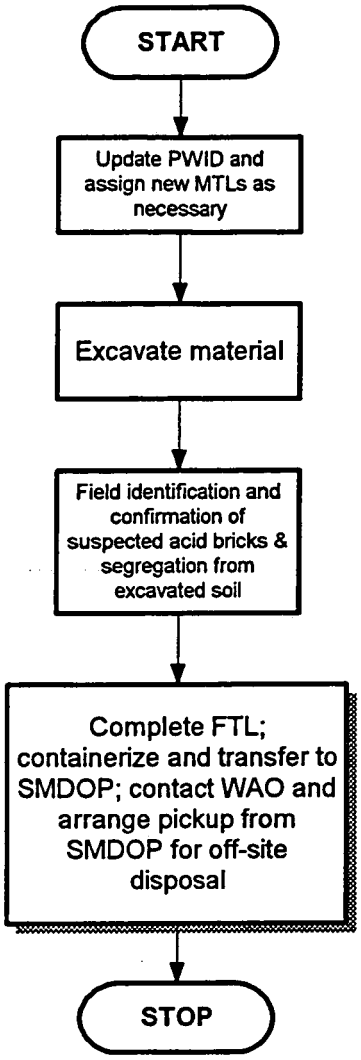



# FIGURE F.5-12 MISCELLANEOUS DEBRIS




**FTL:** Field Tracking Log
**MTL:** Material Tracking Location
**PWID:** Project Waste Identification Document
**SMDOP:** Special Material Drop-Off Point
**WAO:** Waste Acceptance Operation

# FIGURE F.5-13 TIRES




**FTL:** Field Tracking Log
**MTL:** Material Tracking Location
**PWID:** Project Waste Identification Document
**SMDOP:** Special Material Drop-Off Point
**WAO:** Waste Acceptance Operation

# FIGURE F.5-14 ACID BRICK

# APPENDIX G

# CERTIFICATION DESIGN RATIONALE

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| COC | Constituent of Concern |
| DOE | U.S. Department of Energy |
| EPA | U.S. Environmental Protection Agency |
| FEMP | Fernald Environmental Management Project |
| FRL | Final Remediation Level |
| IRDP | Integrated Remedial Design Package |
| LBGR | lower bound of the gray region |
| MDC | minimum detection concentration |
| NaI | sodium iodide |
| OEPA | Ohio Environmental Protection Agency |
| ROD | Record of Decision |
| SEP | Sitewide Excavation Plan |
| UCL | upper confidence level |

## G.1 INTRODUCTION

This appendix describes the statistical approach for making certification decisions for releasing areas at the Fernald Environmental Management Project after soil remediation is complete. Although a 100 percent confidence level cannot be achieved because of inevitable uncertainty with the data, statistical methods provide assurance, to an acceptable level of uncertainty, that the final remediation levels (FRLs) are not exceeded. The described statistical approach has been agreed to by DOE and the regulatory agencies.

The statistical methods used to assess compliance with the release criteria are chosen according to the spatial distribution of contaminants. There are two possibilities in the real world: the residual contaminant may be distributed over a given area in a homogeneous or heterogeneous manner. The two most common homogeneous distributions encountered when assessing environmental data are the normal distribution and the lognormal distribution, and sample populations can be estimated based on observed or estimated variability. The more variable the data, the larger the sample population required to attain a prespecified confidence level.

Sometimes environmental contaminants are distributed in a heterogeneous manner and do not follow a normal distribution. They may be normal but data are not of sufficient number to define the distribution, or they may be multimodal, having one or more areas of higher (or lower) contamination inconsistent with the remaining area. In these situations a large number of samples is required to adequately characterize the contamination over a large area.

At the FEMP, additional information on the nature and extent of contamination in a given area will be collected using scanning and direct measurement technologies [Section 2.4 of the Sitewide Excavation Plan (SEP)]. This approach serves to identify areas of elevated radioactivity so they can be removed before soil certification sampling is performed. This selective removal minimizes the possibility of finding homogeneous areas of elevated contamination during certification activities and reduces the expected variability of contaminants in the remaining soil. The result of this selective removal is the remaining data distribution will most likely be normal or lognormal. Additionally, with a known distribution and lower variability, the number of samples required to characterize the contamination in a certification unit's residual soil will be significantly reduced.

The remainder of this appendix is divided into two sections. Section G.2 presents the statistical approach for determining the certification sample number and density required to document compliance with FEMP cleanup criteria, including a discussion of input parameters and statistical test methods used to make this determination. Section G.3 contains a description of the technical approach used to identify and define areas of elevated gamma activity (i.e., hot spots) with scanning instruments.

## G.2 APPROACH TO STATISTICAL ANALYSIS FOR CERTIFICATION

A statistical sensitivity analysis was conducted to determine the number of soil samples to collect from each certification unit so that reliable pass/fail determinations can be made for the certification unit. The number of samples required is based on the expected distribution of each constituent of concern (COC) (i.e., mean and standard deviations) within the certification unit. This analysis supports the sampling approach presented in Section 3.0 of the SEP.

### G.2.1 Input Parameters for Estimating Sample Population

The number of samples that should be collected per certification unit for final certification was determined using the following five parameters:

1) The COC-specific final remediation levels (FRLs) taken from the Operable Unit 5 Record of Decision (ROD; DOE 1996)

2) The concentration that meets the FRL (i.e., the target or expected average residual soil concentration), assuming the acceptable error levels

3) The acceptable Type I Error probability ($\alpha$). A Type I Error occurs when a certification unit is determined to meet the FRL when it really exceeds the FRL

4) The acceptable Type II Error probability ($\beta$). A Type II Error occurs when a certification unit is determined to exceed the FRL when it really meets the FRL

5) The expected standard deviation of the certification unit soil sample population.

These parameters are further described below.

#### G.2.1.1 Final Remediation Levels

The FRLs used for the statistical approach were developed based on the exposure risk calculated for the undeveloped park user, which is the final land use scenario presented in the Operable Unit 5 ROD.

When determining target cleanup levels (Section G.2.1.2) and sample populations for certification decisions (Section G.2.4), FRLs are used to set the upper and lower bounds of the gray region on the power charts used to determine the sample population required to meet the Type I and II Error probabilities (Figure G-1).

G.2.1.2 Target Cleanup Levels

Before final certification begins, the target cleanup level of each COC is chosen as an answer to the question: How much lower than the FRL must the mean residual COC concentration be set to assure the certification unit will be released within the confidence level established by the Type I and Type II Error probabilities? "How much less" is defined as the target cleanup level, which is also known as the lower bound of the gray region (LBGR) on the power curve, used to estimate the number of samples required to be collected. The upper bound of the gray region is defined as the FRL. Since the FRLs are set in the RODs, the LBGR determines the width of the gray region. The lower the LBGR, the wider the gray region and less samples need to be collected to make a pass or fail decision. Conversely, the higher the LBGR (i.e., the closer the LBGR is to the FRL), the narrower the gray region and more samples need to be collected to make a pass or fail decision. The LBGR can be interpreted as the maximum expected average residual COC concentration in an area after most of the above-FRL materials are removed.

As noted above, the lower the value of the LBGR, the fewer certification samples required for making a pass/fail decision. In most cases, 75 percent of the FRL will be used as the LBGR. However, the LBGR should be distinguishable from background and if background falls within the gray region defined by the LBGR at 75 percent of the FRL, then the probability of exceeding the Type II Error is increased. An increase in the probability of exceeding the Type II Error results in wasted resources by excavating and placing background soil in the On-Site Disposal Facility. Therefore, if the LBGR defined by 75 percent of the FRL is less than the 95 percent upper confidence level (UCL) on the mean background, the smallest LBGR considered for this analysis will be the 95 percent UCL on the mean of the background population. The 95 percent UCLs for background surface and subsurface soil, along with other summary statistics for metals and radionuclides, are presented in Tables G-1 and G-2, respectively. Surface soil data were used only for those COCs not included in the subsurface soil data set. One half of the detection limit was used for nondetect results.

Although the LBGR will not be used to drive any excavation decisions, it should be high enough to indicate a successful remediation during precertification activities. For instance, the LBGR should be higher than the practical quantitation limit for the analytical method used to analyze certification samples. For radionuclides, it should be high enough to enable investigators to use field scanning instruments during precertification activities.

G.2.1.3 Type I Error Probability

A Type I Error occurs by falsely concluding that a certification unit meets the FRL when it really exceeds it. The Type I Error probability ($\alpha$) is usually set at 10 percent, 5 percent, or 1 percent. For certification activities at the FEMP, the Type I Error probability will be set at 5 percent for primary COCs and 10 percent for secondary COCs. Based on meetings between the U.S. Environmental Protection Agency (EPA), Ohio Environmental Protection Agency (OEPA), and DOE, these levels are considered to be protective of the public and environment.

G.2.1.4 Type II Error Probability

A Type II Error occurs by falsely concluding that a certification unit exceeds the FRL when it really meets it. The Type II Error probability ($\beta$) is usually set at levels such as 20 percent, 15 percent, and 10 percent. DOE has established a Type II Error of 20 percent as an acceptable risk for certification decisions.

G.2.1.5 Expected Residual Soil Standard Deviation

The expected standard deviation for certification soil samples was estimated from a subset of the sitewide remedial investigation (RI) data. First, the expected excavation footprint was block-modeled using the RI total uranium sample data for soil. Through this modeling, a remnant soil data file was created that approximates the surface soil profile after uranium-driven excavation has been completed. This modeling produced a profile corresponding to uranium values below two times the FRL and a second profile with uranium values below three times the FRL.

All data points below the modeled profiles were used in the estimation of the expected residual standard deviation. This methodology includes individual sample results exceeding the FRL in the residual data

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set, as long as the block average does not exceed the FRL. If the average concentration of a block exceeded the area-specific FRL, the block was removed (i.e., considered to be excavated) prior to calculating the residual standard deviation.

In the second step of the filtering process, two data sets were developed by eliminating COC results exceeding two times the FRL and three times the FRL. Both data sets were developed by eliminating sample results from the residual data set to simulate precertification hot spot removal at two different hot spot criteria levels (i.e., two and three times the FRL).

The screening method used to estimate the residual standard deviation of COCs in the soil does not inherently underestimate variability, since many individual sample results that exceed the area-specific FRLs are used in the estimation procedure. Only data from soil that is expected to be removed and potential hot spot data were filtered out of the residual data set. For COCs that are expected to drive the required number of certification samples, a comparison of the estimated residual soil standard deviations to background surface and subsurface soil standard deviations is shown in Table G-3.

The data in Table G-3 show that for background soil, subsurface standard deviations are higher than those for surface soil. The same relationship is expected for nonimpacted areas where minimum excavation is planned. That is, non-impacted areas are expected to most closely resemble the background reference areas. Thus, eliminating samples taken from the top foot of soil (which may not necessarily be excavated) should add an additional measure of conservativeness to the estimated sitewide residual soil standard deviations because subsurface standard deviations are higher than those for surface soil. Inspection of the "two times the FRL" and "three times the FRL" estimated standard deviations reveals that they are all significantly larger than the subsurface soil background standard deviations, though not significantly different from each other.

The actual certification sample population proposed for each certification unit will be documented and submitted for approval prior to conducting sampling activities. Additionally, *a posteriori* sample population calculations (Section G.2.4) will be performed to determine if the certification unit sample population was sufficient to meet the confidence criteria. Failure of this analysis would be defined as Condition 1 - Nonattainment Scenario (high variability in the data set), with the subsequent actions as prescribed in Section 3.4.5 of the SEP.

G.2.2 Statistical Test Methods for Certification Compliance

The appropriate test method to assess attainment of the FRLs is chosen based on the distribution of the data. If the data are normally or lognormally distributed, then the Student's t-Test should be used because it provides more accurate results than the nonparametric methods. If the data are not normally or lognormally distributed, then a nonparametric method is required. The decision steps to determine the statistical test to be used for evaluating FRL compliance are shown on Figure G-1 and discussed in Section G.2.3. The analytical procedure selection process, descriptions of methods, and rationale for usage are provided below.

Within the body of certification sample data will be nondetects and duplicate results. During certification analysis, the value used in the calculations for nondetects will be one half of the reported minimum detection concentration (MDC). For duplicate samples, each duplicate sample result is equally likely to represent the true concentration at the sample location. However, the more conservative maximum result will be used in statistical calculations.

Five basic decision points are sequentially applied to the certification data sets to select the appropriate statistical tests.

1) Is there a significantly large proportion (greater than approximately 15 percent) of data reported as nondetected?

2) Are the data normally distributed?

3) Will a log transformation of the data normalize the data?

4) If the proportion of nondetects exceeds 50 percent then perform the Sign Test.

5) If the proportion of nondetects are between 15 and 50 percent and the data are symmetrical, perform the Wilcoxon Signed Rank Test.

For Decision Point 5, the appropriateness of using the Wilcoxon Signed Rank Test, when a large proportion of nondetects are present, is discussed in Section G.2.2.4. A detailed discussion on selecting the appropriate statistical test for assessing compliance with FRLs is presented in Section G.2.3. In all test procedures it is assumed that the certification unit exceeds the FRLs, with the

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alternative that the certification unit meets the FRL requirements; therefore the testing procedures are one-sided tests.

G.2.2.1 Shapiro-Wilk Test for Normality

Tests for normality are widely available though computerized statistical packages. Madansky (1988) summarized studies by Shapiro, Wilk and Chen (1968) and Pearson, D'Agostino and Bowman (1977) that concluded the omnibus Shapiro-Wilk Test was almost always superior to other tests. The one exception was noted by Pearson, D'Agostino and Bowman. Their study concluded that if the sample distribution was symmetric and leptokurtic (long-tailed) the D'Agostino statistic outperformed the Shapiro-Wilk but never by a wide margin. For these reasons, the tests for normality will be performed using the Shapiro-Wilk Test and the resulting statistic ($p$) from the normality test will be repeated in the data summary tables included with the Certification Report.

The Shapiro-Wilk Test procedure essentially formalizes the process of "eyeballing" a probability plot by regressing the sample result ($x_i$) against the standardized quantile ( $_i$). But, since the ordered sample results are not independent of each other, standard regression computations are not valid. Shapiro and Wilk (1965) developed a regression-based statistic to test for normality and a table of coefficients especially derived for computing the statistic for a sample population of up to 50. For sample populations greater than 50, Shapiro and Francia (1972) developed an approximation of the statistic for a sample population up to 99. This statistic is known as the Shapiro-Francia statistic and will be used if the sample population exceeds 50. See Madansky (1988) for specific details of the Shapiro-Wilk and Shapiro-Francia procedures. These procedures can also be applied to log transformed data to test for lognormality.

G.2.2.2 Student's t-Test

The Student's t-Test is a parametric statistical method that can be used to test whether the mean of the COC sample results from the certification unit is less than the FRL at the stated Type I Error probability. This test is performed for each COC in a certification unit that meets the minimum requirements of normality, as defined by the Shapiro-Wilk Test. The following equation is applied to calculate the Student's t-Test statistic (t):

$$t = \frac{FRL - \bar{X}}{\sqrt{S^2 / N}}$$

where

$FRL$ = *final remediation level*
$\bar{X}$ = *the sample mean of the certification sample results*
$S^2$ = *the sample variance of the certification sample results*
$N$ = *the number of certification sample results*

The t-distribution table of critical values for varying numbers of samples and Type I Error probabilities (i.e., rate) is consulted to make the pass/fail determination for the certification unit. If the computed value (t) exceeds the critical value, then the certification unit passes. The Type I Error rate is 0.05 for primary COCs and 0.10 for secondary COCs. The Student's t-Test requires a near-normal distribution of soil sampling results and is influenced more than nonparametric methods by nondetects. In t-Test calculations, nondetects will be assigned a value of one half the MDC.

The Student's t-Test will most likely be used for the vast majority of contaminants, since environmental data are usually normally or lognormally distributed. To simplify the process and interpretation of the methodology, the UCL of the mean, based on the Student's t-distribution, will be compared to the FRL. This is equivalent to performing the t-Test using the data mean and the FRL. If the calculated UCL is less than the FRL than the certification unit passes certification, otherwise the certification unit fails certification and the cause is evaluated to determine the subsequent action (see Section 3.4 of the SEP).

G.2.2.3 Sign Test

This procedure tests the hypothesis that at least 50 percent of the data are greater than the FRL, indicating that the median (a nonparametric estimate of the midpoint of the data) is greater than the FRL, with a prespecified level of confidence. If more than 50 percent of the sample results are greater than the FRL, it is likely that the overall constituent level within the certification unit would be greater

than the FRL, indicating certification failure. Conversely, if fewer than 50 percent of the sample results are greater than the FRL, it is likely that the overall constituent level within the certification unit would be less than the FRL, and meet the FRL requirement. Exact probabilities of the Sign Test have been developed to assess the confidence level on the test of the hypothesis.

The Sign Test method will be used in two situations: when greater than 50 percent of the sample results are reported as below the MDC level, and when the t-Test cannot be used reliably because the data distribution is not normal or lognormal. The first situation may arise with organic COCs, that are difficult to quantify, but which pose a potential risk when present. Traditional methods (e.g., t-Test) require data results above the MDC to calculate the test statistic, whereas the Sign Test only requires that the result be discernible from the FRL. If the MDC is below the FRL, the Sign Test can be used to determine, with a specified level of confidence, if the median of the data is above the FRL. The test method withstands wide data variations, high percentages of nondetects (assuming the detection level is below the FRL), and does not require any prior knowledge of the underlying distribution or that the data be symmetrically distributed (i.e., mean and median are equal).

The probabilities for the binomial distribution when sample populations are between 10 and 16 are shown in Table G-4. The column represents the sample size excluding sample results that are equal to the FRL and the row represents the number of results greater than the FRL. If the resultant probability is less than the prespecified confidence level than the hypothesis would be rejected and the certification unit would meet the FRL (median is less than the FRL).

For example, if 0 of 16 samples taken from a certification unit equaled the FRL, the prespecified confidence level is 0.05 (5%), and four of the samples exceeded the FRL, Table G-4 shows that the probability is 0.038, which is less than 0.05 and the conclusion is that the certification unit passes certification. If five samples exceeded the FRL, the probability increases to 0.105, which is greater than 0.05 and the certification unit would fail certification. Even if the prespecified confidence level was 0.10 (10%), the certification unit would fail certification, because the probability of 0.105 is greater than 0.10.

G.2.2.4 Wilcoxon Signed Rank (One Sample) Test

The appropriateness of using the Wilcoxon Signed Rank Test, which is based on the assumption of symmetry, will be evaluated by calculating the Standardized Skewness of the sample population. The Coefficient of Skewness is the measure of the symmetry of a data set and, for a large sample population, the Coefficient of Skewness is distributed approximately normal with mean equal to zero and variance equal to 6/n (n being the sample size). Therefore, the Coefficient of Skewness can be standardized to approximately standard normal and this standardized parameter is known as Standardized Skewness.

Since the Standardized Skewness is approximately standard normal, a value of greater than +/- 2.0 (i.e., a value greater than +/- two standard deviations from the expected mean Standardized Skewness of zero) indicates a high probability that the data set is not from a symmetric distribution. The Standardized Skewness test is often used as a simple test for normality (along with a similar test of the Standardized Kurtosis - a measure of the flatness or steepness of a data distribution curve). The Standardized Skewness test determines if the data set severely violates the assumption of symmetry. If so, the Wilcoxon Signed Rank Test will not be used and the Sign Test will be used instead (Madansky 1988 and Manugistics 1995).

If the data are symmetrically distributed but are not normally distributed, nor is the logtransformed data normally distributed, then the Wilcoxon Signed Rank Test will be employed to assess compliance with the FRLs. It may also be possible to transform the data to make the data distribution symmetrical.

The Wilcoxon Signed Rank Test is implemented as follows:

- Subtract the FRL from each of the certification sample results
- Sort, then rank the absolute deviations from the FRL
- Carry over the sign of the calculated deviation (positive if the result is greater than the FRL or negative if it is less than) to the rank of the absolute deviation
- Sum the negative ranks (those below the FRL) and positive ranks (those above the FRL).

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For compliance with the FRLs, the absolute sum of the negative ranks (results less than the FRL) must exceed that of the positive ranks (results greater than the FRL). Exact probabilities can be obtained from Wilcoxon Signed Rank probability tables. If the ranks derived from the certification data results are significantly below the FRL, then the certification unit passes. The probability levels are 5 percent for primary COCs and 10 percent for secondary COCs.

G.2.3 Determination of the Appropriate Methodology to Assess Achievement of FRLs

Five decision points will be applied to the certification data sets to choose the appropriate statistical methodology prior to preparing the certification summary table. A discussion of the selection method follows and a summary of the decision hierarchy is shown on Figure G-2.

Step 1. Determine if the maximum concentration/activity of the COC less than the FRL.

If all results for a given COC are below the FRL, the certification unit has passed certification and the data summary table can be prepared without conducting statistical analysis. When one sample result or more exceeds the FRL, the evaluation moves to Step 2.

Step 2. Determine if a significant proportion of the data (> 15 percent) is reported as nondetected.

When a significant proportion of the data (i.e., greater than 15 percent) is below the detection level, the normal or lognormal distribution of the data is questionable. At this point, nonparametric tests need to be used because they do not rely on the assumption of normality (Step 4). A large percentage of nondetects tends to bias the sample distribution to low values and also lowers the mean and increases the standard deviation. When the percentage of nondetects is less than 15 percent, the Shapiro-Wilk Test (Section G.2.2.1) is performed to evaluate if the data can be adequately described by a normal and/or lognormal distribution (Step 3).

There is no exact percentage that invalidates normal or lognormal testing procedures, and 15 percent is not based on any well-studied statistical theory. Therefore, 15 percent should be recognized as a rule-of-thumb value rather than an exact value. Table G-5 summarizes the proposed guidance for assessing whether the data set should be evaluated with the Shapiro-Wilk Test.

Step 3: Perform the Shapiro-Wilk Test to evaluate if the data are normally or lognormally distributed. If nondetects are less than 15 percent of the data set, the next step is to perform the Shapiro-Wilk Test (Section G.2.2.1) to evaluate the data distribution. If the Shapiro-Wilk Test indicates that the data cannot be assumed to be a normal or lognormal distribution, the data are evaluated by nonparametric methods (Step 4), because the Student t-Test cannot evaluate outliers/extreme values in a realistic manner when the sample population is small.

If the Shapiro-Wilk Test indicates both normal and lognormal distributions fit the data, the distribution with the highest p value will be used in the Student's t-Test (Section G.2.2.2) to make the certification decision. However, the Shapiro-Wilk Test will generally return a pass decision for either the normal or lognormal distribution.

When a normal distribution is indicated, the most accurate determination of compliance with FRLs will be achieved. This is because the normal distribution is the most studied statistical distribution and more is known about its properties and exact probability levels than any other distribution. Additionally, the Central Limit Theorem states that the data distribution, known or unknown, of sample means within a random sample population is approximately normal - provided the sample population is sufficiently large. This indicates that although the underlying distribution may not fit the definition of a normal distribution precisely, the Student's t-Test can be used to evaluate compliance with FRLs if no significant deviation from this assumption is present.

When the Shapiro-Wilk Test indicates a lognormal distribution is present, the data are evaluated with the Student's t-Test using the log transformed data. A distribution is lognormal if the data are normally distributed once they have been transformed using the natural log function. The limitations noted above apply.

It is expected that the majority of data will be analyzed with the Student's t-Test assuming either a normal or lognormal data set. During Area 1, Phase I and Area 1, Phase II certification, nearly 85 percent of the primary COCs and approximately 80 percent of all COCs tested used the Student's t-Test on normal and lognormal data sets.

Step 4: Is the proportion of nondetects greater than 50 percent?

If the proportion of nondetects is greater than 50 percent, the Sign Test will be used to make the pass/fail decision for the certification unit (Section G.2.2.3). The Sign Test does not assume any underlying distribution and can accommodate nondetects as long as the detection level is less than the FRL. Unlike the Wilcoxon Signed Rank Test, there is no requirement for the underlying distribution to be symmetric.

When the percentage of nondetects is less than 50 percent, the data distribution is evaluated for symmetry according to Step 5.

Step 5: Are the data symmetrically distributed?

If the data are symmetrically distributed, the Wilcoxon Signed Rank Test is used (Section G.2.2.4). The Wilcoxon Signed Rank Test does not require that the data be normally distributed but assumes that the data be symmetrically distributed. Tests for symmetry are often devised from the chi-square distribution and simple histograms to assess the appropriateness of using the Wilcoxon procedure. Generally speaking, the distribution of sample results should be evenly (but not uniformly) distributed on either side of a central point. Assuming that the data are approximately symmetric, and there are not too many results with the same value, this procedure can provide reliable results. If the data indicate a nonsymmetric distribution, the Sign Test (Section G.2.2.3) will be performed for the certification statistical analysis.

G.2.4 Determination of Number of Samples for Certification

A certification unit can be certified when it can be demonstrated that the average concentration or activity level for each certification unit-specific COC is below its respective FRL within an acceptable confidence level. To estimate of the number of certification samples required per certification unit, the following formula was employed:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{\left(\frac{RG - \bar{x}_{target}}{S_{Est.}}\right)^2}$$

where

$\alpha$ = *probability of a Type I Error*
$\beta$ = *probability of a Type II Error*
$Z$ = *critical level (for the designated probability) the normal distribution*
$RG$ = *the Remedial Goal (i.e., FRL for the given analyte)*
$\bar{x}_{target}$ = *target clean-up level mean (i.e., LBGR)*
$S_{Est.}$ = *standard deviation estimated the remnant soil data*

This equation is based on the assumption that the data are normally distributed. The justification for using this equation is that the majority of environmental data are either normally or lognormally distributed. A review of the data gathered during the Area 1, Phase I and Area 1, Phase II sampling and analysis efforts indicate that this assumption is valid. Eighty percent of certification unit data sets (85 percent for primary COCs) passed the normality or lognormality check. Furthermore, these percentages are low because several of the analytes were seldom detected above their detection limits, with the majority of the certification unit data sets having too few detects for these analytes to determine the distribution. For beryllium, 21 out of 32 certification units had too few detects; for cesium-137, 3 out of 5; and for Aroclor-1260, all 10 had too few detects. If we remove these secondary COCs as erroneously skewing the results, the overall percentage of certification unit data sets that are normal/lognormal climbs from 80 to 85 percent. Clearly, the vast majority of data sets could be analyzed using normal probability theory. Therefore, estimating sample sizes based on the assumption of normality is valid.

To meet the confidence levels for certification (95 percent for primary COCs and 90 percent for secondary COCs) additional assumptions are required. The first assumptions deal with Type I and Type II Errors. A Type I Error is defined as the probability of declaring that a certification unit meets the FRL when the average exceeds the FRL, whereas a Type II Error is defined as the probability of declaring the certification unit as not meeting the FRL when in fact the average is below the FRL. The acceptable Type I Error for the primary COCs is 5 percent and for secondary COCs is 10 percent. The Type I Error was evaluated at 5 and 10 percent while holding the Type II Error to 20 percent. Results for this analysis are given in Table G-6 (using the remnant data set defined by all values below two times the FRL) and Table G-7 (using the remnant data set defined by all values below three times the FRL).

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The second assumption is the maximum expected average concentration or activity level for the certification unit at the time of certification sampling. This is referred to as the "target cleanup level" or the LBGR. This assumed target level or LBGR is set at 75 percent of the FRL for evaluating sample populations for certification or at the 95 percent UCL of the background mean if 75 percent of the FRL is lower than the background mean (Section G.2.1.2). This is the assumed maximum expected average concentration or activity level at the time that certification sampling is to begin. Estimated sample populations are given in Table G-6 assuming the "less than two times the FRL" remnant data set and Table G-7 assuming the "less than three times the FRL" remnant data set.

The last assumption required to calculate certification sample size is an estimate of the data variability (standard deviation) for postremedial conditions. This has been discussed in Section G.2.1.5.

Table G-8 presents the resultant target levels or LBGR and percentages of FRL if the sample population was set at 12 samples, using the assumptions listed above.

G.2.4.1 Examples of Sample Population Calculation

An example calculation for estimating the sample population using this method is provided below. The example calculation is based on thorium-228 remnant soil data, a Type I Error of 0.05, a Type II Error of 0.20, and a target cleanup level or LBGR of 75 percent of the FRL. These were the parameters assumed in the estimation of certification sample populations in Area 1, Phase I. The standard deviation used in this sensitivity analysis was estimated from the remnant data set using values less than two times the FRL, as previously described. Under the current recommended scenario of:

- Type I Error rate = 0.05 (primary COC),
- Type II Error rate = 0.20, and
- An assumed estimated maximum residual level of approximately 75 percent of the FRL,

the following example equation is presented. Starting with the initial equation:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{\left(\frac{RG - \bar{x}_{target}}{S_{Est.}}\right)^2}$$

Then, substituting the values for

$\alpha$ = *probability of a Type I Error* = 0.05
$Z_{(1-0.05)} = Z_{0.95} = 1.645$
$\beta$ = *probability of a Type II Error* = 0.20
$Z_{(1-0.20)} = Z_{0.80} = 0.842$
$RG$ = *the Remedial Goal, FRL* = 1.7 *pCi/g*
$\bar{x}_{target}$ = *target clean-up level mean*
= 75% *of the FRL* = 1.28 *pCi/g*
$S_{Est.}$ = *standard deviation estimated from remnant dataset* = 0.498 (*from Table G-6*)

yields

$$n = \frac{(1.645 + .842)^2}{\left(\frac{1.7 - 1.28}{0.498}\right)^2} = 8.7$$

Under the given assumptions, the calculated number is always rounded up to the next highest integer to ensure that the alpha and beta error rates are satisfied. In this case, the calculated value of 8.7 is rounded up to 9. The additional 20 percent safety factor is added to bring the sample size to 11. Therefore, under the given assumptions, we would need to collect a minimum of 11 samples per certification unit and analyze 9 samples for thorium-228 in order to certify the certification unit.

G.2.5 Sample Size *a posteriori* Confirmation

After the certification testing procedure has been identified an *a posteriori* sample population calculation will be performed to determine if sufficient samples were taken to assess certification. The actual calculated sample size, *m*, is dependent upon the testing procedure used. The equations used were taken from the EPA document EPA QA/G-9, "Guidance for Data Quality Assessment" (EPA 1998).

