006205

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APR 3 2006

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Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF THE DRAFT SECOND FIVE-YEAR REVIEW REPORT FOR THE FERNALD CLOSURE REPORT

Enclosed for your review is the draft Second Five-Year Review Report for the Fernald Closure Project. The five-year review is statutorily required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at National Priority List sites that implement remedial actions which will result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. This review and report were prepared in accordance with U.S. Department of Energy draft guidance for CERCLA five-year reviews and the U.S. Environmental Protection Agency comprehensive five-year guidance document.

If you have any questions or require additional information, please contact me at (513) 648-3139.

Sincerely,

Johnny Reising

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SECOND FIVE-YEAR REVIEW REPORT FOR THE FCP

FERNALD CLOSURE PROJECT
FERNALD, OHIO

MARCH 2006

U.S. DEPARTMENT OF ENERGY

2500-RP-0044
Revision B
DRAFT

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LIST OF ACRONYMS AND ABBREVIATIONS

ACA	Amended Consent Agreement
ARAR	applicable or relevant and appropriate requirement
ARWWT	Aquifer Restoration and Wastewater Treatment Project
AWR	Accelerated Waste Retrieval
AWWT	Advanced Waste Water Treatment (Facility)
CAWWT	Converted Advanced Waste Water Treatment (Facility)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	constituents of concern
CRARE	comprehensive response action risk evaluation
CSOU	Comprehensive Site-Wide Operable Unit
D&D	decontamination and dismantling
DOE	U.S. Department of Energy
DOT	Department of Transportation
ECP	Environmental Closure Project
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
FCP	Fernald Closure Project
FEMP	Fernald Environmental Management Project
FMPC	Feed Materials Production Center
FRL	final remediation level
ft^3	cubic feet
GMA	Great Miami Aqufier
gpm	gallons per minute
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HF	hydrofluoric
HI	hazard index
HWMU	hazardous waste management unit
IC	Institutional Control
ILCR	incremental lifetime cancer risk
IEMP	Integrated Environmental Monitoring Plan
IMPP	Impacted Materials Placement Plan
IRIS	Integrated Risk Information System
IROD	Interim Remedial of Decision
kg	kilogram
km	kilometer
lbs	pounds
LCS	Leachate Collection System
LDS	Leachate Detection System
LMICP	Comprehensive Legacy Management and Institutional Controls Plan
lpm	liters per minute

LIST OF ACRONYMS AND ABBREVIATIONS

LTS	Long-Term Stewardship
MDC	Main Drainage Corridors
MCL	maximum contaminant level
μg/L	micrograms per liter
m^3	cubic meters
mrem	millirem
MSS	Miscellaneous Small Structures
NAR	nitric acid recovery
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NTS	Nevada Test Site
OEPA	Ohio Environmental Protection Agency
OMMP	Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment Project
OSDF	On-Site Disposal Facility
OU	operable unit
PCB	polychlorinated biphenyl
pCi/L	picoCuries per liter
RCRA	Resource Conservation and Recovery Act
RCS	Radon Control System
RD/RA	remedial action/remedial action
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SDFP	Soil and Disposal Facility Project
TBC	to be considered-based
TDSHS	Texas Department of State Health Services
TSCA	Toxic Substances Control Act
TTA	Tank Transfer Area
WAC	waste acceptance criteria
WAO	Waste Acceptance Organization
WCS	Waste Control Specialists LLC
WPP	Waste Pits Project
yd^3	cubic yards

1.0 INTRODUCTION

Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that selected National Priority List sites conduct a five-year review of remedial actions. The five-year review (2000 through 2005) is a statutory requirement for National Priority List sites, such as the Fernald Closure Project (FCP), that implement remedial actions to reduce hazardous substances, pollutants, or contaminants at the site to levels below those allowed for unlimited use and unrestricted exposure. For sites where the U.S. Department of Energy (DOE) is the lead agency, and where a statutory review is required, DOE is responsible for conducting the review. The findings are documented in a report to the U.S. Environmental Protection Agency (EPA), as cited in CERCLA (Section 120 and 121 as well as Executive Order 12580).

1.1 PURPOSE AND OBJECTIVES

This second five-year review documents the status of the remedial actions implemented for each of the five operable units (OUs) at the FCP site. The FCP used the DOE draft guidance for CERCLA five-year reviews (DOE 2000a) and the EPA's Comprehensive Five-Year Review Guidance (EPA 2001a). The DOE guidance is consistent with the intent of EPA's guide; however, it is tailored to the unique challenges posed by DOE sites and reflects the planned activities of the Long-Term Stewardship Monitoring Plan (LTS Plan) (DOE 2000b). The DOE has three primary objectives for its five-year reviews:

1. Ensuring the long-term effectiveness of those engineered or institutional measures put in place to protect human health and the environment

2. Optimizing the effectiveness of remedy controls and the implementation of remedy requirements to minimize life cycle costs

3. Minimizing redundant documentation and paperwork.

With regard to the third objective, this report includes an overview of background information from the OU Records of Decision (RODs), amendments and Explanations of Significant Differences (ESDs) to facilitate review of the report by stakeholders less familiar with the CERCLA actions taken to date.

1.2 OVERVIEW OF THE CERCLA FIVE-YEAR REVIEW

DOE is responsible for conducting the five-year review at sites under its jurisdiction, while EPA is responsible for concurrence with the review. The FCP review is being jointly coordinated and performed by DOE and Fluor Fernald, Inc. (the prime contractor to DOE). As defined by the prime contract, Fluor Fernald, Inc. is responsible for remediation and closure of the site. The review team consists of Fluor Fernald, Inc. personnel from each major remediation project within the site's five OUs, as well as DOE personnel who have oversight responsibility for each OU.

EPA guidance suggests that a CERCLA five-year review should include a full assessment of remedial action data and remedial status for each OU. However, it is appropriate to minimize duplicative information that has been reported in existing CERCLA or DOE documents related to remedial actions. Through the duration of CERCLA activities at the FCP, DOE has proactively developed several forums and channels to report environmental and operational data and remedial action status to EPA and the Ohio Environmental Protection Agency (OEPA). Consequently, the regulatory agencies have played an active oversight role in all remedial phases at the FCP. At present, EPA and OEPA involvement in the remedial actions at the FCP includes weekly teleconference calls, full regulatory review of all remediation documents, a comprehensive split/confirmatory sampling program, and day-to-day interaction with DOE-FCP personnel. This situation is unique compared to National Priority List sites undergoing CERCLA actions conducted and funded by private parties. Therefore, extensive discussion of issues with the regulatory agencies and stakeholders is unnecessary because they have already been informed of the issues through existing channels. Additionally, as a result of the ongoing EPA and OEPA involvement, there are no special site inspections or interviews necessary to support the five-year review, as specified in the EPA guidance.

Per EPA guidance, the FCP has the option to combine the five-year review for each of the OUs into one document, and this option has been selected to place the entire site on the same five-year review schedule for the duration of the remedial actions and post-closure stewardship activities.

For sites with multiple OUs, the five-year review clock is triggered by the onset of construction for the first remedial action, as defined in any of the applicable OU RODs. The first remedial action for the FCP was the April 1996 construction, under the OU1 ROD (DOE 1995a), to support the Waste Pit Remedial Action Project. Consequently, the first five-year review was issued in May 2001 and it concluded that immediate threats posed by the five OUs have been addressed and the remedies are operating effectively to protect human health and the environment. Additionally, a review of the EPA website was performed for the first five-year review to update maximum contaminant levels (MCLs) in groundwater and reference doses and cancer slopes for risk assessment calculations. Updated values were used in risk calculations to conclude that critical assumptions on future land use and exposure pathways remain valid.

Following the process initiated by the first five-year review, the second five-year review examined the remedial objectives, selected remedies, and pertinent information in the OU RODs, amendments, and ESDs, and compared this information with the present remedial status and performance. The second five-year report also examined the most up to date MCLs, reference doses and cancer slope factors to evaluate if the remedies remain protective of human health and the environment. The release of the second five-year report satisfies the statutory requirements for the May 2006 CERCLA submittal.

1.3 OVERVIEW OF SITE HISTORY AND OPERABLE UNITS

In 1951, the Atomic Energy Commission (predecessor of the DOE) began building the Feed Materials Production Center (FMPC) on a 1,050-acre (425-hectare) tract of land outside the small agricultural community of Fernald, Ohio. The FMPC mission was to produce "feed materials" (purified uranium compounds and metal) for other government facilities that produced nuclear weapons. Uranium metal production took place from 1952 through 1989, and material releases to the environment contaminated the soil, surface water, sediment, and groundwater on and around the site.

In 1986, the DOE initiated the CERCLA process to characterize the nature and extent of contamination at the FMPC, establish risk-based cleanup standards, and select the appropriate remediation technologies to achieve those standards. By 1991, the site mission had officially changed from uranium production to environmental remediation and site restoration under CERCLA, and the site was renamed the Fernald Environmental Management Project (FEMP). In 2003, the site was renamed the FCP to reflect the primary mission to close the site in 2006. EPA Region V and the Southwest District Office of OEPA provide regulatory oversight.

As part of the CERCLA process, the FCP was organized into five OUs:

- OU1: Waste Pits 1 through 6, the clearwell, and the burn pit
- OU2: the active and inactive flyash piles and other South Field disposal areas, the lime sludge ponds, and the solid waste landfill
- OU3: the former production area and associated facilities, equipment, and wastes
- OU4: Silos 1, 2, 3, and 4; their berms; and the decant tank system
- OU5: all environmental media, including groundwater, perched water, surface water, soils, sediment, flora and fauna, both on and off site.

The remedy selection process culminated in July 2000 with the approval of the amended ROD for OU4. FCP remedial activities are now being directed toward safely and efficiently moving the site toward closure. Present operations include soil and groundwater remediation, facility decontamination and dismantling operations, treatment and off-site disposal of wastes, construction of the On-Site Disposal Facility (OSDF), and environmental restoration. Table 1-1 provides an abbreviated chronology of the major FCP milestones.

Following approval of each ROD, work began on the design and implementation of the OU remedies. While the OU management approach was successful for completing the characterization and remedy selection process, it was not the most effective organizational structure for completing remedial design and implementing the remedial actions. Therefore, sitewide responsibilities and regulatory obligations were

realigned across the OUs to execute remedial design and remedial action by project organizations, rather than OUs. Realignment into project organizations reflected the actual work processes and operations necessary to complete remediation and maintain the requirements of the ROD. Table 1-2 summarizes each OU remedy and provides a crosswalk between the OUs and the current project organizations responsible for implementing each selected remedy.

TABLE 1-1
ABBREVIATED SITE CHRONOLOGY

Year	Major Fernald Events and Milestones
1951	Construction of the Feed Materials Production Center (FMPC) began.
1952	Uranium production started.
1986	EPA and DOE signed the Federal Facilities Compliance Agreement, thus initiating the remedial investigation/feasibility study process.
1989	Uranium production was suspended and the Fernald site was placed on the National Priorities List for clean up under CERCLA.
1990	As part of the Amended Consent Agreement, the site was divided into OUs for characterization and remedy determination.
1991	Uranium production formally ended. The site mission changed from uranium production to environmental remediation and site restoration. The site was renamed the Fernald Environmental Management Project (FEMP).
1994	Decontamination and dismantling of the first building was completed under the OU3 Interim ROD.
1996	The last OU ROD was signed, signifying the end of the 10-year remedial investigation/feasibility study process (the OU4 ROD was later re-opened and amended). Construction began in support of the OU1 selected remedy. Soil remedial excavations began as part of the OU5 selected remedy.
1997	Construction of Cell 1 of the OSDF took place, and the first waste placement began in December.
1998	OU2 remedial excavations began.
1999	Excavation of the waste pits was initiated under the OU1 ROD, and the first rail shipment of waste was transported to Envirocare of Utah, Inc. Safe Shutdown was completed ahead of schedule.
2000	The Amended ROD for OU4 is signed, thus establishing a new selected remedy for OU4.
2001	The first five-year review report is issued.
2003	The site was renamed the Fernald Closure Project (FCP).
2004	Removal of Silo 3 waste is initiated, and the first shipment of waste arrives at Envirocare of Utah, Inc. Removal of Silo 1 and 2 wastes from the silos to the holding tank facility is initiated.
2005	First shipment of Silo 1 and 2 waste arrives at Waste Control Specialists, Inc. in Texas

TABLE 1-2
CROSSWALK BETWEEN FCP OPERABLE UNITS AND PROJECT RESPONSIBILITIES FOR REMEDY IMPLEMENTATION

Operable Unit	Description	Remedy Overview[a]	Project Organization/Responsibilities
1	– Waste Pits 1 – 6 – Clearwell – Burn pit – Berms, liners, caps, and soil within the boundary	Record of Decision Approved: March 1995 Explanation of Significant Differences Approved: September 2002 Record of Decision Amendment Approved: November 2003 Excavation of materials with constituents of concern above final remediation levels (FRLs), waste processing and treatment by thermal drying (as necessary), off-site disposal at a permitted facility, and remediation of soil footprint. Excavation of waste pit materials is complete. Remediation of soil footprint is in progress.	Waste Pit Project (WPP) is responsible for excavation, processing and shipment of the waste. Environmental Closure Project (ECP) is responsible for planning, designing and directing the remediation of the soil footprint; certifying that the footprint meets the soil FRLs established in the OU5 ROD; final treatment of contaminated runoff and perched water collected during waste pit excavation; and processing wastewater discharges. Each project is responsible for transporting their wastewater to the head works of the Advanced Wastewater Treatment Facility (AWWT). Additionally, the ECP's Waste Acceptance Organization is responsible for field oversight of soil excavations, for reviewing and signing manifests for impacted soil delivered to the OSDF for placement, and for rejecting any unacceptable shipments. Soil and Disposal Facility Project (SDFP) is responsible for excavation of contaminated soil beneath the waste pits, as well as at- and below-grade remediation facilities, including the railroad. Decontamination and Demolition Project (D&D) is responsible for decontamination and dismantling of OU1 remediation facilities that are not the responsibility of the Shaw Group.
2	– Solid waste landfill – Inactive flyash pile – Active flyash pile (now inactive) – North and south lime sludge ponds – Other South Field disposal areas – Berms, liners, and soil within the OU boundary	Record of Decision Approved: May 1995 Post-Record of Decision Fact Sheet Approved: April 1999 Excavation of all materials with constituents of concern (COCs) above FRLs, treatment for size reduction and moisture control as required, disposal in the OSDF, off-site disposal of a small fraction of excavated material that exceeds the waste acceptance criteria for the OSDF and lead-contaminated soil from the South Field firing range, and FCP remediation Excavation of waste materials is complete. Remediation of soil footprint is in progress.	Environmental Closure Project is responsible for planning, designing and directing the excavation of waste and soil; certifying that the footprint meets the soil FRLs established in the OU2 and OU5 RODs; treating contaminated runoff and perched water collected during excavation of OU2 subunit wastes; design of the OSDF liners and caps; and treating leachate from the OSDF. Each project is responsible for transporting remediation wastewater to the head works of the AWWT for treatment. Additionally, the ECP's Waste Acceptance Organization is responsible for field oversight of debris sizing; segregation of OSDF material categories and prohibited items; completing field tracking logs; completing manifests for material bound for the OSDF; and compiling final records for debris and soil placed in the OSDF. Soil and Disposal Facility Project is responsible for excavation and on-site disposal of waste from all OU2 subunits, if the waste meets the OSDF waste acceptance criteria. This project is also responsible for construction and closure of the OSDF, which will contain OU2 wastes, OU3 debris, and OU5 soil.
3	Former production area, associated facilities, and equipment (includes all above- and below-grade improvements) including, but not limited to: – All structures, equipment, utilities, effluent lines, and K-65 transfer line – Wastewater treatment facilities – Fire training facilities – Coal pile – Scrap metals piles – Drums, tanks, solid waste, waste product, feedstocks, and thorium	Record of Decision Approved: September 1996 Adoption of OU3 Interim Record of Decision; alternatives to disposal through the unrestricted or restricted release of materials, as economically feasible for recycling, reuse, or disposal; treatment of material for on- or off-site disposal; required off-site disposal for process residues, product materials, process-related metals, acid brick, concrete from specific locations, and any other material exceeding the OSDF waste acceptance criteria; and on-site disposal for material that meets the OSDF waste acceptance criteria.	Decontamination and Demolition Project is responsible for decontamination and dismantling of all above-grade portions of buildings and facilities at the FCP. Environmental Closure Project is responsible for planning, designing and directing the excavation of subsurface debris and soil; certifying that the footprint meets the soil FRLs established in the OU5 ROD; design of the OSDF liners and caps; treating wastewaters during decontamination, dismantling, and soil excavation activities and processing wastewater discharges. The decontamination and dismantling project is responsible for transporting remediation wastewater to the head works of the AWWT. Additionally, the ECP's Waste Acceptance Organization is responsible for reviewing facility decontamination and dismantling planning documents and for field oversight of debris sizing, segregation of OSDF material categories and prohibited items; completing field tracking logs; completing manifests for material bound for the OSDF; and compiling final records for debris and soil placed in the OSDF. Soil and Disposal Facility Project is responsible for excavation of contaminated soil and for removal of at- and below-grade structures. This project is also responsible for construction and closure of the OSDF, which will contain OU2 wastes, OU3 debris, and OU5 soil.

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TABLE 1-2
CROSSWALK BETWEEN FCP OPERABLE UNITS AND PROJECT RESPONSIBILITIES FOR REMEDY IMPLEMENTATION (Continued)

Operable Unit	Description	Remedy Overview[a]	Project Organization/Responsibilities
4	– Silos 1 and 2 (containing K-65 residues) – Silo 3 (containing cold metal oxides) – Silo 4 (empty and never used) – Decant tank system – Berms and soil within the OU boundary	Record of Decision Approved: December 1994 Explanation of Significant Differences for Silo 3 Approved: March 1998 Record of Decision Amendment for Silos 1 and 2 Approved: July 2000 Record of Decision Amendment for Silo 3 Approved: September 2003 Explanation of Significant Differences for Silos 1 and 2 Approved: November 2003 Explanation of Significant Difference for OU4 Approved: January 2005 Removal of Silo 3 materials and Silos 1 and 2 residues and decant sump tank sludges with on-site stabilization of materials, residues, and sludges followed by off-site disposal; demolition and decontamination, to the extent possible, of silos and remediation facilities; excavation of contaminated soil above the FRLs with on-site disposal for contaminated soils and debris that meet the OSDF waste acceptance criteria; and site restoration. Concrete from Silos 1 and 2, and contaminated soil and debris that exceed the OSDF waste acceptance criteria will be disposed of off site.	Silo 3 Project is responsible for the removal, treatment, and off-site transport of the waste. Silos 1 and 2 Project is responsible for transfer of Silos 1 and 2 residues to temporary transfer tanks, followed by treatment and off-site transport of the waste. Infrastructure and support systems such as roads and utilities will be completed to support the final remediation of the silos. This project is also responsible for decontamination and dismantling of the Silo 1, 2, 3, and 4 structures, the decant dump tank and its associated piping, the transfer tank area, radon control system, and all other ground OU4 remediation facilities and piping. Environmental Closure Project is responsible for planning, designing, and directing the excavation of subsurface debris and soil; certifying that the footprint meets the soil FRLs established in the OU5 ROD; and treating wastewaters during decontamination, demolition and soil excavation activities. Each project is responsible for capturing and transporting wastewater to the head works of the AWWT. Additionally, the ECP's Waste Acceptance Organization is responsible for field oversight of debris sizing; segregation of OSDF material categories and prohibited items; completing field tracking logs; completing manifests for material bound for the OSDF; and compiling final records for debris and soil placed in the OSDF. Soil and Disposal Facility Project is responsible for excavation and disposition of contaminated soil beneath the silos and for removal of subsurface structures, with the exception of those noted above.
5	– Groundwater – Surface water and sediments – Soil not included in the definitions of OUs 1 through 4 – Flora and fauna	Record of Decision Approved: January 1996 Explanation of Significant Difference Approved: November 2001 (adopted EPA maximum contaminant level (MCL) of 30 micrograms per liter (µg/L) for uranium in drinking water as FRL for groundwater) Extraction of contaminated groundwater from the Great Miami Aquifer to meet FRLs at all affected areas of the aquifer. Treatment of contaminated groundwater, storm water, and wastewater to attain concentration and mass-based discharge limits and FRLs in the Great Miami River. Excavation of contaminated soil and sediment to meet FRLs. Excavation of contaminated soil containing perched water that presents an unacceptable threat, through contaminant migration, to the underlying aquifer. On-site disposal of contaminated soil and sediment that meet the OSDF waste acceptance criteria. Soil and sediment that exceed the waste acceptance criteria for the OSDF will be treated, when possible, to meet the OSDF waste acceptance criteria or will be disposed of at an off-site facility. Site restoration, institutional controls (ICs), and post-remediation maintenance.	Environmental Closure Project is responsible for planning, designing and directing the excavation of subsurface debris and soil; certifying that the footprint meets the soil FRLs established in the OU5 ROD; design and certification of the OSDF liners and caps; designing, installing, and operating the extraction/re-injection systems for groundwater restoration; groundwater monitoring; reporting on the progress of aquifer restoration; designing, constructing, and operating all treated effluent discharge systems; treating and discharging contaminated groundwater, storm water, and remediation wastewaters; and operation, maintenance, and monitoring of the OSDF leachate collection system and leak detection system. Additionally, the ECP's Waste Acceptance Organization is responsible for reviewing facility decontamination and dismantling planning documents and for field oversight of debris sizing; segregation of OSDF material categories and prohibited items; completing field tracking logs; completing manifests for material bound for the OSDF; and compiling final records for debris and soil placed in the OSDF. Soil and Disposal Facility Project is responsible for sitewide excavation of contaminated soil, sediment, perched groundwater, and at- and below-grade structures; and disposition of these materials in the OSDF. SDFP is also tasked with construction activities associated with the final site restoration plan, and the construction and closure of OSDF, which will contain OU2 wastes, OU3 debris, and OU5 soil. Decontamination and Demolition Project is responsible for decontamination and dismantling of all OU5 remediation facilities.