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G.2.5.1 Student t-Test

For the Student t-Test under the assumption of normality or lognormality, the *a posteriori* sample population required to assess meeting the FRL is

$$m = \frac{S^2(Z_{1-\alpha}+Z_{1-\beta})^2}{(\mu_1 - C)^2} + (0.5)Z^2_{1-\alpha}$$

where

$S^2$ = *sample variance*
$Z$ = *coefficients from the Normal distribution*
$\alpha$ = *Type I Error percentage*
$\beta$ = *Type II Error percentage*
$\mu_1$ = *sample mean*
$C$ = *FRL Criterion*

An example calculation for the *a posteriori* test is presented below. The calculation uses normally distributed certification data for thorium-232 from the A1PII-CD-01 certification unit. The information needed to make the calculation is as follows.

$S^2$ = *sample variance*
= *0.189,*
$\alpha$ = *Type I error percentage*
= *5 %,*
$\beta$ = *Type II error percentage*
= *20 %,*
$Z_{1-\alpha}$ = *coefficients from the Normal distribution*
$= Z_{0.95}$
= *1.645,*
$Z_{1-\beta}$ = *coefficients from the Normal distribution*
$= Z_{0.80}$
= *0.842,*
$\mu_1$ = *sample mean*
= *1.213*
$C$ = *FRL Criterion*
= *1.50.*

Substituting these values into the *a posteriori* test equation we get

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$$m = \frac{(0.189)^2(1.645+0.842)^2}{(1.213-1.50)^2} + (0.5)(1.645)^2$$
$$m = \frac{(0.0357)(6.1851)}{0.0824} + 1.3530$$
$$m = 4.03$$

Sample size estimates are always rounded up to the next highest integer (i.e., 4.03 is rounded up to 5). Therefore, the *a posteriori* sample size calculation for thorium-232 from the A1PII-CD-01 certification unit is 5, which is less than the actual sample size of 16, and it is concluded that a sufficient number of samples were taken to certify FRL attainment for the CU.

G.2.5.2 Wilcoxon Signed Rank Test

For the Wilcoxon Signed Rank Test, the *a posteriori* sample population required to assess FRL attainment is equivalent to the sample calculation for the t-Test plus a multiplier to account for a slight loss in power. The equation is

$$m = [\frac{S^2(Z_{1-\alpha}+Z_{1-\beta})^2}{(\mu_1 - C)^2} + 0.5Z^2_{1-\alpha}]x1.16$$

where

$S^2$ = *sample variance*
$Z$ = *coefficients from the Normal distribution*
$\alpha$ = *Type I Error percentage*
$\beta$ = *Type II Error percentage*
$\mu_1$ = *sample mean*
$C$ = *FRL Criterion*

G.2.5.3 Sign Test

For the Sign Test, the *a posteriori* sample size required to assess meeting the FRL is

$$m = [\frac{Z_{1-\alpha}\sqrt{P_0(1-P_0)} + Z_{1-\beta}\sqrt{P_1(1-P_1)}}{P_1 - P_0}]^2$$

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where

$P_0$ = *the hypothesized proportion equivalent to the median, 0.5*
$P_1$ = *the sample proportion greater than the median*
$Z$ = *coefficients from the Normal distribution*
$\alpha$ = *Type I error percentage*
$\beta$ = *Type II error percentage*

It can be determined that enough samples were taken to assess FRL attainment by comparing the calculated *m* to the actual sample population. If m is greater than the sample population, more samples should be taken to conclude that the certification criteria are met.

G.2.6 Summary and Recommendations

The appropriate sample population to assess FRL attainment depends on the assumed parameters. The only fixed parameters in the equation are the FRL and the Type I Error (5 percent for primary COCs and 10 percent for secondary COCs); all others are subject to sensitivity analysis. This interdependence on the estimated sample population is summarized in Table G-9.

Tables G-6 and G-7 indicate that, based on the remnant data, the size of the sample population is most sensitive to thorium-228 activity. The sample populations used in Area 1, Phase I were based on estimated residual standard deviations calculated from "unimpacted" areas (based on database queries). More refined estimates were derived using the block modeling technique previously described to generate the remnant data sets. If the remnant data set standard deviation is a good estimate of the residual standard deviation and the target level of 75 percent of the FRL is a good estimate of the residual activity level after remediation, then a sample population of 12 used in Area 1, Phase I is very conservative (more than a sufficient population), nearly a full 50 percent greater than the estimated sample population (Table G-6, maximum N = 9 for thorium-228).

Further evidence of the conservative sample population (i.e., greater then sufficient size) used in Area 1, Phase I can be seen from the summary of analytical results from Area 1, Phase 1 presented in Table G-10. The actual average residual certification unit mean level for the primary COCs is below the estimated 75 percent level, with total uranium concentrations being less than 15 percent of the FRL. For the secondary metal COCs, the arsenic results were similar, whereas the beryllium mean was less than 44 percent of the FRL (many being nondetects). Stronger evidence of the conservative nature of

the sample population estimate is the observed variability levels. The actual standard deviations observed in the Area 1, Phase 1, certification data sets were, on average, well below estimated values. Observed standard deviation for primary COCs was actually down in the range of approximately 35 to 55 percent of estimates, whereas metals were about 65 to 76 percent of estimates. As shown above, the variability of the data within a certification unit greatly influences the required number of samples to demonstrate FRL attainment. The lower the variability the fewer sample points are required to accurately estimate the true average COC level/concentration in the certification unit. The Area 1, Phase I, certification units are far less variable than estimated, especially for the primary COCs, which demonstrates that the estimated sample size of 12 is very conservative to determine FRL attainment.

Because of the apparent conservativeness of the sample population estimate used in Area 1, Phase I, the actual sample populations will be calculated and justified during the development of the Certification Design Letter for the area to be certified. Better estimates for standard deviations may be obtained from precertification sampling.

The parameters and assumptions to be used in the calculation of sample size are as follows:

- Data are normally distributed
- Type I error rate = 0.05 (primary COCs) and 0.10 (secondary COCs)
- Type II error rate = 0.20
- An assumed estimated maximum residual level of approximately 75 percent of the FRL.

For Group 1 certification units, the number of certification samples for primary COCs will be established at a minimum of 12 samples but no greater than 16. In the rare and unforeseen situation where 16 samples would not be enough to meet the Type I and Type II error rates, the target cleanup level may need to be adjusted downward based on actual conditions. Secondary COCs will be sampled in Group I certification units at a rate of 8 to 12 samples. For Group 2 certification units, the sampling rate will be 8 to 12 samples for both primary and secondary COCs. The expected variability should be very low, since there should be little or no secondary contamination prior to excavation. Regardless of

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the numbers of laboratory samples determined, the HPGe gamma spectrometry field measurement will also be conducted at all potential random sampling locations (i.e., 16 locations per certification unit) for comparison to certification sample results, as discussed in Section 2.4 of the SEP.

## G.3 JUSTIFICATION FOR SCANNING AS AN INTEGRAL PART OF PRECERTIFICATION

The goal of certification is to document that the remediation criteria for a certification unit [set forth in the Integrated Remedial Design Package (IRDP) and Certification Design Letter] are met. This will be done by taking direct measurements using a HPGe and by collecting samples of surface soil and analyzing them. This information will be supplemented by the use of scanning technologies during precertification activities.

A typical soil sampling program is based on collecting a finite number of samples over the surface of an area. Such a program will miss elevated areas of contamination located between the sampling points. The propensity of the sampling program to miss a hypothetical hot spot depends on the spacing between the sampling points. As the distance between two sampling points increases, the possibility of missing an area containing contaminated soil increases. Performing a 100 percent scan of the surface for gamma-emitting radionuclides addresses the possibility of missing a hot spot by supplying semiquantitative information between the points.

At the FEMP, for example, approximately 125 feet separate sampling locations on a triangular grid in a 500-ft by 500-ft certification unit with 16 sampling points.[1] This spacing would encompass an unsampled circular area of 24,544 $ft^2$. For a 250-ft by 250-ft area with 16 sampling points, the distance between points shrinks to about 62.5 ft, and the unsampled area becomes 6,136 $ft^2$. In order to justify the size of these certification units and the resulting grid spacing, it is necessary to demonstrate that any areas that might be missed by this sampling do not significantly affect the final risk to humans.

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1 $\sqrt{\frac{Area}{No.\,Samples}} = \sqrt{\frac{250{,}000\,ft}{16}} = 125\,ft$

G.3.1 Impact of Area Size on Risks

The risk to the undeveloped park user from a large area of soil containing uranium at the FRL of 82 mg/kg was determined during the Operable Unit 5 remedial investigation/feasibility study (RI/FS) process. Using this risk as a starting point, the impact on the receptor exposed to this risk in a shrinking area was investigated using RESRAD (DOE 1993a). RESRAD was used to calculate doses from circular areas of soil containing 82 mg/kg natural uranium, using the scenario for the undeveloped park user. The only variation between the runs was the size of the contaminated area. Table G-11 lists the site-specific parameters used in this exercise.

The results of the RESRAD runs were then used to calculate a ratio of the risk produced by a certification unit with soil containing 82 mg/kg uranium compared to the risk produced by a smaller soil area with the same uranium concentration. This ratio, called the area factor, provides a measure of the effect that area size has on risk to the receptor from residual levels of uranium. These area factors, based on a Group 2 certification unit size of 500-ft by 500-ft, are plotted on Figure G-3.

The uranium concentration required to produce the same exposure to the undeveloped park user increases as the area decreases for both sets of area factors. For example, the maximum size of a circular hot spot that may be missed in a 500-ft by 500-ft certification unit with 16 samples laid out in a randomly placed systematic grid is about 25,000 $ft^2$. The area factor for a hot spot this size would approach 10. This means the uranium concentration in that limited area would have to approach 10 times the uranium FRL to produce the same level of risk to a roving receptor as the undeveloped park user at concentrations of one times the FRL in a Group 2 certification unit (250,000 $ft^2$). Similarly, soil concentrations in a 6,000 $ft^2$ unsampled area would need to exceed 40 times the FRL to match the risk from exposure to one times the FRL in soil in a Group 2 (250,000 $ft^2$) certification unit. Figure G-3 plots the relationship between area and the area factor in terms of FRL. Above the 30 times value, the health effects calculations (shown by the dotted line) are provide for reference only, since they are superceded by the DOE directed limit of 30 times the FRL.

This exercise is not intended to justify leaving such material in place, but rather to point out that inadvertently leaving a few isolated hot spots does not necessary result in unacceptable risks to users of the site. The "Manual for Implementing Residual Radioactive Material Guidelines Using RESRAD" (DOE 1993a) states that: "Every reasonable effort shall be made to identify and remove any source that

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has a radionuclide concentration exceeding 30 times the authorized limit, irrespective of area." ALARA implies that it is desirable to minimize the possibility that hot spots will remain after excavation.

G.3.2 Role of Scanning

The proper use of wide area scanning such as RTRAK at the FEMP will greatly reduce the possibility that hot spots will remain undetected. A hot spot is an identifiable area of soil containing radionuclide activity that is elevated when compared to surrounding areas. The ability of available instrumentation to detect such areas depends on the amount of activity in the area and the size of the area. Larger areas are easier to detect than smaller areas with the same activity, and areas with higher activity are easier to detect than similar sized areas with less activity.

Recent work with the RTRAK and other large volume NaI detectors and the HPGe systems currently deployed at the FEMP indicate that these systems can be used to identify areas of soil containing elevated uranium concentrations. Running at 1 mph and using a spectrum acquisition time of 4 seconds allows these systems to discriminate uranium, radium-226 and thorium-232 concentrations at levels equal to three times the Operable Unit 5 FRL in areas larger than 300 $ft^2$ (DOE 1997). These performance-based screening levels, presented in Table G-16 are much lower than the health-based limits derived by the scoping calculation presented in Section G.2.1.

Because area scanning will be able to reliably detect the activity from most hot spots, and procedures such as the ones described in the precertification activities defined in Section 3.0 of the SEP will be in place to remove the soil in those areas if required, then the scanning technology can be used to provide assurance that no areas between the fixed sampling points will exceed the hot-spot criteria. Since these criteria are well below the health based limits for contamination in small areas, this provides additional confidence the final certification decision is health protective.

Scanning with large-volume NaI detectors currently available at the FEMP will be sufficient to detect elevated areas of radioactivity in surface soils. This technology, when combined with direct measurements taken by HPGe instrumentation and supplemented by discrete soil sampling and analysis, will be adequate to identify elevated areas that may pose a health risk. This implies that the combination of RTRAK scanning, selective use of the HPGe to characterize areas of elevated activity,

and the sampling and analysis of discrete soils samples taken on a random sampling pattern for certification will be sufficient to certify that the remediation has met the specific certification criteria set forth for soils.

G.3.3 Implementation of FEMP-Specific Hot Spot Criteria

Section 3.4.6 summarizes the hot spot criteria to be evaluated during precertification and certification activities. The hot spot criteria will be evaluated with the RTRAK and HPGe instruments for the primary radiological COCs (i.e., uranium, thorium, and radium), as well as by the collection and analysis of physical samples. The User Guidelines, Measurement Strategies, and Operational Factors for Deployment of In Situ Gamma Spectrometry at the Fernald Site (DOE 1998) provides details on the set up and collection of data when the RTRAK and HPGe are used during the precertification and certification process.

During precertification scanning, two-point averages will be calculated from RTRAK measurements for the primary COCs and the averages will be compared to values corresponding to three times the FRL to make the hot-spot decision. Areas that exceed three times the FRL will be scanned again with the HPGe instrument to confirm and delineate the hot spot area. If the HPGe measurements confirm the existence of a hot spot (i.e., three times the FRL), the hot spot will be excavated and the scanning will be repeated until the area is precertified as free of hot spots.

During the certification activities, several hot spot criteria are evaluated when any individual laboratory sample result indicates a COC is greater than two times its FRL. First, HPGe measurements are taken above the sample location and surrounding area to delineate the hot spot area. If these measurements indicate any primary COC has exceeded 30 times its FRL, the hot spot is excavated. When this initial evaluation is passed, the hot spot is evaluated with respect to the area represented by the HPGe measurement. If the area is less than $10m^2$ and any primary COC exceeds a value of three times the FRL, the delineated hot spot area will be excavated. When the area is greater than $10\ m^2$, the hot spot criterion is defined as greater than two times the FRL. Failure to meet any of the above criteria will result in excavation of the hot spot followed by an additional round of sampling and analysis to demonstrate all certification criteria have been met.

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## TABLE G-1

## BACKGROUND SURFACE SOIL SUMMARY STATISTICS

| Analyte | Number of Samples | Number Detected | Statistical Distribution | 95% UCL on the Mean[1] |
|---|---|---|---|---|
| Radium-226 | 30 | 30 | Normal | 1.223 |
| Radium-228 | 30 | 30 | Undefined | 1.101 |
| Thorium-228 | 30 | 29 | Normal | 1.119 |
| Thorium-232 | 30 | 30 | Lognormal | 1.08 |
| Uranium, Total[2] | 30 | 30 | Normal | 3.27 |
| | | | | |
| Cesium-137 | 30 | 30 | Lognormal | 0.443 |
| Lead-210 | 30 | 30 | Lognormal | 1.005 |
| Strontium-90 | 30 | 0 | - | - |
| Thorium-230 | 30 | 29 | Normal | 1.496 |
| | | | | |
| Arsenic | 26 | 26 | Lognormal | 6.03 |
| Beryllium | 14 | 1 | Undefined | 0.31 |
| Lead | 27 | 27 | Lognormal | 18.24 |

Source: CERCLA/RCRA Background Soil Study, (DOE 1993b).

[1] All radionuclides are given in pCi/g; total uranium, arsenic, beryllium and lead are given in mg/kg.
[2] Total uranium was not included in the Background Soil Study and has been calculated from the original background data.

## TABLE G-2

## BACKGROUND SUBSURFACE SOIL SUMMARY STATISTICS

| Analyte | Sample Depth Interval | Number of Samples | Number Detected | Statistical Distribution | 95% UCL on the Mean |
|---|---|---|---|---|---|
| Radium-226 | 36"-42" | 30 | 30 | Undefined | 1.021 |
| | 48"-54" | 21 | 21 | Undefined | 0.923 |
| Radium-228 | 36"-42" | 30 | 30 | Lognormal | 0.911 |
| | 48"-54" | 21 | 21 | Lognormal | 0.865 |
| Thorium-228 | 36"-42" | 30 | 25 | Normal | 0.955 |
| | 48"-54" | 21 | 16 | Normal | 0.856 |
| Thorium-232 | 36"-42" | 30 | 20 | Undefined | 0.91 |
| | 48"-54" | 21 | 16 | Normal | 0.846 |
| Uranium, Total* | 36"-42" + 48"-54" | 51 | - | Normal | 2.572 |
| Cesium-137 | 36"-42" | - | - | - | - |
| | 48"-54" | - | - | - | - |
| Lead-210 | 36"-42" | 30 | 26 | Undefined | 0.658 |
| | 48"-54" | 21 | 17 | Undefined | 0.684 |
| Strontium-90 | 36"-42" | 30 | 0 | - | - |
| | 48"-54" | 21 | 1 | Undefined | 0.283 |
| Thorium-230 | 36"-42" | 30 | 26 | Normal | 1.268 |
| | 48"-54" | 21 | 19 | Normal | 1.311 |

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**TABLE G-2**

**BACKGROUND SUBSURFACE SOIL SUMMARY STATISTICS**
**(Continued)**

| Analyte | Sample Depth Interval | Number of Samples | Number Detected | Statistical Distribution | 95% UCL on the Mean |
|---|---|---|---|---|---|
| Arsenic | 36"-42" | 26 | 26 | Lognormal | 6.77 |
| | 48"-54" | 18 | 18 | Normal | 5.42 |
| Beryllium | 36"-42" | 30 | 9 | Undefined | 0.37 |
| | 48"-54" | 20 | 6 | Undefined | 0.4 |
| Lead | 36"-42" | 28 | 28 | Lognormal | 10.93 |
| | 48"-54" | 19 | 19 | Normal | 8.8 |

Source: CERCLA/RCRA Background Soil Study, (DOE 1993b).

[1] All radionuclides are given in pCi/g; total uranium, arsenic, beryllium and lead are given in mg/kg.
[2] Total uranium was not included in the Background Soil Study and has been calculated from the original background data.

## TABLE G-3

## COMPARISON OF ESTIMATED RESIDUAL SOIL STANDARD DEVIATIONS TO BACKGROUND SOIL STANDARD DEVIATIONS*

| Analyte | Surface Soil Background | Subsurface Soil Background | Less than 2 x FRL Soil Data File | Less than 3 x FRL Soil Data File |
|---|---|---|---|---|
| Radium-226 pCi/g | 0.15 | 0.24 | 0.45 | 0.49 |
| Radium-228 pCi/g | 0.12 | 0.27 | 0.38 | 0.38 |
| Thorium-228 pCi/g | 0.23 | 0.32 | 0.50 | 0.52 |
| Thorium-232 pCi/g | 0.19 | 0.32 | 0.36 | 0.39 |
| Uranium, total mg/kg | 0.32 | 0.58 | 12.60 | 13.90 |
| Arsenic mg/kg | 1.98 | 2.45 | 2.96 | 2.96 |
| Beryllium mg/kg | 0.06 | 0.16 | 0.42 | 0.45 |

* Calculated assuming a normal distribution for comparison purposes.

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## TABLE G-4

## SIGN TEST PROBABILITIES FOR THE BINOMIAL DISTRIBUTION

| | Sample Population[a] | | | | | | |
|---|---|---|---|---|---|---|---|
| *B* | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 0 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 1 | 0.011 | 0.006 | 0.003 | 0.002 | 0.001 | 0.000 | 0.000 |
| 2 | 0.055 | 0.033 | 0.019 | 0.011 | 0.006 | 0.004 | 0.002 |
| 3 | 0.172 | 0.113 | 0.073 | 0.046 | 0.029 | 0.018 | 0.011 |
| 4 | 0.377 | 0.274 | 0.194 | 0.133 | 0.090 | 0.059 | 0.038 |
| 5 | 0.623 | 0.500 | 0.387 | 0.291 | 0.212 | 0.151 | 0.105 |
| 6 | | | 0.613 | 0.500 | 0.395 | 0.304 | 0.227 |
| 7 | | | | | 0.605 | 0.500 | 0.402 |
| 8 | | | | | | | 0.598 |

[a] Excluding sample results that are equal to the FRL.

## TABLE G-5

## PROPOSED MAXIMUM NUMBER OF NONDETECTS FOR A GIVEN SAMPLE SIZE

| Sample Size | Number of Nondetects | Percentage of Nondetects |
|---|---|---|
| 8 | 1 | 13% |
| 9 | 1 | 11% |
| 10 | 2 | 20% |
| 11 | 2 | 18% |
| 12 | 2 | 17% |
| 13 | 2 | 15% |
| 14 | 2 | 14% |
| 15 | 3 | 20% |
| 16 | 3 | 19% |

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## TABLE G-6

## ESTIMATED SAMPLE POPULATIONS FOR A TYPE II ERROR RATE OF 20%

Remnant Data Less Than 2 Times the FRL

| | Type I Error Rate = 5% | | | | | |
|---|---|---|---|---|---|---|
| | FRL[1] | LBGR[2] | SD | calc N | N | N+20% |
| Radium-226 | 1.7 | 1.275 | 0.448 | 6.87 | 7 | 9 |
| Radium-228 | 1.8 | 1.350 | 0.376 | 4.32 | 5 | 6 |
| Thorium-228 | 1.7 | 1.275 | 0.498 | 8.49 | 9 | 11 |
| Thorium-232 | 1.5 | 1.125 | 0.364 | 5.83 | 6 | 8 |
| Uranium, total[3] | 82 | 61.50 | 12.6 | 2.34 | 3 | 4 |
| Uranium, total | 50 | 37.50 | 12.6 | 6.28 | 7 | 9 |
| Arsenic | 12 | 9.000 | 2.96 | 6.02 | 7 | 9 |
| Beryllium | 1.5 | 1.125 | 0.419 | 7.72 | 8 | 10 |

| | Type I Error Rate = 10% | | | | | |
|---|---|---|---|---|---|---|
| | FRL | LBGR | SD | calc N | N | N+20% |
| Radium-226 | 1.7 | 1.275 | 0.448 | 5.01 | 6 | 8 |
| Radium-228 | 1.8 | 1.350 | 0.376 | 3.15 | 4 | 5 |
| Thorium-228 | 1.7 | 1.275 | 0.498 | 6.19 | 7 | 9 |
| Thorium-232 | 1.5 | 1.125 | 0.364 | 4.25 | 5 | 6 |
| Uranium, total | 82 | 61.50 | 12.6 | 1.70 | 2 | 3 |
| Uranium, total | 50 | 37.50 | 12.6 | 4.58 | 5 | 6 |
| Arsenic | 12 | 9.000 | 2.96 | 4.39 | 5 | 6 |
| Beryllium | 1.5 | 1.125 | 0.419 | 5.63 | 6 | 8 |

[1] All radionuclides are given in pCi/g; total uranium, arsenic, and beryllium are given in mg/kg.
[2] LBGR is calculated as 75% of the FRL (i.e., 0.75 x FRL).
[3] Total uranium was not included in the Background Soil Study and has been calculated from the original background data.

FRL = Final remediation level
LBGR = Lower bound of the gray region
N = Size of sample population
SD = Standard deviation

# TABLE G-7

## ESTIMATED SAMPLE POPULATIONS FOR A TYPE II ERROR RATE OF 20%

Remnant Data Less Than 3 Times the FRL

| Type I Error Rate = 5% | | | | | | |
|---|---|---|---|---|---|---|
| | FRL | LBGR | Stand. Dev. | calc N | N | N+20% |
| Radium-226 | 1.7 | 1.275 | 0.492 | 8.29 | 9 | 11 |
| Radium -228 | 1.8 | 1.350 | 0.376 | 4.32 | 5 | 6 |
| Thorium-228 | 1.7 | 1.275 | 0.515 | 9.08 | 10 | 12 |
| Thorium-232 | 1.5 | 1.125 | 0.387 | 6.59 | 7 | 9 |
| Uranium, total[3] | 82 | 61.50 | 13.9 | 2.84 | 3 | 4 |
| Uranium, total | 50 | 37.50 | 13.9 | 7.65 | 8 | 10 |
| Arsenic | 12 | 9.000 | 2.96 | 6.02 | 7 | 9 |
| Beryllium | 1.5 | 1.125 | 0.451 | 8.95 | 9 | 11 |

| Type I Error Rate = 10% | | | | | | |
|---|---|---|---|---|---|---|
| | FRL | LBGR | Stand. Dev | calc N | N | N+20% |
| Radium-226 | 1.7 | 1.275 | 0.492 | 6.05 | 7 | 9 |
| Radium-228 | 1.8 | 1.350 | 0.376 | 3.15 | 4 | 5 |
| Thorium-228 | 1.7 | 1.275 | 0.515 | 6.62 | 7 | 9 |
| Thorium-232 | 1.5 | 1.125 | 0.387 | 4.80 | 5 | 6 |
| Uranium, total | 82 | 61.50 | 13.9 | 2.07 | 3 | 4 |
| Uranium, total | 50 | 37.50 | 13.9 | 5.58 | 6 | 8 |
| Arsenic | 12 | 9.000 | 2.96 | 4.39 | 5 | 6 |
| Beryllium | 1.5 | 1.125 | 0.451 | 6.53 | 7 | 9 |

[1] All radionuclides are given in pCi/g; total uranium, arsenic, and beryllium are given in mg/kg.
[2] LBGR is calculated as 75% of the FRL (i.e., 0.75 x FRL).
[3] Total uranium was not included in the Background Soil Study and has been calculated from the original background data.

FRL = Final remediation level
LBGR = Lower bound of the gray region
N = Size of sample population
SD = Standard deviation

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## TABLE G-8

## ESTIMATED TARGET LEVELS (LBGR) REQUIRED FOR A SAMPLE SIZE OF 12:
**Type I Error Rate = 5% (* = 10%);**

**Type II Error rate = 0.20**

| | | Less than 2 times the FRL | | Less than 3 times the FRL | |
|---|---|---|---|---|---|
| Analyte | FRL | LBGR % of FRL | LBGR | LBGR % of FRL | LBGR |
| Radium-226 (pCi/g) | 1.7 | 79% | 1.34 | 77% | 1.31 |
| Radium-228 (pCi/g) | 1.8 | 83% | 1.49 | 83% | 1.49 |
| Thorium-228 (pCi/g) | 1.7 | 76% | 1.29 | 76% | 1.29 |
| Thorium-232 (pCi/g) | 1.5 | 80% | 1.20 | 79% | 1.19 |
| Uranium, total (mg/kg) | 82 | 87% | 71.3 | 86% | 70.5 |
| Uranium, total (mg/kg) | 50 | 80% | 40.0 | 78% | 39.0 |
| Arsenic (mg/kg)* | 12 | 83% | 9.96 | 83% | 9.96 |
| Beryllium (mg/kg)* | 1.5 | 81% | 1.22 | 79% | 1.19 |

## TABLE G-9

## VARIATION OF SAMPLE POPULATION WITH CHANGE IN PARAMETER

| Parameter | Increase Value | Decrease Value |
|---|---|---|
| Type II Error | Fewer Samples | More Samples |
| Target Level | More Samples | Fewer Samples |
| Estimated Standard Deviation | More Samples | Fewer Samples |

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## TABLE G-10

## COMPARISON OF AREA 1, PHASE I CERTIFICATION RESULTS TO ESTIMATES USED IN THE DETERMINATION OF SAMPLE SIZE

| Primary COCs | FRL | Avg. CU Mean | % FRL | Remnant SD (2x FRL) | Avg. CU St. Dev. | % Remnant |
|---|---|---|---|---|---|---|
| Radium-226 (pCi/g) | 1.7 | 1.210 | 71.2% | 0.448 | 0.188 | 42.0% |
| Radium-228 (pCi/g) | 1.8 | 1.241 | 69.0% | 0.376 | 0.208 | 55.2% |
| Thorium-228 (pCi/g) | 1.7 | 1.224 | 72.0% | 0.498 | 0.175 | 35.2% |
| Thorium-232 (pCi/g) | 1.5 | 1.117 | 74.5% | 0.364 | 0.150 | 41.1% |

| Secondary COCs | FRL | Avg. CU Mean | % FRL | Remnant SD 2x FRL | Avg. CU St. Dev. | % Remnant |
|---|---|---|---|---|---|---|
| Uranium, total (mg/kg) | 82 | 11.712 | 14.3% | 12.602 | 6.625 | 52.6% |
| Arsenic (mg/kg) | 12 | 8.310 | 69.2% | 2.962 | 2.258 | 76.2% |
| Beryllium (mg/kg) | 1.5 | 0.648 | 43.2% | 0.419 | 0.271 | 64.8% |

## TABLE G-11

## SITE-SPECIFIC VALUES IN RESRAD AREA SIZE ANALYSES

| Parameter Name | ID | Value | Units | Reference |
|---|---|---|---|---|
| Exposure Duration | ED | 38 | y/life | OU5 FS |
| Exposure Frequency | EF | 40 | d/y | OU5 FS |
| Exposure Time | ET | 2 | h/d | OU5 FS |
| Inhalation Rate | IRair | 0.83 | m3/h | OU5 FS (20/24) |
| | IRair | 66.7 | m3/y | 0.8333*2*40 |
| Soil Ingestion Rate | IRsoil | 13 | mg/d | OU5 FS |
| | IRsoil | 0.52 | g/y | 40*13/1000 |
| Soil Porosity | P | 0.457 | unitless | OU5 RI Appendix A.VIII-5 |
| Effective Porosity | | 0.25 | | OU5 FS |
| Density of Contaminated Zone | RHO | 1.44 | g/cm | OU5 RA |
| Radon Emanation Fraction | E | 0.2 | unitless | OU5 RI Appendix A.VIII-5 |
| Radon Diffusion Coefficient | D | -1 | cm2/s | Flag indicating code calcs |
| Thickness of Contaminated Zone | | 0.45 | m | OU5 FS |
| Erosion Rate | | 0.00001 | m/y | OU5 FS |
| Hydraulic Conductivity | | 22 | m/y | OU5 FS |
| Mass Loading in Air | | 2.00E-05 | g/m3 | OU5 FS |

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## TABLE G-12

## RTRAK PERFORMANCE AT THE FRL AND AT THREE TIMES THE FRL (DOE 1997)

| | Ra-226 (pCi/g) | | | Th-232 (pCi/g) | | | Total U (ppm) | | |
|---|---|---|---|---|---|---|---|---|---|
| Activity Level | Error (pCi/g) | Averaging Radius (ft) | # of points | Error (pCi/g) | Averaging Radius (ft) | # of points. | Error (pCi/g) | Averaging Radius (ft) | # of points |
| FRL | 0.17 | 20 | 25 | 0.15 | 10 | 12 | 8 | 40 | 100 |
| 3 x FRL | 0.51 | 10 | 12 | 0.45 | 8 | 5 | 24 | 25 | 45 |

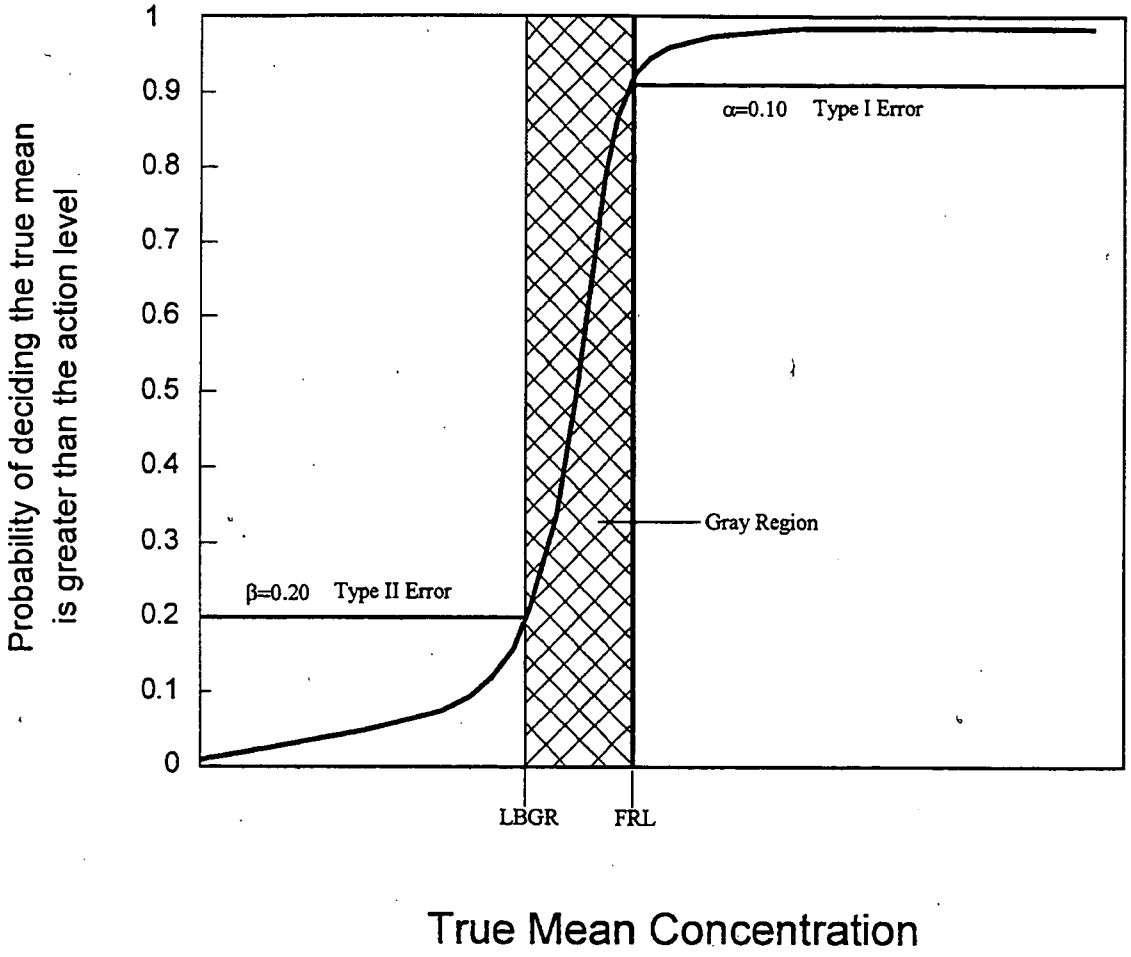


**FIGURE G-1 EXAMPLE OF A POWER CHART ILLUSTRATING TYPE I AND II ERRORS AND GRAY REGION**

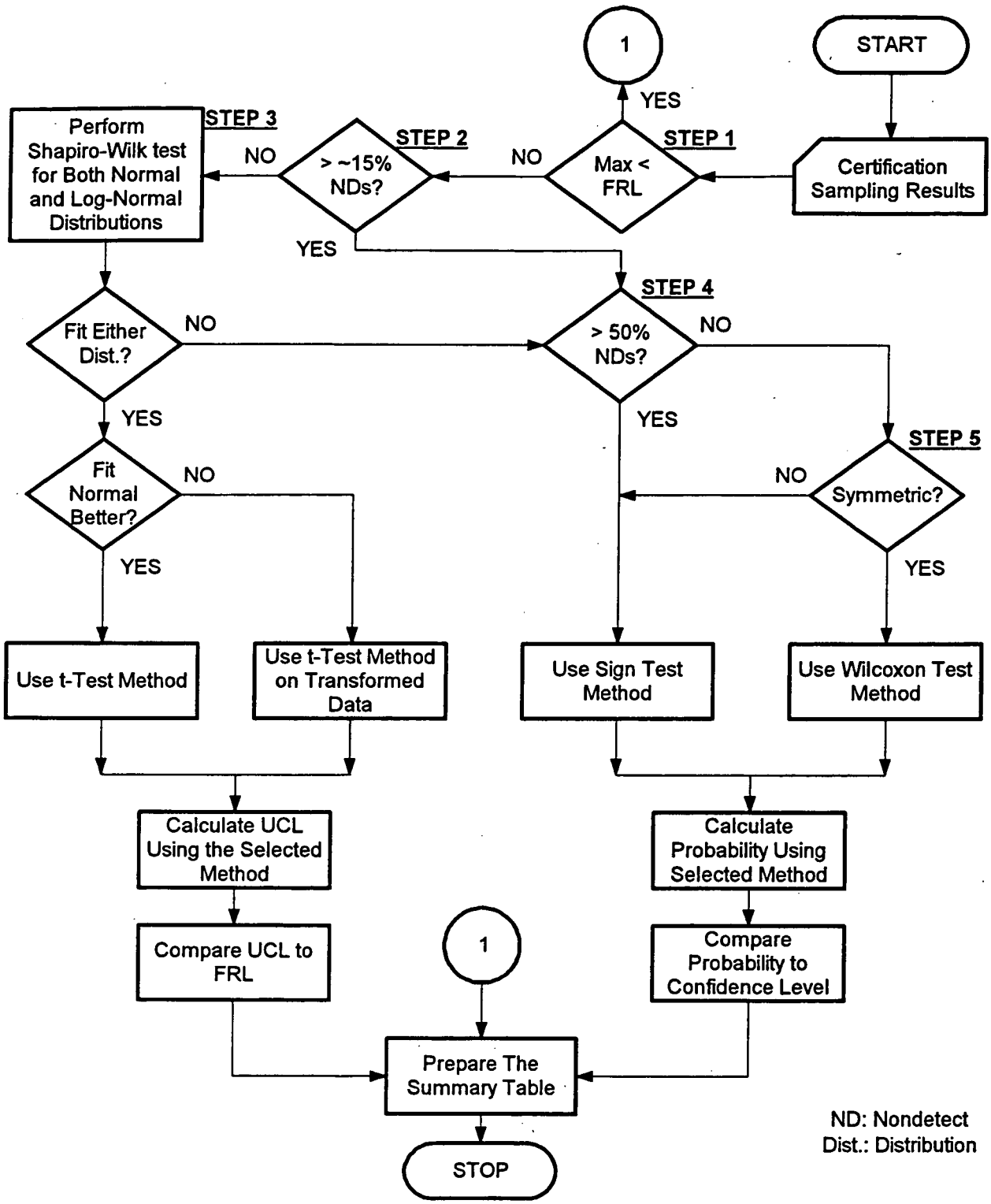


FIGURE G-2 SELECTION PROCEDURE FOR THE CERTIFICATION STATISTICAL ANALYSIS METHOD

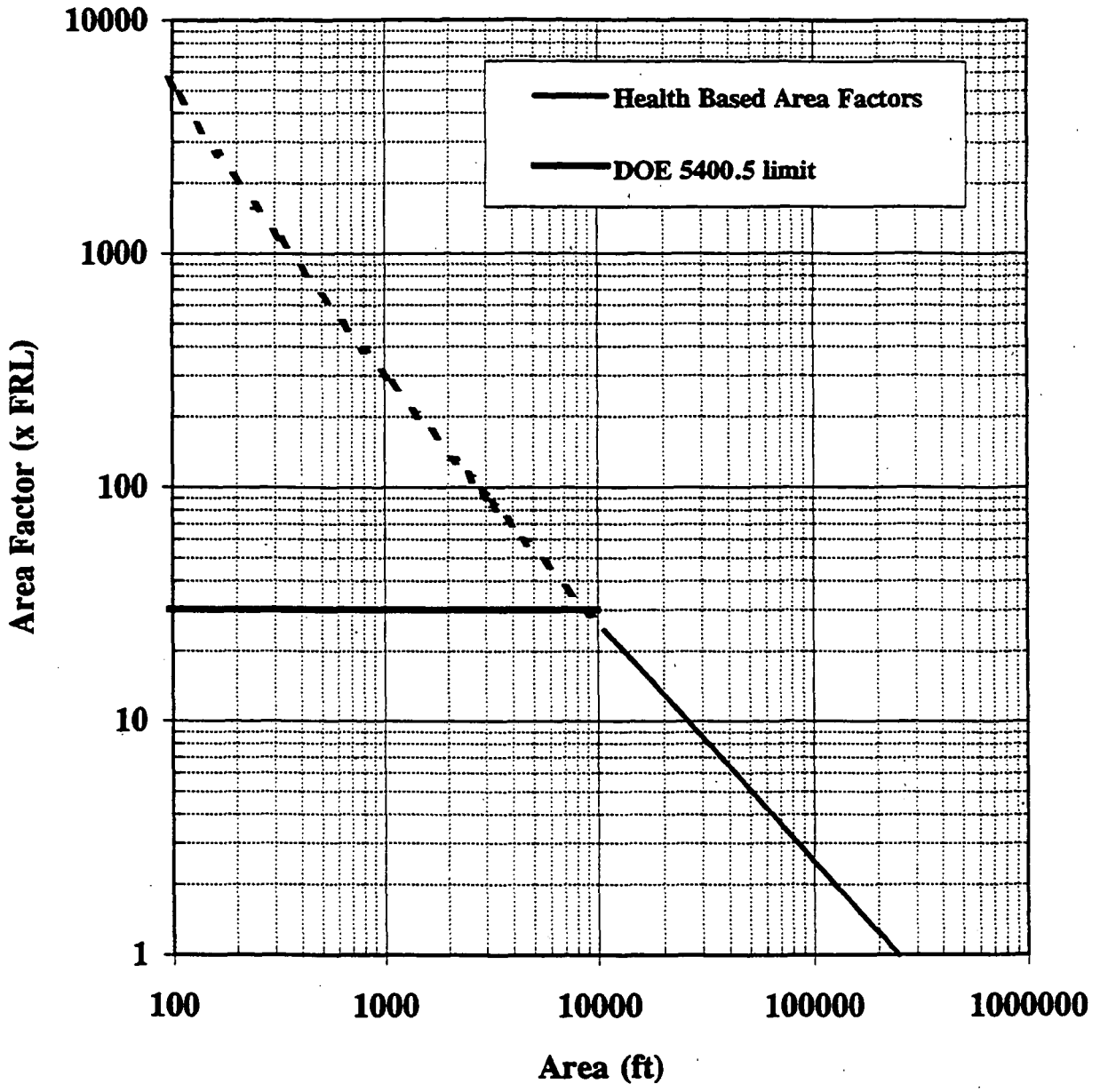


FIGURE G-3 SITE-SPECIFIC AREA FACTORS FOR A ROVING UNDEVELOPED PARK USER BASED ON HEALTH EFFECTS AND DOE ORDER 5400.4 UPPER LIMIT OF 30 TIMES THE GUIDELINE LIMIT

# APPENDIX H

## SUMMARY OF FIELD MEASUREMENT AND LABORATORY ANALYTICAL TECHNOLOGIES

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# LIST OF ACRONYMS

| | |
|---|---|
| ALARA | as low as reasonably achievable |
| ASL | analytical support level |
| ASTM | American Society of Testing and Materials |
| BTEX | benzene, toluene, ethylbenzene, xylene |
| COC | constituent of concern |
| CFR | Code of Federal Regulations |
| CLP-SOW | contract laboratory program statement of work |
| ECD | electron capture detector |
| EPA | U.S. Environmental Protection Agency |
| FEMP | Fernald Environmental Management Project |
| FID | flame ionization detector |
| FRL | final remediation level |
| GCECD | gas chromatography/electron capture detector |
| GCMS | gas chromatography/mass spectroscopy |
| GS | gas chromatography |
| HAMDC | highest allowable minimum detectable concentration |
| HPGe | high purity germanium detector |
| HRMS | high resolution mass spectroscopy |
| ICP | inductively coupled plasma |
| KeV | kiloelectron volts |
| LIMS | laboratory information management system |
| LCS | liquid scintillation counter |
| MeV | million electron volts |
| MS | mass spectroscopy |
| nm | nanometers |
| OSDF | On-Site Disposal Facility |
| OVA | organic vapor analyzer |
| OU | operable unit |
| PAH | polyaromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PID | photoionization detector |
| ppm | parts per million |
| PQL | practical quantitation limit |
| QC | quality control |
| RCRA | Resource Conservation and Recovery Act |
| RI/FS | remedial investigation/feasibility study |
| ROD | Record of Decision |
| RTRAK | real-time radiation tracking system |
| SCQ | Sitewide CERCLA Quality Assurance Project Plan |
| SW-846 | Solid Waste, Tracking No. 846 |
| TAT | turn-around time |
| TCE | trichloroethene |
| TCLP | toxicity characteristic leaching procedure |
| TPH | total petroleum hydrocarbons |

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## LIST OF ACRONYMS
## (Continued)

| | |
|---|---|
| VOC | volatile organic compound |
| WAC | waste acceptance criteria |
| XRF | X-ray fluorescence |

## H.1 INTRODUCTION

Physical sampling and analysis of environmental media samples collected on site and off site during the Remedial Investigation/Feasibility Study (RI/FS) resulted in the identification of media-specific contaminants of concern (COCs). Final remediation levels (FRLs) for these COCs were established in the Operable Unit 2 and Operable Unit 5 Records of Decision (RODs). Successful remediation of soil and other contaminated media will rely on physical samples being tested in on-site and off-site analytical laboratories. The purpose of this appendix is to present sufficient information on analytical methods to allow the engineering and characterization staff to correctly select analytical methods during the design phase.

Analytical testing of physical samples during remediation is performed for a variety of reasons including:

- Predesign Investigations
  Predesign sampling and analytical testing is utilized when additional contaminant information is needed for engineering and construction design.

- Attainment of Waste Acceptance Criteria (WAC)
  Physical samples and or real-time readings are required to demonstrate that soil and soil-like material destined for the On-Site Disposal Facility (OSDF) meets the chemical WAC.

- Precertification
  Physical samples may be obtained and analyzed during precertification to ensure all contaminated media has been removed prior to obtaining certification samples.

- Certification
  Physical samples are obtained and analytical testing is conducted on samples taken after excavation is completed. Certification sample results are subjected to statistical analysis to demonstrate whether or not the cleanup levels (FRLs) have been met.

The soil COCs include representatives from the following classes of analytes:

1) Radionuclides - including the primary contaminants total uranium, thorium-232, thorium-228, radium 226, and radium-228, and secondary contaminants such as technetium-99.

2) Inorganic metals - including the metal contaminants arsenic, lead, and beryllium.

3) Organic compounds - include volatiles like benzene and trichloroethene (TCE), and semi volatiles like polyaromatic hydrocarbons (PAHs).

## H.2 LABORATORY ANALYTICAL METHODS

For the purposes of this appendix, laboratory analytical methods can be discussed by analyte class since most methods are specific to one class of analyte. The selection of the actual analytical methods used for a particular task will be dependent on a variety of factors that must be considered during project design, including:

- Type of media being analyzed
- Level of contamination demonstrated or suspected in the media
- Analytical target level(s) including FRL and WAC concentrations
- Level of accuracy desired or required
- Turnaround time needed
- Validation level to be attained
- Cost of analytical testing
- Regulatory commitments
- Laboratory capacity

Successful remediation of the FEMP site depends on an integrated approach that combines the application of analytical techniques with engineering and construction schedules. This appendix provides a variety of analytical techniques that will be utilized by project personnel to screen and analyze COCs during predesign, precertification and certification activities. The analytical techniques include, but are not limited to, gamma spectroscopy, alpha spectroscopy, gas proportional counting, liquid scintillation counting, colorimetry, gas chromatography (GC), ion chromatography, inductively coupled plasma (ICP) atomic emission spectroscopy, mass spectroscopy (MS), atomic absorption spectroscopy, X-ray fluorescence (XRF), selective ion electrode, and photoionization detector (PID).

The analytes of interest can be divided into two categories, chemical and radiochemical. Analytical requirements for each of these are different. An example of a set of laboratory analytical requirements for identification and quantification of chemical analytes are the EPA guidance documents SW-846, promulgated in July 1997, and the contract laboratory program statement of work (CLP-SOW), promulgated in August 1994. However, the EPA has not provided guidance for the identification and quantification of radionuclides. This has lead to two approaches for performing laboratory analysis: reference method specifications for chemical analyses versus performance based specifications for radiological analyses. Table G-1 of the FEMP Sitewide CERCLA Quality Assurance Plan (SCQ)

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contains the EPA method number for chemical analyses with its corresponding ASL level, while Table G-4 of the SCQ contains the performance specifications for radiological analyses. It should be noted that any deviation from the QC requirements listed in the SCQ results in defaulting the laboratory analysis to ASL E, and the change to the QC requirement will be noted. A brief summary of the two approaches is provided.

The reference methods for environmental chemical analyses are usually contained in SW-846 and the contract laboratory program statement of work (CLP-SOW). Standard Methods, 40 CFR and ASTM are additional reference guidance documents that may be permissible for use in selection of analytical reference methodology. The reference methods are prescriptive in that they generally contain initial calibration criteria, method acceptance criteria, method detection limits, practical quantitation limits, contract required detection limits, quality control criteria and type of detection systems.

Laboratory radiological analyses are based upon performance based specifications, which are criteria consisting of the highest allowable minimum detectable concentration (HAMDC), percent overall tracer/chemical recovery, percent matrix spike recovery, method blank concentration, percent recovery of laboratory control sample, and percent recovery for duplicate samples. Each of these criteria is affected by the matrix and ASL requirements. The performance based approach for radiological analyses allows the laboratory to choose how the analyte of interest will be analyzed. The choice of instrumentation, sample preparation, and quantification of final results are left to the discretion of the laboratory. Quantification of the analyte of interest is based on meeting the performance specifications.

DOE may in the future modify the performance based approach for radiological analyses. Performance based specifications for the appropriate ASL will not be changed, but the flexibility given to the laboratory may be restricted to reflect a more prescriptive approach. The prescriptive approach will incorporate the counting methodology, sample preparation, sample extraction, and quantification for the analyte of interest. This will result in consistent analytical results and better data comparability, especially for radionuclides that can be analyzed by more than one radiological technique (e.g., uranium-238 and thorium-232, Table H-1).

### H.2.1 Radionuclide Analytical Methods

Radionuclides can be divided into different classifications based on the mode of decay. The two principal modes of decay are alpha emission and beta emission, which can be accompanied by the release of gamma photons. Table H-1 summarizes common analytical methods used to measure the distinct decay modes and associated gamma photons. Uranium-238, uranium-235, uranium-234, thorium-232, thorium-230, thorium-228, radium-226, neptunium-237, and plutonium-238 are alpha emitters, and some of these nuclides have gamma photons associated with the emission of the alpha particle. Potassium-40, strontium-90, technetium-99, cesium-137, lead-210, and radium-228 are beta emitters. Potassium-40, cesium-137, and radium-228 are quantified by the gamma photons associated with their beta decay or by the decay of a daughter (Table H-1). It should be noted from Table H-1 that some alpha emitters can be quantified by measuring their gamma emitting daughters. A brief discussion of the techniques available for radionuclide analyses follows.

#### Alpha Spectroscopy

Alpha spectroscopy is used to quantify the activity of a radionuclide that decays by alpha emission (i.e., emission of a helium nucleus). Radionuclides of interest at the FEMP that can be characterized by alpha spectroscopy are listed in Table H-1. The alpha emission occurs at discrete energy levels that are characteristic of the specific isotope and generally range from 3 to 8 million electron volts (MeV). Alpha particles are easily absorbed by the matrix of the sample, due to the very weak penetration of the associated radiation. Therefore, a chemical separation is required prior to analysis to isolate the nuclide of interest. The separation process consists of a mineral acid digestion of the sample and separation of the element of interest utilizing ion exchange resin. After separation, a thin and uniform film of the nuclide is evaporated on a slide for counting under high vacuum conditions. As opposed to gamma spectroscopy, where the daughter products may be measured and the parent concentration is back calculated, alpha spectroscopy only measures the activity of the isotope of interest. Alpha spectroscopy is used when the analyte of interest is an alpha emitter and when a lower limit of detection is needed.

#### Gamma Spectroscopy

Gamma spectroscopy can be utilized to quantify some radioisotopes and/or their daughters by detecting characteristic gamma photons emitted by the nuclide or its daughter during alpha or beta decay. Radionuclides of interest at the FEMP that can be characterized using gamma spectroscopy are listed in

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Table H-1. Gamma photons are highly penetrating radiation, and samples can be analyzed by this technique without any chemical preparation other than homogenizing the samples. After homogenizing the sample, it is placed in a standardized geometry within a shielded area housing the gamma detector and counting commences. The characteristic energy of the gamma photon associated with the nuclide and/or its daughter is measured in thousands of electron volts (KeV) by "counts" that are quantified via collection in a multichannel pulse height analyzer.

Gas Proportional Counting

Gas proportional counting is suitable for determining gross alpha activity and gross beta activity. Alpha/beta differentiation is based on the detector energy plateau for each type of particle. The alpha energy plateau is approximately 400 to 500 volts and the beta energy plateau is approximately 1,400 to 1,500 volts. Beta decay is based on an energy distribution or continuum up to an energy maximum (E max), in contrast to discrete energy levels characteristic of alpha and gamma radiation. The shape of the energy distribution is comparable to a skewed bell curve, with maximum energy (i.e., E max) corresponding to its zenith. Because of this phenomena, discrete energy of the characteristic isotope cannot be quantified thus the term "gross" beta is used. Therefore, when gross alpha/beta activity is measured it represents the entire (gross) activity contributed by all alpha and beta emitting radionuclides. Gross beta counts can be used to quantify a specific "pure" beta emitter if the extraction process can isolate the analyte of concern. This analytical technique is commonly used for analysis of technetium-99, strontium-90, and lead-210.

Liquid Scintillation Counting

Liquid scintillation counting is a technique that is applicable to all forms of nuclear emissions. It is an analytical technique which measures radionuclide activity by the rate of emission of light photons in a scintillating matrix. The scintillator solution (cocktail) consists of the scintillating solute, a solvent, and the dissolved sample. The solute and solvent are usually organic compounds. A prepared sample is placed in a vial and then placed into the instrument called a liquid scintillation counter (LSC) to perform the counting. This technique is commonly applied to the low energy beta emitters technetium-99, strontium-90, and lead-210. There is not a clear preference for the use of liquid scintillation versus gas proportional counting, and the use of one method over the other is generally a function of laboratory equipment or protocol.

Colorimetry

Colorimetry is a spectrophotometric method based on Beer's Law. Beer's Law relates the absorbency of a sample to its concentration, path length, and molar absorptivity. For a compound to be analyzed by spectrophotometry, it must absorb light, and this absorption should be a distinct wavelength of light for the analyte of interest in the sample. In order to quantify the amount of absorption in the sample, an instrument called a spectrophotometer is used, which generally has the capability to select the wavelength in nanometers (nm). A calibration curve is established using standards prepared at various concentrations. Quantification of the sample is calculated against the calibration curve. Colorimetry is used by the on-site laboratory for the determination of total uranium by FEMP Method 5512, titled "The Colorimetric (Br PADAP) Determination of Uranium Using an Auto Analyzer." It is commonly referred to as Bromo PADAP. This method is site specific and may not be procured at an off-site laboratory facility.

Inductively Coupled Plasma/Mass Spectroscopy (ICP\MS)

The ICP\MS is a unique instrument in that it has the capability to detect and quantify some radionuclides as well as detect and quantify metals. This technique quantifies on a mass basis as opposed to an energy basis. This instrument is very sensitive and can potentially quantify in the part per trillion range (i.e., nanogram per kilogram). The limiting factor for the quantification of radionuclides is the specific activity of the nuclide. If a radionuclide has a short half-life (i.e., a high specific activity), there is not enough mass for the instrument to detect when ALARA issues are considered. At the FEMP, uranium-235, uranium-238, and thorium-232 can be analyzed by ICP/MS, and the method is being expanded to analyze for technetium-99.

H.2.2 Chemical Analytes

Chemical analytes are divided into two broad classifications, inorganic and organic compounds. Further subdivision is needed in order to classify the analytes of interest by their analysis type. Inorganic elements and compounds are commonly divided into metals (e.g., calcium, iron, lead, etc.) and general chemistry (e.g., pH, alkalinity, chloride, sulfate, etc.). Organic compounds can be divided into volatiles, semi-volatiles, pesticides/PCBs, and dioxins/furans.

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H.2.2.1 Inorganic Analytical Methods for Metals

A variety of analytical methods can be used for metal analysis and the selection of one over another is generally tied to the practical quantitation limit (PQL) of the method and instrument and turn-around time (TAT). Table H-2 summarizes analytical methods and PQLs for metals that have established FRLs and WAC. The EPA guidance documents for some of these techniques are SW-846 promulgated in July 1997 and the contract laboratory program statement of work (CLP-SOW) promulgated in August 1994.

Inductively Coupled Plasma Emission Spectroscopy

Inductively coupled plasma (ICP) is a high-temperature plasma that derives its energy from an oscillating radio frequency field that is used to atomize a sample and then measure its emission spectrum. It is commonly used for metals analysis because it can detect a large number of elements simultaneously based on the distinct emission energy associated with ionizing a given element (Table H-2). When coupled to a mass spectrometer (i.e., ICP/MS), the instrument can be used to detect very low concentrations, commonly on the order of parts per trillion.

Atomic Emission Spectroscopy

Atomic emission spectroscopy is an analytical technique commonly used to quantify a broad list of metals (Table H-2). The instrument energy source atomizes the liquid sample and energy from a heat source is absorbed by the atoms. Excited atoms then release the absorbed energy in the form of light. Each element will release light of specific and characteristic wavelengths. The intensity of the light at the selected wavelength is measured to quantify the element.

Atomic Absorption Spectroscopy

Atomic absorption spectroscopy is an analytical technique commonly used to quantify metals (Table H-2). The instrument energy source dissociates a liquid sample into elements (i.e., atomized) and light of a selected wavelength is shined through the atoms. The element of interest absorbs the selected wavelength and the amount of light absorbed is proportional to the quantity of the element present. A graphite furnace is a hollow graphite rod that can be heated to decompose and atomize a sample for atomic absorption spectroscopy. Graphite furnace provides higher sensitivity because the entire sample is confined in the light path for a few seconds.

X-Ray Fluorescence

Flourescence is the process in which a molecule emits an energy photon shortly after absorbing a photon. X-ray fluorescence refers to the transition of electrons from higher energy levels to their ground state after excitation of the atoms by an x-ray source. Excitation is achieved by irradiating the sample with a beam of X-rays from an X-ray tube or radioactive source. X-ray fluorescence can be used to identify elements in solid material when the elements have atomic numbers greater than oxygen. A sample is usually prepared by drying and grinding the solid to a specified particle size followed by pressing the powder into pellets. This allows for sample geometry consistency. Sample geometry, sample density, moisture, and interfering elements can affect the identification and quantification of the analyte of interest. This analytical technique can be employed for qualitative, semiquantitative, and quantitative elemental analysis, and it may be used at the FEMP under specific conditions (e.g., a high FRL for a metal) when rapid TAT is essential.

H.2.2.2 Inorganic Analytical Methods for General Chemistry

The principal method used to characterize COCs at the FEMP that fall into the general chemistry category is liquid chromatography. Table H-3 contains FEMP constituents that are analyzed using liquid chromatography.

Liquid Chromatography

Liquid chromatography (a.k.a. ion chromatography) is the technique generally used for identification and quantification of anions and some cations (e.g., ammonium). Ion chromatography is sequential separation of anions and cations using ion-exchange resins. This technique is suitable for the separation and detection of common anions in groundwater (e.g., fluoride).

H.2.2.3 Organic Analytical Methods

Several analytical methods are used to quantitate organic compounds. The choice of method and sample preparation is determined by the physical properties of the compound, and the EPA has provided guidance documents for the separation methods, detection, identification, and quantification of the regulated analytes. The EPA guidance documents are SW-846 promulgated in July 1997 and the contract laboratory program statement of work (CLP-SOW) promulgated in August 1994. Tables H-4 through H-7 summarize the FEMP analytes of interest and PQLs.

Gas Chromatography/Mass Spectroscopy (GCMS)

Gas chromatography is the technique used in the identification and quantification of a variety of organic compounds (Tables H-4 and H-5). Samples are prepared for the gas-chromatography column by concentrating the organic compounds in the sample through extraction with an organic solvent, mass transfer of the compound from a solid or liquid phase to a gas phase, and/or synthesizing the initial compound into a new compound for easier detection (i.e., derivitization).