[a]Source of information is each OU's ROD and remedial design documents.

1.4 STATUS OF OPERABLE UNIT REMEDIAL ACTIONS

The selected remedies for each OU are at different points in the implementation phase, due to the unique nature of the remedy and remedial objectives. Table 1-3 provides a summary of the remediation status for each OU.

TABLE 1-3
STATUS OF THE FIVE OPERABLE UNITS AT THE FCP

Operable Unit	Status
1	The ROD was signed in March of 1995. Construction of facilities necessary to support the selected remedy began in April of 1996, and the remedial actions associated with waste removal were finished in June 2005. Soil certification and restoration activities are in progress.
2	The ROD was signed in June 1995. Remediation and restoration of the southern waste units was completed in 2004. Excavation of the lime sludge ponds and sanitary waste landfill was completed in 2003, and soil certification and restoration activities are in progress.
3	The ROD was signed in September 1996. The implementation of the selected remedy is ongoing, and as of January 1, 2006, 233,060 cubic yards (yd^3) of debris [178,198 cubic meters (m^3)] have been demolished and size-reduced for placement in the OSDF.
4	The ROD, as amended for Silos 1 and 2, was signed in June 2000. Construction of facilities for retrieval of material in Silos 1, 2, and 3 was completed in 2004, and the Silo 1 and 2 materials have been transferred to the new holding tanks. Treatment of waste in Silos 1, 2 and 3 is ongoing, with completion of Silo 3 scheduled for early 2006, followed by Silos 1 and 2 in late spring of 2006.
5	The ROD was signed in January 1996, and implementation of the selected remedy for groundwater, soil, and sediment is ongoing. As of January 1, 2006, approximately 80 percent of the site has been certified as meeting the FRLs for soil. Three of four groundwater remediation modules, consisting of extraction and re-injection wells, have been constructed and operated, with the first module becoming operational in 1993. Groundwater re-injection was shut down in 2004, based on an updated groundwater model and the results of a cost benefit analysis. The size and capacity of the AWWT Facility were reduced in 2004 and 2005 to be more cost efficient and to align with the remaining pre- and post-closure water treatment needs. This facility is now called the Converted AWWT, or CAWWT. Construction of the liner systems is complete for all the OSDF cells, and the caps have been constructed for Cells 1 through 6.

In addition to the five operable units discussed above, the 1991 Amended Consent Agreement (ACA) (EPA 1991) envisioned a sixth operable unit; the Comprehensive Site-Wide Operable Unit (CSOU). Conceptually, the purpose of Operable Unit 6 was to ensure that the acceptability of the selected remedies for operable units one through five would be confirmed within six months of approval of the Operable Unit 3 Record of Decision (which was the last ROD scheduled to be signed).

DOE and EPA are in agreement that sufficient mechanisms are in place, including the CERCLA five-year review requirement, to ensure the site-wide remedies will be protective of human health and the environment. Therefore, DOE and EPA have agreed to delete the CSOU from the ACA. The formal modification is expected to be completed in the spring of 2006.

An Interim Residual Risk Assessment will be completed to document conditions remaining at the time the FCP enters the legacy management phase. This assessment will be completed within 90 days after physical completion of the FCP. A Final Residual Risk Assessment will be performed at the completion of all remedial actions, including groundwater remediation, and will focus on the target receptor based on the actual land use selected for the site.

1.5 FIVE-YEAR REVIEW SCHEDULE AND EXPECTATIONS OF FUTURE REVIEWS

This is the second CERCLA five-year review conducted for the FCP. It covers all remedial activities that have taken place to date for each OU, regardless of the implementation phase of the selected remedy. As discussed in Section 1.2, the start of construction for the OU1 remedy in 1996 triggered the first five-year review report submitted in May 2001. A third report will be submitted to EPA in 2011 to provide an update on remedial actions across the site.

The third five-year review report will present the same type and level of information as contained in this report using a similar review strategy. All of the remedial actions, except groundwater, will be finished when the review is performed in early 2011. Therefore, the third report is expected to focus largely on the groundwater remedial actions and the assessment of risk from the groundwater pathways.

1.6 ROLE OF THE IEMP AND LEGACY MANAGEMENT PLAN

A major element of the ongoing performance evaluation of the selected remedies is conducted through the Integrated Environmental Monitoring Plan (IEMP) (DOE 2005a), particularly for OU5. The IEMP assesses site environmental conditions through sampling of various media, including groundwater, surface water, sediment, and air. Media concentration data are reviewed to assess the collective overall site environmental conditions, as well as the impacts that individual remedial projects are having on their surrounding environment. This program also provides ongoing monitoring of remedial actions and their impact on potential exposure pathways, and an early indication of adverse impacts should upward contamination trends be recorded. If adverse impacts occur, the IEMP will establish a decision process to assess the impact and to take appropriate corrective measures, up to and including interim shutdown.

IEMP reporting also serves as the mechanism for assessing the remedial action performance of:

- The groundwater remedy for the Great Miami Aquifer (OU5)
- Wastewater treatment operations (OU5)
- The OSDF leak detection program (primarily serves OUs 2, 3, and 5).

The monitoring results are presented in the annual integrated site environmental reports, which are made available to the public in June of each year. IEMP monitoring data are also made available to the regulatory agencies, as they become available, through the internet-based IEMP Data Information Site. During the period covering this five-year review (i.e., 2000 through 2005), quarterly status reports were available through 2002. During 2002, reporting for the IEMP went to a semiannual frequency. At the end

of 2005, EPA and OEPA agreed that IEMP reporting could be reduced to annually (i.e., annual site environmental reports).

The IEMP program and related reporting process is being transitioned to the Office of Legacy Management and was included as part of the Comprehensive Legacy Management and Institutional Controls Plan (LMICP) (DOE 2006), Volume II, Attachment D. This transitioned program will monitor and evaluate all environmental aspects of the post-closure remedial operations. Subsequent five-year reviews will be one of the reporting mechanisms for data collected under DOE's office of legacy management.

1.7 INSTITUTIONAL CONTROLS

The DOE defines Institutional Controls (ICs) as "any mechanism used to restrict inappropriate uses of land, facilities, and environmental media by limiting exposure to residual contamination left behind as part of a CERCLA or Resource Conservation and Recovery Act Remedy" (DOE 2000a). DOE has committed to implementing ICs to protect the general public from residual contamination exposure in each ROD, consistent with the final land use for the site, and this is addressed as part of its LTS planning for the FCP.

DOE has developed and revised a Comprehensive LMICP for the FCP that includes the proposed ICs and the approach to their implementation. The LMICP will reference a detailed Institutional Controls Plan that will be developed and issued closer to closure of the FCP. DOE is planning to implement the ICs in an overlay pattern to minimize the adverse impact of one IC failure. For example, DOE will ensure deed restrictions regarding development of the property are in place at the same time that zoning restrictions are in place.

ICs will be implemented at the FCP in conjunction with physical barriers, such as fencing around the OSDF area. Physical barriers are not considered ICs because they do not involve an administrative or legal barrier, but should be used in conjunction with ICs to further ensure protectiveness. The types of ICs that will be implemented include continued Federal ownership of the FCP, restricted access to the OSDF, land use/deed restrictions to prevent the residential or agricultural use of the FCP property, and regular monitoring and inspection of the OSDF. The effectiveness of ICs will be evaluated as part of each five-year review conducted at the FCP.

1.8 REPORT ORGANIZATION

The following five sections of this report cover the status of each OU in a summary fashion to avoid repeating information already provided in other CERCLA and DOE reports. All sections use approximately the same format: a project description, a summary of ROD commitments and the selected remedy, remedial action status, and an assessment of the selected remedy including remedy optimization opportunities. Sections 2.0 and 3.0 cover the OU1 and OU2 remedy, respectively. Section 4.0 covers the OU3 activities, including decontamination and dismantling of all at- and above-grade structures at the

FCP. Section 5.0 provides an update on the OU4 remediation process for Silos 1, 2, and 3. Finally, Section 6.0 covers OU5 environmental media and the OSDF, with key subsections for groundwater remedial activities, soil/sediment remedial activities, and the OSDF.

2.0 OPERABLE UNIT 1

2.1 PROJECT DESCRIPTION

2.1.1 Operable Unit 1 Characteristics

Operable Unit 1 (OU1), also referred to as the Waste Pits Project (WPP), is a 37.7-acre (15.3-hectare) area in the northwest quadrant of the FCP site. Large quantities of liquid and solid wastes were generated by various chemical and metallurgical processing operations during the production era (1952 through 1989). These wastes were stored or disposed of in six waste pits (referred to as Waste Pits 1, 2, 3, 4, 5, and 6), the burn pit, and the clearwell. Radionuclides (e.g., uranium and thorium) are the primary contaminants of concern, although the pit waste is also contaminated with trace metals and organics.

The WPP mission was cleanup of wastes in the pits as well as miscellaneous structures and facilities such as berms, liners, concrete pads, underground piping, utilities, railroad tracks, and fencing, as well as soil located within the WPP boundary. The planned strategy for producing closeout reports for the CERCLA OU remedial actions at the FCP is described in a DOE and EPA Fact Sheet (DOE 2005b) developed to inform stakeholders of the strategy. The decision was to proceed with formal closeout of OU1 when the waste pit contents and liners were shipped off site. The remaining OU scope [soil remediation within the OU1 boundary, and decontamination and dismantling (D&D) of OU1 remediation facilities] would be documented in the closeout reports for OU5 and OU3, respectively. Therefore, only the source waste material will be addressed in the Remedial Action Report for OU1 (draft to be released in 2006).

In June 2005, remedial actions associated with excavation, processing and shipment of the waste were completed when the last unit train containing OU1 source waste left the site. All source waste activities were completed in compliance with the applicable or relevant and appropriate requirements (ARARs) and protection of human health and the environment, in accordance with the ROD for Remedial Actions at OU1 (DOE 1995a) and the Remedial Design/Remedial Action (RD/RA) Work Plan (DOE 1997a) and Packages. Remaining activities include D&D of the treatment facilities, soil certification and restoration. The Remedial Action Report for OU1 (which is scheduled for release in 2006) will:

- provide an overview of the remedial actions that were selected in the OU1 ROD
- address construction activities associated with the OU1 remedial actions
- provide an annotated chronology of the key events contributing to successful completion and documentation of the OU1
- summarize operations, maintenance, performance standards, quality control, and final inspections and certifications
- provide remedy cost information
- compare actual remedial costs with the original estimates contained in the OU1 ROD.

2.1.2 Roles and Responsibilities

Fluor Fernald, Inc. is responsible for completing D&D, soil certification and restoration work.

2.2 SUMMARY OF REMEDIAL ACTION OBJECTIVES

The remedial action objectives will be documented in the Remedial Action Report for OU1. Briefly, the key elements of the approved OU1 ROD include:

- Construction of waste processing and loading facilities and equipment
- Removal of water from open waste pits for treatment at the site's wastewater treatment facility
- Removal of waste pit contents, caps and liners, and excavation of surrounding contaminated soil
- Preparation (e.g., sorting, crushing, shredding) of waste
- Treatment of the waste by thermal drying as required to meet Envirocare of Utah waste acceptance criteria (WAC)
- Waste sampling and analysis prior to shipment to ensure that the WAC is met
- Off-site shipment of waste for disposal at Envirocare of Utah
- Decommissioning and removal of the drying treatment unit and associated facilities, as well as miscellaneous structures and facilities within the OU
- Disposition of remaining WPP residual contaminated soils in the OSDF, consistent with the selected remedy for contaminated process area soils as documented in the OU5 ROD
- Backfilling excavations and construction of a cover system.

As remedial actions were implemented, it became clear that some FCP soils and other waste materials would require disposition off site. The ability to accommodate those materials was integrated into the OU1 remedial action approach. Accordingly, an ESD was prepared to document the cost effectiveness and safety advantages associated with using the OU1 remedial infrastructure to process for disposal other FCP waste streams originating outside of OU1. The final ESD for OU1 was approved in September 2002 (DOE 2002a).

Additionally, an Amendment to the OU1 ROD was prepared to address the last bullet of the OU1 ROD actions and other changes:

- Backfilling excavations and construction of a cover system, as originally designated in the OU1 Feasibility Study (DOE 1995b), is handled with the design in the final Natural Resources Impact Assessment (DOE 2002b) and final Natural Resources Restoration Plan (DOE 2002c).

- Aligning the surface and subsurface soil FRLs found in the OU1 ROD with the approved FRLs for soil in the OU5 ROD
- Placement of Waste Pit 4 soil cover materials into FCP's OSDF for permanent disposal
- The amendment also provides clarification of terminology.

The final ROD Amendment for OU1 Remedial Actions, reflecting the above, was signed in November 2003 (DOE 2003a).

Lastly, a DOE and EPA Fact Sheet (DOE 2005b) dealt with the D&D of the treatment facilities and OSDF disposition of residual contaminated soil under the source waste. Decommissioning and removal of the drying treatment unit and associated facilities, as well as miscellaneous structures and facilities within the OU, were placed under the work scope of OU3 and will be covered in the Remedial Action Report for OU3. Consistent with the selected remedy of placement of contaminated process area soils in the OSDF, as documented in the OU5 ROD, residual contaminated soils from OU 1 were placed under the work scope of OU5 and will be covered in the interim Remedial Action Report for OU5.

2.2.1 Project Execution Phases

The following is a summary of the project execution phases.

Site Preparation Activities

Site improvements needed to support remediation activities were completed in December 1997.

Facility Construction

Limited construction activities began in July 1998, while the EPA and OEPA completed their review of the Remedial Design Package. These were essentially site preparation activities that were impacted by Remedial Design Package comments and issues raised by the EPA and OEPA. On November 13, 1998, full construction activities began and activities were completed in November 1999.

First Loadout

On February 23, 1999, WPP initiated loadout activities, thereby achieving the March 1, 1999 Enforceable Milestone for initiating operations (i.e., loading of waste).

Last Shipment

In June 2005, WPP initiated the last shipment of OU1 waste.

Decontamination and Dismantling of the WPP Facilities

These D&D activities have been passed to OU3 operations, per the Fact Sheet.

Remediation of the Soil Footprint

These activities were passed to OU5 operations, per the Fact Sheet.

2.2.2 Required Monitoring

Monitoring to support remedial operations included waste sampling and analysis to ensure the waste material met the Envirocare of Utah WAC and U.S. Department of Transportation (DOT) requirements for shipping, industrial hygiene monitoring for dust, general air and breathing zone, water monitoring to meet established discharge criteria, and dryer stack air monitoring for radon and radiological isotopes to comply with the National Emissions Standards for Hazardous Air Pollutants (NESHAP).

2.3 REMEDIAL ACTION STATUS

The selected remedy for disposition of OU1 source waste has been completed, with over 600,000 yd^3 (459,000 m^3) of waste material (i.e., pit wastes, cover materials, and pit liner) excavated and shipped to Envirocare of Utah. D&D, soil certification and restoration activities are in progress.

2.4 ASSESSMENT OF CONFIRMATORY DATA AND/OR PERFORMANCE DATA

2.4.1 Identify the Scope of the Review

This assessment of the WPP remedial actions notes that the primary remedial actions are complete and final actions are limited to soil certification and restoration activities.

2.4.2 Assessment of Remedial Actions

Is the remedy operational and functioning as intended in the ROD?

The selected remedy for disposition of OU1 source waste has been completed and sampling of the waste material was effective in ensuring compliance with the Envirocare WAC. Environmental data collected and reported in the IEMP and annual site environmental reports, during execution of the waste-removal work and continuing through the soil certification and restoration, indicates that the remedy is operating and functioning as intended in the ROD.

2.4.3 Validity of ROD Assumptions

Are the critical assumptions (to ensure protection of human health and the environment) used at the time of remedy selection still valid?

Critical ROD assumptions to protect human health and the environment are valid, and environmental data indicate that the processes and facilities used in accordance with ROD assumptions functioned in a manner that allowed WPP to meet the intent of the OU1 ROD.

2.4.4 Remedy Optimization

Has any new information come available that could allow for optimization of the selected remedy; or call into question the validity of the selected remedy?

Remedy optimization was not performed during the remedial action.

2.5 FINDINGS AND RECOMMENDED ACTIONS FROM CURRENT REVIEW

As summarized above, and to be discussed in detail in the Remedial Action Report for OU1, the remediation process and facilities operated efficiently to complete the remediation of the OU1 waste pits.

2.6 PROTECTIVENESS STATEMENT

The selected remedy for OU1 is protective of human health and the environment, and all immediate threats are addressed. The remedy for the source waste accomplished the remedial objectives within the confines of the design and assumptions, and in accordance with ARARs and monitoring requirements imposed on the remedial activities. Remedial actions are being completed in accordance with sampling and analysis requirements and parameters. All available data indicate compliance with regulatory requirements and with the Envirocare of Utah WAC.

3.0 OPERABLE UNIT 2

3.1 PROJECT DESCRIPTION

3.1.1 Operable Unit 2 Characteristics

As defined in the ROD for Remedial Actions at Operable Unit 2 (OU2) (DOE 1995c), OU2 is one of five CERCLA OUs at the FCP and consists of six former individual waste disposal sites: the active and inactive flyash piles; the south field waste disposal area; two lime sludge ponds; and the solid waste disposal landfill. These six components covered a total of approximately 21.5 acres (8.6 hectares) and contained an estimated 109,000 yd^3 (83,000 m^3) of ash, 16,000 yd^3 (12,000 m^3) of sludge, and 193,000 yd^3 (147,000 m^3) of soil and debris in the form of berms, cover, and fill material. Waste removal actions began in the field in August 1997 and were completed in November 2003. A draft Remedial Action Report for OU2 (DOE 2005c) has been issued to the regulatory agencies for informal review.

Design and construction of the OSDF is another provision of the OU2 ROD. The OSDF was established as part of the balanced approach to waste disposal in that low-level radioactive waste will be disposed of at the FCP while higher radioactive and chemically contaminated materials, such as the K-65 Silo contents, nuclear production residues, process wastes, and waste pit materials, are to be sent off site for disposal. However, the OU2 ROD preceded the ROD decisions for OU5 and OU3 by nearly a year, and the costs, waste volumes, size, and configuration of the OSDF represented in the OU2 ROD are specific to OU2 materials only. Ultimately, once the OU5 and OU3 on-site disposal decisions were finalized, the OSDF was sized and designed to accommodate all three OUs. The OSDF will be discussed further under the update for OU5.

3.1.2 Roles and Responsibilities

Fluor Fernald, Inc. implemented the OU2 remedial activities under contract to the DOE. Remediation designs, sampling plans, and soil certification reports were prepared by Fluor Fernald, Inc.'s Environmental Closure Project (ECP). Fluor Fernald, Inc.'s Soil and Disposal Facility Project (SDFP) personnel directed the FCP labor force and managed the excavation aspects of the remedial action work. Removal actions began in the field in August 1997 and were completed in November 2003.

3.2 SUMMARY OF REMEDIAL ACTION OBJECTIVES

Briefly, the key elements of the approved OU2 ROD include:

- Excavation of all waste material containing contaminants above the established FRLs
- Material processing for size reduction and moisture control, as required
- On-site disposal of material meeting the OSDF WAC
- Off-site disposal of any material that does not meet the OSDF WAC
- Continued federal ownership of the FCP with access restrictions.

CERCLA requires that changes to approved RODs be done through an ESD or a Fact Sheet for minor modifications. There were two minor changes to the May 1995 OU2 ROD:

- A Fact Sheet to allow the disposal of the lead-contaminated soil from the firing range in the OSDF after successful treatment (DOE 1999a).

- A Fact Sheet to address the OSDF under OU5, as well as document the cleanup of soils underlying the waste units in OU2 through OU5 (DOE 2005b). These changes did not result in any changes to cleanup levels, design or operational requirements, or remedial action schedules; and they were initiated to better align the original OU2 remedial actions with those in the OU5 ROD.

Following soil certification under the OU5 ROD, the soil footprints for all OU2 components except the lime sludge ponds and solid waste landfill were restored under the Natural Resources Restoration Plan. Soil certification and restoration for the remaining two OU2 components are in progress.

3.2.1 Project Execution Phases

The following is a summary of the project execution dates:

Site Preparation Activities

Site improvement activities needed to support the remedial actions were initiated in June 1997 and completed in May 1998.

Southern Waste Units

Excavation of the southern waste units (i.e., active/inactive flyash piles and South Field) was initiated in July 1998 and completed in September 2002. Soil certification and restoration was completed in 2004.

Lime Sludge Ponds

Excavation of the lime sludge ponds was initiated in October 2001 and completed in October 2002. Soil certification and restoration are in progress.