Gas Chromatography/Electron Capture Detector (GC/ECD)

The electron capture detector (ECD) usually is used for the analysis of compounds that have high electron affinities, such as chlorinated pesticides and PCBs. The detector is operated by passing the effluent from the gas chromatograph over a beta particle emitter, usually nickel-63 adsorbed on platinum foil. An electron from the emitter causes ionization of the carrier gas (often nitrogen) and the production of a burst of electrons. In the absence of organic compounds, a constant standing current between a pair of electrodes results from this ionization process. The current decreases in the presence of those organic compounds that tend to capture electrons. Table H-6 lists analytes of interest and PQLs.

High Resolution Mass Spectroscopy (HRMS)

High resolution mass spectroscopy is used to identify and quantify dioxins and furans. This technique uses magnetic sector mass spectroscopy as opposed to the quadrupole technique. The magnetic sector mass spectrometer has a resolution on the order of 0.001 atomic mass units. These analyzers employ a permanent or electromagnet to cause the ion beam to be deflected into a semicircular path. Particles of different mass can be focused on the exit slit by varying the field strength of the magnet. The ions passing through the exit fall on a collector electrode, which results in an ion current that is amplified and recorded. Table H-7 contains analytes of interest and PQLs.

H.2.3 Decision Process for Selecting Appropriate Analytical Techniques

Before selection of the proper analytical technique, the end user of the data should perform a process similar to the determination of the data quality objectives. Determination of the analyte(s) of interest, required quantitation limits, appropriate ASL, time available for analysis, data validation, and data interpretation must be considered to ensure that the analytical needs of the project are met.

It is vital to determine the list of COCs and to have a clear plan as to the analytical needs of the project prior to requesting analytical work. The characterization lead or data requestor must specify all of the analytical information needed to make the remediation decision. When additional information is requested after the samples have gone through method-specific preparation, there may be insufficient sample remaining to perform the additional analysis and there will be a delay in reporting analytical results to the project.

After the analytes of interest have been determined, the requestor should place each of the analytes of interest into the principal analytical categories of general chemistry (e.g., pH, alkalinity, chloride, sulfate, etc.), metals (e.g., calcium, sodium, lead, etc.), organic compounds (e.g., volatile, semivolatile, pesticides, etc.), and radionuclides (e.g., alpha and beta emitters). Performance of this step will allow the data requestor to group the analytes of interest by their physical properties and better select the appropriate analytical technique(s). The data requestor should note that there may detection overlap for some analyte(s) of interest. For example, bis(2-chloroisopropyl)ether can be analyzed as a volatile or semivolatile (Tables H-4 and H-5) and thorium-232 can be analyzed by alpha or gamma spectrometry (Table H-1).

After the analytes of interest have been determined, the required quantitation limits must be addressed. In general, the quantitation limit of the COC of interest will be set at one-tenth of the COC FRL or the quantitation limit defined in the SCQ, whichever is greater. Project management and the characterization lead must be certain that the method of analysis meets the detection limit requirements of the project. Some analytes can be quantified by more than one method, and use of the fastest appropriate method is generally preferred.

After the required quantitation limits have been determined, the question of the end use of data must be addressed. This is the decision point where an ASL should be designated. The data requestor should refrain from assigning a higher ASL than is needed. Section 2.3.3 of the SCQ provides defines ASLs and their use. For analysis of metals and organic compounds, the selection of the ASL defaults to the appropriate analytical reference method (see Appendix G, Table G-1 of the SCQ). For radiological analyses, the choice of ASL defaults to the performance specifications for the analyte of interest and its matrix (see Appendix G, Table G-4 of the SCQ).

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After selection of the appropriate ASL, the data requestor should take into account the time available for sample analysis. Sample TAT is probably the least understood aspect of analytical analyses by project management and characterization leads. TAT encompasses request for analysis, sample preparation, sample extraction, sample analysis, data reporting, and data deliverable. The request for analysis includes a list of analytes and/or analyses, number of samples, sample matrix, sample delivery date, ASL, and expected delivery date. The ability of the laboratory to accept the request for analysis is based on its operation capacity, or backlog. Once your request for analysis has been accepted, the laboratory schedules your project and assigns resources. Failure to meet your request for analysis, especially failure to meet sample delivery date, can have a negative effect on the completion of the project.

Sample preparation and sample extraction are the areas that are most time consuming. During the initial phase of the HPGe Comparability Study (DOE 1997), it was noted that data comparability for radionuclide analysis between on-site and off-site laboratory facilities was a concern. In order to minimize the heterogeneity of the soil samples, the decision was made to dry and grind samples before the sample extraction step (Table H-8). Project management and characterization leads should note that excess sample volume given to the lab can increase TAT, because the lab has more soil or material to process. Sample extraction is the critical step for accurate analysis, and it is defined as the process performed to isolate and/or concentrate the analyte(s) of interest. Sample extraction may be performed on a class-specific basis, such as semi-volatiles, using an organic solvent extraction, or an elemental specific basis, such as uranium, using a mineral acid digestion and use of an ion-exchange resin.

Sample analysis is the actual analysis of the sample, and it is commonly referred to as "instrument time." Instrument time is the amount of time that is needed to analyze the sample and produce a printout of the results. On an actual time basis, this step is fairly short.

Data reporting and data deliverable are separate processes. Data reporting includes data reduction and data entry. Data reduction is performed by the analyst and is the step where the final results are determined and approved by a secondary party, usually a supervisor. Data entry is the input of the final results into a database called a laboratory information management system (LIMS). A data deliverable is the data report that the data requestor receives from the lab. The data deliverable can be a report that is generated by the lab or a copy of the entire data file that may include all aspects of the

analysis. The ASL is usually the determinate for the type of data deliverable. Project management or the characterization lead may request a data package for any analysis.

Table H-9 summarizes the TAT components that a characterization lead would evaluate to make the best decision on the selection of a uranium analytical method for a batch of 20 samples. This exercise should be performed for every COC of interest prior to requesting laboratory analysis. Project management and the characterization lead are encouraged to contact the on-site laboratory to obtain a realistic TAT estimate for radionuclide analyses.

## H.3 FIELD SCANNING AND ANALYTICAL METHODS

Field analytical technologies will be utilized during the remediation of the FEMP. Field analytical and site characterization technologies offer potential savings in time and cost compared with traditional laboratory technologies. The advantage of field measurements is that they provide rapid TAT and can assist in decision making on a real-time basis. Various field analytical and site characterization technologies have been used at CERCLA and RCRA sites around the country and EPA has been encouraging the use of these technologies. The FEMP will be utilizing some of these technologies during the remediation of the site. These technologies can be used for predesign and precertification activities. Field measurements will be taken at the FEMP to assist project management for decisions pertaining to the following: 1) regulatory compliance issues such as air monitoring for VOCs, 2) delineation for contaminants of concern, and 3) determination/compliance of hot spots. These technologies may be used to screen for constituents and may assist in field activities. These technologies include, but not limited to flame ionization, photoionization, immunoassay, field-portable XRF, and in situ gamma spectrometry.

### H.3.1 VOC Monitoring

Field activities during the excavation/remediation phase(s) increases the possibility to encountering organic vapors. The presence of organic vapor(s) in a field setting are usually detected through the use of an organic vapor analyzer (OVA). The OVA can be hand held or field stationary. This can allow for constant monitoring during field activities. The OVA operates via two modes of detectors, flame ionization detector (FID) and photoionization detector (PID). The FID measures the physical property of flammability of the sample. The PID measures the ionization potential of the sample. The sample

is introduced by pumping the air sample into the reaction chamber. The FEMP uses the PID for air monitoring. Table H-10 provides a list of the analytes of concern that can be detected .

Flame ionization detector (FID) is a detector that has a high sensitivity to organic carbon containing compounds. The detector consists of a small hydrogen/air diffusion flame burning at the end of the jet. When organic compounds enter the flame the detector measures an increase in current. The response of the detector is directly proportional to the total mass entering the detector per unit time.

Photoionization occurs when a molecule absorbs a photon of light energy and dissociates into a parent ion and an electron. The photoionization detector (PID) detects many organic and some inorganic compounds by this process. A PID is equipped with a sealed, ultraviolet light source that emits photons into an ionization chamber that contains the organic species of interest. Compounds having ionization potential less than the UV source energy are ionized and the resulting current is detected using an electrometer. This current is proportional to the concentration. The PID has high sensitivity for aromatic compounds and alkanes based on their ionization potential. The PID is used on site to monitor for VOCs in the field by the Health and Safety Division. The procedure number is OS-ISH-019 titled "MicroTip Photoionization Air Analyzer."

When conducting VOC monitoring during excavation, the FEMP proposes the following criteria to be used to determine the need for follow-up soil treatment:

1) All soil that is visually determined to be saturated with free-phase organic product will be set aside for treatment.

2) If the health and safety monitoring for organic vapors at the excavation site identifies an organic vapor concentration of 5 ppm or greater in the breathing zone during excavation, the soil tied to the reading will be segregated for follow-up evaluation.

3) If it is visually determined that the soil set aside by the 5 ppm criterion is saturated with free organic phase, it will be designated for treatment. The visual examination will be supplemented with closer-proximity organic vapor readings of the set-aside soil to help with the observations and final decision.

4) If the visual examination indicates the soil is not saturated with a free organic phase, then treatment will not be necessary and the soil can be delivered to the OSDF for disposal, provided it meets all other WAC.

5) Soil that is segregated for inspection will be held until such time that EPA has had an opportunity to visually inspect the soil as they feel necessary.

6) Excavated soil will continue to be segregated until such time that the breathing zone concentrations at the sire return to below 5 ppm, at which point normal excavation activities will resume.

7) If it cannot be agreed between DOE and EPA that the soil has passed the visual inspection for saturated levels of free organic phase, then follow-up evaluations may be needed, with the details on the volume of soil and degree of contamination to be decided by DOE and EPA.

8) All soil that requires treatment will be treated to a level that allows the soil to pass follow-up TCLP testing for organic RCRA toxicity characteristic constituents (also any additional FEMP-specific organic constituents the EPA deem appropriate).

### H.3.2 Immunoassay

During the RI phase at the FEMP, some chemical contaminants of concern were discovered. Their presence was detected in small areas around the site and not as site wide. The class of COCs that were detected are PAHs and PCBs. These compounds can be detected in the field by the use immunoassay field test kits. The field test kits are manufactured by various commercial vendors. Immunoassay is a technique for detecting and measuring a target compound through the use of an antibody that binds only to that substance. Quantitation is performed by monitoring color change, either visually or with a spectrophotometer. The technology has been used to detect or to measure the concentrations of halogenated VOCs, PAHs, TPH, BTEX, PCBs, and organic pesticides in field activities. The EPA has included immunoassay technology in SW-846 Method 4000 series (promulgation date December 1995). The SW-846 method number and approximate detection limit are shown in Table H-11.

### H.3.3 X-Ray Fluorescence

Detection and delineation of metals contamination can be accomplished the use of field-portable XRF. The unit uses a solid state detector to quantify metal concentrations in soil and can be used for rapid TAT, usually in less than one hour. Information on the analytical instrument was provided under Section H.2. Table H-12 contains PQLs for some elements commonly detected by the field-portable XRF.

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H.3.4 In Situ Gamma Spectrometry

High purity germanium detectors (HPGe) and vehicle-mounted sodium-iodide detectors (RTRAK and RSS systems) are being used to quantify radionuclides at the FEMP in near real-time mode. These are in situ systems currently used for the detection and quantitation (ASL A or B) of uranium-238, uranium-235, thorium-232, thorium-228, and radium-226. These systems can be employed for predesign investigations, precertification investigations, individual measurements, WAC attainment, and hot-spot evaluations. Details on the application of in situ gamma spectroscopy to remediation activities at the FEMP can be found in "The Users Guidelines, Measurement Strategies, and Operational Factors for the Deployment of In-Situ Gamma Spectrometry at the Fernald Site" (DOE 1998).

## REFERENCES

U.S. Dept. of Energy, 1997, "Comparability Study of In Situ Gamma Spectroscopy and Laboratory Data," July Draft, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

U.S. Dept. of Energy, 1998, "User Guidelines, Measurement Strategies, and Operational Factors for Deployment of In-Situ Gamma Spectrometry at the Fernald Site," Draft, Fernald Environmental Management Project, DOE Fernald Area Office, Cincinnati, OH.

**TABLE H-1**
**QUANTIFICATION TECHNIQUES FOR FEMP RADIONUCLIDES OF INTEREST**

| Analyte | FRL (pCi/g) | Gamma Spectroscopy Isotope and Photon Energy (KeV) Measured | Alpha Spectroscopy Isotope Measured | Gas Proportional or Liquid Scintillation for Beta Emitters |
|---|---|---|---|---|
| Uranium- 238 | a | Thorium-234 (63.29 & 97.56) | Uranium-238 | NA |
| Uranium-235 | a | Uranium-235 (143.76 & 185.72) | Uranium-235/236 | NA |
| Uranium-234 | a | NA | Uranium-234 | NA |
| Thorium-232 | 1.5 | Thallium-208 (583.14)<br>Lead-212 (238.63)<br>Actinium-228 (911.07 & 969.11) | Thorium-232 | NA |
| Thorium-230 | 280 | NA | Thorium-230 | NA |
| Thorium-228 | 1.7 | Thallium-208 (583.14)<br>Lead-212 (238.63) | Thorium-228 | NA |
| Radium-228 | 1.8 | Thallium-208 (538.14)<br>Lead-212 (238.63)<br>Actinium-228 (911.07 & 969.11) | NA | NA |
| Radium-226 | 1.7 | Lead-214 (295.21 & 351.92)<br>Bismuth-214 (609.31, 1120.3 & 1764.5) | Radium-226 | NA |
| Cesium-137 | 1.4 | Barium-137m (661.65) | NA | NA |

**TABLE H-1**
**QUANTIFICATION TECHNIQUES FOR FEMP RADIONUCLIDES OF INTEREST**

| Analyte | FRL (pCi/g) | Gamma Spectroscopy Isotope and Photon Energy (KeV) Measured | Alpha Spectroscopy Isotope Measured | Gas Proportional or Liquid Scintillation for Beta Emitters |
|---|---|---|---|---|
| Potassium-40 | NA | Potassium-40 (1460.8) | NA | NA |
| Neptunium-237 | 3.2 | Protactinium-233 (311.98) | Neptunium-237 | NA |
| Plutonium-238 | 78 | NA | Plutonium-238 | NA |
| Technetium-99 | 29.1 | NA | NA | Technetium-99 |
| Strontium-90 | 14 | NA | NA | Strontium-90 |
| Lead-210 | 38 | NA | NA | Lead-210 |

NA = not applicable
a = FRL not established for individual uranium isotopes. FRL is established for total uranium at 82 mg/kg, except in regions of the production area (20 mg/kg) and below the Southern Waste Units (10 mg/kg).

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**TABLE H-3**
**FEMP CONSTITUENTS ANALYZED USING ION CHROMATOGRAPHY**

| CONSTITUENT | FRL OU2/5 ROD (mg/kg) | PQL (mg/kg) |
|---|---|---|
| Chromium VI | 300 | 10 |
| Cyanide | 120,000 | 50 |
| Fluoride | 78,000 | 150 |

FRL = final remediation level
mg/kg = milligram per kilogram
OU = operable unit
PQL = practical quantitation limit
ROD = record of decision

# TABLE H-2
# PRACTICAL QUANTITATION LIMITS FOR ANALYTICAL METHODS SUITABLE FOR METALS

| CONSTITUENT | FRL (OU2/5 ROD) | WAC | ICP PQL (mg/kg) | GFAA PQL (mg/kg) | AA PQL (mg/kg) | ICP/MS PQL (mg/kg) | XRF PQL (mg/kg) |
|---|---|---|---|---|---|---|---|
| Antimony | 96.0 | NA | 17.5 | NR | 100 | 0.33 | 20 |
| Arsenic | 12.0 | NA | NR | 0.8 | 1.0 | 0.33 | 20 |
| Barium | 68,000 | NA | 2.1 | NR | 50 | 0.33 | 20 |
| Beryllium | 1.50 | NA | 0.8 | NR | 2.5 | 0.33 | 20 |
| Boron | 7,400 | 1.04E3 | 3.3 | NR | NR | 0.33 | NR |
| Cadmium | 82.0 | NA | 0.9 | NR | 2.5 | 0.33 | 20 |
| Cobalt | 740 | NA | 2.5 | NR | 25 | 0.33 | 20 |
| Copper | 220,000 | NA | 1.5 | NR | 10 | 0.33 | 20 |
| Lead | 400 | NA | 17.1 | 1.2 | 50 | 0.33 | 20 |
| Manganese | 4,600 | NA | 0.5 | NR | 5.0 | 0.33 | 20 |
| Mercury | 7.50 | 5.66E4 | NR | 0.005 | 1.0 | NR | NR |
| Molybdenum | 2,900 | NA | 15 | NR | 50 | 0.33 | 20 |
| Nickel | 15,000 | NA | 2.4 | NR | 20 | 0.33 | 20 |
| Selenium | 5,400 | NA | NR | 1.5 | 1.0 | 0.33 | NR |
| Silver | 29,000 | NA | 3.6 | 0.2 | 5.0 | 0.33 | 20 |
| Thallium | 91.0 | NA | NR | 0.8 | 50.0 | 0.33 | 20 |
| Vanadium | 5,100 | NA | 7.1 | NR | 100 | 0.33 | 20 |
| Zinc | 120,000 | NA | 9.0 | NR | 2.5 | 0.33 | 20 |

AA = atomic absorption
GFAA = gas furnace atomic absorption
mg/kg = milligrams per kilogram
OU = operable unit
ROD = record of decision
NA = not applicable
FRL = final remediation level
ICP = inductively coupled plasma
NR = not recommended
PQL = practical quantitation limit
XRF = x-ray fluorescence

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**TABLE H-4**
**SEMI-VOLATILE ORGANIC CONSTITUENTS ANALYZED BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY**

| CONSTITUENT | FRL (mg/kg) | WAC (mg/kg) | GC/MS PQL (mg/kg) |
|---|---|---|---|
| Benzo(a)anthracene | 20.0 | NA | 0.66 |
| Benzo(a)pyrene | 2.00 | NA | 0.66 |
| Benzo(b)fluoranthene | 20.0 | NA | 0.66 |
| Bis(2-chloroisopropyl)ether | 420 | 0.22 | 0.66 |
| Bis(2-ethylhexyl)phtalate | 820 | NA | 0.66 |
| Carbazole | 12.0 | NA | 0.66 |
| Chrysene | 2,000 | NA | 0.66 |
| Dibenzo(a,h)anthracene | 2.00 | NA | 0.66 |
| 3,3'-Dichlorobenzidine | 0.55 | NA | 1.3 |
| Di-n-octylphtalate | 1,100 | NA | 0.66 |
| Indeno(1,2,3-cd)pyrene | 20.0 | NA | 0.66 |
| 4-Methylphenol | 250 | NA | 0.66 |
| 4-Nitroaniline | 150 | NA | 3.3 |
| N-nitrosodiphenylamine | 51.0 | NA | 0.66 |
| N-nitrosodipropylamine | 0.20 | NA | 0.66 |
| Pentachlorophenol | 2.30 | NA | 3.3 |
| Tributyl phosphate | 250 | NA | NR |
| Toxaphene | NA | 106,000 | NR |

FRL = final remediation level
GC/MS = gas chromatography/mass spectroscopy
mg/kg = milligram per kilogram
PQL = practical quantitation limit
WAC = waste acceptance criteria
NR = not recommended
NA = not applicable

# TABLE H-5
# VOLATILE ORGANIC COMPOUNDS ANALYZED BY GAS CHROMATOGRAPHY/MASS SPECTROSCOPY

| CONSTITUENT | FRL (mg/kg) | WAC (mg/kg) | GC/MS PQL (mg/kg) |
|---|---|---|---|
| Acetone | 43,000 | NA | 0.1 |
| Benzene | 850 | NA | 0.005 |
| Bis(2-chloroisopropyl)ether | 420 | 0.22 | 0.1 |
| Bromodichloromethane | 4.00 | 0.9 | 0.005 |
| Bromoform | 31.0 | NA | 0.005 |
| Carbon disulfide | 5,000 | NA | 0.1 |
| Carbon Tetrachloride | 2.10 | NA | 0.005 |
| Chlorobenzene | 340 | NA | 0.005 |
| Chloroform | 45.0 | NA | 0.005 |
| 1,2 Dichloroethane | 0.16 | NA | 0.005 |
| 1,1 Dichloroethene | 0.41 | NA | 0.005 |
| Ethylbenzene | 5,100 | NA | 0.005 |
| Methyl-2-pentanone | 2,500 | NA | 0.05 |
| Methylene chloride | 37.0 | NA | 0.005 |
| Tetrachloroethene | 3.60 | 128 | 0.005 |
| Toluene | 100,000 | NA | 0.005 |
| 1,1,2 Trichloroethane | 4.30 | NA | 0.005 |
| Trichloroethene | 25.0 | 128 | 0.005 |
| Vinyl Chloride | 0.13 | 1.51 | 0.01 |
| Xylenes, total | 920,000 | NA | 0.005 |
| Chloroethane | NA | 3,920 | 0.01 |

FRL = final remediation level
mg/kg = milligram per kilogram
WAC = waste acceptance criteria
GC/MS = gas chromatography/mass spectroscopy
PQL = practical quantitation limit
NA = not applicable

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**TABLE H-6**
**PESTICIDES AND PCBS ANALYZED BY AN ELECTRON CAPTURE DETECTOR**

| CONSTITUENT | FRL (mg/kg) | WAC (mg/kg) | ECD PQL (mg/kg) |
|---|---|---|---|
| Aroclor-1254 | 0.13 | NA | 0.0033 |
| Aroclor-1260 | 0.13 | NA | 0.0033 |
| Dieldrin | 0.015 | NA | 0.0033 |
| Chlordane | 0.019 | NA | 0.0033 |

ECD = electron capture detector
FRL = final remediation level
mg/kg = milligram per kilogram
PQL = practical quantitation limit
WAC = waste acceptance criteria
NA = not applicable

**TABLE H-7**
**DIOXINS AND FURANS**

| CONSTITUENT | FRL OU2/5 ROD (mg/kg) | PQL (mg/kg) |
|---|---|---|
| Heptachlorodibenzofuran | 0.00088 | 0.00025 |
| Heptachlorodibenzo-p-dioxin | 0.00088 | 0.00025 |
| Octachlorodibenzofuran | 0.0088 | 0.0005 |
| Octachlorodibenzo-p-furan | 0.0088 | 0.0005 |

FRL = final remediation level
mg/kg = milligram per kilogram
OU = operable unit
PQL = practical quantitation limit
ROD = record of decision

000744

## TABLE H-8

## SAMPLE PREP FOR SOILS AND SEDIMENTS FOR RADIOLOGICAL ANALYSES

1. Remove, weigh, and record all sample material (including any organic matter) in the sample core tube and place it in a disposable aluminum pan. The analyst performing this step should describe the appearance of each sample.

2. Dry the entire sample at 105 to 112 degrees C for at least 8 hours to constant weight.

3. Calculate and record the percent moisture content of the sample.

4. Grind the entire sample until all material passes through a 1mm sieve.

5. Remove the necessary aliquot for analysis and archive the remaining sample material.

## TABLE H-9
## TURN-AROUND TIME FOR TOTAL URANIUM ANALYSIS ON A 20 SAMPLE BATCH

| INSTRUMENTATION | DETECTION LIMIT (mg/kg) | PREP TIME (hours) | EXTRACTION TIME (hours) | INSTRUMENT TIME (hours) | DATA DELIVERABLE (hours) | ASL |
|---|---|---|---|---|---|---|
| Alpha | 0.6 | 12 | 72 | 20 | 8 | B |
| | 0.2 | 12 | 72 | 20 | 40 | D |
| Gamma | 0.6 | 12 | 0 | 120 | 8 | B |
| | 0.2 | 12 | 0 | 240 | 40 | D |
| ICP/MS | 0.05 | 12 | 8 | 4 | 8 | B |
| Colorimetry (Bromopadap) | 1 | 12 | 8 | 4 | 8 | B |
| XRF | 25 | 12 | NA | 4 | 8 | B |
| EDXRF | 50 | 3 | NA | 3 | 1 | A |

ASL = analytical service level
EDXRF = energy dispersive x-ray fluoresence
ICP/MS = inductively coupled plasma/mass spectroscopy
XRF = x-ray fluoresence
NA = not applicable

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**TABLE H-10**
**FEMP ORGANIC COCS DETECTED BY PID**

| Constituent | IONIZATION POTENTIAL (eV) |
|---|---|
| 1,1-Dichloroethene | 10.00 |
| Tetrachloroethene | 9.32 |
| Trichloroethene | 9.45 |

COCs = constituents of concern
eV = electron volts
PID = photoionization detector

**TABLE H-11**
**IMMUNOASSAY METHOD NUMBERS FOR SOME ORGANIC COMPOUNDS**

| EPA METHOD NUMBER | ANALYTE(S) | DETECTION RANGE (mg/kg) |
|---|---|---|
| 4010A | Pentachlorophenol | 0.5--100 |
| 4015 | 2,4-D | 0.1--5.0 |
| 4020 | PCBs | 5--50 |
| 4030 | Petroleum Hydrocarbons | 5--500 |
| 4035 | PAHs | >1 |
| 4040 | Toxaphene | >0.5 |
| 4041 | Chlordane | 20--600 |
| 4042 | DDT | 0.2--10 |

2,4-D = 2,4-dichlorophenoxyacetic acid
DDT = dichloro-diphenyl-trichloroethane
mg/kg = milligram per killogram
PAHs = polyaromatic hydrocarbons
PCBs = polychlorinated biphenyls

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**TABLE H-12**
**PRACTICAL QUANTITATION LIMITS**
**FOR THE FEMP FIELD-DEPLOYABLE X-RAY FLUORESCENCE SYSTEM**

| CONSTITUENT | PQL (mg/kg) |
|---|---|
| Antimony | 32 |
| Arsenic | 25 |
| Cadmium | 86 |
| Lead | 14 |
| Manganese | 210 |
| Molybdenum | 4 |
| Silver | 100 |
| Zinc | 35 |
| Beryllium | 0.03 |

mg/kg = milligram per kilogram
PQL = practical quantitation limit

# APPENDIX I

## SITEWIDE EXTENT OF CONTAMINATION BY CONSTITUENT

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Introduction . . . . . I-1

## LIST OF FIGURES

**Primary ASCOCs**


| | |
|---|---|
| Uranium, total | I-1 |
| Radium-226 | I-2 |
| Radium-228 | I-3 |
| Thorium-228 | I-4 |
| Thorium-232 | I-5 |


**Secondary ASCOCs**


| | |
|---|---|
| Aroclor-1254 | I-6 |
| Aroclor-1260 | I-7 |
| Arsenic | I-8 |
| Benzo(a)anthracene | I-9 |
| Benzo(a)pyrene | I-10 |
| Benzo(b)fluoranthene | I-11 |
| Berillium | I-12 |
| Bis(2-chloroisopropyl)ether | I-13 |
| Cesium-137 | I-14 |
| Dibenzo(a,h)anthracene | I-15 |
| 1,1-Dichloroethene | I-16 |
| Dieldrin | I-17 |
| Fluoride[a] | |
| Heptachlorodibenzo-p-dioxin | I-18 |
| Indeno(1,2,3-cd)pyrene | I-19 |
| Lead | I-20 |
| Lead-210 | I-21 |
| Manganese | I-22 |
| Neptunium-237 | I-23 |
| 4-Nitroaniline | I-23 |
| Octachlorodibenzo-p-dioxin | I-25 |
| Plutonium-238 | I-26 |
| Strontium-90 | I-27 |
| Technetium-99 | I-28 |
| Tetrachloroethene | I-29 |
| Thorium-230 | I-30 |
| Trichloroethene | I-31 |


[a] No data for soil in the Sitewide Environmental Database.

As described in Section 2.1.3.2 of the Sitewide Excavation Plan, the spatial extent of area-specific constituents of concern was determined by comparing them to final remediation levels, Benchmark Toxicity Values, and Waste Acceptance Criteria for the On-Site Disposal Facility. The maps in this appendix show the distribution of contamination sitewide at the time the Operable Unit 5 Remedial Investigation was released (DOE 1995). They identify the extent of contamination within the ten remediation areas described in Section 1.2.2 and Appendix B. Nine of these remediation areas are shown on Figure 1-3; Remediation Area 10 consists of corridors left after the first nine remediation areas have been certified, as shown on Figure B-18. Area 9 is not included in these maps because no off-site sampling was done during the Remedial Investigation.

The maps in Appendix I also indicate if a constituents of concern distribution is confined to a limited area or if it impacts larger areas. The area-specific constituents of concern for each remediation area were identified based on the sample results represented by these maps, augmented by process knowledge. Primary and secondary area-specific constituents of concern are listed in Tables 2-6 and 2-7.

## REFERENCES

U.S. Dept. of Energy, 1995, "Remedial Investigation Report for Operable Unit 5," Final, Fernald Environmental Management Project, DOE, Fernald Area Office, Cincinnati, OH.

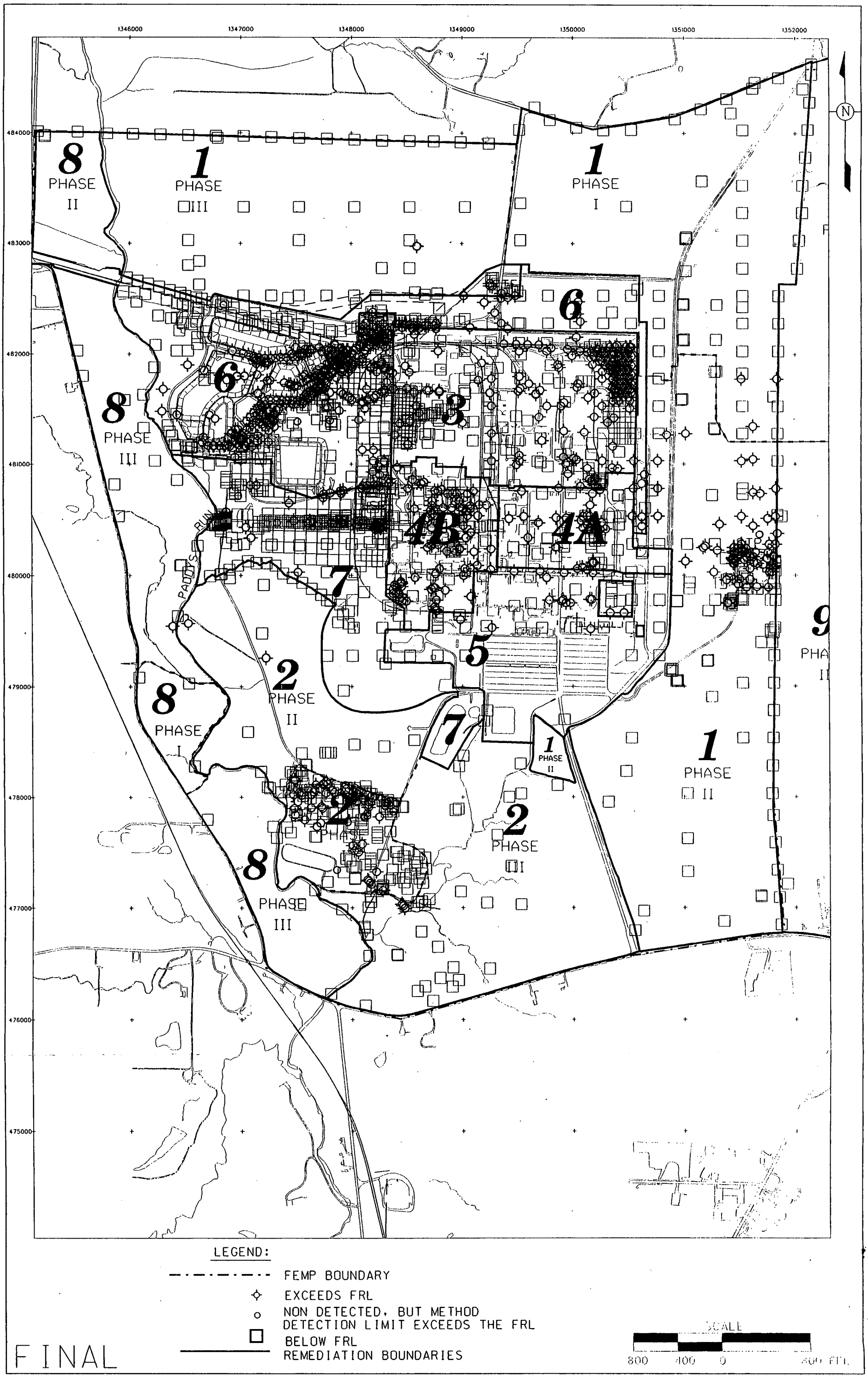


FIGURE I-1. SITEWIDE DISTRIBUTION OF TOTAL URANIUM BASED ON RI/FS DATA

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1621

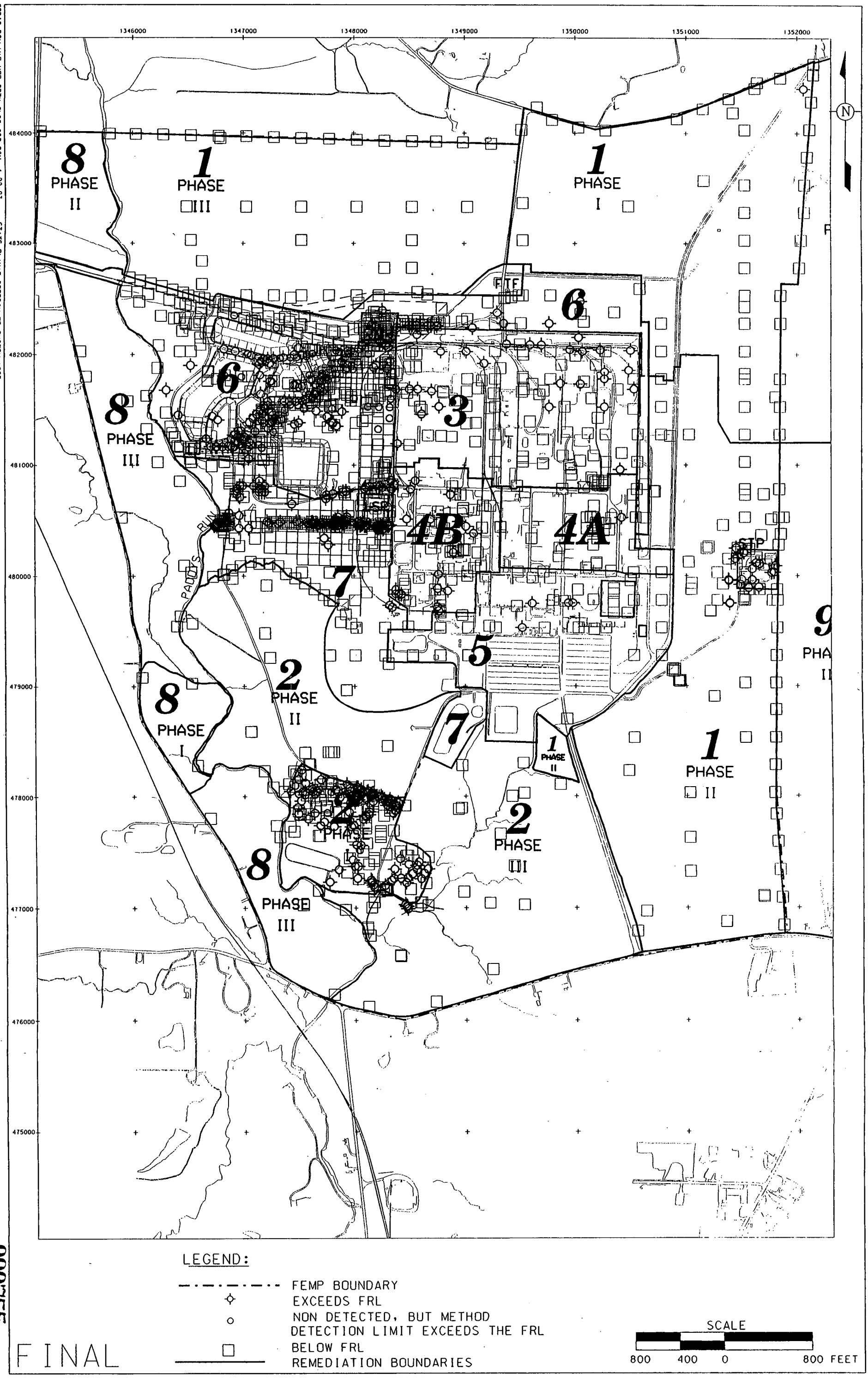


FIGURE I-2. SITEWIDE DISTRIBUTION OF RADIUM-226 BASED ON RI/FS DATA

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1621

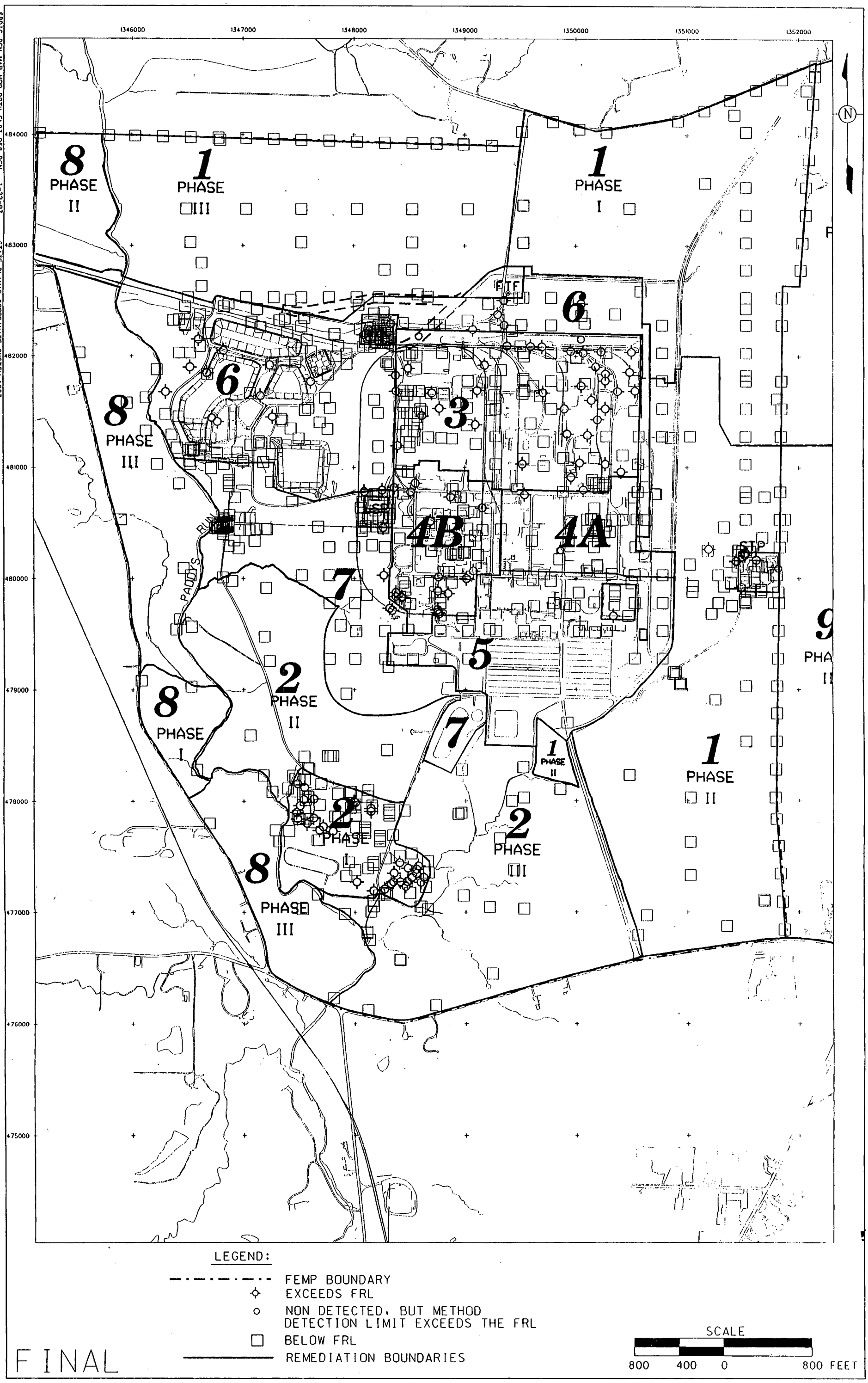



FIGURE I-3. SITEWIDE DISTRIBUTION OF RADIUM-228 BASED ON RI/FS DATA

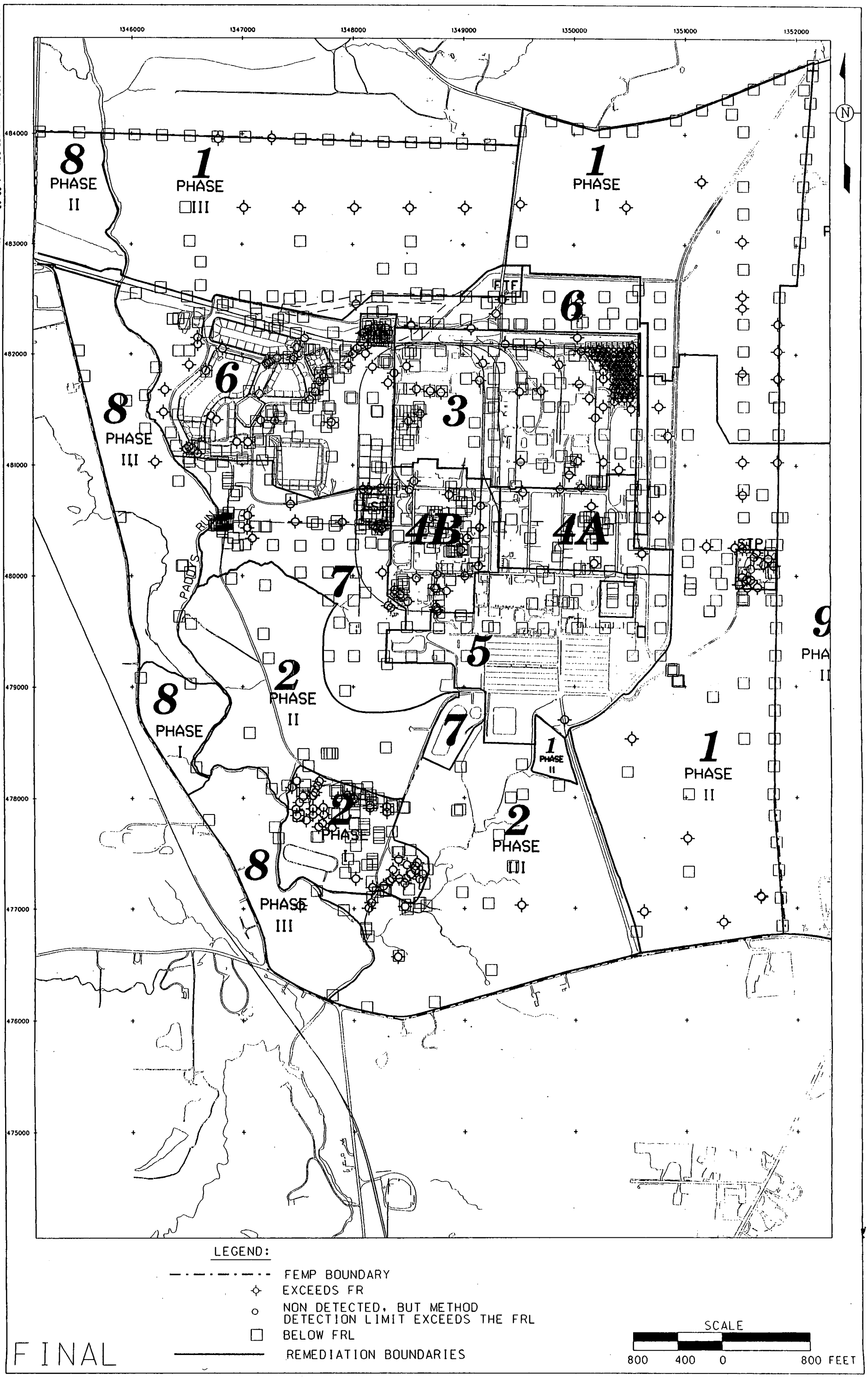



FIGURE I-4. SITEWIDE DISTRIBUTION OF THORIUM-228 BASED ON RI/FS DATA

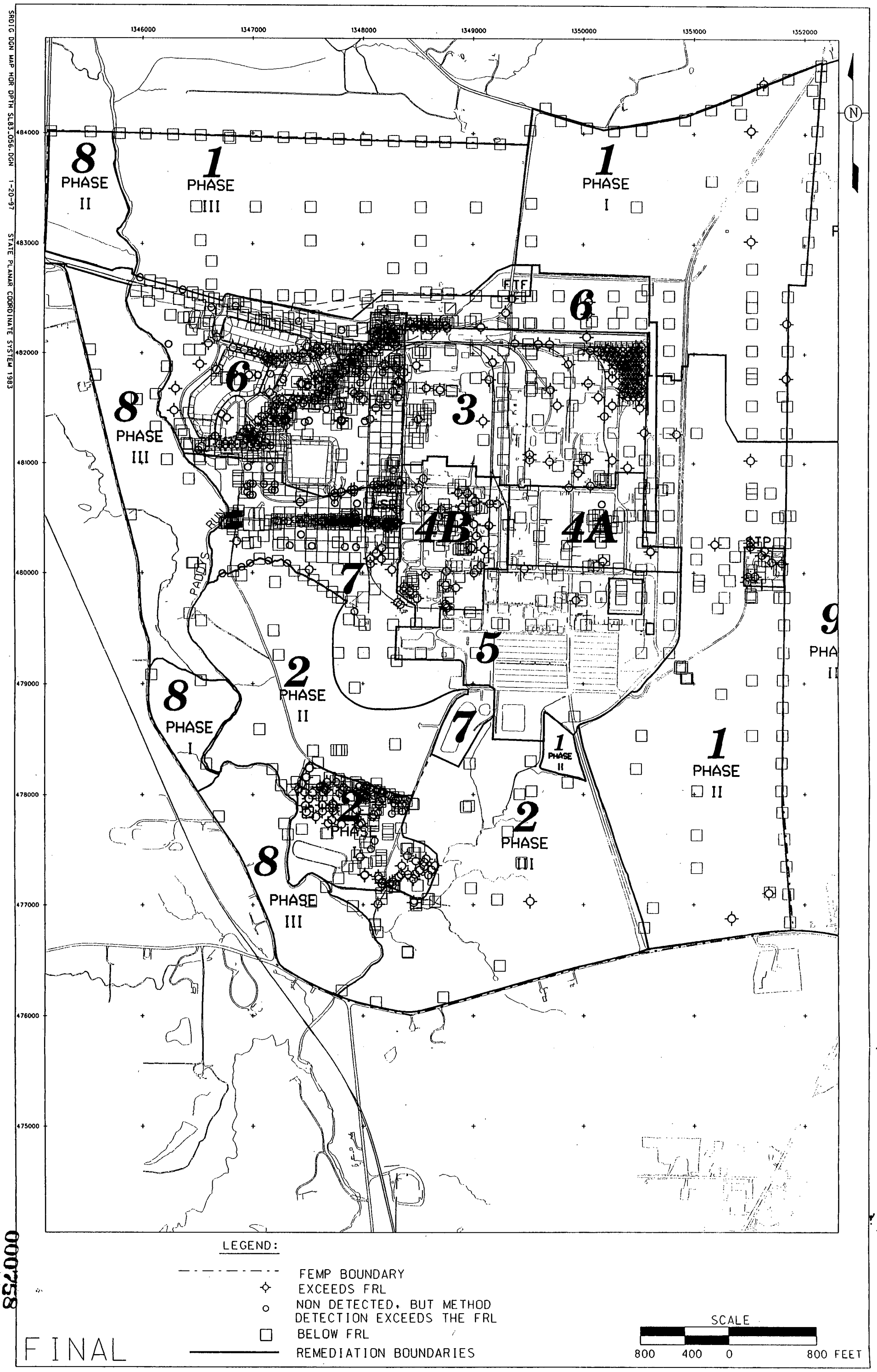



FIGURE I-5. SITEWIDE DISTRIBUTION OF THORIUM-232 BASED ON RI/FS DATA

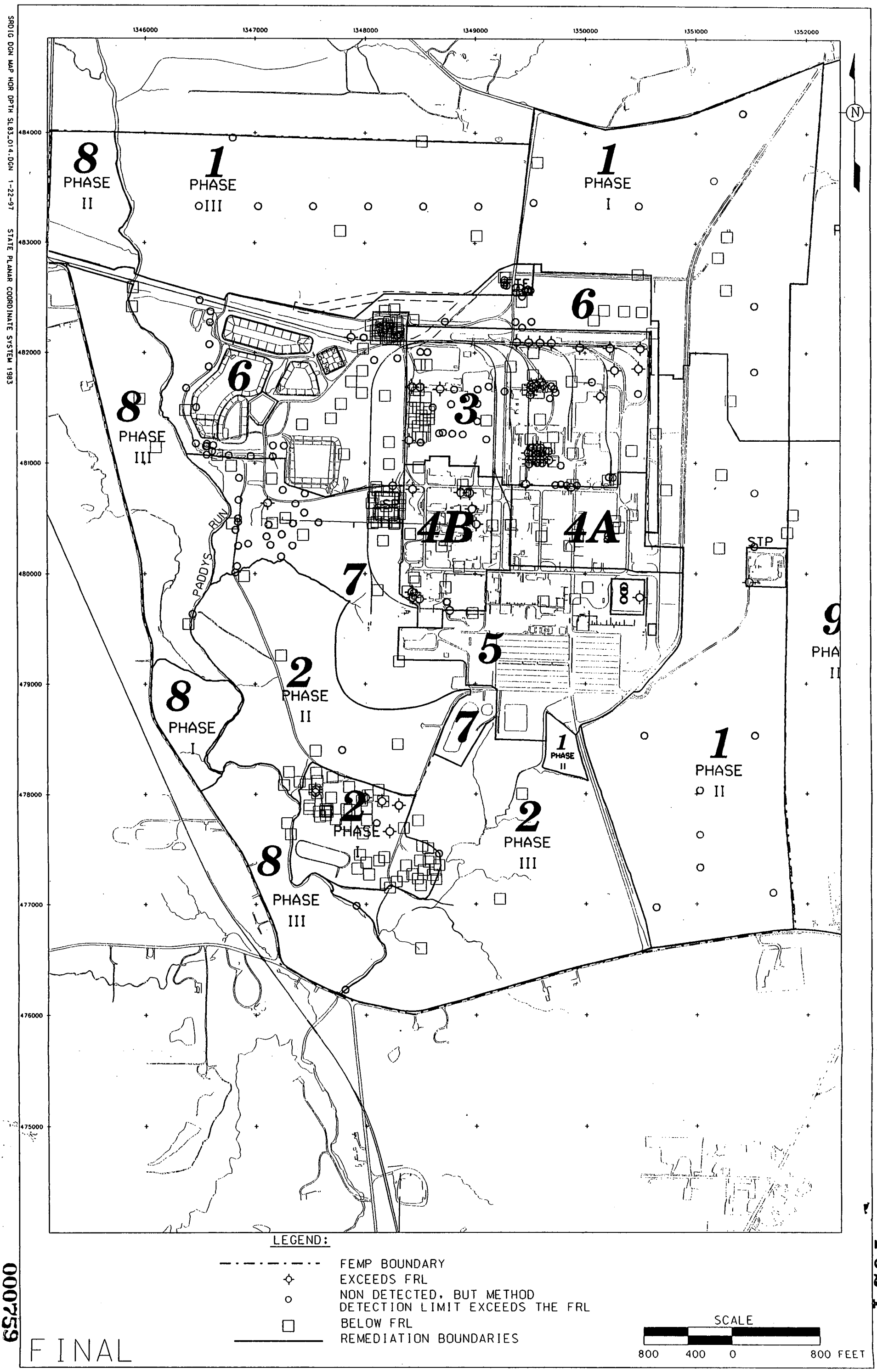



FIGURE I-6. SITEWIDE DISTRIBUTION OF AROCLOR-1254 BASED ON RI/FS DATA.

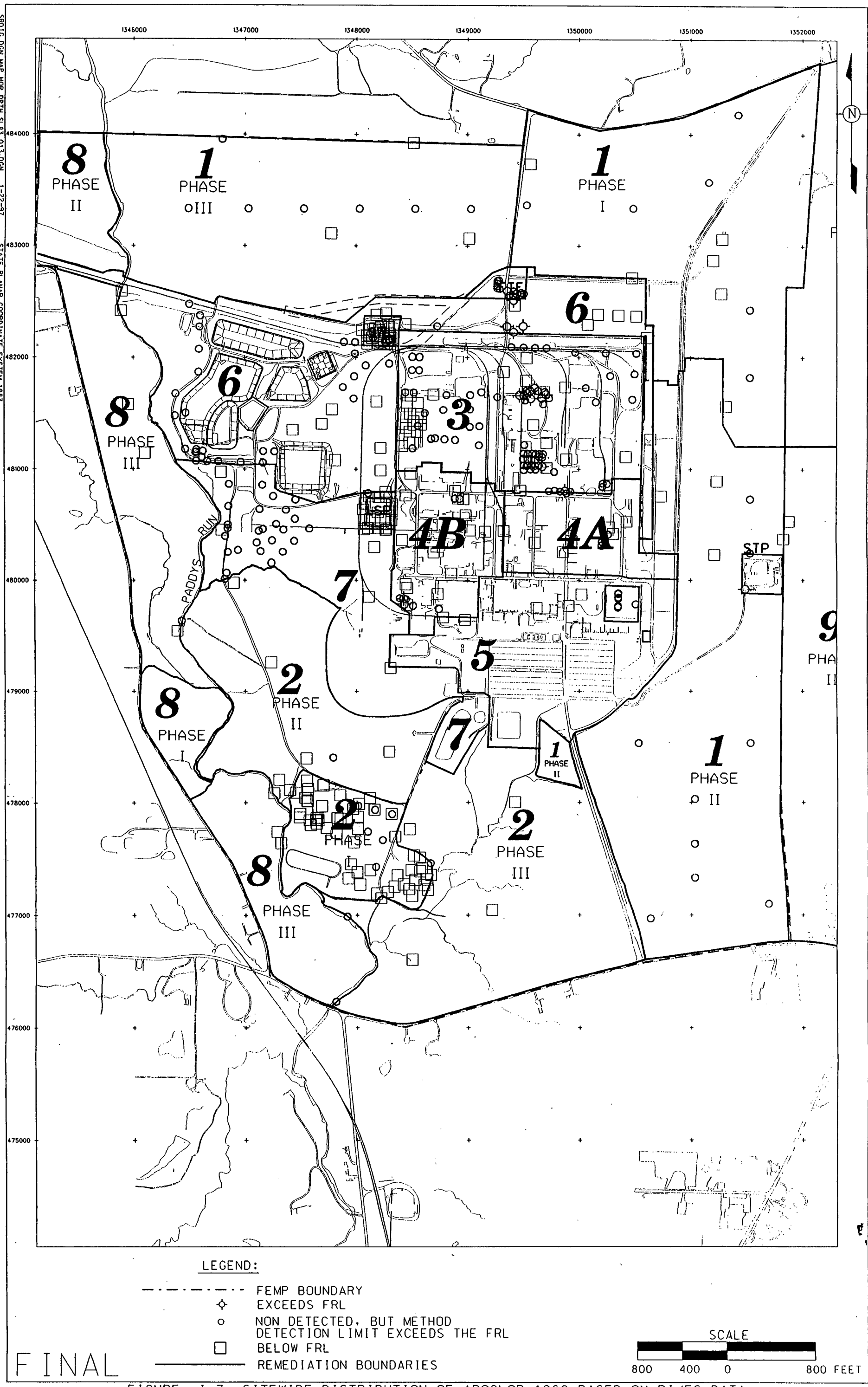



FIGURE I-7. SITEWIDE DISTRIBUTION OF AROCLOR-1260 BASED ON RI/FS DATA.

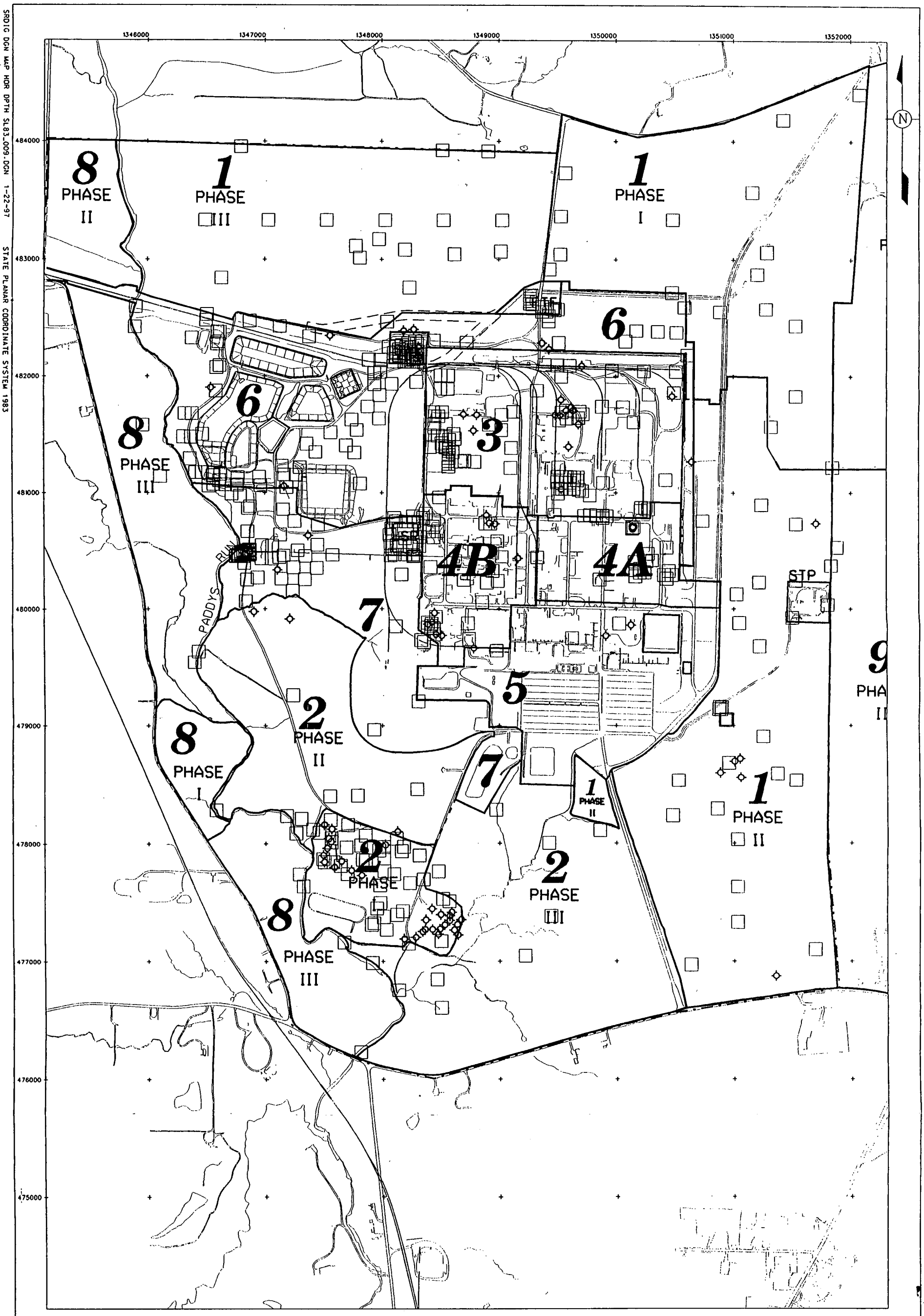



FIGURE I-8. SITEWIDE DISTRIBUTION OF ARSENIC BASED ON RI/FS DATA.