Solid Waste Landfill

Excavation of the solid waste landfill was initiated in October 2003 and completed in November 2003. Soil certification and restoration are in progress.

3.2.2 Required Monitoring

Monitoring to support remedial operations included industrial hygiene monitoring for dust, general air and breathing zone, and water monitoring to meet established discharge criteria. These results are published in the IEMP and annual site environmental reports.

3.3 REMEDIAL ACTION STATUS

The selected remedy for OU2 waste materials has been completed, and soil certification and restoration will be complete in the spring of 2006. A draft Remedial Action Report for OU2 has been submitted to the regulatory agencies for informal review. Approximately 470,000 yd^3 (359,362 m^3) of waste material was placed in the OSDF and 8,400 yd^3 (6,423 m^3) of material exceeded the OSDF WAC and was shipped off site.

3.4 ASSESSMENT OF CONFIRMATORY DATA AND/OR PERFORMANCE DATA

3.4.1 Identify the Scope of the Review

This assessment notes that the primary remedial action, to remove waste material in the OU2 waste units, is complete and the final actions of soil certification and restoration remain for the lime sludge ponds and solid waste landfill.

3.4.2 Assessment of Remedial Actions

Is the remedy operational and functioning as intended in the ROD?

The selected remedy for OU2 is operating and functioning as intended in the ROD.

3.4.3 Validity of ROD Assumptions

Are the critical assumptions (to ensure protection of human health and the environment) used at the time of remedy selection still valid?

Critical ROD assumptions to protect human health and the environment are valid, and all processes and facilities used, in accordance with the ROD assumptions, are functioning in a manner that will allow DOE to meet the intent of the OU2 ROD.

3.4.4 Remedy Optimization

Has any new information come available that could allow for optimization of the selected remedy; or call into question the validity of the selected remedy?

The *in situ* gamma spectrometry program was introduced during remedial actions to optimize the OU2 remedy. The program was used extensively during excavation to expedite contamination surveys, identify hot spots or above-WAC areas, and produce precertification data for the primary radionuclides that drive the soil certification process.

3.5 FINDINGS AND RECOMMENDED ACTIONS FROM CURRENT REVIEW

The remediation process is operating efficiently and mitigative actions are unnecessary to complete the remediation of the OU2 waste units. Soil certification and restoration continues for the remedial footprints associated with the lime sludge pond and solid waste landfill.

3.6 PROTECTIVENESS STATEMENT

The selected remedy for OU2 is protective of human health and the environment, and immediate threats were addressed. Remedial objectives are being met within the confines of the design and assumptions, in accordance with ARARs and monitoring requirements imposed on the remedial activities. Remedial actions are being completed in accordance with sampling and analysis requirements and parameters. All available environmental data indicate compliance with regulatory requirements and with the OSDF, Nevada Test Site (NTS) and Envirocare of Utah WAC.

4.0 OPERABLE UNIT 3

4.1 PROJECT DESCRIPTION

Operable Unit 3 (OU3) includes the former production area buildings and equipment, all above- and below-grade improvements, containerized materials, storage pads, roads, above- and below-ground tanks, and utilities not encompassed by the other operable units. OU3 does not include the soil and groundwater beneath the various former production area facilities.

Based on the results of the OU3 Remedial Investigation/Feasibility Study (RI/FS), materials were categorized based on type and regulatory status [mixed waste, polychlorinated biphenyl (PCB) waste, low-level waste, and below radiological background] to evaluate treatment and disposal options. Section 4.3.2 provides a summary of estimated volumes of OU3 materials by segregation category as detailed in the OU3 Proposed Plan for Final Remedial Action (DOE 1996a).

The Fluor Fernald, Inc. D&D Project, in conjunction with demolition subcontractors, manage remediation responsibilities of OU3 with DOE oversight. Decontamination and demolition design packages, development of requests for proposals, planning and scheduling, development of implementation plans, oversight of demolition subcontractors, and direct-hire of D&D personnel are the responsibility of the D&D Project staff. The Fluor Fernald, Inc. Waste Acceptance Organization (WAO) performs inspections of debris to ensure conformance with the OSDF WAC and/or criteria for off-site disposal facilities.

4.2 SUMMARY OF REMEDIAL ACTION OBJECTIVES

4.2.1 Selected Remedy (Interim Remedial Action)

The former production buildings were beyond their design lives and no future mission existed for the buildings and structures. The OU3 Interim Record of Decision (IROD) (DOE 1994a) documents the selected remedy for the D&D of all above- and below-grade buildings and facilities. The main advantage offered by the 1994 IROD was the decision to allow structural D&D and temporary debris stockpiling activities to proceed concurrently while OU3 field investigations were underway, thereby allowing significant early skyline change and demolition work to begin ahead of the final treatment and dispositioning decisions accomplished by the final remedial action ROD. The specific activities associated with the interim remedial action included:

- Decontamination of more than 200 structures by removing loose contamination
- Dismantling the above-grade structures
- Removal of foundations, storage pads, ponds, basins and underground utilities, and other at- and below-grade structures

- Off-site disposal of no more than 10 percent by volume of the non-recoverable or non-recyclable waste and debris generated from structural D&D until the OU3 final ROD was approved

- Interim storage of the remaining waste and debris until final decision is reached for treatment and/or disposition.

The sequence and schedule by which the above-grade portions of all OU3 structures will undergo D&D were initially outlined in the OU3 Remedial Design Prioritization and Sequencing Report (DOE 1995d).

4.2.2 Selected Remedy (Final Remedial Action)

The final ROD (DOE 1996b) established the strategy for the final disposition of the materials generated from the interim remedial actionas "Selected Material Treatment, On-Property Disposal, and Off-Site Disposition." The final OU3 ROD includes the following:

- Provides for unrestricted/restricted release of material, as economically feasible, for recycling, reuse, or disposal

- Permits treatment of material to meet the OSDF and/or off-site disposal facility WAC

- Requires off-site disposal of process residue, product material, and process-related metals

- Requires off-site disposal of acid brick and concrete from specific locations, and any other material exceeding the OSDF WAC

- Permits disposal of remaining OU3 waste in the OSDF

- Imposes administrative controls through deed restrictions and access controls

- Incorporates post-remediation activities that include long-term monitoring and maintenance of the OSDF, and operation of a groundwater monitoring network to evaluate the performance of the OSDF.

The final ROD incorporated, by reference, the decisions provided in the IROD to integrate implementation of any repetitive decisions. To ensure the proper integration of the OU3 interim and final remedial actions, the OU3 Remedial Design/Remedial Action Work Plan for Interim and Final Remedial Actions (DOE 1995e) was superseded by a subsequent work plan that combined implementation strategies for the OU3 IROD with implementation strategies developed for the final OU3 ROD.

Additionally, when production operations ceased in 1989, 30 removal actions were put in place across the site by DOE and EPA (ahead of the CERCLA RODs) to further stabilize existing site conditions, prepare the site for longer-term actions, and abate any immediate physical or environmental threats posed by the site's facilities and contaminants. Four of the removal actions were programmatic in nature, and were subsequently integrated directly into the final OU3 ROD:

- Removal Action 9 - Removal of Waste Inventories
- Removal Action 12 - Safe Shutdown
- Removal Action 17 - Improved Storage of Soil and Debris
- Removal Action 26 - Asbestos Abatement.

A summary of the four programmatic removal actions that were incorporated into the Final Remedial Action ROD (DOE 1996b) is provided in Section 4.3. A letter issued by DOE in June 1997 and approved by EPA (DOE 1997b) formally closed the administrative record file for the four removal actions and acknowledged that future documentation associated with the completion of the activities would be included in the OU3 Remedial Action Closeout Report.

4.2.3 Implementation Documents

In addition to routinely developing Safe Shutdown turnover reports and implementation plans for each building or complex in preparation for D&D activities, the D&D Project (or former OU3-related organizations) executes the OU3 remedial action in accordance with the OU3 Prioritization and Sequencing Report and the OU3 RD/RA Work Plan for the Interim and Final Remedial Actions.

4.3 REMEDIAL ACTION STATUS

4.3.1 Removal Action 9 - Removal of Waste Inventories

Removal Action 9 involved the safe, off-site disposal of existing waste inventories, including low-level waste, mixed waste, and Toxic Substances Control Act (TSCA) wastes that were generated as a result of production operations, facility maintenance, site upgrades, and pre-ROD cleanup activities. Containerization of Fernald's major waste streams was initiated in August 1985, and Removal Action 9 was formally set in motion in 1991 to provide for the transfer of inventoried waste to the NTS. The removal action is nearly complete, and it will be completed under the OU3 ROD remedial actions.

4.3.2 Removal Action 12 - Safe Shutdown

Removal Action 12 was created to provide the planning, engineering, and program control for the removal and disposition of in-process residue materials, excess supplies, chemicals, and the associated process equipment that remained when Fernald stopped production in 1989. Residue materials removed during safe shutdown were sent for off-site disposal under Removal Action 9. The removal action also provided for the isolation and de-energizing of former production-related equipment and utilities and provided for the identification of new customers for Fernald equipment and nuclear products. This removal action was completed in March 1999 with the safe shut down of Plant 6. A total of 690,050 pounds (lbs) [313,283 kilograms (kg)] of hold-up materials were removed from nine facilities.

4.3.3 Removal Action 17 - Improved Storage of Soil and Debris

Removal Action 17 was initiated to provide controlled storage of excess contaminated soil and debris generated during maintenance, construction, removal, and remedial actions through a soil and debris

management plan. The removal action is nearly complete, and it will be completed under the OU3 ROD remedial actions.

4.3.4 Removal Action 26 - Asbestos Removal

Removal Action 26 was established as a specialized maintenance-related activity to mitigate potential asbestos release during conduct of ongoing maintenance, safe shutdown, and site cleanup activities. Since asbestos removal and abatement activities were going to continue throughout the life of the OU3 remedy, the final remedial action ROD adopted the earlier management procedures and approaches established under Removal Action 26, while also deciding on the final destination disposal locations (on site and off site) and eligibility for the categories of asbestos-containing materials generated during the remedial actions. The removal action is nearly complete, and it will be completed under the OU3 ROD remedial actions.

4.3.5 Decontamination and Dismantling

The D&D component of the selected remedy for OU3 is in the implementation phase. D&D of former production facilities/components allows access for excavation and remediation of soils in the former production area. As of December 2005, 220 of the 256 former production facilities have been removed, as summarized in Table 4-1.

TABLE 4-1
OPERABLE UNIT 3 STRUCTURES DISMANTLED
Through December 2005

Project	Remedial Duration	Number of Structures (X) and ID
Plant 1 pad Continuing Release	07/94	(3) TS-1, TS-2, TS-3
Plant 7 Complex	08/94 - 09/94	(3) 4C, 7A, 7B
Fire Training Facility	08/94 - 10/94	(5) 73A, 73B, 73C, 73D, 73E
Plant 1 Ore Silos	12/94	(1) 1C
Site Maintenance	5/95 - 6/97	(2) 28C, 30C
Plant 1 - Phase 1	4/96 - 4/97	(8) 1A, 30B, 56B, 56C, 66, 67, 72, TS-7
High/Low Nitrate Tanks	7/96 - 12/96	(2) 18K, 18L
Building 4A	8/96	(1) 4A
Boiler Plant/Water Plant	10/97 - 10/98	(7) 10A, 10B, 10C, 10E, 20B, 20C, 24A
Thorium/Plant 9 Complex	3/98 - 11/98	(11) 9A, 9B, 9C, 9D, 9E, 9F, 32A, 32B, 69, 78, 81
Sewage Treatment Plant	7/98 - 8/98	(6) 25A, 25B, 25D, 25E, 28F, 39D
Miscellaneous Small Structures (MSS)[1]	8/98 - 10/02	(23) 38A, 38B, 24B, 3F, 3G, 39C, 8F, 22A, 45B, 2G, 10D, 39B, 63, 28A, 28B, 28N, 2E, 62, 3B, 3C, 34C, 18M, 5F
Maintenance/Tank Farm	4/99 - 2/00	(9) 12A, 12B, 12C, 12D, 19A, 19C, 19D, 19E, 20H
Plant 5 Complex[2]	4/99 - 5/01	(9) 4B, 5A, 5B, 5C, 5D, 5E, 5G, 55A, 55B
Plant 6 Complex[3]	1/01 - 7/02	(7) 6A, 6B, 6C, 6D, 6E, 6F, 6G
Multi-Complex (Plant 2/3, Plant 8, etc.)	9/01 - 5/04	(33) 2A, 2D, 2F, 2H, 3D, 3E, 3J, 3K, 39A, 8A, 8B, 8C, 8D, 8E, 8G, 8H, 2B, 2C, 3A, 3H, 3L, 18B, 18D, 18H, 20G, 22B, 22D, 22E, 26A, 26B, 28D, 45A, 80
Administration Complex Phase I	1/02 - 8/02	(1) 53A
Pilot Plant Complex	3/02 - 7/04	(8) 13A, 13B, 13C, 13D, 37, 54A, 54B, 54C
Maintenance Tank Farm	3/02 - 9/02	(2) 64, 65
MSS Phase II[4]	10/02 - 12/05	(43) and 124 trailers) 12E, 12F, 16A, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 16J, 16M, 16N, 16P, 18J, 18U, 19B, 20E, 20F, 21A, 21B, 21C, 22C, 22G, 24C, 25C, 25J, 25K, 26C, 31B, 35A, 50, 52A, 52B, 60, 61, 82B, 93A, TS-8, TS-10, TS-11, TS-12, TS-14
Laboratory Complex	11/02 - 4/04	(4) 15A, 15B, 15C, 68
Plant 1 Complex Phase II	6/03 - 10/03	(9) 1B, 20A, 30A, 30D, 56A, 71, TS-4, TS-5, TS-6
Administration Complex Phase II	5/04 - 5/05	(7) 11, 14A, 14B, 20K, 31A, 46, 53B
East Warehouse Complex	7/04 - 5/04	(4) 20D, 77, 79, 82A
Operable Unit 1 Complex (OU1)	8/04 - 8/05	(11) 18G, 91A, 9AB, 91C, 91D, 91E, 91F, 91G, 91H, 91J, 91K
Operable Unit 4 Silos 1 and 2 (OU4)	2/05 - 9/05	(2) 34A, 34B
Advanced Wastewater Treatment Facility[5]	3/05 - 7/05	(2) 51B, 51C
OU4 Silos 1 and 2 Remediation Facility[6]	12/05 - 12/05	(1) 94Y
	TOTAL	224

(1) Revision 1 of this document indicated 17 structures from the MSS Project were dismantled as of February 2001. MSS Task Orders #033, 627, 049, 080 and 086 were performed after February 2001. Therefore, six additional structures (Buildings 62, 3B, 3C, 34C, and Components 18M, 5F) for a total of 23 structures were dismantled under the MSS Project.

(2) Revision 1 of this document indicated eight structures from the Plant 5 Complex were dismantled as of February 2001. Building 5D was dismantled in March 2001. Therefore, a total of nine structures were dismantled under the Plant 5 Complex.

(3) Revision 1 of this document indicated five structures from the Plant 6 Complex were dismantled as of February 2001. Buildings 6A and 6G were dismantled after February 2001 (completed in December 2001). Therefore, a total of seven structures were dismantled under the Plant 6 Complex.

(4) MSS Phase II is an ongoing project and the number of dismantled structures and trailers through December 2005 is included above. The final number of dismantled structures and trailers will be available once D&D work is completed at the FCP.

(5) Unlike all previous site complex D&D activities at the FCP, a portion of Component 51A now identified as the CAWWT remains intact for operation after the AWWT dismantlement activities were completed.

(6) OU4 Silos 1 and 2 Remediation Facility is an ongoing project and one structure (Building 94Y) has been dismantled through December 2005. The final number of dismantled structures will be available once D&D work is completed at the FCP.

Table 4-2 presents the volume of material generated by Safe Shutdown and D&D activities since January 1993. Table 4-2 does not include the material volumes for the MSS Phase II and the OU4 Silos 1 and 2 Remediation Facility Project since these projects are ongoing. All of the materials are summarized by material categories as presented in the OU3 ROD.

TABLE 4-2
MATERIAL GENERATED AND DISPOSITIONED UNDER OU3 INTERIM AND FINAL REMEDIAL ACTION[e]

OU3 Category[a]	OSDF Category	Material Description[a]	Total OU3 Estimated Volume in ROD[b,c]	Generated Volume to Date[c]	Dispositioned Volume to Date[c]	Disposal Location
A	2	Accessible Metals	2,348 yd^3	5,257 yd^3	5,192 yd^3	OSDF
B	2	Inaccessible Metals	64,448 yd^3	2,483 yd^3	2,211 yd^3	OSDF
C	NA[d]	Process-Related Metals	5,593 yd^3	2,359,857 lbs	338,540 lbs 11,317 lbs 1,211,496 lbs 11,258 lbs	Alaron, Inc., Lockeed Martin, Inc., NTS, DOE-Portsmouth
D	2	Painted Light-Gauge Metals	265 yd^3	375 yd^3	345 yd^3	OSDF
NA[d]	NA[d]	Lead	35,400 lbs	34,113 lbs	11,258 lbs	Envirocare of Utah
E	2	Concrete	174,083 yd^3	10,286 yd^3	7,063 yd^3	OSDF[c]
NA[d]	NA[d]	Scabbled Concrete	NA[d]	472982 lbs	0	
F	NA[d]	Acid Brick	767 yd^3	38,349 lbs	0	NA[d]
G	3	Non-Regulated Asbestos-Containing Material	2,641 yd^3	2,696 yd^3	647 yd^3	OSDF
H	5	Regulated Asbestos-Containing Material	2,971 yd^3	1,986 yd^3	493 yd^3	OSDF
I	2 or 4	Miscellaneous Materials	26,075 yd^3	14,192 yd^3	12,491 yd^3	OSDF
J	NA[d]	Product, Residues, and Special Materials	64,077 yd^3	5,097,002 lbs	4,414 lbs 296,782 lbs 2,556,780 lbs 645 lbs 260 lbs	Allied Signal, Inc., Envirocare of Utah, NTS, DOE-Portsmouth, Safety Kleen, Inc.
Commingled	2	Category A, B, D, and incidental materials	NA[d]	49,106 yd^3	38,747 yd^3	OSDF

[a] Refer to Table 4-2 of the OU3 ROD for category and material description breakdown.

[b] Refer to Table 4-3 of the OU3 ROD

[c] OU3 ROD estimates of material were based on volumes (cubic yards). Actual quantities of material generated and disposed at the OSDF are also measured in cubic yards. However, the measurement of materials requiring off-site disposal is measured in weight (pounds). A volume estimate of materials shipped off site is not provided because it would not be sufficiently accurate. This is due to shipping weight requirements that often result in containers that are not filled to capacity.

[d] NA = not applicable

[e] Table 4-2 does not include the material volumes for the MSS Phase II and the OU4 Silos 1 and 2 Remediation Facility Project because these projects are ongoing.

4.3.6 Hazardous Waste Management Units Remediation

Remediation fieldwork for 33 of the 39 hazardous waste management units (HWMUs) (refer to Table 4-3) in OU3 have been completed under the Resource Conservative and Recovery Act (RCRA), constituting a partial closure of the FCP facility. Applicable RCRA closure requirements under Ohio Administrative Code 3745-66 (40 Code of Federal Regulation 265, Subpart G) have been followed to address closure of these units. Nineteen of the 26 closed HWMUs (numbers 1, 4, 10, 14, 15, 18, 19, 20, 25, 28, 29, 33, 34, 37, 46, 47, 49, 50 and 54) were closed under the RCRA/CERCLA integrated process.

4.4 ASSESSMENT OF CONFIRMATORY DATA AND/OR PERFORMANCE DATA

4.4.1 Identify the Scope of the Review

This review covers the activities implemented by the Safe Shutdown, Facilities Shutdown, and D&D Projects.

4.4.2 Assessment of Remedial Actions

Is the remedy operational and functioning as intended in the ROD?

There have been no major design changes or modifications to either the D&D or Safe Shutdown/Facilities Shutdown remedial action processes. Scheduled completion dates for previously dismantled buildings and structures were met and the completion dates for the buildings/structures currently being dismantled are attainable. Based on current and past OU3 activities, the selected material treatment, on-property disposal, and off-site disposition of generated material should be accomplished as outlined in the ROD.

D&D activities for OU3 have been in compliance with NESHAP Subpart H standard for radiological emissions. Compliance has been confirmed through emission modeling before each major demolition project and control of fugitive dust emissions. The IEMP property boundary air monitoring program has reported the data that support compliance with the 10 millirem (mrem) radiological dose standard for air inhalation dose to members of the public.

TABLE 4-3
OPERABLE UNIT 3 HAZARDOUS WASTE MANAGEMENT UNITS

HWMU No.	HWMU Description	HWMU Status	Documentation Status
1	Fire Training Facility	Closed - Integrated RCRA/CERCLA	March 29, 2004
3	Waste Oil Storage in Garage	Closed	OEPA letter, June 6, 1996
4	Drum Storage Area Near Loading Dock (Lab Bldg.)	Closed - Integrated RCRA/CERCLA	January 12, 2006
5	Drum Storage Area South of W-26 (Lab Bldg.)	Open	
6	Drummed Hydrofluoric (HF) Residue/Associated Storage Areas Northwest of Plant 4	Closed	OEPA letter, April 28, 1995
7	Drummed HF Residue/Associated Storage Areas South of Cooling Towers	Closed	OEPA letter, July 2, 1996
8	Drummed HF Residue/Associated Storage Areas South of Cooling Towers	Closed	OEPA letter, July 2, 1996
9	Nitric Acid Rail Car and Area	Closed	OEPA letter, April 25, 1995
10	Nitric Acid Recovery (NAR) System Components	Closed - Integrated RCRA/CERCLA	July 8, 2004
11	Tank Farm Sump	Open	
13	Wheelabrator Dust Collector (Bldg. 66)	Closed	OEPA letter, April 5, 1996
14	Box Furnace	Closed - Integrated RCRA/CERCLA	July 8, 2004
15	Oxidation Furnace #1	Closed - Integrated RCRA/CERCLA	July 8, 2004
17	Plant 8 East Drum Storage Pad	Open	
18	Plant 8 West Drum Storage Pad	Closed - Integrated RCRA/CERCLA	January 16, 2006
19	CP Storage Warehouse - Bldg. 56 (Butler Bldg.)	Closed - Integrated RCRA/CERCLA	November 7, 2003
20	Plant 1 Pad	Closed - Integrated RCRA/CERCLA	February 7, 2005
22	Abandoned Sump West of Pilot Plant	Open	
25	Plant 1 Storage Bldg. (Bldg. 67)	Closed - Integrated RCRA/CERCLA	December 31, 1997
26	Detrex Still	Closed	OEPA letter, November 27, 1995
28	Trane Thermal Liquid Incinerator	Closed - Integrated RCRA/CERCLA	January 16, 2006
29	Plant 8 Warehouse (Bldg. 80)	Closed - Integrated RCRA/CERCLA	July 8, 2004

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TABLE 4-3
OPERABLE UNIT 3 HAZARDOUS WASTE MANAGEMENT UNITS
(Continued)

HWMU No.	HWMU Description	HWMU Status	Documentation Status
30	Barium Chloride Salt Treatment Facility	Closed	OEPA letter, April 19, 1990
31	Tank for Bulk Storage of Solvents, T5	Closed	OEPA letter, November29, 1996
32	Tank for Bulk Storage of Solvents, T6	Closed	OEPA letter, November 29, 1996
33	Pilot Plant Warehouse (Bldg. 68)	Closed - Integrated RCRA/CERCLA	July 15, 2004
34	KC-2 Warehouse (Bldg. 63)	Closed - Integrated RCRA/CERCLA	October 28, 1999
35	Plant 9 Warehouse (Bldg. 81)	Closed	OEPA letter, June 8, 1998
36	Storage Pad North of Plant 6	Open	
37	Plant 6 Warehouse (Bldg. 79)	Closed - Integrated RCRA/CERCLA	July 28, 2005
38	HF Tank Car	Closed	OEPA letter, November 27, 1995
46	Uranyl Nitrate Tanks (NFS Storage Area)	Closed - Integrated RCRA/CERCLA	January 16, 2006
47	Uranyl Nitrate Tanks (North of Plant 2)	Closed - Integrated RCRA/CERCLA	January 16, 2006
48	Uranyl Nitrate Tanks (Southeast of Plant 2)	Open	
49	Uranyl Nitrate Tanks [Digestion Area (2 locations)]	Closed - Integrated RCRA/CERCLA	January 16, 2006
50	Uranyl Nitrate Tanks [Raffinate Building (2 locations)]	Closed - Integrated RCRA/CERCLA	January 16, 2006
52	Experimental Treatment Facility (ETF)	Closed	OEPA letter, December 6, 1995
53	North and South Solvent Tanks (Pilot Plant)	Closed	OEPA letter, June 24, 1996
54	Thorium Nitrate Tank (2)	Closed - Integrated RCRA/CERCLA	OEPA letter, November 23, 1998

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4.4.3 Validity of ROD Assumptions

Are the critical assumptions (to ensure protection of human health and the environment) used at the time of remedy selection still valid?

The following critical assumptions used at the time of remedy selection are still valid:

- The OSDF engineering design would be sufficient for the OEPA to grant a waiver to allow its siting over the Great Miami Aquifer (GMA).
- The OSDF engineering design will provide long-term (at least 200 to 1,000 years) protection of human health and the environment from OU3 materials.
- Mixed waste treatment through solidification and encapsulation will allow land disposal requirements to be met.
- Risks from radiological and chemical exposure to workers performing the selected remedy will remain within acceptable levels.

The EPA guidance for five-year reviews states that only the ARARs and to-be-considered (TBC) requirements that bear on the final protectiveness of the remedy need to be re-evaluated during the review. Because the OU2 and OU5 remedies set in motion the ARARs for the OSDF and restored environmental media to remain at the FCP after all remedial actions are complete, the OU2 and OU5 sections of the report address the re-evaluation of ARARs and TBCs that are relevant to protectiveness.

4.4.4 Remedy Optimization

Has any new information come available that could allow for optimization of the selected remedy or call into question the validity of the selected remedy?

Due to limited soil quantities generated prior to and during demolition of the former production area, an OSDF material transfer area was established to store D&D debris until adequate quantities of soil can be excavated to meet the required soil to debris ratio for OSDF placement. Before the material transfer area was established, roll-off boxes were filled and could not be emptied until they were taken to the OSDF. At this time, full roll-off boxes are immediately transported to and emptied at the OSDF material transfer area. The roll-off boxes are then re-used at the D&D Project site. The OSDF material transfer area allows for a better waste handling process.

4.5 FINDINGS AND RECOMMENDED ACTIONS FROM CURRENT REVIEW

No findings or deficiencies have been identified in Section 4.4.2. As a result, no corrective measures are necessary.

4.6 PROTECTIVENESS STATEMENT

The remedy for OU3 is expected to be protective of human health and the environment, and immediate threats have been addressed. The selected material treatment, on-property disposal and off-site disposition of generated material continue to eliminate radiological and hazardous substances of concern.

5.0 OPERABLE UNIT 4

5.1 PROJECT DESCRIPTION

Operable Unit 4 (OU4) is in the southwestern portion of the waste storage area, west of the former production area. It originally consisted of two earthen-bermed, concrete silos containing K-65 materials, a decant sump tank, one silo containing cold metal oxides, one unused silo, and various quantities of contaminated soils, perched water, and debris associated with these structures.

The OU4 silos were constructed in the early 1950s for storage of byproduct materials (as defined in Section 11(e)(2) of the Atomic Energy Act of 1954). Silos 1 and 2 contained approximately 8,012 yd^3 (6,126 m^3) of residues, known as K-65 material, which were generated from the processing of high-grade uranium ores, and approximately 878 yd^3 (671 m^3) of BentoGrout™ clay. K-65 material is a non-cohesive silty material containing significant concentrations of radionuclides, including radium-226, thorium-230, lead-210, and polonium-210. The material also contains significant levels of leachable lead. Due to the radium content of the K-65 material, Silos 1 and 2 represent a significant source of radon-222 emanations.

A 9,000-gallon (34,000 liter), carbon steel decant sump tank was located underground adjacent to Silos 1 and 2. This tank was originally used to collect water decanted from Silos 1 and 2 during the process of slurrying the residues into the silos, and was also connected to the underdrain and skirt drain system around the silos. The tank also collected water due to leakage from the silos and infiltration from groundwater. The tank also contained an estimated 1,000 gallons (3,800 liters) of solid residue from the former decant operation.

Silo 3 contained approximately 5,088 yd^3 (3,890 m^3) of material, known as cold metal oxides, which were generated at the FCP site during uranium extraction operations in the 1950s. Thorium-230 is the primary radiological contaminant of concern associated with the Silo 3 material. Data from the Remedial Investigation Report for Operable Unit 4 (DOE 1994b) indicate that Silo 3 material contains significant concentrations of arsenic, cadmium, chromium, and selenium.

The DOE performed a RI/FS for OU4, which was approved by the EPA in August 1994. The EPA signed the ROD for Remedial Actions at OU4 (DOE 1994c) on December 7, 1994. The ROD identified vitrification and disposal at the NTS as the selected remedy for the contents of Silos 1, 2 and 3, and the decant sump tank. The four silos would then be demolished, decontaminated, and dispositioned.

During 1996, DOE (with input from EPA, the OEPA, and the public) evaluated the results of treatability testing on the selected remedy, and the technical and schedule impacts of alternatives for OU4 remediation. These evaluations culminated in a decision that Silo 3 material will be remediated separately from Silos 1 and 2 material.

An ESD for OU4 Silo 3 Remedial Action was approved by EPA on March 27, 1998 (DOE 1998a), after completion of formal public review. The ESD documented the basis for revising the treatment portion of the original selected remedy for Silo 3 from vitrification to chemical stabilization or polymer-based encapsulation.

A revised Feasibility Study for Silos 1 and 2 (DOE 2000c) was prepared to re-evaluate the remedial alternatives for Silos 1 and 2. A Proposed Plan was subsequently prepared, recommending chemical stabilization as the revised remedy for Silos 1 and 2. The EPA approved the Final Record of Decision Amendment for Operable Unit 4 Silos 1 and 2 Remedial Actions on July 13, 2000 (DOE 2000d).

5.1.1 Roles and Responsibilities

Fluor Fernald, Inc is responsible to the DOE for the execution of all aspects of the Silos Project, including design, construction, startup, operations, shutdown and final demoltion.

5.2 SUMMARY OF REMEDIAL ACTION OBJECTIVES

The remedial action objectives identified in the original OU4 Feasibility Study include:

- Prevent direct contact with or ingestion of waste material
- Prevent release or migration of waste materials to soil, groundwater, surface water, or sediment
- Prevent exposure to waste material that may cause an individual to exceed applicable dose limits.

The selected remedy documented in the OU4 ROD consisted of the following components:

- Removal of contents from the Silos 1, 2, and 3 structures, on-site vitrification of the silo materials, and transportation and disposal at the NTS

- Decontamination and demolition of all silo structures and the vitrification facility in accordance with the approved OU3 ROD

- Excavation and treatment of contaminated soils, and treatment of perched water encountered during remedial action, in accordance with the approved OU5 ROD.

Five changes have been made to the OU4 ROD subsequent to its approval in December 1994. CERCLA requires that changes to approved RODs be documented and approved through a formal ROD amendment for modifications determined to be fundamental to the scope, performance, or cost of the remedy. For modifications determined to be significant but not fundamental, an ESD or Fact Sheet is used. The five post-ROD decision changes were:

- Explanation of Significant Differences for Operable Unit 4 Silo 3 Remedial Action (DOE 1998a), signed and effective March 27, 1998, modified the treatment component of the Silo 3 remedy to on-site or off-site treatment by chemical stabilization or polymer encapsulation, and allowed the option for disposal at a permitted commercial disposal facility in addition to the NTS

- Record of Decision Amendment for Operable Unit 4 Silos 1 and 2 Remedial Action (DOE 2000d), signed and effective on July 13, 2000, modified the treatment component of the Silos 1 and 2 remedy to on-site treatment by chemical stabilization

- Record of Decision Amendment for Operable Unit 4 Silo 3 Remedial Action (DOE 2003b), signed and effective on September 24, 2003, modified the treatment component of the Silo 3 remedy to the degree reasonably implementable, to address material dispersability and metals mobility

- Explanation of Significant Differences for Operable Unit 4 Silos 1 and 2 Remedial Action (DOE 2003c), signed and effective November 24, 2003, removed the RCRA toxicity characteristic leaching procedure test as a performance standard for the chemical stabilization process (maintaining the requirement to treat by chemical stabilization to meet disposal facility WAC), and allowed the option for disposal at a permitted commercial disposal facility in addition to the disposal at the NTS.

- Explanation of Significant Differences for Operable Unit 4 (DOE 2005d), signed and effective January 18, 2005, allowed the option for temporary off-site storage of treated Silos 1, 2, and 3 materials prior to permanent off-site disposal.

The final remedy defined by the OU4 ROD and its subsequent revisions consists of:

- Removal of the contents of Silos 1 and 2 and the Decant Sump Tank System sludge from the silos and transfer to the Transfer Tank Area (TTA) for storage pending subsequent transfer to the Silos 1 and 2 Remediation Facility

- Complete removal of contents of Silos 1 and 2 and the Decant Sump Tank System sludge from the TTA followed by treatment using chemical stabilization to attain the disposal facility waste acceptance criteria

- Removal of material from Silo 3 by pneumatic and/or mechanical processes, followed by treatment to the extent practical by addition of a chemical stabilization reagent and a reagent to reduce dispersability

- Off-site shipment and disposal of the treated silo materials at the NTS and/or an appropriately permitted commercial disposal facility

- Temporary off-site storage for a maximum of two years, if required, prior to permanent off-site disposal

- Gross decontamination, demolition, size reduction, and packaging of the Silos 1, 2, and 3 structures and remediation facilities in accordance with the OU3 ROD

- Shipment of the concrete from the Silos 1 and 2 structures for off-site disposal at the NTS or an appropriately permitted commercial disposal facility

- Disposal of contaminated soil and debris, excluding concrete from Silos 1 and 2 structures, in accordance with the FCP OSDF WAC or an appropriate off-site disposal facility, such as the NTS or a permitted commercial disposal facility;

- Removal of the earthen berms and excavation of the contaminated soils within the OU4 boundary to achieve the remediation levels outlined in the OU5 ROD

- Appropriate treatment and disposal of all secondary wastes at either the NTS or an appropriately permitted commercial disposal facility

- Collection of perched water encountered during remedial activities for treatment at OU5 water treatment facilities

- Continued access controls and maintenance and monitoring of the stored waste inventories

- Institutional controls of the OU4 area, such as deed and land-use restrictions.

5.3 REMEDIAL ACTION STATUS

At the time of this review, implementation of the on-site portions of the selected remedy for OU4 is nearing completion. Dates for key events during implementation of the OU4 remedy, as well as projected dates for remaining activities, are summarized in Table 5-1.

TABLE 5-1
SUMMARY OF EVENTS FOR OPERABLE UNIT 4 REMEDIATION

Event	Date
Operable Unit 4 Decision Related Documents	
Approval of Operable Unit 4 Record of Decision	December 1994
Approval of Explanation of Significant Differences for Silo 3	March 1998
Approval of Record of Decision Amendment for Silos 1 and 2	July 2000
Approval of Record of Decision Amendment for Silo 3	September 2003
Approval of Explanation of Significant Differences for Silos 1 and 2	November 2003
Approval of Explanation of Significant Differences for Operable Unit	January 2005
Operable Unit 4 Remedial Design Documents	
Remedial Design Work Plan for Remedial Actions at Operable Unit 4	June 1995
Vitrification Pilot Plant Treatability Study Work Plan	June 1996
Remedial Design Work Plan for Silo 3	June 1998
Remedial Design Work Plan for Silos 1 and 2	October 2001
Silo 3 Site Preparation Package	April 2000
Silos 1 and 2 Accelerated Waste Retrieval Project Site Preparation Package	May 2000
Remedial Design/Remedial Action Package for Silo 3	February 2004
Remedial Design Package for Silos 1 and 2 Accelerated Waste Retrieval (includes RCS design)	October 2002
Remedial Design Package for Silos 1 and 2	June 2003
Operable Unit 4 Remedial Action Documents	
Remedial Action Work Plan for Silo 3 (combined with RD/RA Package)	February 2004
Remedial Action Work Plan for RCS Phase 1	October 2002
Remedial Action Work Plan for Silos 1 and 2 Waste Retrieval Operations	October 2003
Remedial Action Work Plan for Silos 1 and 2 Remediation Facility	October 2004
Silo 3 Transportation and Disposal Plan	March 2005
Silos 1 and 2 Transportation and Disposal Plan	May 2005
Remedial Action Field Activities	
Removal Action #4 (Silos 1 and 2 Bentonite)	November 1991
Silo 3 Dust Collector Removal	December 1991
Initiation of Vitrification Pilot Plant Operations	July 1996
Failure of Vitrification Pilot Plant Melter Hardware	December 1996
Initiation of Site Preparation Construction (Silos Infrastructure Project)	April 1999
Initiation of Silo 3 Remediation Facility Construction	June 2000
Initiation of Radon Control System/Silos 1 and 2 AWR Construction	July 2000
Initiation of Radon Control System Phase 1 Operation	April 2003
Initiation of Silos 1 and 2 Remediation Facility Construction	July 2002
Initiation of Silos 1 and 2 Waste Retrieval	September 2004
Completion of Silos 1 and 2 Waste Retrieval and Decant Sump Tank Sludge Removal	March 2005
Initiation of Silo 3 Remediation Facility Operation	March 2005
Decontamination and Demolition of Silo 1 and 2 Structures	April 2005
Initiation of Silos 1 and 2 Remediation Facility Operation	May 2005
Completion of disposal of Silo 3 Material at Envirocare (*projected*)	*February 2006*
Completion of Transportation of Treated Silos 1 and 2 Material to WCS for Temporary Storage (*projected*)	*March 2006*
Initiation of Final Disposal of Silos 1 and 2 Material	to be determined
Completion of Final Disposal of Silos 1 and 2 Material	to be determined

The major components of the final remedy for Silo 3 are:

- Pneumatic (vacuum) retrieval of Silo 3 material via man ways on the silo dome
- Cutting an opening in the silo sidewall for at-grade access by mechanical equipment
- Mechanical retrieval of Silo 3 material using remotely controlled mechanical excavation equipment (in combination with continued pneumatic retrieval as required)
- Application of a solution of lignosulfonate, water, and ferrous sulfate to the Silo 3 material as it enters the package to reduce leachability and dispersability
- Packaging of conditioned Silo 3 material in 96-cubic-foot, double layer, coated woven polypropylene soft-sided packages (certified to meet DOT's Industrial Package Type 2 (IP-2) requirements) with a 30-mil PVC inner liner
- Transportation to an off-site disposal facility in accordance with DOT regulations and transportation risk criterion specified by the ROD.

Construction of the Silo 3 Remediation Facility was completed in late 2004, and operation of the facility was initiated in March 2005. As of the end of calendar year 2005, more than 1,500 packages of Silo 3 material had been retrieved, conditioned, packaged, and shipped to Envirocare of Utah for disposal in accordance with the ROD Amendment for Silo 3. Retrieval, packaging, and disposal of the remaining material is expected to be completed in early 2006, followed by decontamination and demolition of the Silo 3 structure, the Silo 3 Remediation Facility, and the underlying soil.

The final plan for the remediation of Silos 1 and 2 consisted of two distinct projects. The Silos 1 and 2 Accelerated Waste Retrieval (AWR) Project was initiated to provide facilities and equipment for transferring the material from Silos 1 and 2, and the Decant Sump Tank to safe temporary storage while awaiting construction and startup of the Silos 1 and 2 Remediation Facility. Facilities for the Silos 1 and 2 AWR Project were constructed between mid-2000 and mid-2004 and included:

- A Radon Control System (RCS) to treat radon emissions from the Silos 1 and 2 headspaces, waste retrieval and storage equipment, and the Silos 1 and 2 Remediation Facility
- A TTA, consisting of four 750,000-gallon steel tanks housed in a concrete shielding structure
- The Silo Waste Retrieval System, consisting of piping and equipment for the retrieval of the material from Silos 1 and 2 and transfer to the TTA
- The Transfer Tank Waste Retrieval System consisting of equipment identical to the Silo Waste Retrieval System, for retrieving the material from the TTA and transferring it to the future Silos 1 and 2 Remediation Facility

- Test Stand consisting of a steel tank and sluice/slurry module support structure used to test and demonstrate silo waste retrieval equipment and methods using non-radioactive, non-hazardous surrogate material

Phase 1, operation of the RCS, was initiated In April 2003 to minimize radon concentrations in the headspaces of Silos 1 and 2, thereby minimizing radon emissions and worker exposure during construction of the remaining AWR facilities. Transfer of the material from Silos 1 and 2 and the decant Sump Tank to the TTA was initiated in September 2004 and was completed in March 2005. Decontamination and demolition of the Silo 1 and 2 structures was completed during April 2005, and was followed by off-site disposal of the Silos 1 and 2 concrete and residual heel material, as well as excavation and disposal of the Decant Sump Tank and contaminated soil from the Silo 1 and 2 footprint.

The Silos 1 and 2 Remediation Facility was constructed between July 2002 and early 2005 and includes the following components:

- TTA Waste Retrieval System - three carbon steel tanks for receipt of the Silos 1 and 2 material, in slurry form, from the TTA

- Feed Preparation System - slurry from the receipt tanks is mixed with additives, as necessary to settle suspended solids, and overflows to a clarifier in order to thicken the slurry to approximately 30-weight-percent solids in preparation for product mixing

- Processor Feed System - the clarifier continuously feeds the slurry to the feed tanks, where it is transferred by batches to the product mixers

- Product Additive System - cement and flyash are unloaded and transferred to the product mixers

- Processor System - three product mixers are used to mix the thickened slurry with cement and flyash on a batch basis. After mixing has been completed, the chemically stabilized product is discharged via gravity to the transport/disposal containers.

- Container Handling System - subsystems for the receipt, preparation, and filling of the containers

- Disposal Containers - 6-foot-diameter, 6.5-foot-high, ½-inch-thick cylindrical carbon steel containers; external volume of 196 cubic feet (ft^3), meeting DOT's Industrial Package Type 2 (IP-2) requirements.