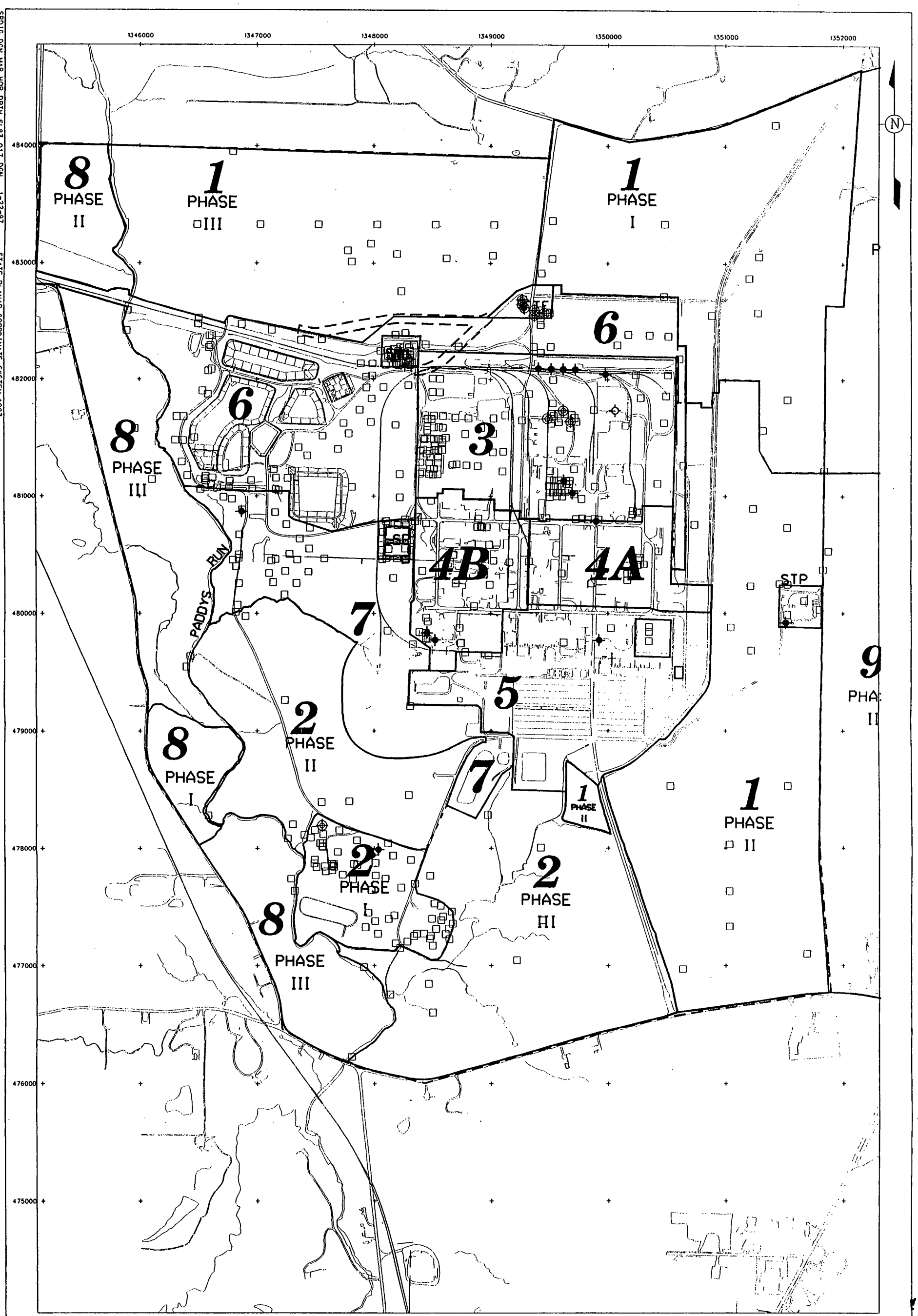



FIGURE I-9. SITEWIDE DISTRIBUTION OF BENZO(A)ANTHRACENE BASED ON RI/FS DATA.

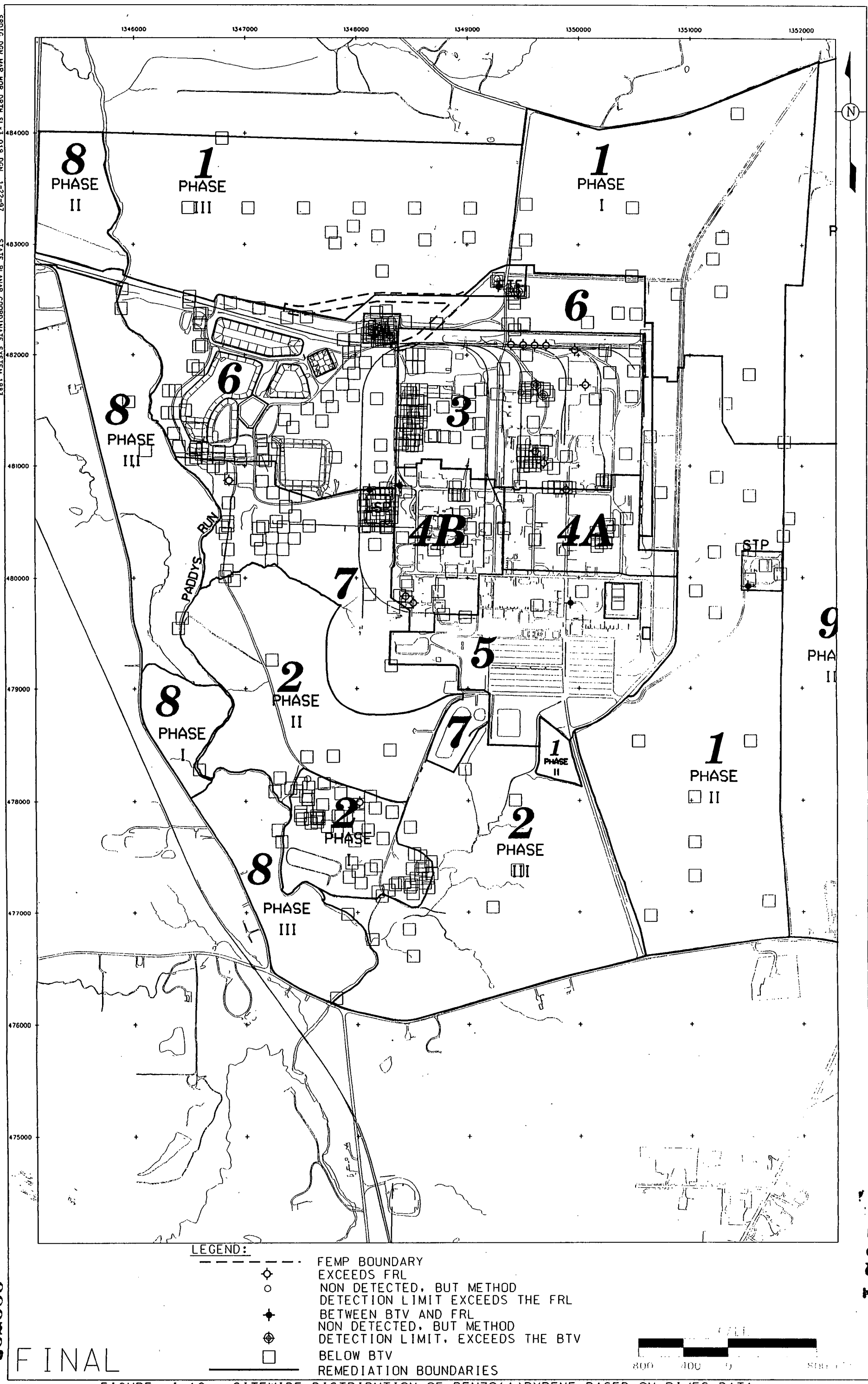



FIGURE I-10. SITEWIDE DISTRIBUTION OF BENZO(A)PYRENE BASED ON RI/FS DATA

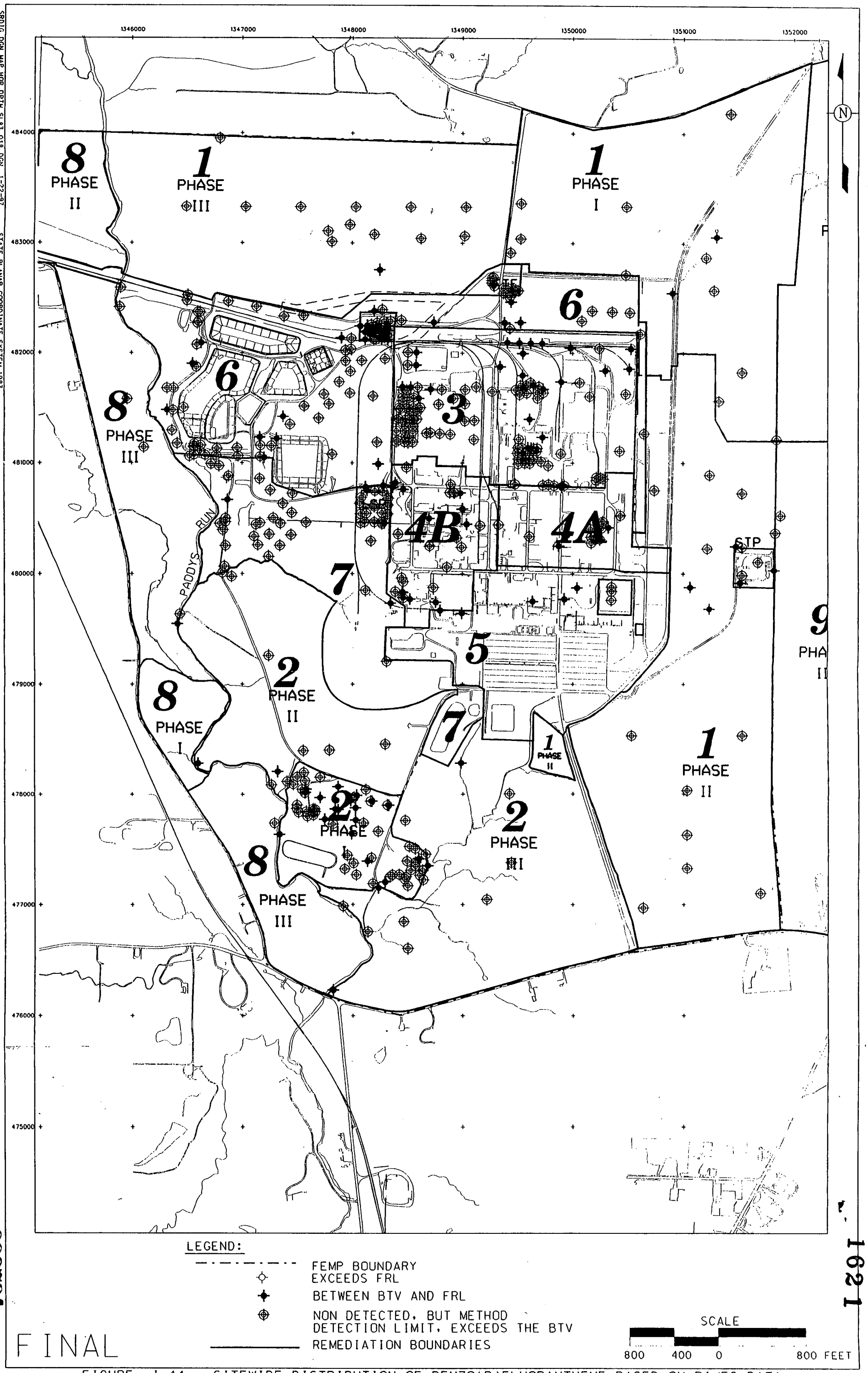



FIGURE I-11. SITEWIDE DISTRIBUTION OF BENZO(B)FLUORANTHENE BASED ON RI/FS DATA

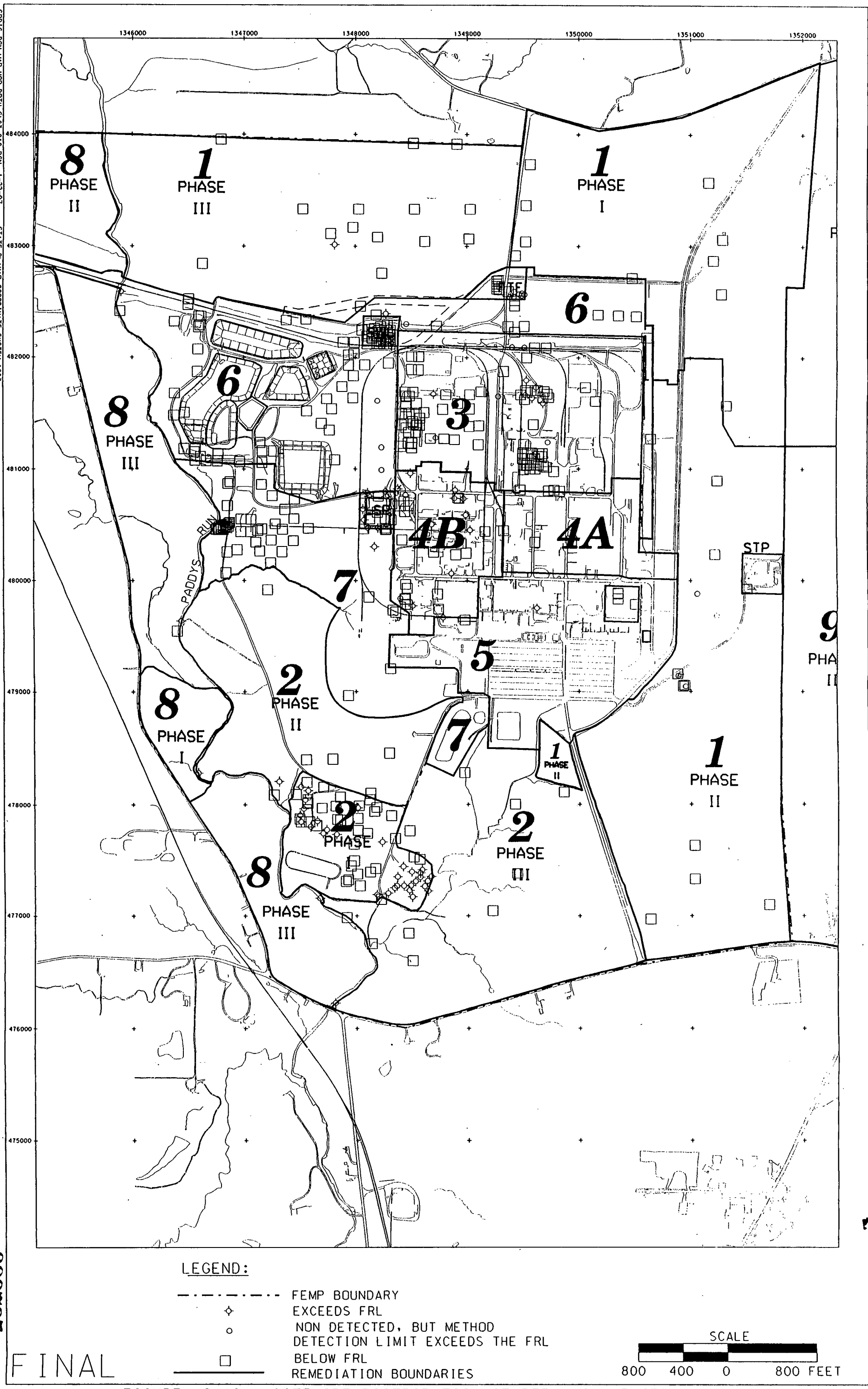



FIGURE I-12. SITEWIDE DISTRIBUTION OF BERYLLIUM BASED ON RI/FS DATA

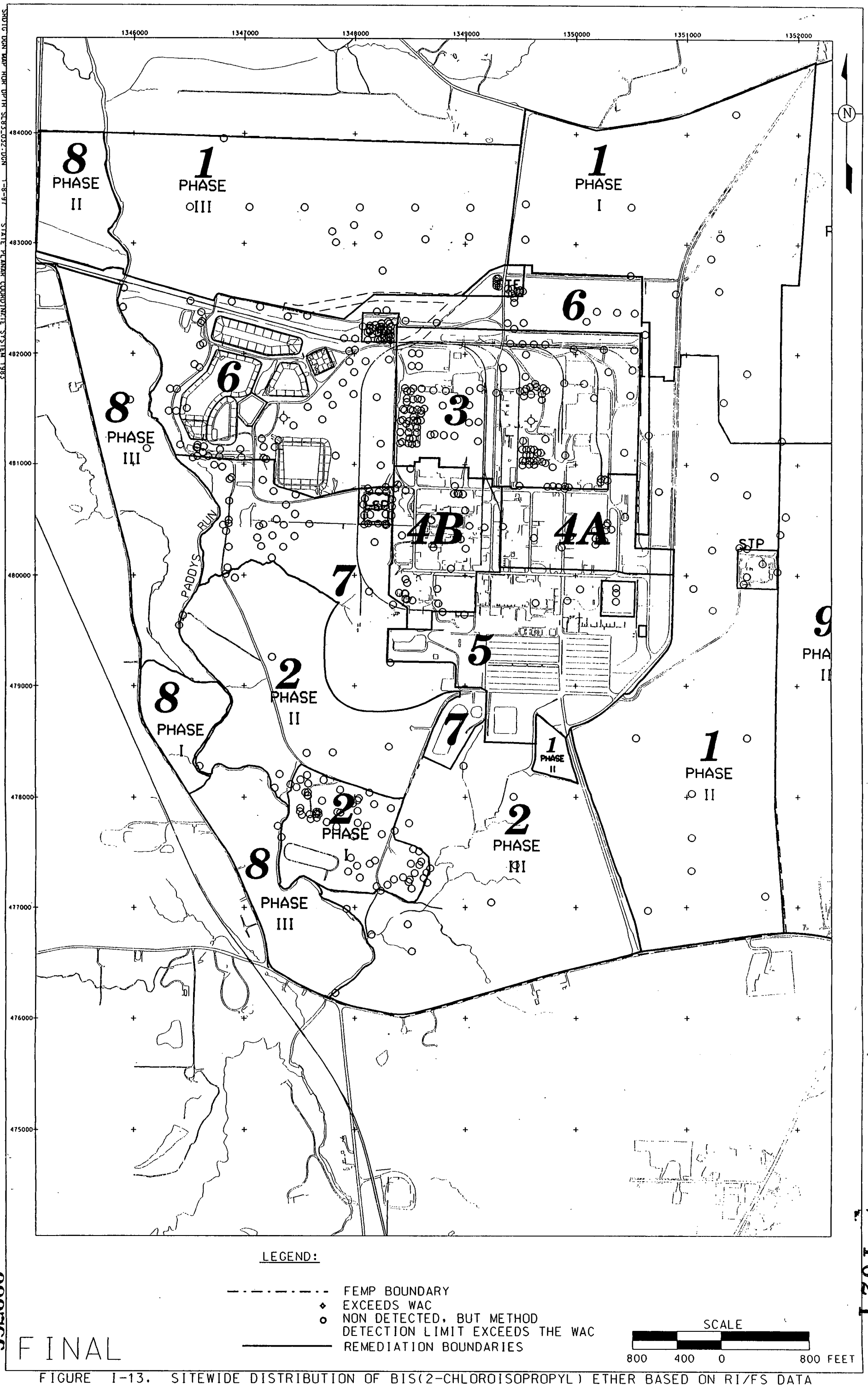



FIGURE I-13. SITEWIDE DISTRIBUTION OF BIS(2-CHLOROISOPROPYL) ETHER BASED ON RI/FS DATA

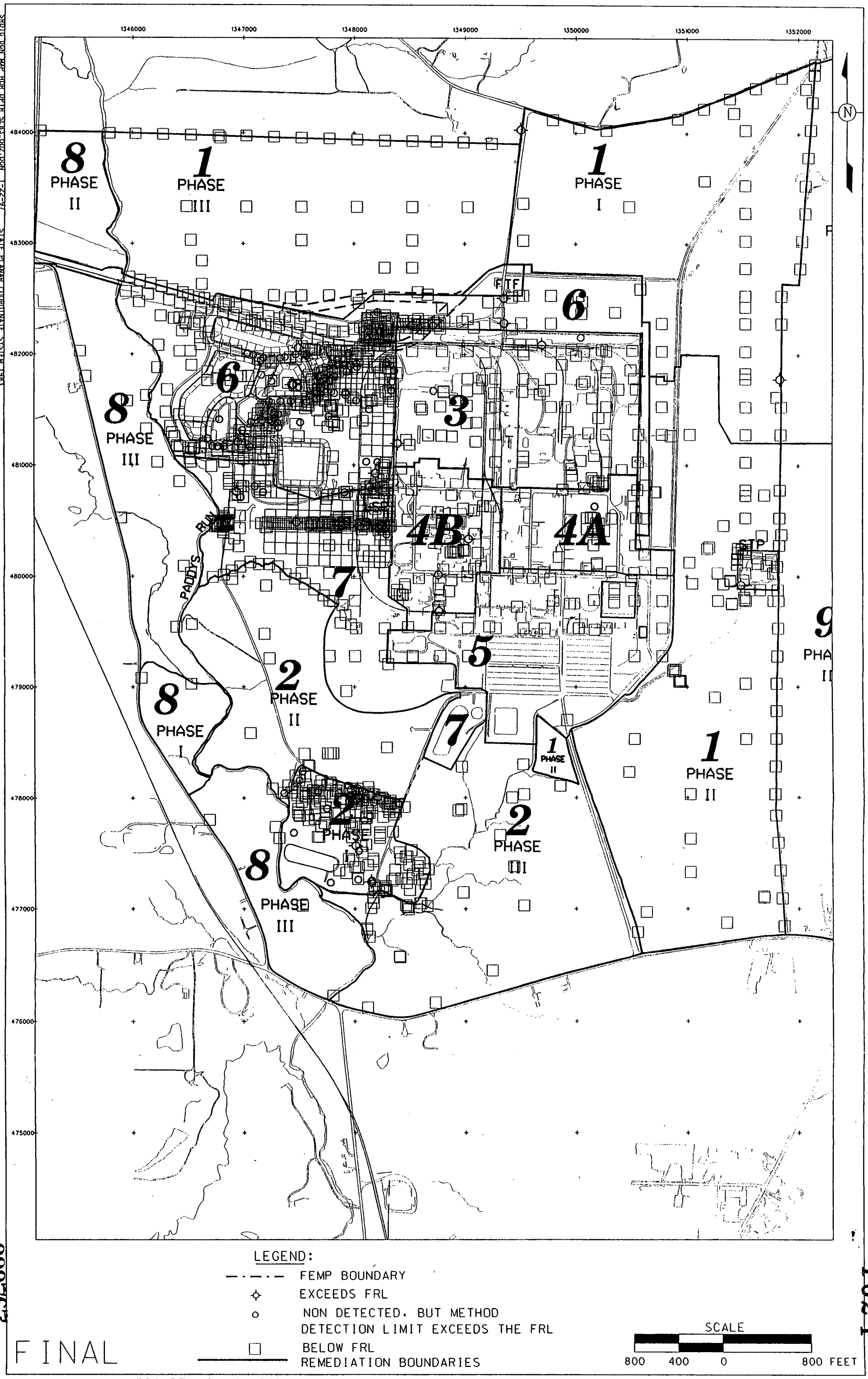



FIGURE I-14. SITEWIDE DISTRIBUTION OF CESIUM-137 BASED ON RI/FS DATA

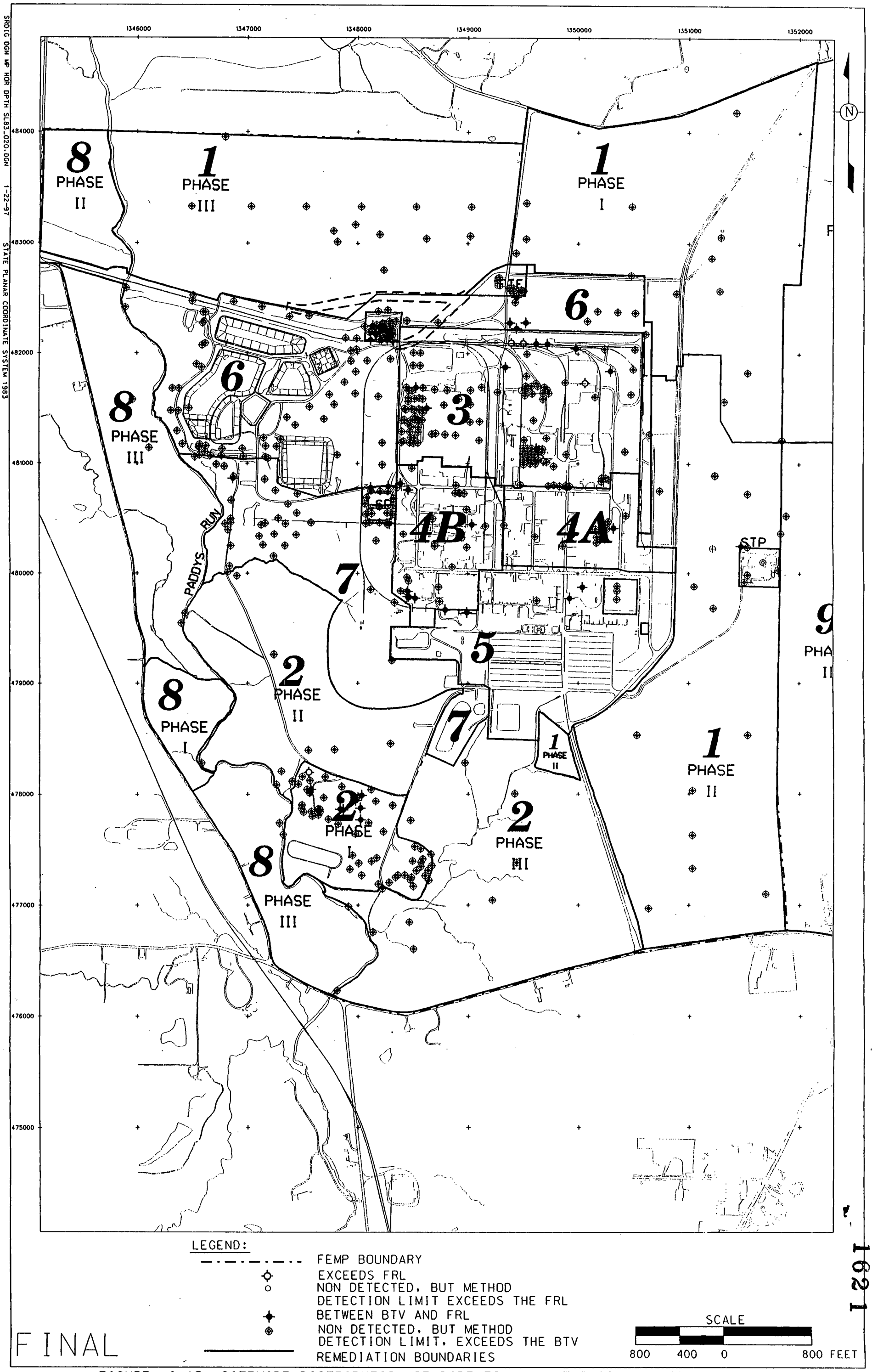



FIGURE I-15. SITEWIDE DISTRIBUTION OF DIBENZO(A,H)ANTHRACENE BASED ON RI/FS DATA

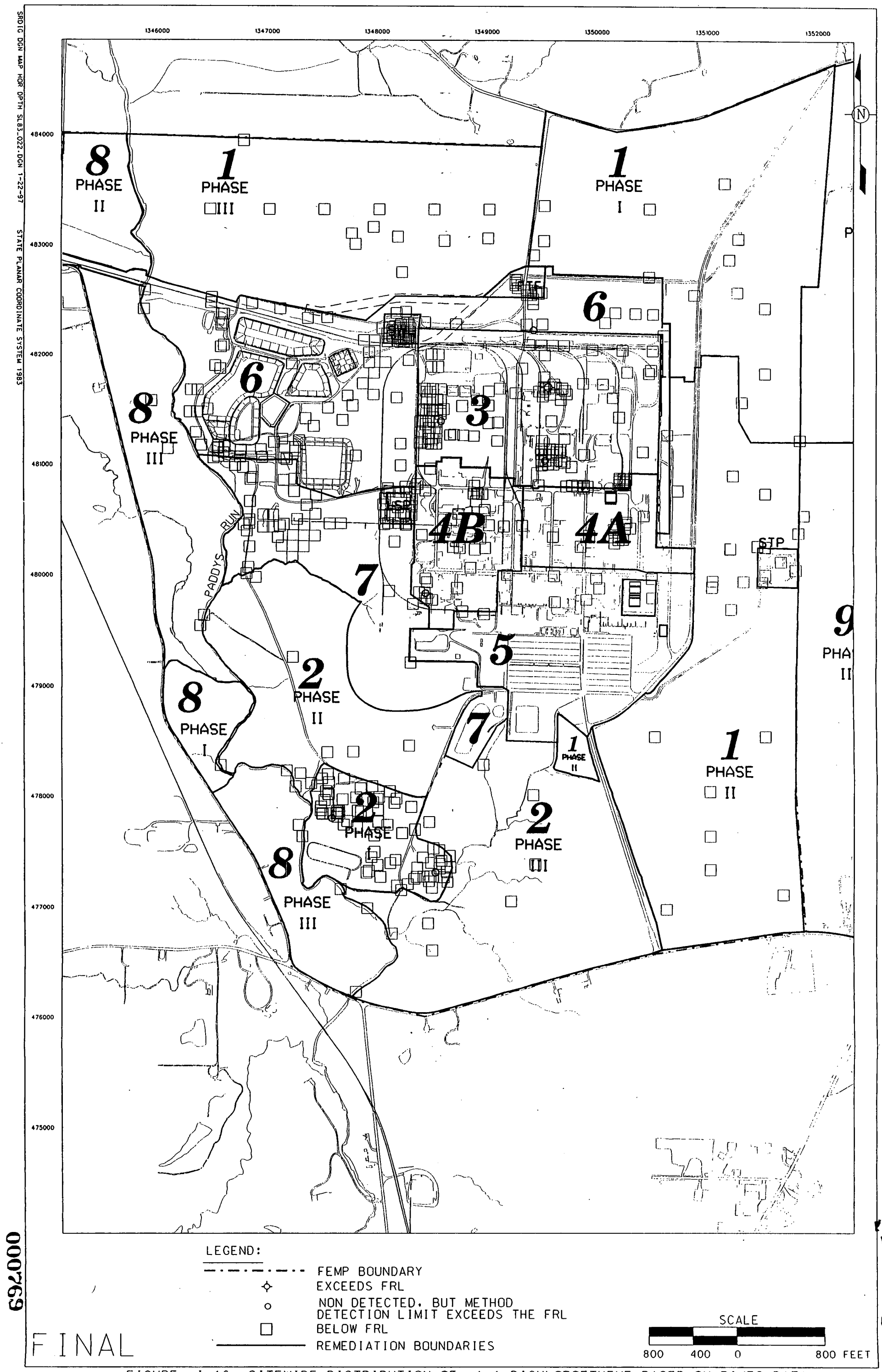
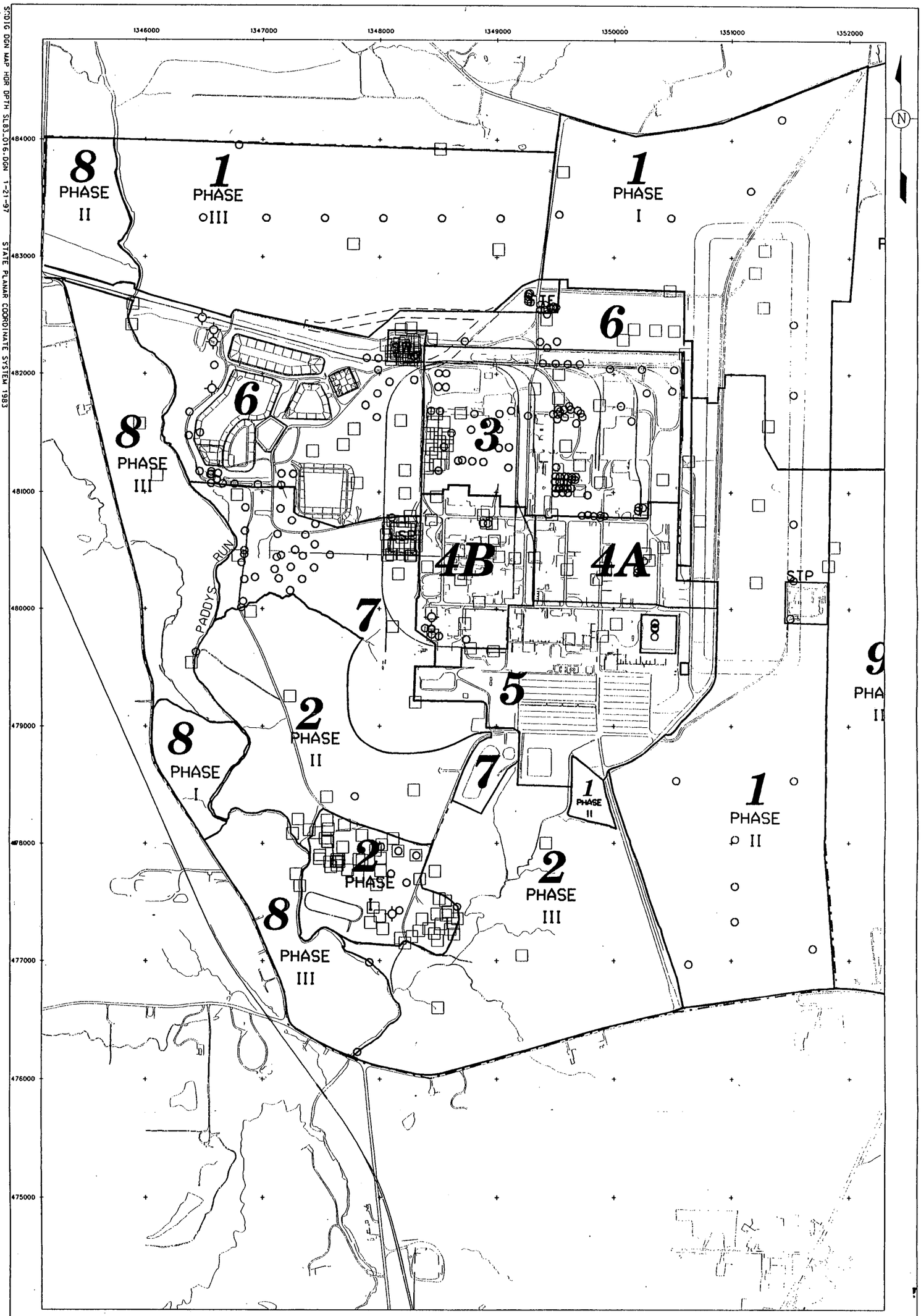



FIGURE I-16. SITEWIDE DISTRIBUTION OF 1,1-DICHLOROETHENE BASED ON RI/FS DATA




LEGEND:

- FEMP BOUNDARY
- EXCEEDS FRL
- NON DETECTED, BUT METHOD DETECTION LIMIT EXCEEDS THE FRL
- BELOW FRL
- REMEDIATION BOUNDARIES

SCALE

800 400 0 800 FEET

FINAL

FIGURE I-17. SITEWIDE DISTRIBUTION OF DIELDRIN BASED ON RI/FS DATA

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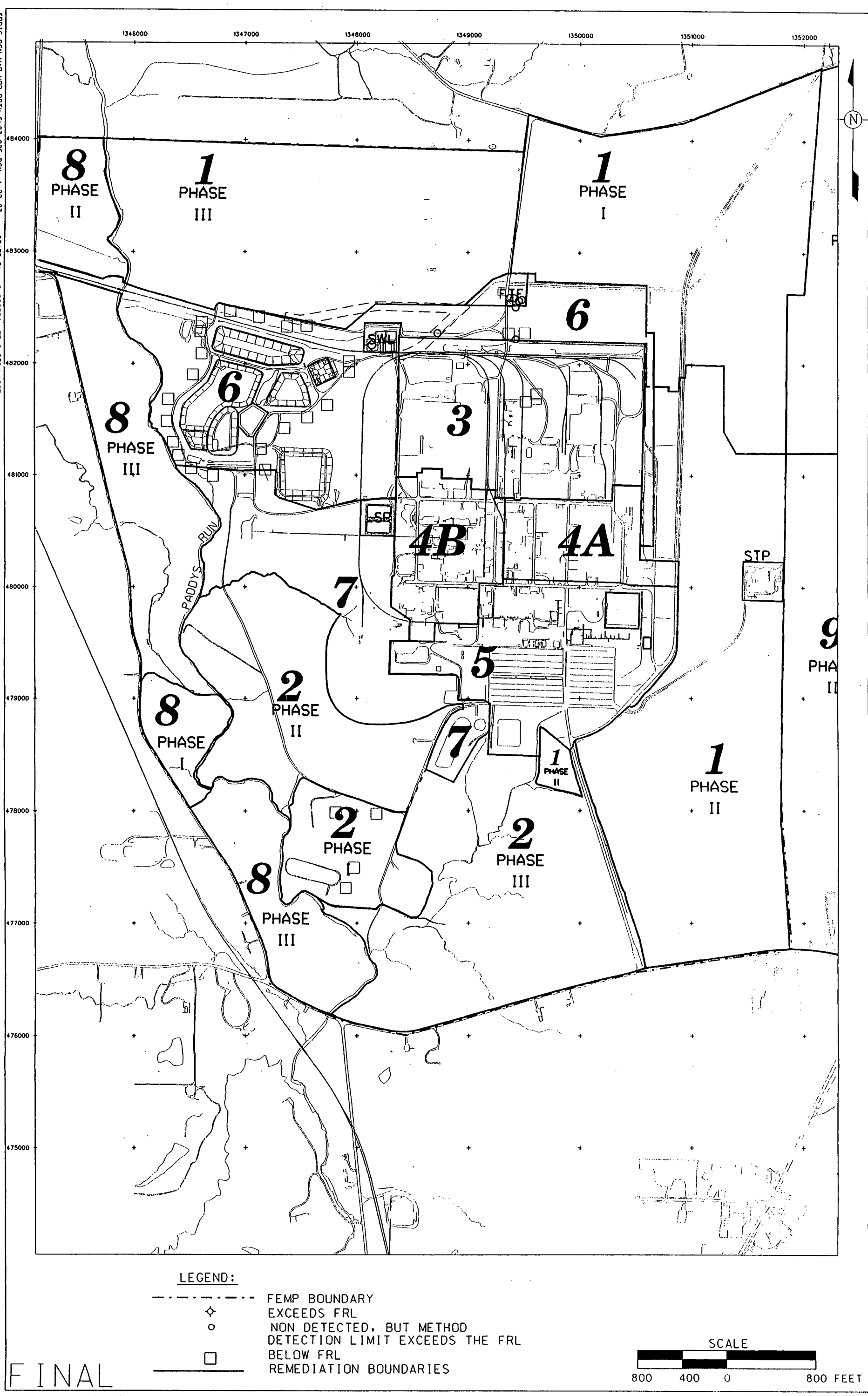


FIGURE I-18. SITEWIDE DISTRIBUTION OF HEPTACHLORODIBENZO-P-DIOXINS BASED ON RI/FS DATA

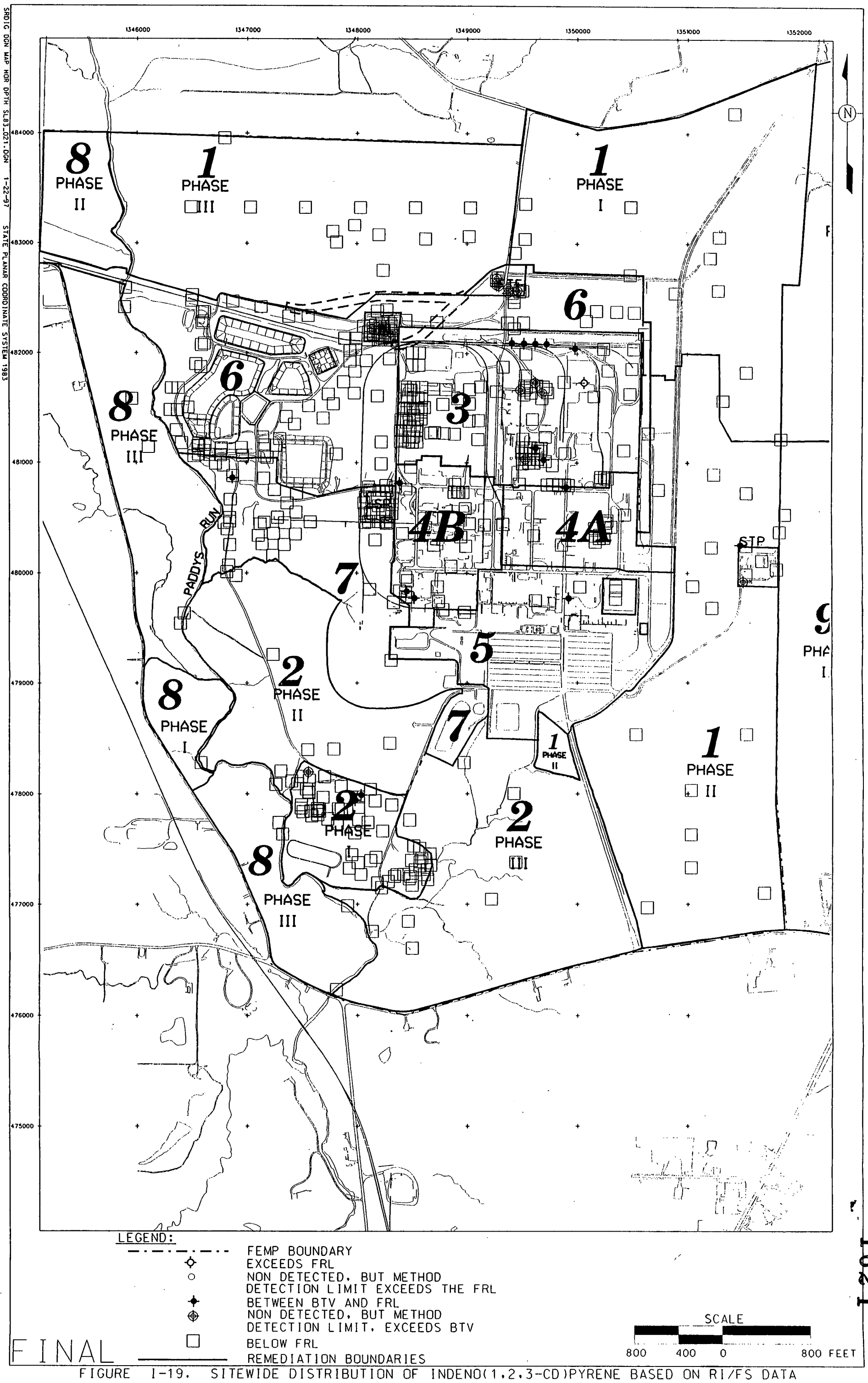


FIGURE I-19. SITEWIDE DISTRIBUTION OF INDENO(1,2,3-CD)PYRENE BASED ON RI/FS DATA

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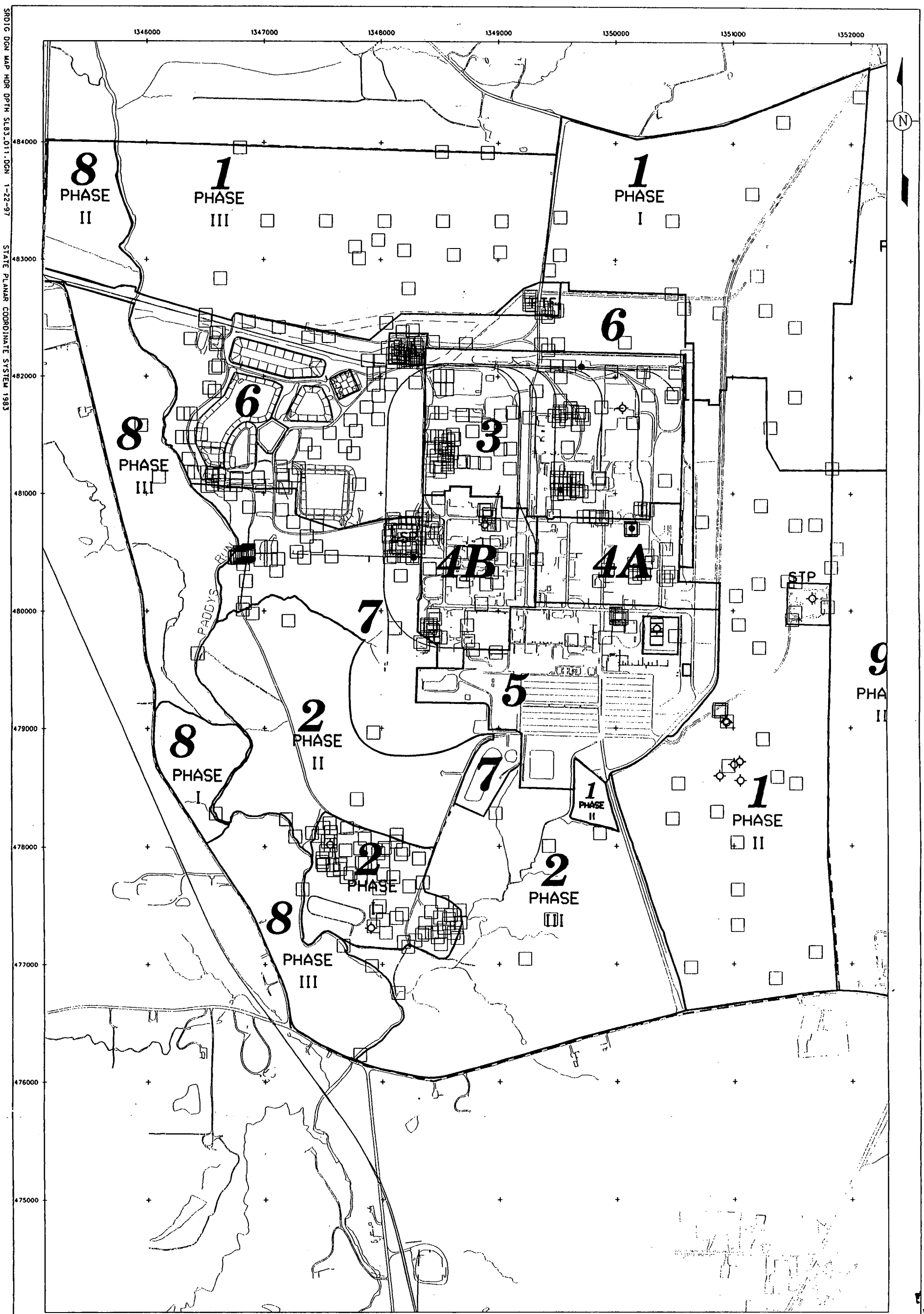


FIGURE I-20. SITEWIDE DISTRIBUTION OF LEAD BASED ON RI/FS DATA

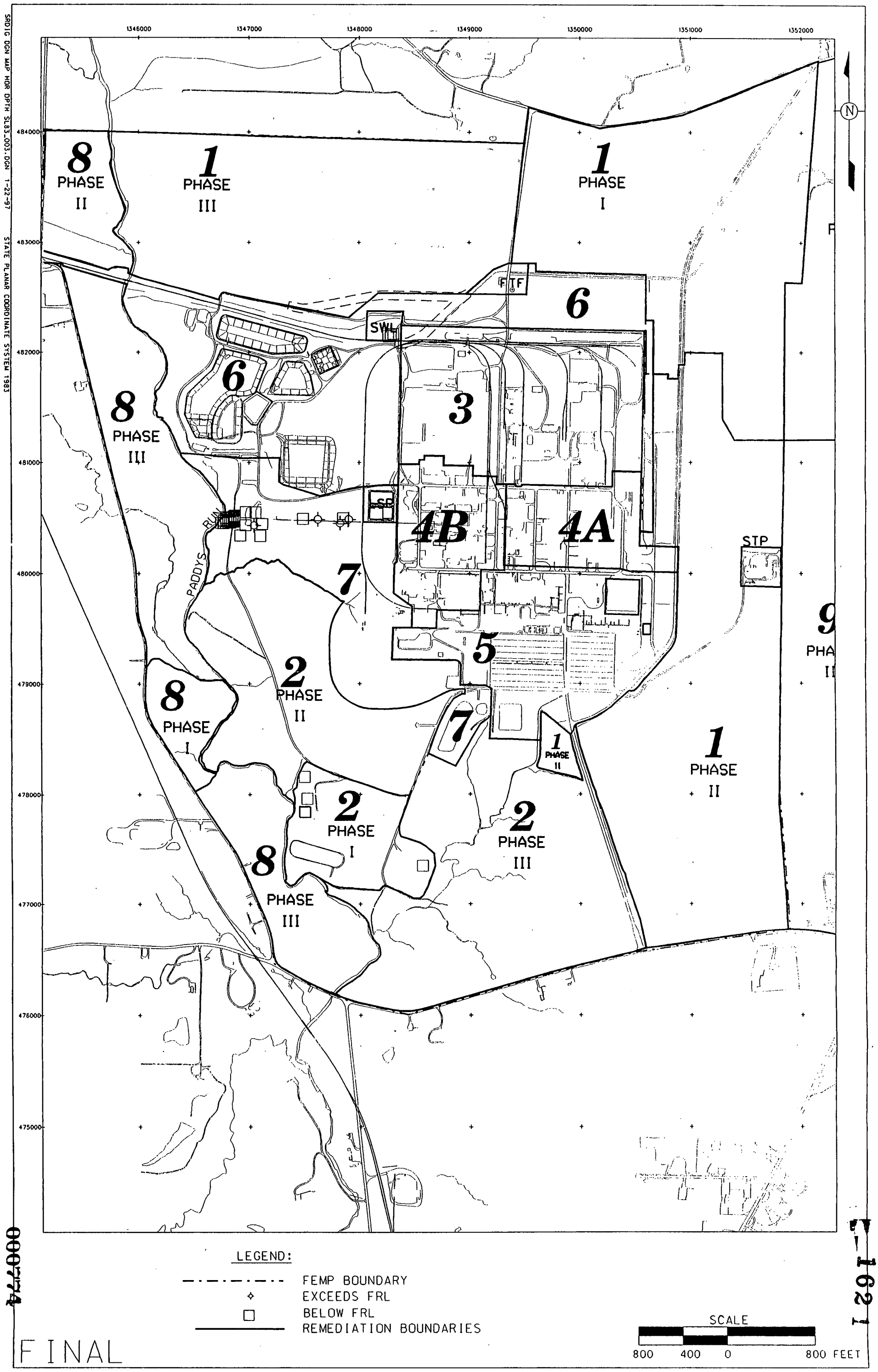


FIGURE I-21. SITEWIDE DISTRIBUTION OF LEAD-210 BASED ON RI/FS DATA



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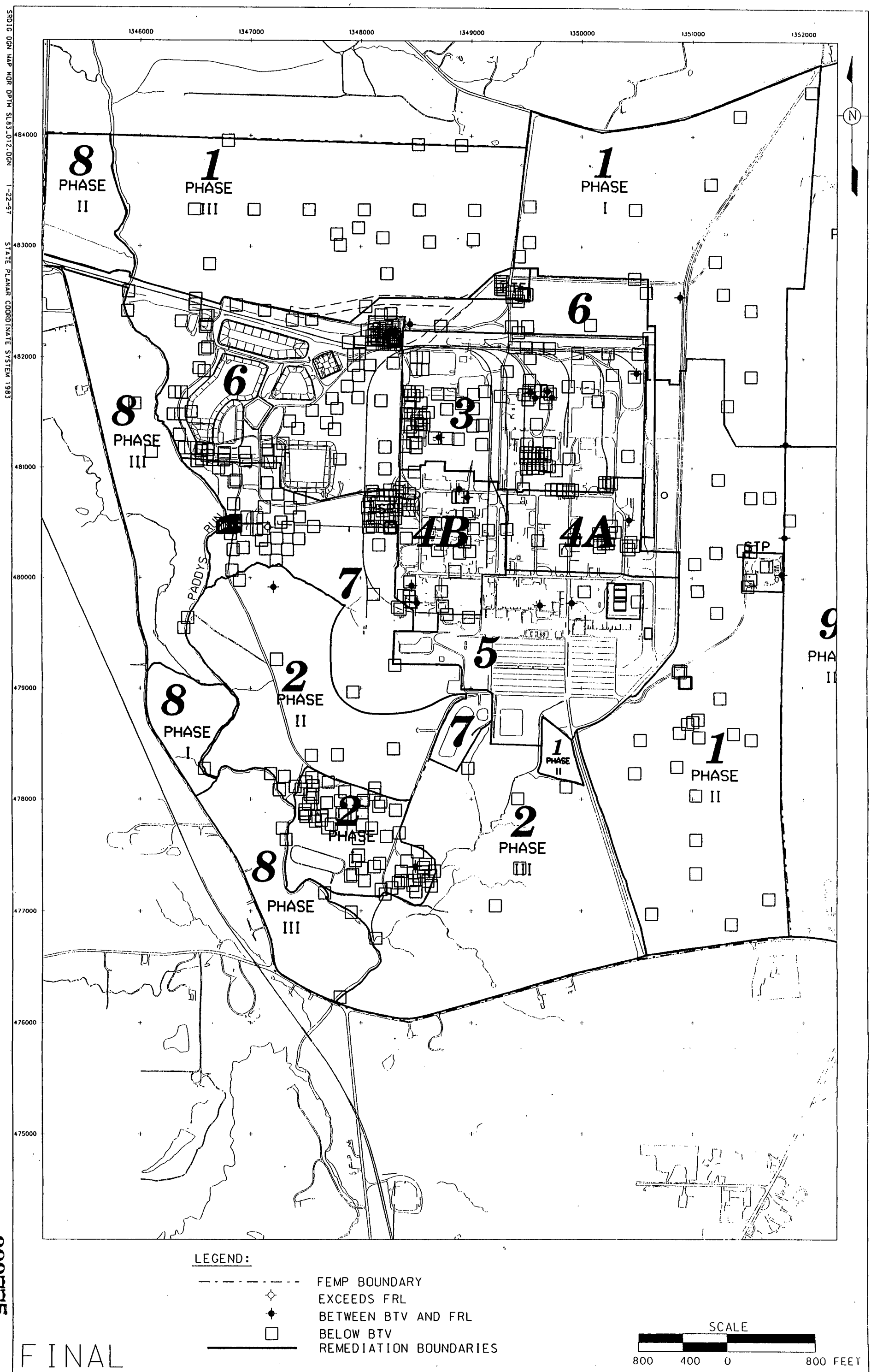


FIGURE I-22. SITEWIDE DISTRIBUTION OF MANGANESE BASED ON RI/FS DATA

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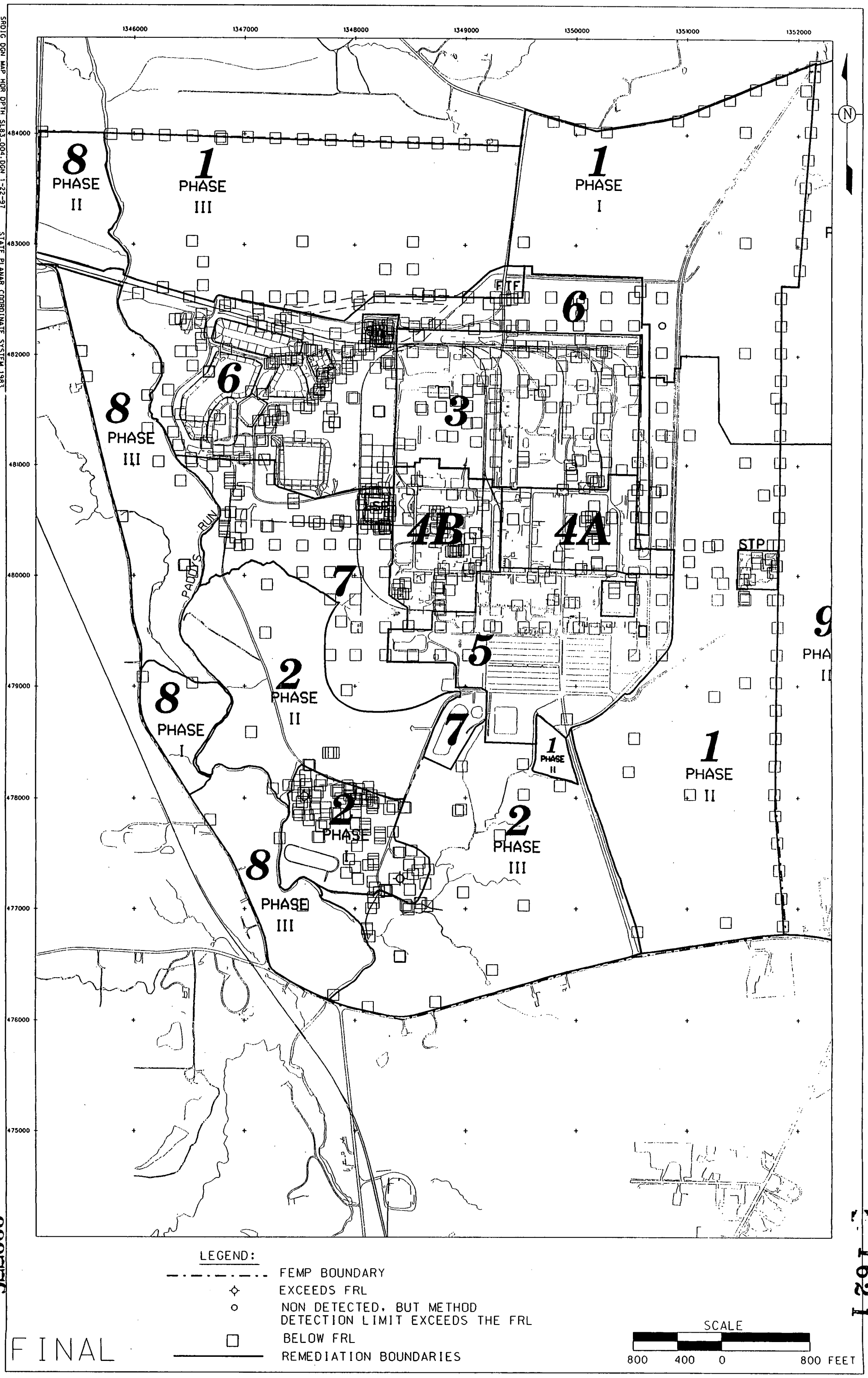