In letters to the DOE (dated April 13, 2004 and August 23, 2004), the Nevada Attorney General raised several legal issues concerning disposal of the treated silo materials at the NTS. After careful evaluation of the issues, EPA's and DOE's position was that the current OU4 remedy, originally specified in 1994 with input from regulatory agencies and stakeholders in the states of Ohio and Nevada, is legal, compliant, and fully implementable. However, in order to allow the on-site portions of the Silos 1 and 2 remedy to proceed while issues regarding permanent off-site disposal were resolved, DOE and EPA modified the remedy, as documented in the January 2005 ESD for OU4 to allow for the option of temporary off-site

storage of Silo materials, after necessary treatment, prior to permanent off-site disposal at the NTS and/or a permitted commercial disposal facility.

Following a competitive procurement process, Waste Control Specialists, LLC (WCS) in Andrews, Texas was awarded a contract for temporary storage of Silos 1 and 2 material, in accordance with the requirements of the OU4 ESD. On February 23, 2005, WCS received approval modification to the radioactive materials license (L04971) from the Texas Department of State Health Services (TDSHS) to allow temporary storage of the treated Silos 1 and 2 materials at their disposal facility in Andrews, Texas. In addition, WCS has submitted an application for a license for disposal of 11e.(2) byproduct material to the TDSHS. In accordance with the ESD, the treated Silos 1 and 2 material will be stored at WCS for a period of up to two years before being permanently disposed at the NTS, or an appropriately permitted commercial facility.

Operation of the Silos 1 and 2 Remediation Facility was initiated in May 2005. At the time of this evaluation (December 2005), more than 70 percent of the Silos 1 and 2 material has been transferred from the TTA to the Remediation Facility, treated, and packaged. More than 2,300 containers have been transported to WCS for storage. Treatment, packaging, and transportation of the remaining Silos 1 and 2 material to WCS is anticipated to be completed during the first half of 2006, and will be followed by decontamination and decommissioning of the Silos 1 and 2 Remediation Facility and AWR facilities. The last remedial actions will consist of soil excavation, soil certification and restoration of the OU4 footprint.

5.4 EVALUATION OF CONFIRMATORY DATA AND/OR PERFORMANCE DATA

5.4.1 Scope of the Review

At the time of this review, the on-site portions of the OU4 remedial action required to remove sources of contamination to the environment have been nearly completed. Review of the performance of the remedy consisted of review of information regarding the performance of measures addressing the immediate threats to the environment, the validity of the assumptions used as a basis for remedy selection, and the acceptability of the waste materials at the selected disposal facilities.

5.4.2 Assessment of Remedial Actions

Is the remedy operational and functioning as intended in the ROD?

At the time of this review, the on-site portions of the OU4 remedial action required to remove sources of contamination to the environment are operating and functioning as intended. Silo 3 material is being successfully packaged and disposed at Envirocare of Utah, and Silos 1 and 2 material is being treated, packaged, and placed in protective off-site storage pending final disposal. These actions eliminate the primary ("immediate threats") from OU4 of chronic radon emissions and potential contamination of

groundwater. As illustrated in Figures 5-1 and 5-2, operation of the RCS has provided mitigation of radon emissions while remedial actions were completed.

5.4.3 Validity of ROD Assumptions

Are the critical assumptions (to ensure protection of human health and the environment) used at the time of remedy selection still valid?

Toxicity and Other Contaminant Characteristics

Assumptions regarding the contaminants of concern and toxicity characteristics of the Silos 1, 2, and 3 material are documented in detail in the original OU4 Remedial Investigation Report. These same assumptions remain intact as the basis for selecting the revised remedies documented in the ESD for Silo 3 and the ROD Amendment for Silos 1 and 2.

Human and Ecological Risk Assessment

Neither new exposure scenarios nor risk assessment methodologies were identified in re-evaluating the remedies for Silos 1 and 2 or for Silo 3.

Waste Disposal

The original OU4 remedy assumed that, after treatment in accordance with the selected remedy, the treated Silos 1, 2, and 3 residues would be acceptable for disposal at the NTS. The ROD further assumed that, with the exception of concrete from Silos 1 and 2 exhibiting a "highly elevated direct radiation field," all concrete and debris from D&D of above-ground OU4 structures would be acceptable for on-site disposal in the ODSF. The assumptions regarding disposal of the treated silo materials remain valid.

The assumption for debris was re-evaluated as part of the revised Feasibility Study for Silos 1 and 2. As documented in the ROD Amendment for Silos 1 and 2, all of the concrete from Silos 1 and 2 has been determined to be more appropriately managed in the same manner as Category C, Processed-Related Metals. Therefore, concrete from Silos 1 and 2 is administratively excluded from disposal at the FCP OSDF.

ARARs and TBC Requirements

The revised Feasibility Study for Silos 1 and 2 included a re-evaluation of the ARARs and requirements as documented in the original OU4 ROD. This re-evaluation is documented in detail in Appendix A, Section A.1.3 of the revised Feasibility Study. Based on (1) the scope of and rationale for the change in remedy under consideration; (2) review of requirements promulgated since signature of the original OU4 ROD; and (3) requirements of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), the re-evaluation concluded that the change in remedy for OU4 did not require revision of the existing OU4 ARARs.

The EPA guidance for five-year reviews states that only the ARAR and TBC requirements that bear on the final protectiveness of the remedy need to be re-evaluated during the review. Because only the OU2 and OU5 remedies pertain to the OSDF and restored environmental media to remain at the FCP after all remedial actions are complete, these two operable unit sections of the report address the re-evaluation of ARARs and TBCs that are relevant to protectiveness.

5.4.4 Remedy Optimization

Has any new information come available that could allow for optimization of the selected remedy or call into question the validity of the selected remedy?

As previously discussed, the selected remedies for both of the primary subunits of OU4 (Silos 1, 2, and 3) were re-evaluated based on technical issues identified during initial implementation of the original selected remedy. Based on these re-evaluations, documented in the ESD for Silo 3, the revised Feasibility Study, and the subsequent ROD Amendment for Silos 1 and 2, both remedies were revised. Both alternate remedies were selected because they were judged to be superior to the original remedy in their certainty of meeting the criterion of CERCLA and the NCP, consisting primarily of superior certainty of technical implementability.

5.5 FINDINGS AND RECOMMENDED ACTIONS FROM CURRENT REVIEW

The review of the OU4 remedy documented in Section 5.4 identified no new information or data that significantly impact the planned remedy. Further, the review indicates that measures are in place and still functioning adequately to provide protection from the principal immediate threats posed by OU4 while the final remedy is being implemented. Review and subsequent amendment of the original selected remedy should provide a remedy with greater certainty of being successfully implemented in accordance with the criteria of CERCLA and the NCP, compared to the original remedy.

5.6 PROTECTIVENESS STATEMENT

The selected final remedy for OU4 is expected to be protective of human health and the environment upon completion, and immediate threats have been addressed. Interim measures in place to address the immediate radon threats from OU4 have proven to be effective in reducing radon-222 emanating from Silos 1 and 2.

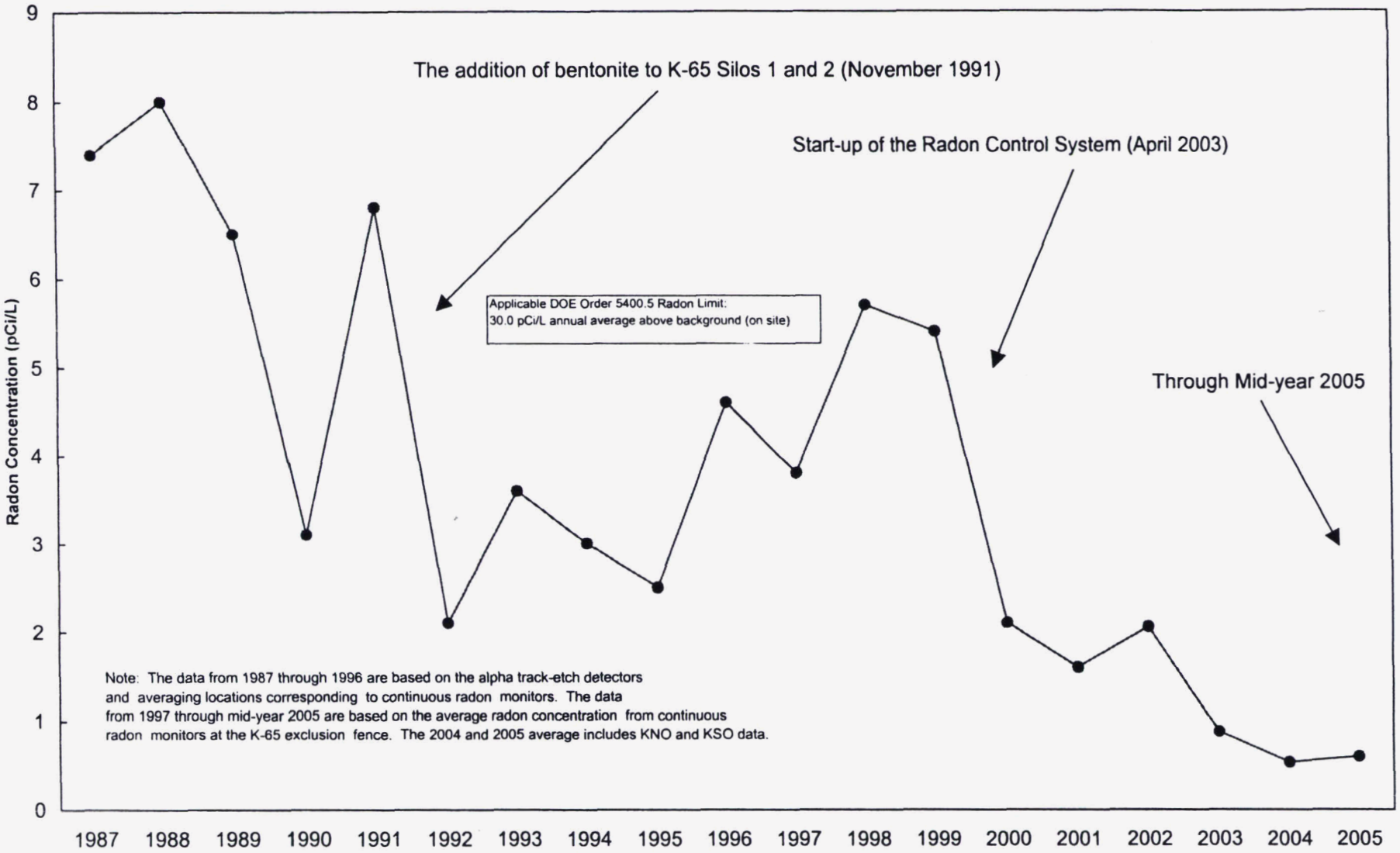


Figure 5-1 Annual Average Radon Concentrations at K-65 Silos Exclusion Fence

006205

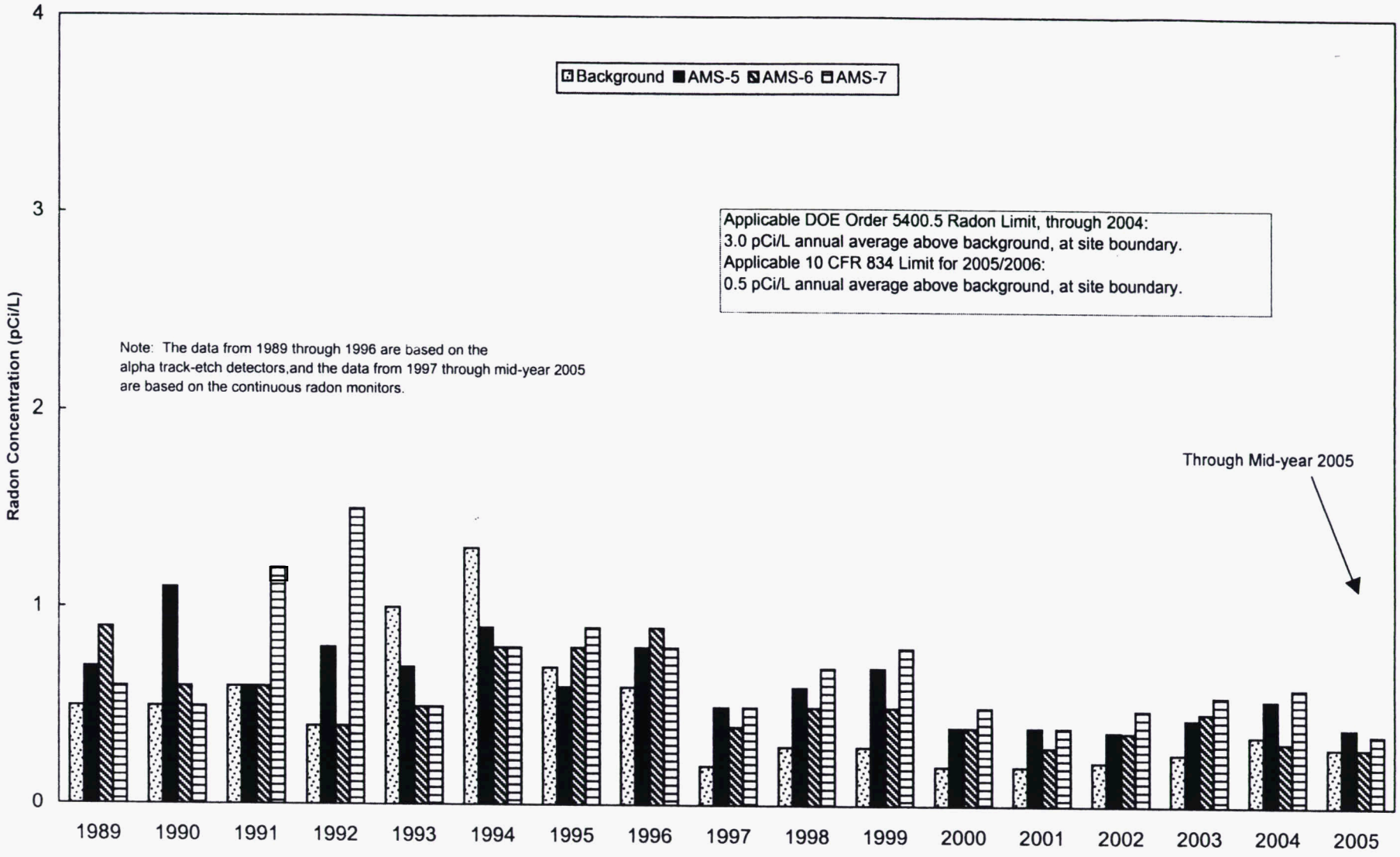


Figure 5-2 Annual Average Radon Concentrations at Selected Radon Locations

6.0 OPERABLE UNIT 5

6.1 PROJECT DESCRIPTION

Operable Unit 5 (OU5) encompasses all environmental media, both on and off the FCP property, affected by contaminants released from the FCP site. It has no operational history, but it reflects the impacts of the "source" operable units (1, 2, 3, and 4) on the soil, sediment, surface water, groundwater, and plants and animals in the affected area. The selected remedy to address OU5 consists of the excavation and disposal of contaminated soil and sediment, and the restoration of the GMA to its full beneficial use.

Additionally, the OSDF was evaluated as a remedial alternative in the OU2, OU3, and OU5 Feasibility Studies. Once all the on-site disposal decisions were finalized, the OSDF was sized and designed to accommodate all three OUs. It is discussed under OU5 because the OU5 remedial actions will be the last work that uses the OSDF.

6.1.1 Operable Unit 5 Characteristics

6.1.1.1 Nature and Extent of Groundwater Contamination

The GMA underlying the site is typically stratified into an upper and lower portion separated by a discontinuous clay interbed. Below the lower portion of the aquifer is bedrock. An extensive network of groundwater monitoring wells has been installed and is being maintained as necessary to monitor the progress of aquifer restoration on and off the site prperty.

Uranium, the principal site-related contaminant in the GMA, is only found in the uppermost portion of the aquifer. Contamination in the GMA is found beneath the former production area, beneath the waste storage area, east of Paddys Run along the length from the OU1 waste pits, to approximately 1 mile south [1.609 kilometers (km)] of the FCP property, and beneath the OU2 southern waste units. Several other site-related contaminants are present in the aquifer as localized zones within the plume of uranium contamination. As of June 2005, the estimated area of affected groundwater in the GMA, at a concentration at or above 30 μg/L total uranium, is approximately 196 acres (79 hectares). Section 5.1.2 of the ROD for Remedial Actions at OU5 (DOE 1996c) and subsequent annual site environmental reports contain a more complete description of the GMA and the associated contamination.

6.1.1.2 Nature and Extent of Surface Water Contamination

The FCP's primary drainageways are the storm sewer outfall ditch and Paddys Run. Over the period covered by this five-year review, above-FRL concentrations of uranium, and several other constituents, have been detected in the storm sewer outfall ditch and the on-property portions of Paddys Run. The annual site environmental reports contain summary tables on the number of exceedances at each monitored location.

During the remedial investigation, samples collected from the Great Miami River immediately down-stream of the FCP effluent line indicated concentrations of uranium slightly above background, which diminished to background within 1 mile (1.609 km). Additionally, inorganic COCs and volatile and semi-volatile organic compounds are detected immediately up- and down-stream of the FCP outfall line, because these constituents arise from all agriculture and industrial sources that discharge to the river. No remedial activities are planned for surface water at the FCP because the planned remediation of contamination sources at the site will result in contaminant concentrations in surface water that are below the FRLs for surface water established in the OU5 ROD.

6.1.1.3 Nature and Extent of Soil Contamination

Soil contaminants resulting from former production operations at the FCP include radiological, inorganic, and organic contaminants. The predominant radiological soil contaminant at the FCP is uranium. Radium and thorium isotopes have also been detected in soil, largely concentrated in the former production area and the waste storage areas. The predominant inorganic contaminants are cadmium and beryllium, although several other metals have been identified as soil COCs. Isolated areas contain volatile and semi-volatile organic compounds, and PCBs are also found within uranium contamination boundaries. Soil contamination levels are described in detail in the Remedial Investigation Report for Operable Unit 5 (DOE 1995f) and summarized in the OU5 ROD. More recently, the Sitewide Excavation Plan (DOE 1998b) and follow-up predesign field characterization studies have refined the extent and concentration of contaminants in the major areas slated for remediation.

Under the selected remedial alternative, the total volume of soil to be excavated was estimated at 1,800,000 yd3 (1,400,000 m^3); of this volume, approximately 85 percent was expected to meet OSDF WAC. As of December 2005, 2,920,000 yd^3 (2,230,000 m^3) of contaminated soil and debris have been excavated, with more than 94 percent of this soil meeting the OSDF WAC and the remainder shipped to an off-site commercial disposal facility.

6.1.1.4 Nature and Extent of Sediment Contamination

During the remedial investigation, sediment samples collected from the storm sewer outfall ditch exceeded background concentrations for total uranium and several inorganic contaminants. On-property sediment samples from Paddys Run indicated above-background levels for uranium, radium-226, volatile and semi-volatile organic compounds, and inorganic constituents. Off-property sediment sampling in Paddys Run revealed uranium to be the only constituent with a concentration above background. Sediment samples from the Great Miami River indicated concentrations of total uranium, radium-226, and total thorium at or slightly above background. The remedy for drainage areas containing sediment above FRLs includes excavation and disposal of the sediment, after the affected soil in the associated drainage basin has been removed and certified as clean. The annual site environmental reports document

the present extent of contamination in the sediment, and all monitored locations presently show all COCs to be below FRLs established in the OU5 ROD.

6.1.2 Roles and Responsibilities

The Aquifer Restoration and Wastewater Treatment Project (ARWWT), aligned under the ECP, is responsible for:

- Designing, installing, and operating the extraction system for GMA groundwater
- Groundwater monitoring
- Reporting on the progress of aquifer restoration
- Designing, constructing, and operating all treatment and effluent discharge systems
- Operation, maintenance, and monitoring of the OSDF leachate collection system (LCS) and leak detection system (LDS)

The remaining divisions of the ECP are responsible for:

- Planning, designing, and directing the excavation of subsurface debris and soil, and certifying that the footprint meets the soil FRLs established in the OU5 ROD
- Sampling soil, water and air
- Managing and reporting the analytical results
- Designing and approving the construction of the OSDF liners and caps
- Reviewing decontamination and dismantlement plans
- Field oversight of debris sizing, segregation of materials to remove prohibited items prior to placement in OSDF
- Completing field tracking logs and manifests for material bound for the OSDF
- Compiling final records for debris and soil placed in the OSDF.

The SDFP is responsible for the excavation of contaminated soil and debris; placement of soil and debris into the OSDF in accordance with the WAC; and construction of the OSDF liners and caps in accordance with the design specifications and plans.

The specific responsibilities for implementing the OU5 remedy are defined as follows.

- Design and construction of the groundwater restoration infrastructure (wells, pipelines, and valving) are typically accomplished through engineering and construction subcontracts. Personnel in the ARWWT operate these systems, including the operation of all treatment systems and the OSDF LCS.

- Design and excavation of soil remediation projects are managed through the ECP and the SDFP. Also, the ECP performs the required predesign, precertification, and certification sampling for soil media.

- Soil excavation and OSDF waste placement are monitored by personnel in the WAO, which is within the ECP. The design and certification of individual disposal cells is the responsibility of the engineering organization within the ECP. Placement of waste and construction of OSDF liners and caps falls to the SDFP.

- The monitoring of environmental media at the FCP, including groundwater, surface water, air, and the OSDF leak detection monitoring is conducted by the ECP. Environmental monitoring data have been published in IEMP data reports (e.g., the annual site environmental reports). The annual site environmental reports are made available to the public and will continue post-closure.

6.2 SUMMARY OF REMEDIAL ACTION OBJECTIVES

The objective of the selected remedy is to provide for the protection of existing and future human and environmental receptors through the implementation of several remedial actions. The selected alternative established an engineered waste disposal facility on FCP property (the OSDF) with restricted use of the remaining areas of the FCP property.

The selected remedy for OU5 is composed of the following major components:

- Excavation, using conventional construction equipment, of contaminated soil and sediment to the extent necessary to establish statistically, with reasonable certainty, the concentration of contaminants in soil across the entire site are below FRLs.

- Excavation, using conventional construction equipment, of contaminated soil containing perched water that presents an unacceptable threat, through contaminant migration, to the underlying aquifer.

- Placement of contaminated soil and sediment, which attain the concentration-based waste acceptance criteria, in the OSDF. Soil exhibiting contaminant concentrations above these acceptance criteria will be treated prior to on-site disposal, or shipped off site for disposal at an appropriate commercial disposal facility or federal disposal facility. Soil from six designated areas in OU5, where a reasonable potential exists for the presence of characteristic waste under the RCRA, will be treated as needed prior to disposition.

- Extraction of contaminated groundwater from the GMA to the extent necessary to provide reasonable certainty that FRLs have been attained in all affected zones of the aquifer.

- Treatment of contaminated groundwater, storm water, and wastewater to the extent necessary to attain performance-based concentration discharge limits, mass-based discharge limits, and FRLs in the Great Miami River.

- The application of institutional controls, such as access controls, deed restrictions, and alternate water supplies, during and after remedial activities to minimize the potential for human exposure to site-introduced contaminants and ensure the continued protection of human health.

- Implementation of a long-term environmental monitoring program and maintenance program to ensure the continued protectiveness of the remedy, including the integrity of the OSDF.

The general implementation strategy for OU5 remediation is contained in the Remedial Design Work Plan (DOE 1996d). This plan provided for the development and issuance of the IEMP, which addresses sitewide environmental monitoring and reporting requirements. The plan also provided for development and issuance of the Sitewide Excavation Plan, which contains detailed methods and protocols used by the ECP during each phase of soil remediation.

The following documents outline the strategy for executing the major elements of the OU5 remedy:

- The Operable Unit 5 Remedial Design Work Plan (DOE 1996d) defines the tracks and schedules for developing the final construction drawings, specifications, plans, and procurement documents necessary for the implementation of the OU5 selected remedy.

- The Operable Unit 5 Baseline Remedial Strategy Report (DOE 1997c) is a remedial design document that served as the technical basis for the detailed design and operation of the FCP's groundwater remedy, including the location and number of wells, pumping and re-injection rates, cleanup progress tracking, and aquifer response predictions. This report has been superseded by the following module-specific design reports: South Field Phase II (DOE 2002d), Waste Storage Area Phase I (DOE 2001b) and Waste Storage Area Phase II (draft). The Waste Storage Area Phase II design is in the process of being finalized via comment resolution with EPA and OEPA.

- The Remedial Action Work Plan for Aquifer Restoration at Operable Unit 5 (DOE 1996e) provides the implementation strategy and enforceable schedule for initiating restoration of contaminated portions of the GMA.

- The Sitewide Excavation Plan provides technical guidance for activities related to the excavation and disposition of soil and at- and below-grade structures and debris associated with soil cleanup.

- The Waste Acceptance Criteria Attainment Plan for the On-Site Disposal Facility (DOE 1998c) defines the on-site disposal requirements for materials generated by the FCP's environmental restoration and facility D&D efforts.

- The OSDF Impacted Materials Placement Plan (IMPP) (DOE 2005e) describes the acceptance, placement, compaction, and quality assurance/quality control activities that will be conducted throughout construction, filling, and closure of the OSDF.

- The Operations and Maintenance Master Plan for the Aquifer Restoration and Wastewater Treatment Project (OMMP) (DOE 2005f) establishes the operational philosophy for the groundwater and wastewater treatment systems.

- The IEMP defines monitoring requirements to assess achievement of aquifer remedy goals and the collective impact of the sitewide remedial actions on pathways, receptors, and the site's environmental media.

- The OSDF Groundwater/Leak Detection and Leachate Monitoring Plan (GWLMP) (DOE 2005g) defines the montoring requirements for the leachate detection and collection systems below the OSDF cells and the groundwater zones in the glacial till and Great Miami aquifer.

The OMMP, OSDF GWLMP and IEMP are support plans contained in Volume II of the LMICP.

6.3 REMEDIAL ACTION STATUS

6.3.1 Soil and Sediment

The selected remedy for OU5 soil is in the implementation phase. As of December 2005, 2,920,000 yd^3 (2,230,000 m^3) of contaminated soil and debris have been excavated, with more than 94 percent of this soil meeting the OSDF WAC and the remainder shipped to an off-site commercial disposal facility. Remediation activities continue in Areas 1, 5, 6, 7, the stream corridors, and the main drainage corridor (MDC) within the former production area. Approximately 132,000 yd^3 (101,000 m^3) of impacted soil and debris remain to be excavated and placed in the OSDF, with the bulk of this material coming from Areas 6 and 7.

Soil certification is complete in Areas 3A, 3B, 4A, 4B, 8 and 9, and nearly complete in Areas 1 and 2. These certified areas account for 841 of the 1,135 acres (74 percent) that must be certified as part of the OU5 ROD remedy for contaminated soil. The certification process is in progress for the MDC, the stream corridors and portions of Areas 5, 6, and 7. Table 6-1 provides a summary of the certification status for each remediation area.

TABLE 6-1
STATUS OF SOIL REMEDIATION

Remediation Area	Total Acres	Approved Certification Acres	Certification Acres in Progress	Remediation Acres in Progress
Area 1	395.8	394	0	1.8
Area 2	174.7	173.9	0	0.8
Area 3A/4A	29.3	29.3	0	0
Area 3B/4B	26.2	26.2	0	0
Area 5	26.9	7.6	8.4	10.9
Area 6	140.8	18.8	31.9	90.1
Area 7	85.1	0	1.2	83.9
Area 8 (off site)	98.9	98.9	0	0
Area 9 (off site)	85.6	85.6	0	0
MDC	39.0	0	17.9	21.1
Stream Corridors	32.7	7.0	0	25.7

6.3.2 Groundwater (Great Miami Aquifer)

The selected remedy for OU5 groundwater is in the implementation phase. The groundwater remedy will be accomplished through the installation of restoration modules, which are discussed in detail in the annual site environmental reports. Currently, there are three operational groundwater modules:

- The South Plume Module became operational in August 1993 and consists of five extraction wells, installed at the leading edge of the southern uranium plume. Pumping of four of the five wells is currently required to contain the plume. In August 1998, two new extraction wells in the South Plume Optimization Module became operational to accelerate the recovery of contaminants in the off-property portion of the south plume.

- Thirteen extraction wells comprise the South Field Module. Phase I of the South Field Module became operational in July of 1998 and consisted of an on-site network of ten wells that remove uranium-contaminated groundwater from the South Field area. Four of the initial ten wells were shut down and replaced by four new wells between 1998 and 2002, and one of the initial wells was converted to an injection well in 2003. Phase II of the South Field Module consists of four extraction wells that became operational in July of 2003.

- Phase I of the Waste Storage Area Module became operational in May 2002 and consisted of three extraction wells placed in the Pilot Plant drainage ditch area. One of the wells was plugged and abandoned in 2004 to complete soil remediation activity in the area. The two remaining wells were shut down in late 2004 to accommodate construction activities associated with the conversion of the AWWT to a smaller footprint, which is now known as the CAWWT Facility. In 2005, the two wells became operational once again and a new extraction well was installed to bring the module back to three operational wells. Phase II of the Waste Storage Area Module will be installed in the OU4 waste pit area sometime in 2006.

In June 2004, the EPA and OEPA approved the decision to discontinue the use of injection wells as part of the groundwater remedy, and the Re-Injection Demonstration Module was permanently shut down in September 2004. However, the wells remain in place and serve as monitoring points to assess the performance of the aquifer restoration.

As discussed in the Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas, and based on present monitoring activities, the groundwater extraction module originally planned for the Plant 6 area does not appear to be necessary. Investigation of the uranium concentration in the groundwater below Plant 6 was performed with direct-push sampling methods after soil remediation activities ceased in 2004, and the data do not support the presence of a uranium plume that requires remediation. Analytical results for groundwater samples from Monitoring Well 2389 occasionally exceed the uranium FRL, but there is not an extensive zone of contamination that warrants the placement of an extraction module. The Plant 6 area will continue to be evaluated via groundwater results reported by the monitoring program.

The methodology for operating the existing modules (treatment prioritization decisions, well set points for extraction, etc.) is described in the OMMP. Table 6-2 provides a performance summary for these modules.

TABLE 6-2
AQUIFER RESTORATION SYSTEM OPERATIONAL SUMMARY SHEET
(AUGUST 1993 THROUGH DECEMBER 2005)

	Gallons Pumped/Re-injected (M gal)	Total Uranium Removed/Re-Injected (lbs.)	Uranium Removal Index[a] (lbs./M gal)
South Field (Phases I and II)	7477.196	4174.637	0.56
South Plume and South Plume Optimization Module	9408.362	2011.990	0.21
Waste Storage Area (Phase I)	1456.559	1013.380	0.70
Re-Injection Module	1936.478	76.270	NA
Aquifer Restoration Systems Totals			
Extraction Wells	18342.117	7200.007	0.39
Re-Injection Wells	1936.478	76.27	NA
Net	16405.639	7123.737	NA

[a]NA = not applicable

6.3.3 Wastewater Treatment

The FCP currently operates a single treatment system: the CAWWT. The AWWT expansion system was "converted" to CAWWT between October 2004 and March 2005, and it currently provides 1,200 gallons per minute (gpm) [4,500 liters per minute (lpm)] capacity for groundwater and 600 gpm (2,300 lpm) of storm water/remediation wastewater capacity (including carbon treatment) to handle the last remaining storm water/remediation wastewater flows. Once the remediation wastewater and contaminated storm water flows have ceased, CAWWT will provide a dedicated long-term groundwater treatment capacity of up to 1,800 gpm (6,800 lpm), which includes treatment of OSDF leachate. The unit operations of the CAWWT system include granular multi-media filtration and ion exchange on all three trains and activated carbon filtration on train 3, the storm water/remediation wastewater treatment train.

Older facilities that collected and treated contaminated storm water, wastewater and groundwater were retired as follows: the west storm water retention basin was removed from service in October 2005; the Biodenitrification Surge Lagoon was removed from service in July 2005; the interim advanced wastewater treatment systems were taken out of service in July 2005; the South Plume interim treatment

system was removed from service in July 2005; Phases I and II of the original AWWT were removed from service in March 2005; and the AWWT expansion conversion to the CAWWT was completed and became operational in March 2005.

A complete description of FCP collection and treatment systems and operational philosophy is described in the OMMP, which lies within the ECP.

All discharges from the CAWWT are discharged to the Great Miami River via the Parshall Flume, which is the final monitoring point of the combined FCP effluents. These discharges must meet mass-based and concentration-based discharge standards for uranium specified in the OU5 ROD, as well as effluent limitations for other constituents specified in the FCP National Pollutant Discharge Elimination System Permit. The FCP is limited to an annual discharge of 600 lbs (272 kg) of total uranium. In addition, the total uranium concentration of FCP effluents is currently limited to 30 µg/L on a flow-weighted monthly average subject to conditions stipulated in the ROD relative to storm water bypassing and maintenance activities.

6.3.4 On-Site Disposal Facility

The OSDF was designed as an above-grade unit to provide permanent disposal for contaminated soil, wastes, and materials generated by site remedial actions. Containment of materials in the facility minimizes the potential for direct contact or incidental ingestion/inhalation of residual contaminants. It also minimizes migration of contaminants to air and surface water, and will protect groundwater for a minimum period of 200 years and up to 1,000 years. The OSDF GWLMP documents the monitoring program that is in place to protect groundwater in the GMA.

The OSDF was originally designed for 2.5 million unbulked yd^3 (1.9 million m^3), but now will contain 2.85 million yd^3 (2.18 million m^3) within a footprint that measures approximately 800 by 2,600 ft (244 by 792 m). It consists of eight cells, each containing multi-layer composite cover and liner systems with an LDS and an LCS. The collected leachate is treated prior to discharge. The majority of the material placed in the OSDF is excavated soil and wastes from OU2 and OU5, with the remainder derived from debris generated by the OU3 cleanup.

The OSDF design was performed in phases, and each phase is documented in a separate design package. As of December 2005, eight liners and six caps have been constructed and certified. A detailed account of the remedial actions and construction history of the OSDF will be provided in the interim remedial action report for the OU5, which will be issued in the summer of 2006.

6.4 ASSESSMENT OF CONFIRMATORY DATA AND/OR PERFORMANCE DATA

6.4.1 Identify the Scope of the Review

The scope of the review covers all soil remedial activities, soil certification efforts, and groundwater actions that are ongoing or completed at the time of this review. Soil remediation is complete in Areas 2, 3A, 3B, 4A, 4B, 8, and 9; and is ongoing in Areas 1, 5, 6, 7, and the MDC. Certification is complete in Areas 3A, 3B, 4A, 4B, 8, and 9; nearly complete in Areas 1 and 2; and in progress for Areas 5, 6, 7, and the MDC. Groundwater remedial actions include extraction of groundwater and treatment at the CAWWT prior to discharging the treated water to the Great Miami River.

6.4.2 Assessment of Soil Remedial Actions and OSDF

Is the remedy operational and functioning as intended in the ROD?

The selected remedy for soil remediation is operational and functional as intended in the OU5 ROD. Remediation and certification progress is shown on Figure 6-1. Certification samples are collected and analyzed to demonstrate that the soil FRLs have been achieved and the area can be released for its final land use objective.

Two design changes have been implemented since the OU5 ROD was signed in 1996. The first was the result of a treatability study that indicated lead-contaminated soil in the trap range could be treated *in situ*, then excavated and disposed of in the OSDF. The second change, documented in an Explanation of Non-Significant Differences issued in January 2001 (DOE 2001c), updated the background subsurface soil database to allow better delineation of the extent of FCP-introduced contamination in the off-property area. The new background soil data have been presented in a draft addendum to the CERCLA/RCRA Background Soil Study (DOE 1993). Neither of these changes impacts the final remedial goals for OU5.

A monitoring program is in place to assess the performance of the OSDF liner system and to provide early warning of potential releases of contaminated leachate. Leachate volume measurements are obtained from metering of the total gallons pumped through the Leachate Transmission System. The LDS is also monitored for the presence of liquids (e.g., construction water and/or leachate). These results indicate that the cell liners are performing adequately, with LDS volumes consistently well below the established initial response leakage rate of 20 gallons per acre per day. Analytical data are also collected from each cell's LCS and LDS, from horizontal wells located in the till beneath each cell, and from both up- and down-gradient GMA monitoring wells for each cell. Individual cell LCS and LDS performance results and volumes can be found in the annual site environmental reports.

6.4.2.1 Validity of ROD Assumptions for Soil Remedial Actions

Are the critical assumptions (to ensure protection of human health and the environment) used at the time of remedy selection still valid?

The target final land use for the FCP, which was used to set cleanup levels, has not changed from that originally documented in the OU5 ROD. Site remediation and restoration activities remain consistent with the final land use recommended by the Fernald Citizens Task Force, which is continued government ownership of the site and maintenance of the OSDF and a surrounding buffer zone, with the remaining areas made available for use as an undeveloped park. Based on data obtained during remediation of Areas 1, 2, 3A, 3B, 4A, 4B, 8, and 9, and predesign data obtained for Areas 5, 6, and 7, the assumptions identified in the OU5 ROD remain valid with regard to the established FRLs and OSDF WAC.

A re-examination of the OU5 ARARs and TBC requirements, relevant to the protectiveness of the soil remedy was performed as part of this five-year review. No changes were identified that would adversely affect the planned protectiveness related to soil FRLs. Section 6.4.4 provides the results of a re-examination of the sitewide risk assessment, based on recent updates to cancer slope factors and chemical toxicity factors for several of the COCs.

The OSDF performance data reviewed through the end of 2005 indicate that the OSDF liner system is functioning as intended in the OSDF Design Criteria Package (DOE 2004a).

6.4.2.2 Remedy Optimization

Has any new information come available that could allow for optimization of the selected remedy for soil remediation or call into question the validity of the selected remedy?

In situ gamma spectrometry has been used extensively in the soil precertification process to provide nearly 100 percent survey coverage for primary radionuclide COCs in the remediated soil footprint, and to reduce the costs for sampling and analysis associated with physical samples. The *in situ* gamma spectrometry measurements are carried out by the Real Time Instrumentation Measurement Program using an integrated suite of hardware and software technologies that allow for real-time radionuclide detection, mapping, and evaluation. This technology has also been deployed in OU5 remediation areas to identify uranium contamination that exceeds the OSDF WAC and uranium, thorium and radium hot spots (defined as three times the FRL of the COC). The use of *in situ* gamma spectrometry in the soil certification process provides a high level of confidence that the soil remediation goals will be achieved and has resulted in cost savings of approximately $15 million, due to the diminished number of physical samples that must be collected and analyzed.

Several measures to enhance the performance of the OSDF have been implemented in OSDF construction and OSDF IMPP since construction began in April 1997. The enhancements are documented in revisions to the OSDF Final Design Package and in design change notices approved by EPA and OEPA. These revisions and design change notices include:

- Modifications to the acceptable permeability zone criteria for the clay liner and cap construction based on the Test Pad Program Final Report - Addendum No. 1 (DOE 1999b)
- Improvements to the impacted material compaction methods by the use of a Caterpillar 826 self-propelled static pad-foot compactor or approved equal
- Inspection of the primary geomembrane liner and geomembrane cap with the use of electrical leak detection testing
- Use of Ohio DOT Type D dumped rock fill for the biointrusion barrier
- Use of topsoil for final lift of vegetative cover
- Revised cap geomembrane thickness from 60 mil to 80 mil
- Added intercept ditch on west side of Cells 1 and 2 to relieve water surface elevation in riprap ditch
- Expanded the size of Cell 8 to accommodate increasing excavation volumes.

Modifications were done to the IMPP to improve impacted material placement into the OSDF cells. The IMPP modifications are as follows:

- Revised the placement criteria for transite panels eliminating size reduction to minimize generation of friable asbestos and added alternate placement requirements for transite
- Revised Category 1 intervening layer thickness from 4 ft to 2 ft (0.6 to 1.2 m) to minimize use of Category 1 material and improve the long-term safety performance
- Increased the Category 2 grid size to 200 ft by 200 ft (61 by 61 m) at the bottom of the cell
- Issued Addendum 1, Revision 0, Specialized Placement Plan for Bagged Impacted Material, to discuss placement of bagged material
- Issued Addendum 2, Revision 1, Specialized Placement Plan for Thorium and Non-Bagged Impacted Material, to discuss placement of thorium debris and non-bagged material
- Issued Addendum 3, Revision 1, Alternative Trenching Method for Placement of Category 2 Impacted Material, to discuss placement of Category 2 items by trenching method
- Issued Addendum 4, Revision 0, Spreading and Grading, to discuss use of scraper to spread impacted Category 1 soil in the OSDF
- Issued Addendum 5, Revision 0, Placement of Category 5 Oversized Materials by Category 3 Placement Procedures.

The DOE has formed a legacy management team to assist the FCP OSDF project team and stakeholders in developing a long-term, post-closure monitoring plan. The OSDF GWLMP addresses monitoring for leaks in the liners and migration of leachate to the glacial till and GMA. Attachment A.5 of the IEMP annual site environmental report summarizes volumes and constituent concentrations for the LCS, LDS, horizontal till wells, and GMA wells. Additionally, quarterly inspections are performed on the vegetated

caps to identify erosion rills, animal burrows, woody vegetation, and bare soil patches. Identified discrepancies are addressed as part of the routine maintenance for the OSDF.

There have been no significant changes in site physical conditions (exposure pathways, contaminant sources, or site receptors) that would call into question the protectiveness of the remedy as envisioned in the OU5 ROD. A review of contaminant characteristics, as they affect the remedy, is provided in Section 6.4.4.1.

6.4.3 Assessment of Groundwater Remedial Action

Is the OU5 groundwater remedy operational and functioning as intended in the ROD?

The groundwater remedy, as currently constructed and operated, is functional and achieving important benchmarks relative to design-based performance indicators. Moreover, the aquifer is responding in an overall predictable manner. A review of the progress and effectiveness of the groundwater remedy, through the end of 2005, was made based on three criteria:

- Basic performance indicators comparing actual groundwater pumping rates and uranium removal amounts to those projected in the Baseline Remedial Strategy Report (DOE 1997c)
- An evaluation of the capture zone to reaffirm that the contamination plume is still effectively bounded
- An assessment of groundwater monitoring results to establish the degree to which the contamination in the aquifer is responding to the remedial actions undertaken

Assessment of Performance Indicators

Performance projections for the finalized baseline strategy were presented in Section 5.3 of the Baseline Remedial Strategy Report. This finalized strategy predicted the remediation schedule could be shortened from that presented in the Feasibility Study Report for OU5 (DOE 1995g) from 27 years to a period between 10 and 20 years.