FIGURE I-23. SITEWIDE DISTRIBUTION OF NEPTUNIUM-237 BASED ON RI/FS DATA

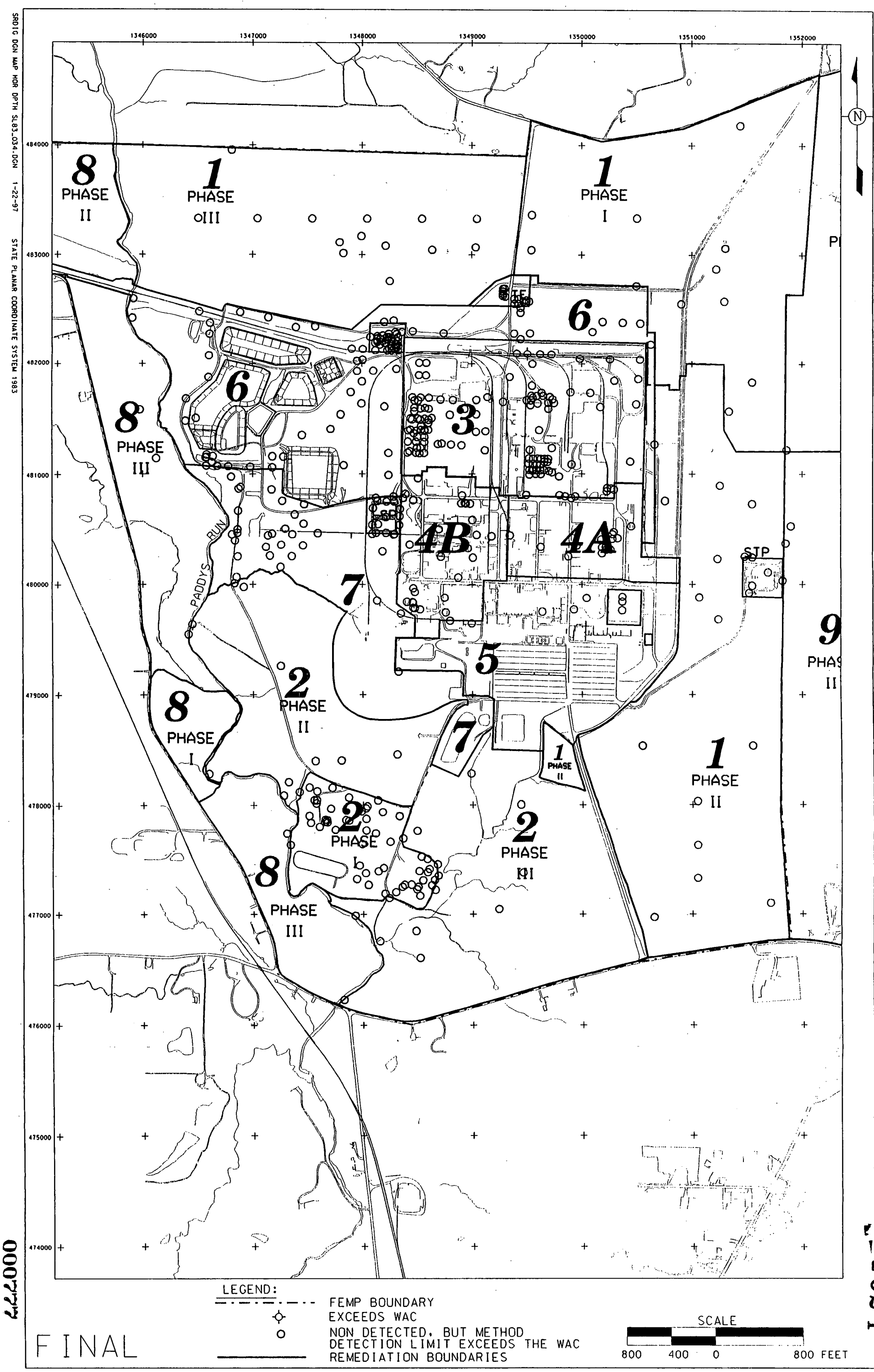


FIGURE I-24. SITEWIDE DISTRIBUTION OF 4-NITROANILINE BASED ON RI/FS DATA

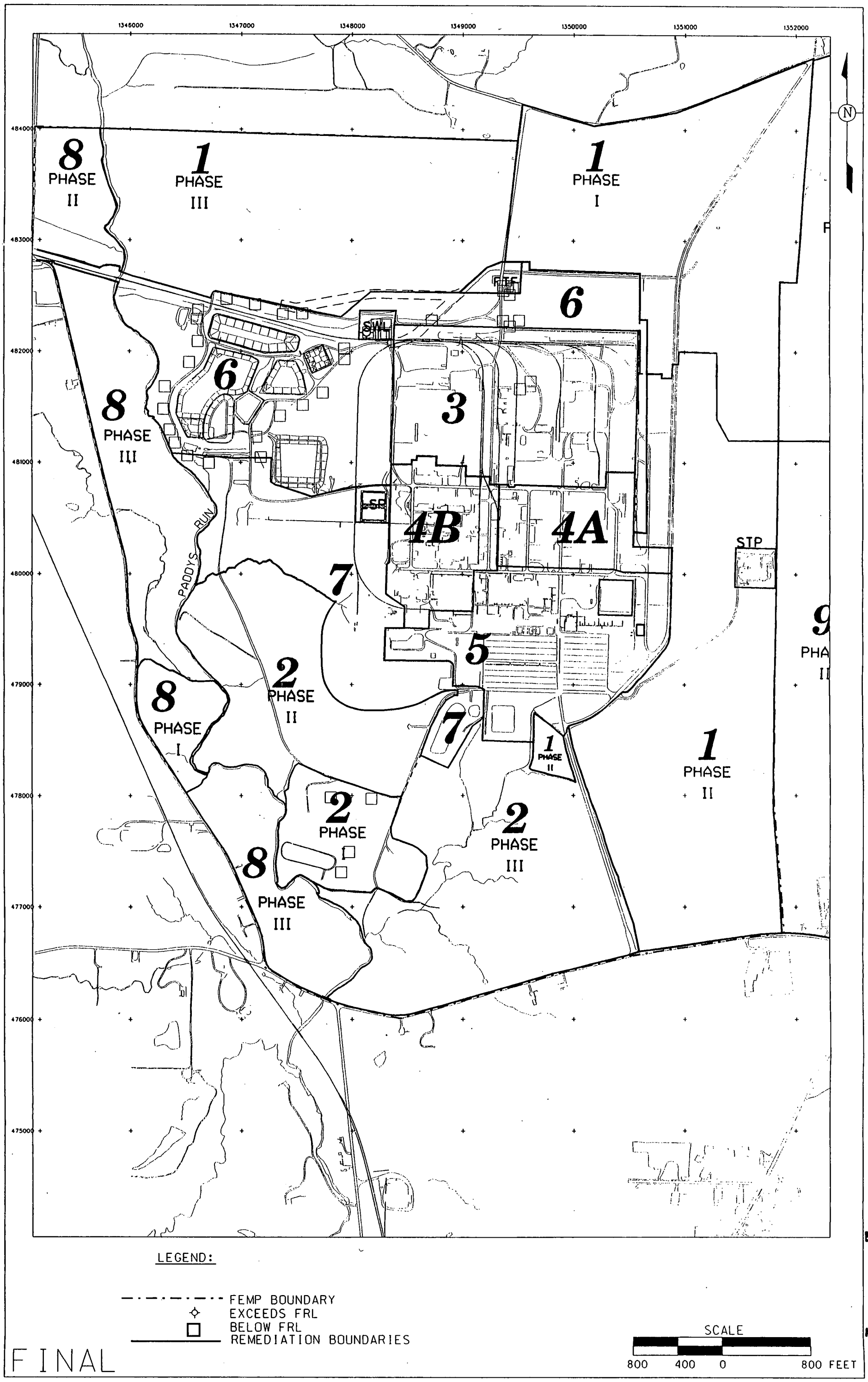


FIGURE I-25. SITEWIDE DISTRIBUTION OF OCTACHLORODIBENZO-P-DIOXIN BASED ON RI/FS DATA

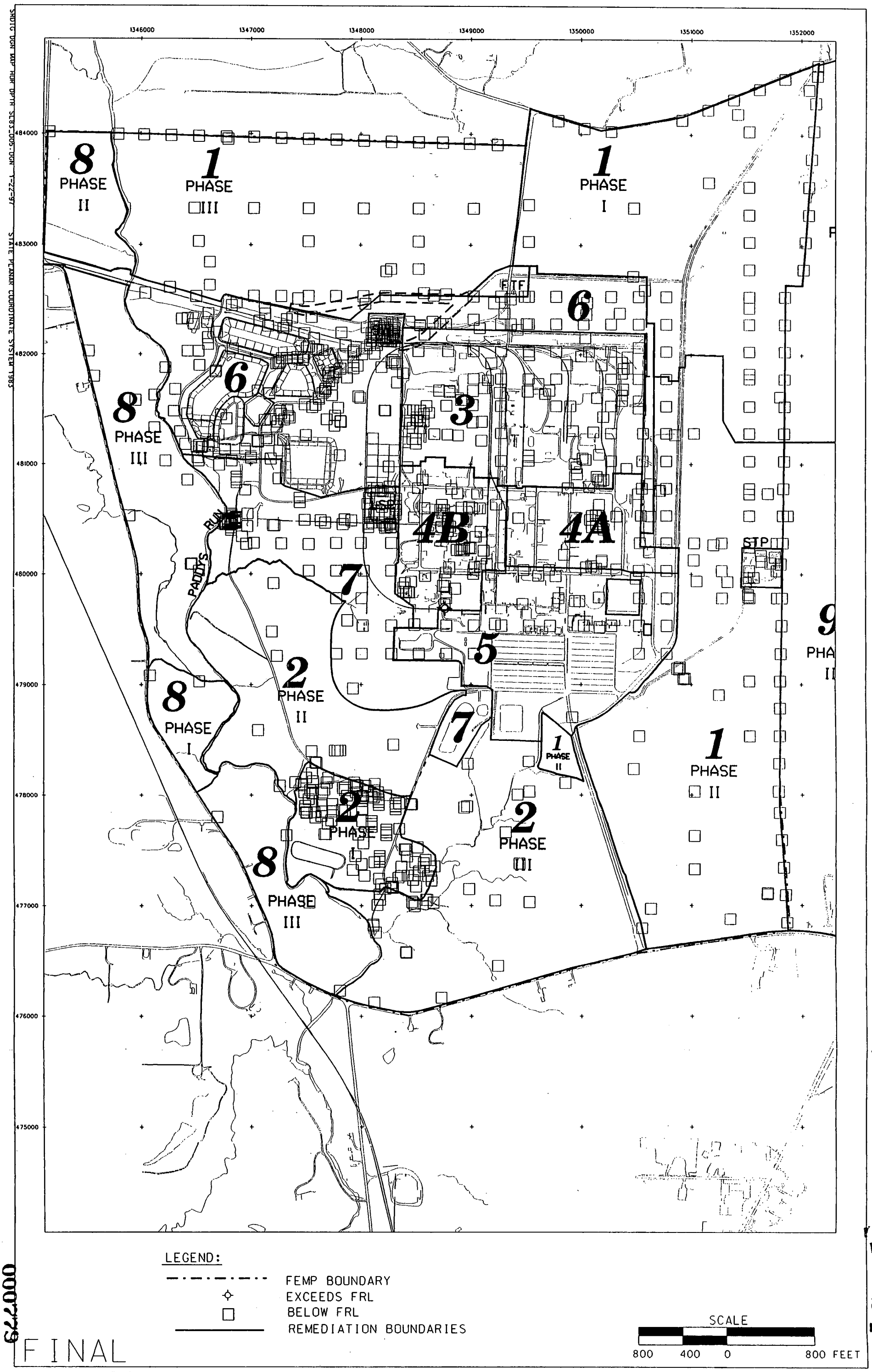


FIGURE I-26. SITEWIDE DISTRIBUTION OF PLUTONIUM-238 BASED ON RI/FS DATA

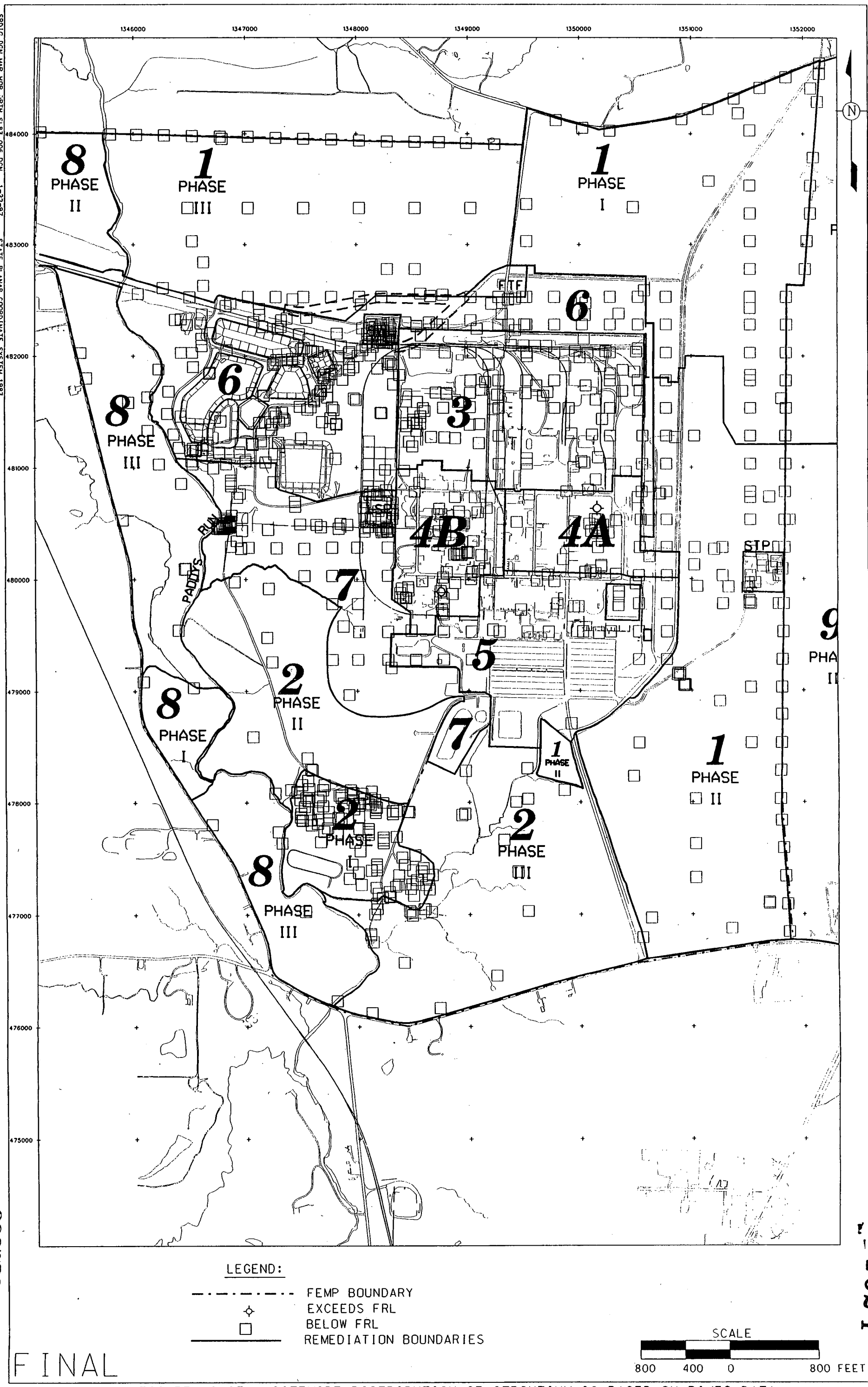


FIGURE I-27. SITEWIDE DISTRIBUTION OF STRONTIUM-90 BASED ON RI/FS DATA

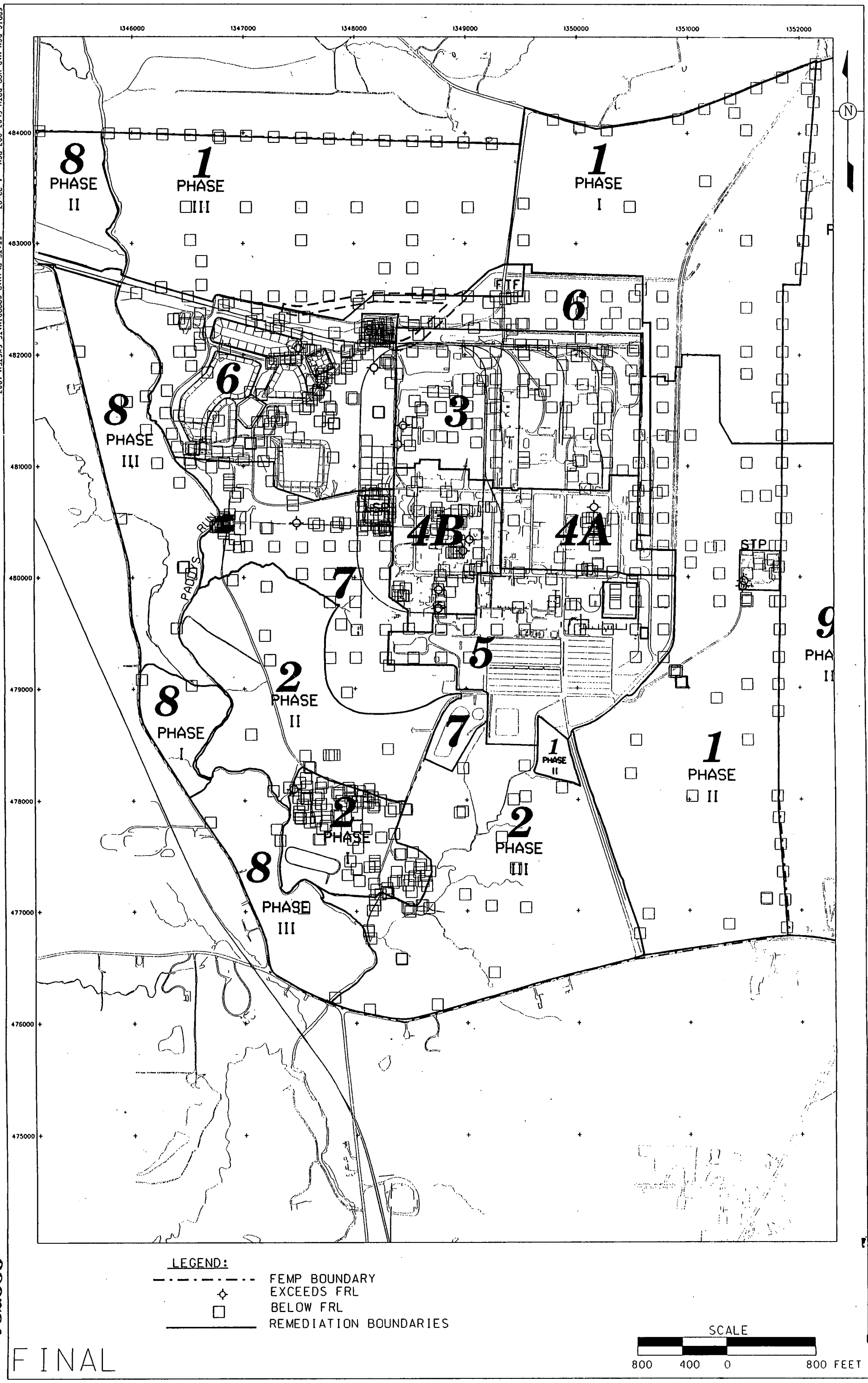


FIGURE I-28. SITEWIDE DISTRIBUTION OF TECHNETIUM-99 BASED ON RI/FS DATA

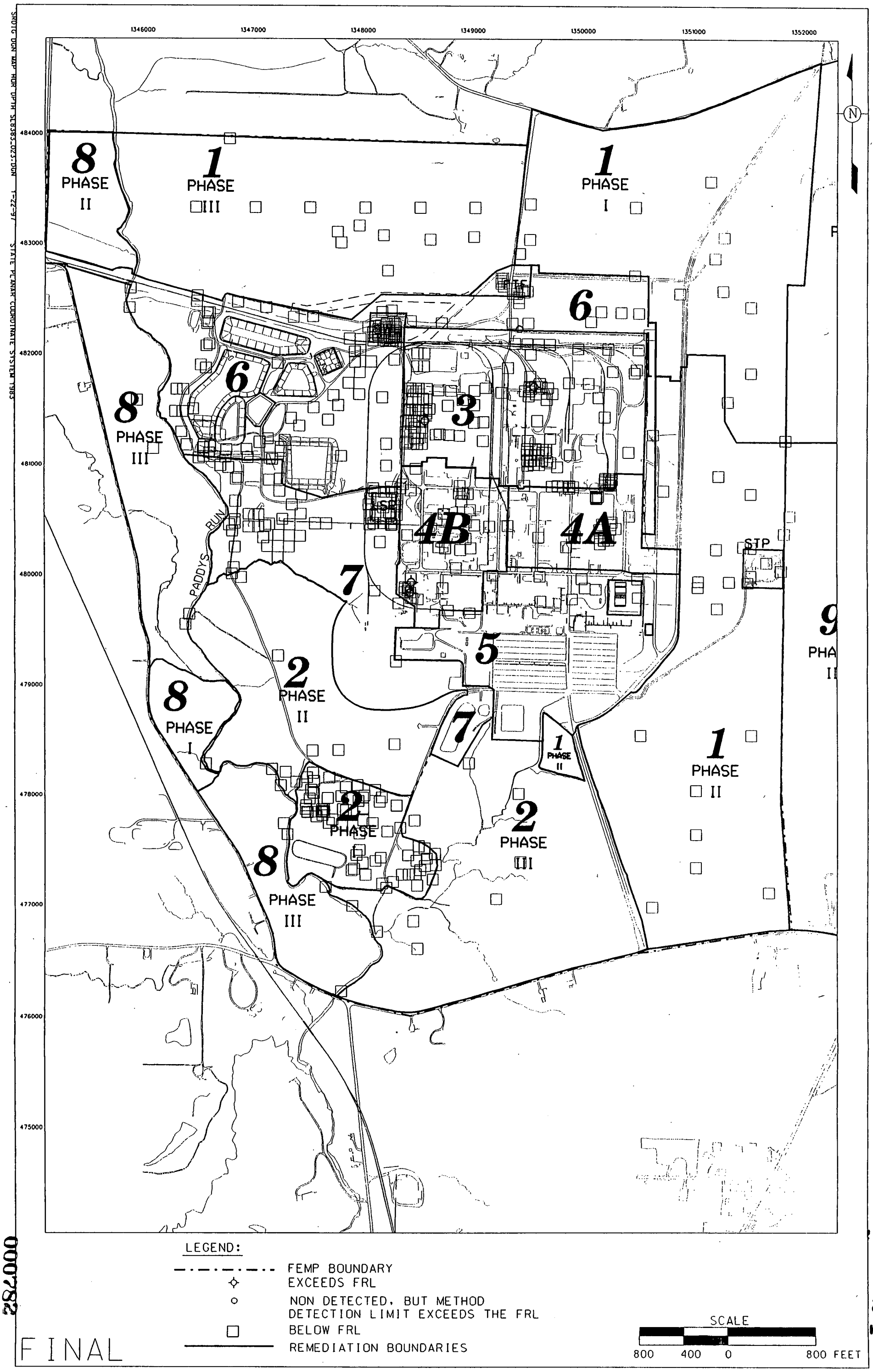


FIGURE I-29. SITEWIDE DISTRIBUTION OF TETRACHLOROETHENE BASED ON RI/FS DATA

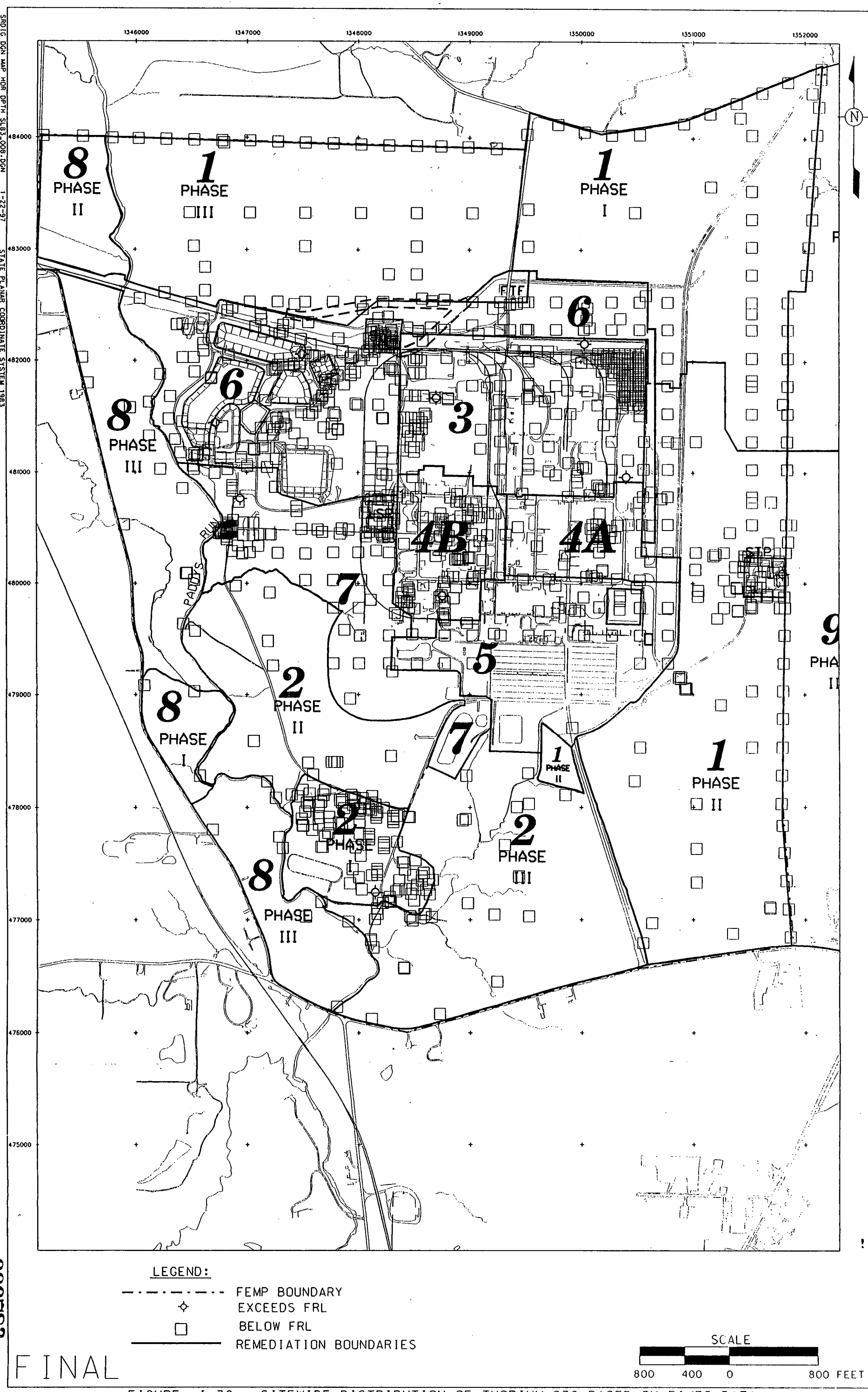


FIGURE I-30. SITEWIDE DISTRIBUTION OF THORIUM-230 BASED ON RI/FS DATA

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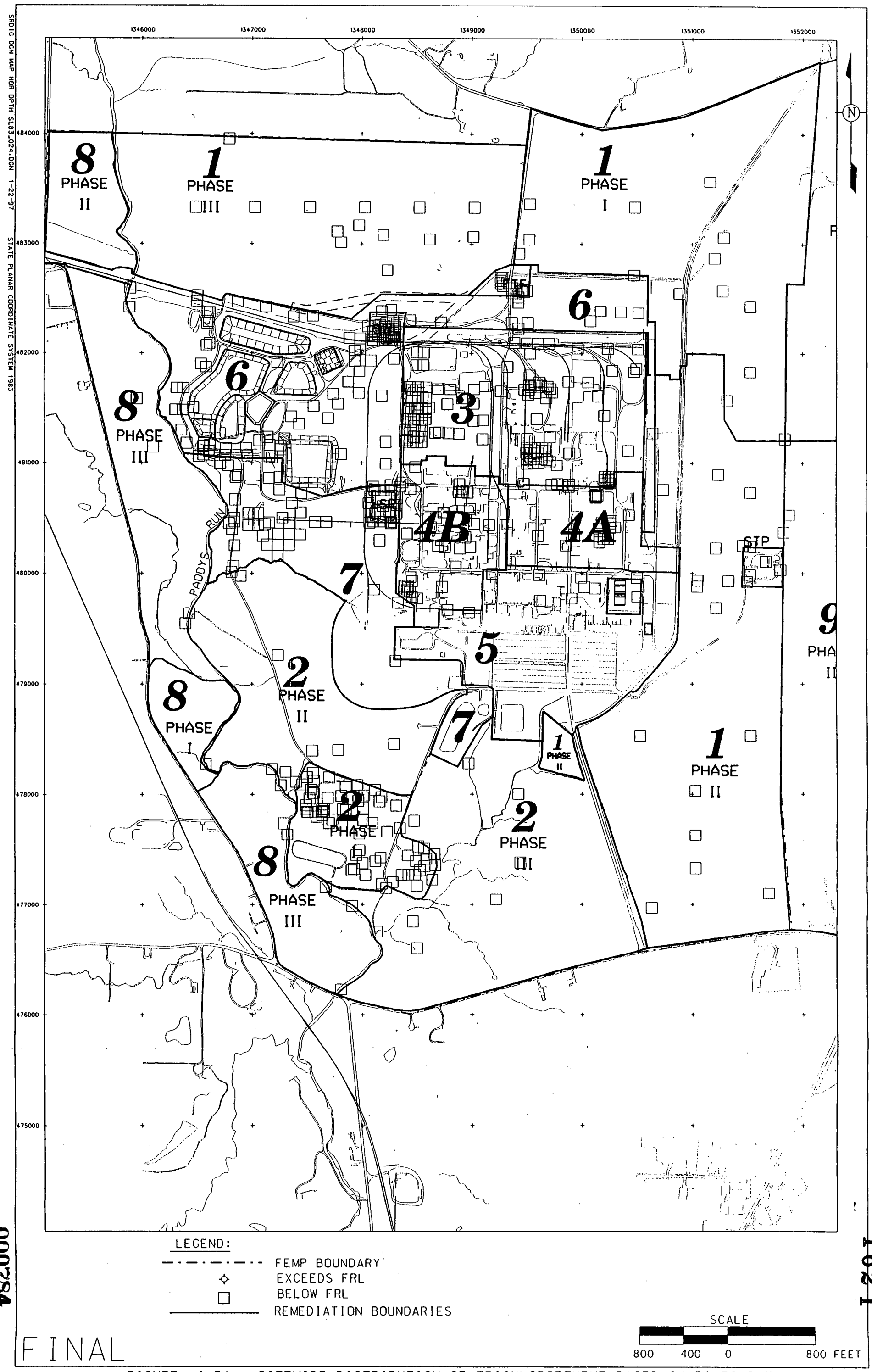


FIGURE I-31. SITEWIDE DISTRIBUTION OF TRICHLOROETHENE BASED ON RI/FS DATA

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