A comparison of actual performance for key remedial indicators (e.g., quantities of groundwater pumped, uranium extracted, groundwater treated, and the concentration of groundwater directed to treatment) with the performance predicted in the Baseline Remedial Strategy Report reveals how well the groundwater remediation system is operating. While the comparison does not provide an absolute quantitative measure of how the remediation of the aquifer is progressing, it does indicate how well the remediation system is operating with respect to the Baseline Remedial Strategy Report and subsequent design documents. Figures 6-2 through 6-5 provide these comparisons.

Assessment of Capture Zone

The primary objectives of the South Plume and South Plume Optimization Modules are to prevent the further southward movement of the contamination plume and to actively remediate the interior of the off-property portion of the plume. These modules are evaluated quarterly and the results are summarized through the IEMP reports. Detailed operational information supporting the evaluation and conclusions in meeting these primary objectives are provided in Appendix A of the 2004 Site Environmental Report (DOE 2005h).

Figures 6-6 and 6-7 indicate that contaminant migration southward, beyond the South Plume extraction wells, has not occurred, and that active remediation of the central portion of the off-property total uranium plume continues. Additionally, there is good agreement between the modeled capture zone and the measured capture zone for the South Plume, South Field and Waste Storage Area, based on water level measurements through 2004.

Assessment of Groundwater Monitoring Results

The FCP implements a routine groundwater monitoring effort using a system of monitoring wells and direct-push groundwater sampling techniques to track the 30-μg/L total uranium plume boundary; identify the size, shape, and extent of contamination lobes; pinpoint future extraction well locations; and monitor increasing or decreasing trends in total uranium concentration. These trends, in the form of total uranium concentration versus time plots, indicate the aquifer response to the remedial pumping.

Figure 6-8 summarizes the concentration versus time plot trends for select monitoring wells. The figure indicates most wells have decreasing uranium concentrations, which is in line with groundwater extraction and the remedial plan. Monitoring Wells 2649, 2389, 63122, 83117-C1, 3927, and 3926 show increasing trends, which is indicative of groundwater fluctuation in a contaminated vadose zone or plume movement towards the respective extraction wells. Many of the wells indicate no significant trend with respect to observed uranium concentrations.

Non-uranium constituents are also monitored to evaluate aquifer concentrations relative to FRLs established in the ROD. Forty-nine non-uranium constituents were evaluated through a detailed selection process presented in Appendix A of the IEMP, Revision 4. Currently, 35 of 50 chemical constituents have never exceeded their FRL, and one COC has had a single exceedance. As documented in the Groundwater Certification Plan (DOE 2005i), these 36 parameters will be monitored during groundwater certification to determine if they remain below their FRL. The remaining 14 constituents are monitored semiannually and evaluated in the IEMP annual site environmental report.

Most of the locations where non-uranium constituents are present at concentrations above their FRL lie within the 10-year, uranium-based restoration footprint (Appendix A of the IEMP). However, based on

monitoring results for 2004, 10 of 15 constituents have above-FRL concentrations that lie outside of the 10-year footprint. Zinc and manganese (common trace elements in the calcite and dolomite grains within the aquifer) exceed their FRL in most monitoring wells on the east side of the OSDF. Antimony, fluoride, and lead exceed their FRL at several locations east and south of the OSDF. Arsenic, carbon disulfide, nickel, mercury, and vanadium exceed their FRL at a single location outside of the 10-year, uranium-based restoration footprint.

Continued monitoring and evaluation are reported in Appendix A of the annual site environmental reports. The conclusions to date continue to indicate that no changes to the uranium-based aquifer remedy are necessary.

Storm Water Control and Wastewater Treatment

Figure 6-9 shows that the FCP has met the 600-lb total uranium mass limitation every year since the ROD was signed in 1996. Since January 1, 1998, the effective date for the concentration-based limitation, the FCP has achieved compliance with the terms and conditions relative to the 30-μg/L monthly average standard in 93 of the 96 months. In response to sequential exceedances in December 1998 and January 1999, major revisions were made to the OMMP to modify treatment operations. No exceedances have occurred since these revisions were implemented. Additionally, the FCP has been in compliance with the NPDES effluent limitations over 99 percent of the time since January 1996.

6.4.3.1 Validity of ROD Assumptions

Are the critical assumptions (to ensure protection of human health and environment) used at the time of remedy selection for groundwater still valid?

As part of the five-year review, an assessment of critical assumptions relative to future land use, exposure pathways, and contaminant toxicity, was conducted. The critical assumptions involve the exposure pathway and contaminant toxicity. The sources of residual contamination to the GMA after remediation include leaching and infiltration of storm water through soils with residual contamination and leachate from the OSDF, as well as residual contamination left in the GMA after all groundwater extraction efforts have been completed. The cumulative residual contamination remaining in the GMA from all of these sources is projected to meet the FRLs contained in Table 9-4 of the OU5 ROD. These FRLs were developed from:

- Finalized or proposed MCL values pursuant to the National Primary Drinking Water Regulations under the Safe Drinking Water Act
- Risk-based concentrations derived from reference doses and cancer slope factors in the absence of MCLs/proposed MCLs

- Background levels, if background concentrations are greater than the MCLs/proposed MCLs or the risk-based concentrations

- Analytical detection limits, if detection limits are above the risk based concentrations.

The target receptors for the groundwater pathway analysis conducted for the OU5 risk assessment were the off-property adult and off-property child who used the GMA as a source of drinking water (ingestion), had dermal contact with the water through showering, and who used the water in food preparation and crop irrigation.

All of the assumptions relative to sources of residual contamination, target receptors, and exposure pathways remain valid. There has been no change to the land use objectives that formed the basis of the selected remedy.

The groundwater FRLs for the GMA (Table 9-4 of the OU5 ROD) were reviewed for consistency with current MCL values as published in "Current Drinking Water Standards/National Primary Drinking Water Regulations" from the EPA website. The 10 radionuclides and 40 chemicals (50 total COCs) with GMA FRLs were reviewed for consistency with the most current MCLs. Of the 50 GMA COCs, 21 had published MCLs. Of these 21, the following four changes have occurred since issuance of the ROD:

- The FRL for total uranium in groundwater adopted in the OU5 ROD as 20 μg/L was based on the proposed MCL. The final MCL for total uranium was promulgated at 30 μg/L (National Primary Drinking Water Regulations; Federal Register Volume 65, Number 236; December 7, 2000). The OU5 ROD was revised with an ESD to change the groundwater FRL for uranium from 20 μg/L to 30 μg/L and to revise the performance-based monthly average concentration limit for discharge to the Great Miami River from 20 μg/L to 30 μg/L (DOE 2001b).

- The FRL for arsenic in groundwater adopted in the OU5 ROD as 50 μg/L was based on the existing MCL. EPA is decreasing the MCL for arsenic to 10 μg/L effective January 23, 2006 (National Primary Drinking Water Standards, EPA website). There are no plans to change the groundwater FRL for arsenic because the existing FRL yields a risk within the acceptable CERCLA risk range.

- The FRL for cadmium in groundwater, adopted in the OU5 ROD as 14 μg/L, was based on the existing MCL. EPA decreased the MCL for cadmium to 5 μg/L (National Primary Drinking Water Standards, EPA website). There are no plans to change the groundwater FRL for cadmium because the existing FRL yields a risk within the acceptable CERCLA risk range.

- The FRL for radium-226 and radium-228 adopted in the OU5 ROD was based on a proposed MCL of 20 picoCuries per liter (pCi/L) for each isotope. The proposed MCL was not adopted and reverted to the existing MCL of 5 pCi/L combined (National Primary Drinking Water Regulations; Federal Register Volume 65, Number 236; December 7, 2000). There are no plans to change the groundwater FRLs for radium-226 and radium-228because the existing FRLs yield risk values within the acceptable CERCLA risk range.

Consistent with EPA CERCLA policy on MCL revisions (EPA 1989), as long as a CERCLA remedy remains protective under the standard in force at the time of ROD signature, it does not have to be modified to address the revised requirement.

In addition to the MCL evaluation, the OU5 cancer slope factors and chemical reference doses were compared to the latest published information to identify changes that could result in alterations to the original assumptions driving the selected remedy for OU5. The results of this review are summarized in Section 6.4.4.

6.4.3.2 Remedy Optimization

Has any new information come available that could allow for optimization of the selected remedy for groundwater or call into question the validity of the selected remedy?

As noted in Section 6.3.3 and 6.4.3.1, the OU5 ROD-established groundwater FRL for total uranium and the monthly average total uranium discharge limit were revised based on EPA's promulgation of a uranium drinking water MCL at 30 μg/L. Aligning the FRL and the discharge limit with the MCL has resulted in a reduction in the time and cost required to cleanup groundwater at the site. Adoption of the MCL has also resulted in less construction of infrastructure (wells, pipelines, etc.) to complete the groundwater remediation.

The OU5 ROD commits to an ongoing evaluation of innovative remediation technologies so that remedy performance can be improved as such technologies become available. As a result of this commitment, an enhanced groundwater remedy was presented in the OU5 Baseline Remedial Strategy Report, Remedial Design for Aquifer Restoration (Task 1). Evolution of this enhanced groundwater remedy has been documented through a series of approved designs: Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 Areas, Design for Remediation of the Great Miami Aquifer South Field (Phase II) Module, Comprehensive Groundwater Strategy Report (DOE 2003d), and the Groundwater Remedy Evaluation and Field Verification Plan (DOE 2004b).

Groundwater modeling studies conducted to design the enhanced groundwater remedy (DOE 1997c) suggested that, with the early installation of additional extraction wells and the use of re-injection technology, the remedy might be reduced to 10 years. EPA and OEPA approved the enhanced groundwater remedy that combined pump-and-treat and re-injection technology. As the remedy was being implemented, additional modeling and geochemical studies were carried out to evaluate improvements to the selected remedy. Geochemical studies evaluated the mobility of uranium in the aquifer and concluded that the K_d value for uranium is higher than that used in the original model (due to chemisorption of weakly sorbed uranium as time passes) and a significant percentage of the mobile uranium resides in the vadose zone (SNL 2003, 2004). The new geochemical information was used in

updated groundwater models to show that re-injection of groundwater would not significantly shorten the time to remediate the aquifer and flushing of the vadose zone would be beneficial to the overall remedial process. These conclusions were published in the Comprehensive Groundwater Strategy Report and the Groundwater Remedy Evaluation and Field Verification Plan.

In May 2004, EPA and OEPA approved the decision to reduce the size of the AWWT. Reducing the size of the AWWT provides the opportunity to dismantle and dispose of approximately 90 percent of the existing facility in the OSDF in time to meet the 2006 closure schedule, and results in a protective, more cost-effective, long-term water treatment facility to complete aquifer restoration. As part of the overall strategy to reduce the size of the AWWT, and based on groundwater modeling cleanup predictions presented in the Comprehensive Groundwater Strategy Report and the Groundwater Remedy Evaluation and Field Verification Plan, the decision was made to discontinue re-injection. Model results showed that the benefit of continuing re-injection did not justify the cost of operation and the larger footprint for the AWWT. EPA and OEPA approved this decision in June 2004.

Well-based re-injection was discontinued in September 2004 to support construction of the CAWWT. All re-injection wells will remain in place as potential points for groundwater monitoring. Other operational strategies are being explored to determine if the remedy can be optimized in the future (e.g., inducing infiltration to the GMA through the storm sewer outfall ditch).

6.4.4 Review of Post-Remedial Action Contaminant Toxicity Assumptions

Both the EPA and DOE five-year review guidance documents suggests the following evaluation:

"Evaluate those assumptions critical to the effectiveness of remedial measures on the protection of human health and the environment (made at the time of the remedial decision) to determine, given current information, whether these assumptions are still valid."

In the first five-year review, the assumptions and toxicity factors used for risk assessments conducted during the RI/FS were re-examined to ensure that the remedy for OU5 remains protective. Results presented in the 2001 Five-Year Review indicate a slight increase in the risk to human receptors, but the overall increase was insignificant with respect to changing post-remedial risk assumptions for the target receptors.

The re-assessment process used for the first five-year report was repeated in this review to establish that the risk assumptions remain valid for the OU5 post-remedial conditions.

6.4.4.1 Human Health Risks and Remedial Design

In the OU5 Baseline Risk Assessment (Appendix A of the OU5 Remedial Investigation Report), risk was calculated for a series of modeled human receptors representing a variety of possible land uses. The risk to the modeled receptor had to be less than 10^{-4} for the incremental lifetime cancer risk (ILCR) and less than one for the Hazard Index (HI) to ensure that the selected remedy was protective of human health and the environment. The OU5 Baseline Risk Assessment considered all radionuclides and chemicals that passed a preliminary screening for their presence or absence on site (Tables A.4-1 and A.4-3 of the OU5 Remedial Investigation Report).

In Appendix H of the Feasibility Study Report for OU5, the Comprehensive Response Action Risk Evaluation (CRARE) was performed to focus on the remedial alternatives and the risk imposed on target receptors from contaminants remaining under post-remedial conditions. The target receptors evaluated in the CRARE supported the OU5 selected remedies of: (1) undeveloped park user; (2) off-property farm adult; and (3) off-property farm child. Calculated post-remedial risks to these receptors were evaluated using projected residual concentrations of COCs (the projected residual concentrations became the OU5 ROD FRLs for soil, sediment, surface water, and groundwater). The human health risk to these receptors met the CERCLA upper bound limit of less than 10^{-4} for ILCR and less than one for HI.

After the CRARE was completed, an evaluation was performed to determine which COCs were driving risk to the target receptors. As a result of the evaluation, it was found that more than 99 percent of the modeled post-remedial risk (ILCR and HI) to the target receptors came from 26 COCs (10 radionuclides, 12 inorganics, and four organics; refer to Table 6-4 of OU5 ROD). These 26 COCs were used in the risk assessment presented here to evaluate if the OU5 remedy remains protective of human health.

6.4.4.2 Cancer Slope Factors

Cancer slope factors are published values that specify a cancer morbidity value (risk) to a receptor for a given quantity of contaminant intake, referred to as an ILCR. The resulting value determines whether post-remedial concentrations of contaminants will result in a cancer risk that is in compliance with CERCLA guidance (ILCR risk of less than 10^{-4}). EPA publishes cancer slope factors for most radionuclides and some non-radionuclide chemicals that are proven or suspected carcinogens.

6.4.4.3 Chemical Reference Dose

Non-cancer health risks, due to exposure to non-radiological chemicals, are evaluated by application of a reference dose for oral and inhalation exposure routes. Reference doses estimate the upper bound chronic dose of a chemical that a human receptor can be exposed to without suffering ill effects. The contaminant intake for a receptor is multiplied by the appropriate reference dose factor to yield the HI. If the HI is greater than 1, a negative health impact to the receptor is anticipated. The EPA's Integrated Risk Information System (IRIS) database contains the reference dose factors.

6.4.4.4 Changes in Slope Factors and Reference Dose

As the body of knowledge regarding radiological and chemical toxicity increases, the EPA occasionally finds it necessary to change the cancer slope factors and/or reference doses. At the time that the OU5 documents were written (1994), the most current cancer slope factors and reference doses were used in the risk assessments. For this five-year review, a risk assessment was conducted to determine if changes in the slope factors or reference doses could result in a significant change to the post-remedial risk calculated for the target receptors identified in the OU5 ROD.

The most current cancer slope factors and reference doses were obtained from the EPA website (radionuclide tables and IRIS database) and were used in the risk calculations presented in Attachment IV of the CRARE for the undeveloped park user, off-property farm adult and off-property farm child. All pathways were evaluated and summed to produce the results in Table 6-3. Background risk is included with the reported results.

For the undeveloped park user, the HI decreased and the ILCR increased slightly, but values remain below the CERCLA limit of less than one and less than 10^{-4}, respectively. The HI values decreased slightly and the ILCR values increased for the off-property farm adult and child. HI values decreased because copper, mercury, and uranium are no longer assessed for chemical toxicity under the EPA IRIS program. An increase in the ILCR values is due to the slight to moderate increase in the cancer slope factor for most radionuclides.

TABLE 6-3
COMPARISON OF CRARE (1995) AND PRESENT RISK FOR ALL PATHWAYS

Receptor	CRARE Result*		Present Result*	
	HI	ILCR	HI	ILCR
Undeveloped Park User	1.58E-01	2.08E-05	4.42E-02	2.37E-05
Off-Property Farm Adult	1.49E00	1.07E-03	1.36E00	1.26E-03
Off-Property Farm Child	7.04E00	1.54E-04	6.43E00	1.58E-04

*Includes background risk

The present risk values for the three receptors were calculated without subtracting the background contaminant concentrations. As noted in the CRARE (Tables H.IV-4, H.IV-5 and H.IV-6), most of the radiological and chemical risk to the receptors is due to the presence of natural (i.e., background) levels of radionuclides (e.g., radium and uranium) and metals (e.g., arsenic and beryllium) in the environment. Therefore, although the ILCR values for the off-property farm receptors exceed the CERCLA upper limit of 10^{-4}, approximately 94 (adult) and 76 (child) percent of the reported ILCR value in Table 6-3 is due to background. Removing the background contribution for the adult and child results in ILCR values of

$8x10^{-5}$ and $4x10^{-5}$, respectively, which are below the CERCLA limit of 10^{-4}. In a similar fashion, removing the background for the HI values in Table 6-3 results in HI values for the adult and child of 0.2 and 0.7, respectively, which are below the CERCLA limit of 1.

As a result of this evaluation, the original risk assumptions upon which the FCP remedy is based remain valid. Alteration of the planned remedial design is unnecessary because changes in the cancer slope factors and reference doses will not result in background corrected ILCR and HI values that exceed 10^{-4} and 1, respectively.

6.5 FINDINGS AND RECOMMENDED ACTIONS FROM CURRENT REVIEW

6.5.1 Soil and Sediment Remedial Actions

Based on the review of data and remedial actions to date, the remedy identified in the OU5 ROD is proceeding according to plan and no changes to the remedy are envisioned. Adequate monitoring and oversight activities are in place to ensure protectiveness of human health and the environment while the remedy is being implemented. A review of critical assumptions and new information on contaminant toxicity does not change the protectiveness of the soil remedy.

6.5.2 Groundwater Remedial Actions

An evaluation of groundwater remedy performance and a review of critical assumptions indicate:

- All planned infrastructure is in place on or ahead of schedule, with the exception of the Phase II module for the waste pits. A delay in the construction of this module is tied to the schedule extension needed to remove contaminated soil from the waste pit footprint.
- Since 1993, the total volume of groundwater pumped has exceeded the planned amount by approximately 400 million gal (1,500 million liters).
- More groundwater was sent to treatment than anticipated. However, FCP groundwater treatment capacity was optimized to meet the demand prior to downsizing of the AWWT to the CAWWT in spring 2005.
- Accounting for uranium extracted and the mass of uranium re-injected, the net total uranium mass extracted from the GMA exceeds the planned mass by 1,814 lbs (823 kg).
- The total uranium plume capture zone is being maintained.
- The total uranium plume concentration is generally decreasing.
- Non-uranium constituents are being closely monitored and have not required any changes to the uranium-based remedy.
- A review of critical assumptions and new information on contaminant toxicity does not change the protectiveness of the groundwater remedy being implemented.

6.6 PROTECTIVENESS STATEMENT

The remedy for OU5 soil is protective of human health and the environment, and immediate threats have been addressed. Soil remedial actions are proceeding as planned and soil certification is achieving the FRLs identified in the OU5 ROD. Access restrictions and other protective measures ensure risk to human health and the environment is minimized while remedial activities are being implemented.

The remedy for OU5 groundwater is protective of human health and the environment, and immediate threats have been addressed. Protection is being achieved through an alternate public water supply and a vigorous environmental monitoring program to ensure site contaminants are not discharged in quantities inimical to human health and the environment. Groundwater monitoring data have shown decreasing total uranium concentrations in response to groundwater extraction, the plume is not migrating beyond the boundary of hydraulic capture, and storm water controls and wastewater treatment measures have proven effective in complying with regulatory requirements. The OSDF has been constructed and operated according to design plans and is actively monitored to ensure protection of the groundwater resource.

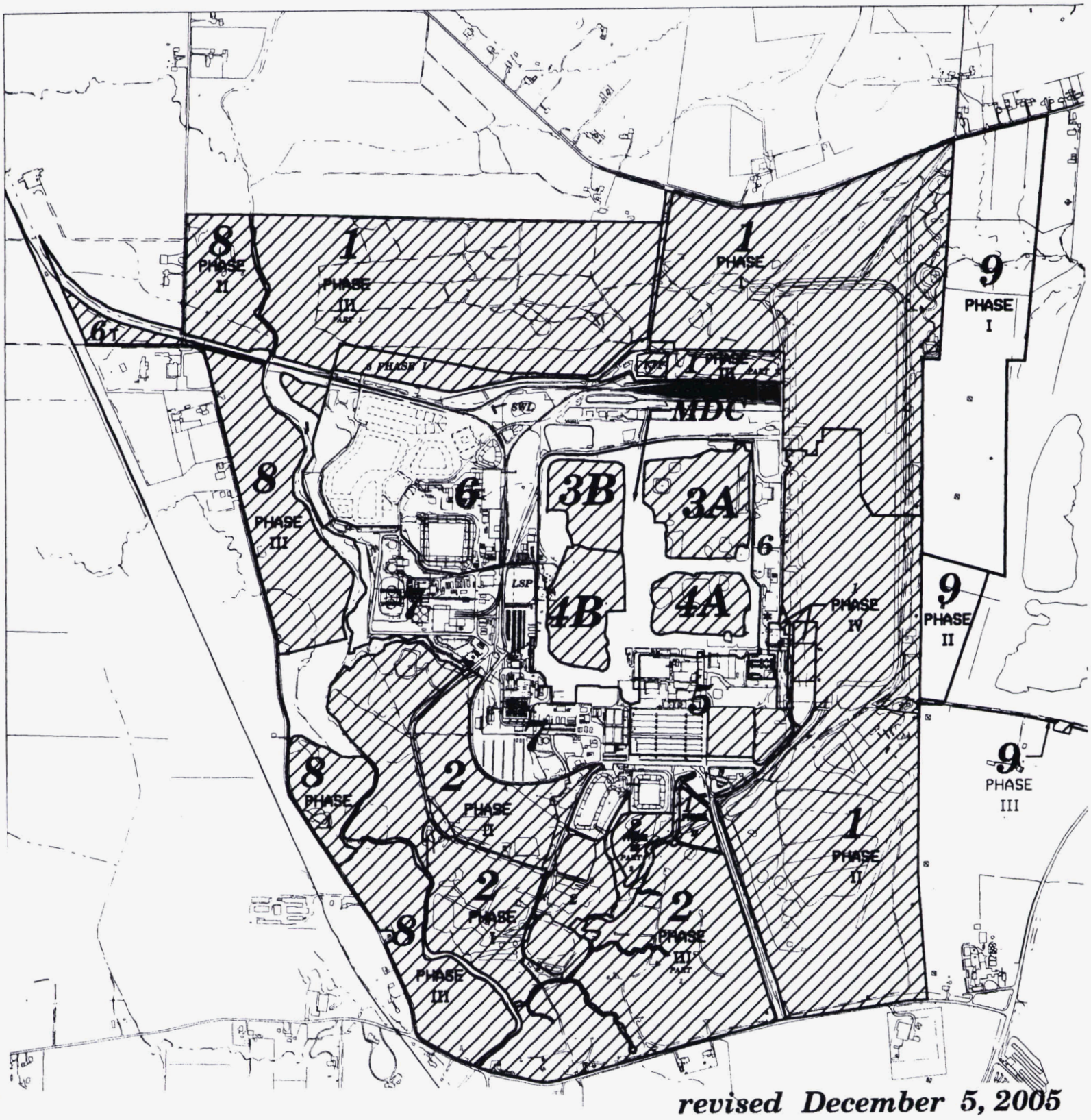
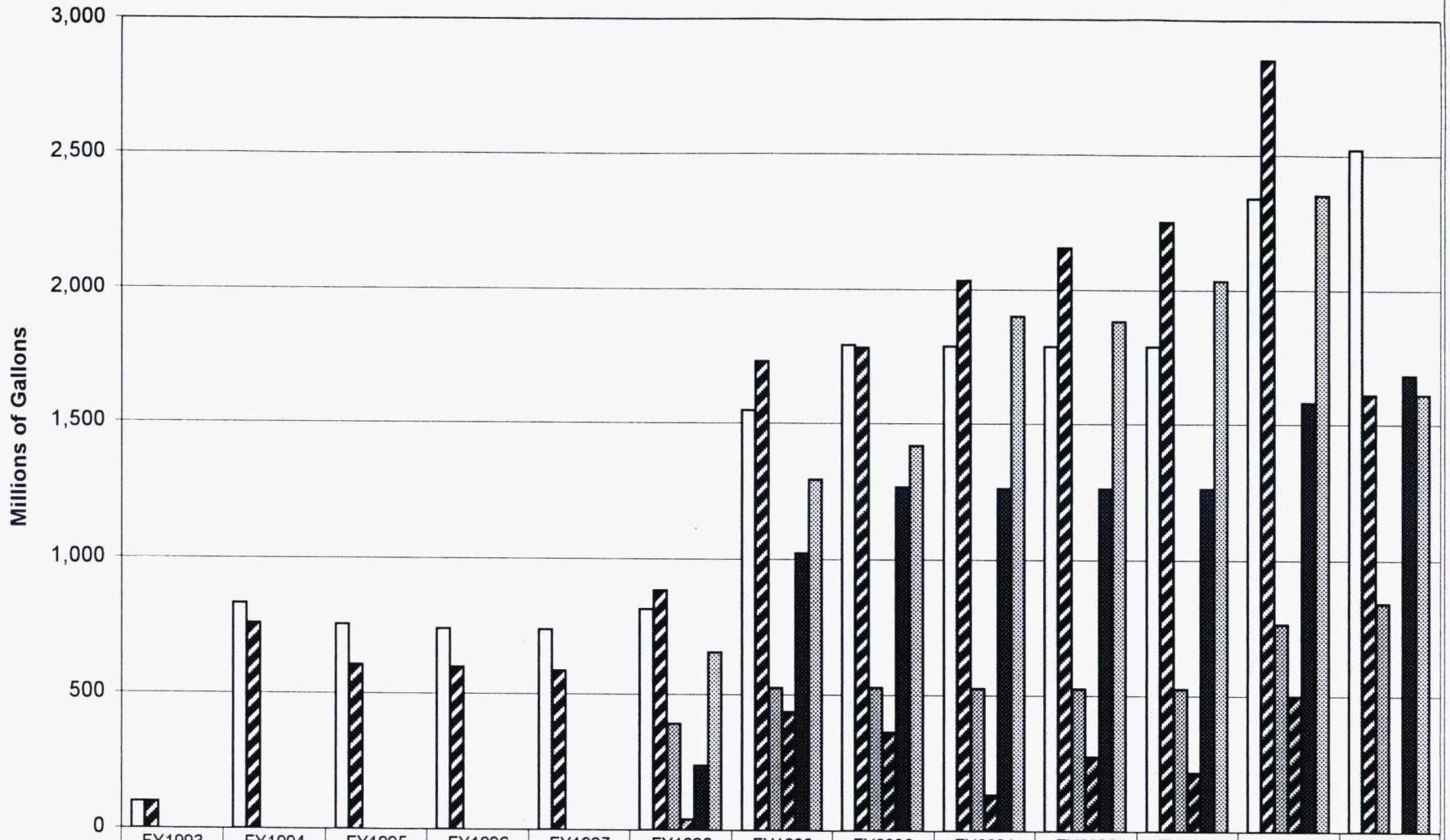


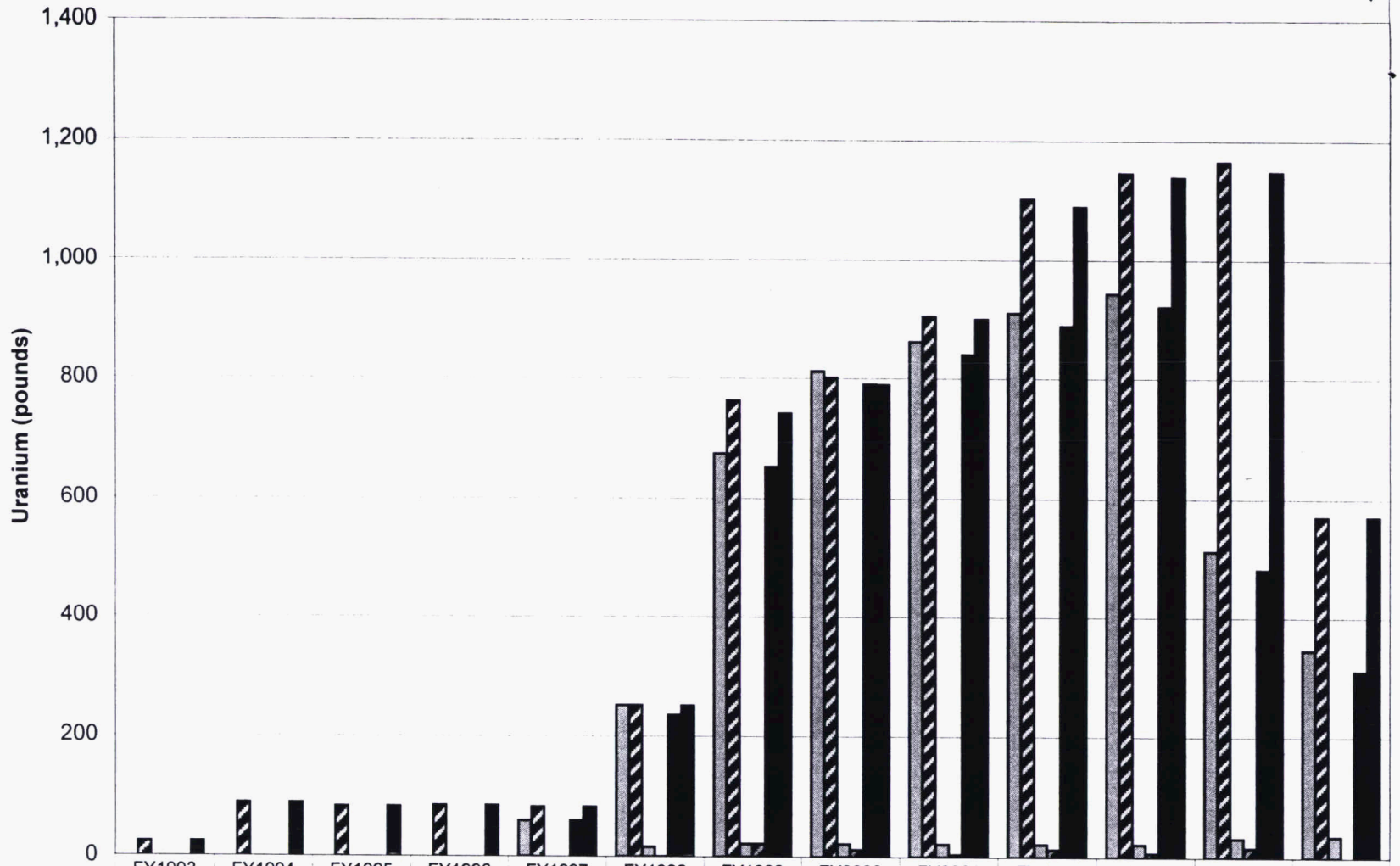
Figure 6-1 Soil Remediation Areas and Certified Areas (hatched)



	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005
Planned Total GW Pumped (Mgal)	97.920	832.320	753.552	737.856	735.840	814.464	1548.576	1791.936	1787.040	1787.040	1787.040	2344.320	2522.880
Actual Total GW Pumped (Mgal)	97.183	756.976	605.541	597.200	585.123	883.804	1729.578	1781.524	2035.166	2155.971	2253.355	2855.224	1610.678
Planned Injected GW (Mgal)	0.000	0.000	0.000	0.000	0.000	393.120	525.600	527.040	525.600	525.600	525.600	763.776	840.960
Actual Injected GW (Mgal)	0.000	0.000	0.000	0.000	0.000	39.842	436.652	361.052	132.460	273.188	216.340	499.365	0.000
Planned Net GW Extracted (Mgal)	0.000	0.000	0.000	0.000	0.000	235.872	1,022.976	1,264.896	1,261.440	1,261.440	1,261.440	1,580.544	1,681.920
Actual Net GW Extracted (Mgal)	0.000	0.000	0.000	0.000	0.000	657.184	1,292.927	1,420.473	1,903.095	1,882.366	2,034.642	2,355.859	1,610.678

Fiscal Year

FIGURE 6-2. TOTAL GROUNDWATER PUMPED, INJECTED, AND NET EXTRACTED

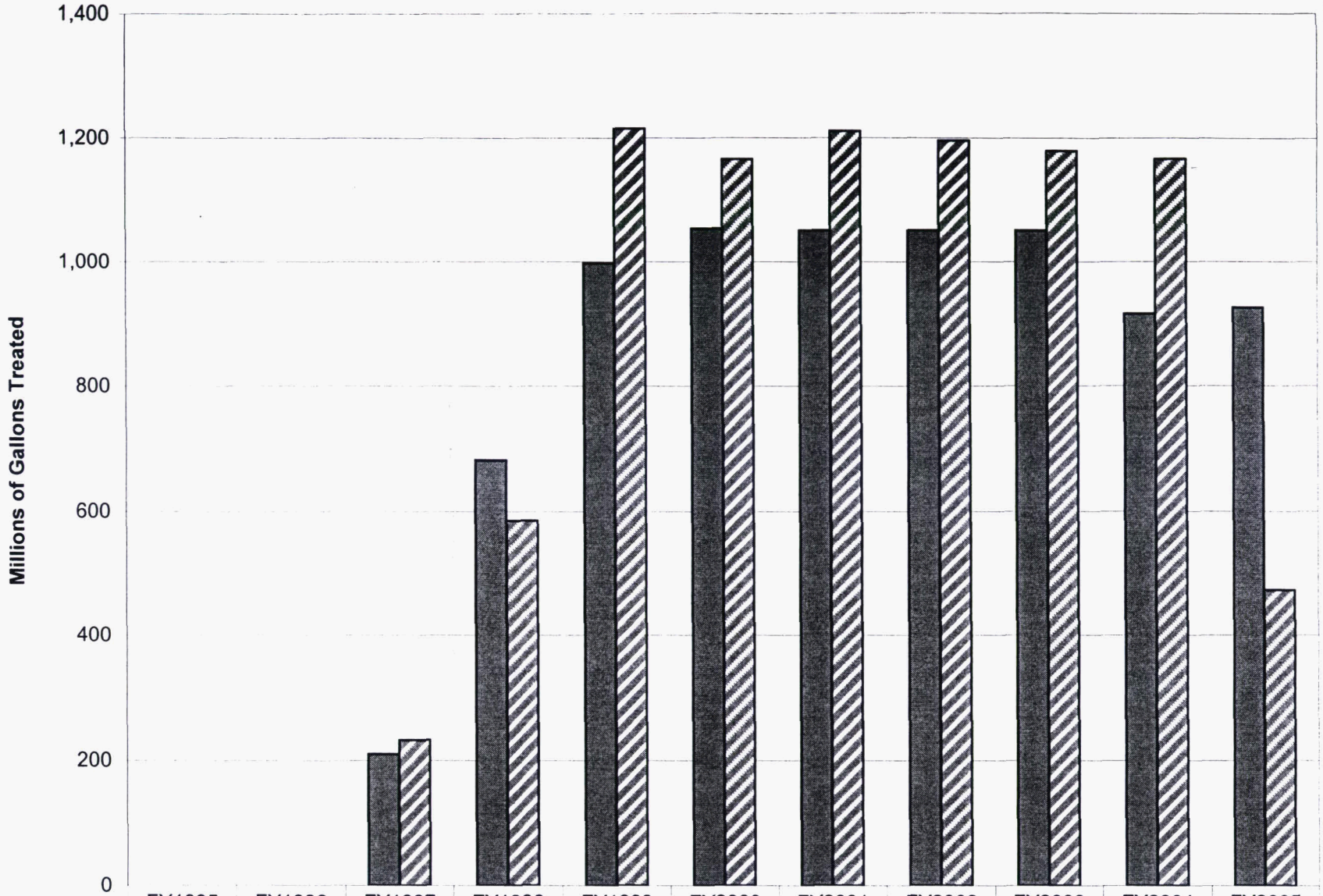


	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005
Planned Total U Extracted from GMA (lbs)	0.0	0.0	0.0	0.0	59.6	251.7	674.8	812.3	862.2	910.9	943.4	512.7	346.0
Actual Total U Extracted from GMA (lbs)	24.0	89.0	83.0	85.0	82.6	251.3	763.6	801.8	904.9	1,103.4	1,146.9	1,165.0	570.6
Planned Total U Injected (lbs)	0.0	0.0	0.0	0.0	0.0	16.4	21.9	22.0	21.9	21.9	21.9	31.8	35.0
Actual Total U Injected (lbs)	0.0	0.0	0.0	0.0	0.0	0.3	22.0	12.3	4.6	13.4	7.2	16.4	0.0
Planned Net Total U Removed from GMA (lbs)	0.0	0.0	0.0	0.0	59.6	235.3	652.9	790.4	840.3	889.0	921.5	480.9	311.0
Actual Net Total U Removed from GMA (lbs)	24.0	89.0	83.0	85.0	82.6	251.0	741.6	789.5	900.3	1090.0	1139.7	1148.6	570.6

Fiscal Year

FIGURE 6-3. TOTAL URANIUM EXTRACTED, INJECTED, AND NET FROM GREAT MIAMI AQUIFER

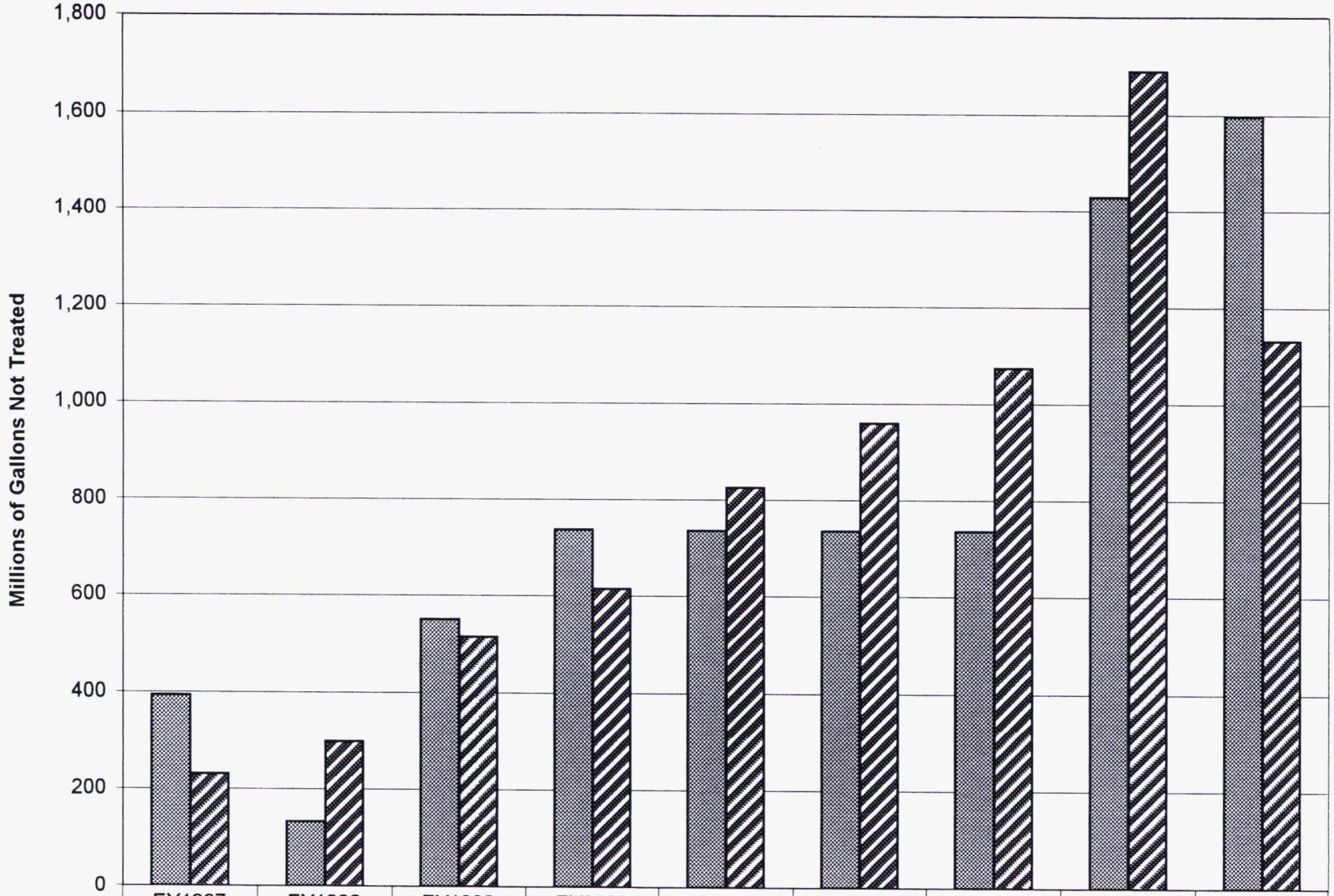
006205



	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005
Planned GW to Treatment (Mgal)	0.000	0.000	210.240	681.984	998.208	1,054.080	1,051.200	1,051.200	1,051.200	915.984	926.208
Actual GW to Treatment (Mgal)	0.000	0.000	232.670	584.722	1,214.547	1,166.106	1,210.031	1,195.682	1,179.626	1,166.283	473.201

Fiscal Year

FIGURE 6-4. TOTAL GROUNDWATER TREATED



	FY1997	FY1998	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005
Planned Water to Bypass (Mgal)	393.120	132.480	550.368	737.856	735.840	735.840	735.840	1,428.336	1,596.672
Actual Water to Bypass (Mgal)	231.553	299.061	514.367	614.418	825.523	960.289	1,073.999	1,688.941	1,131.464

Fiscal Year

FIGURE 6-5. GROUNDWATER NOT TREATED

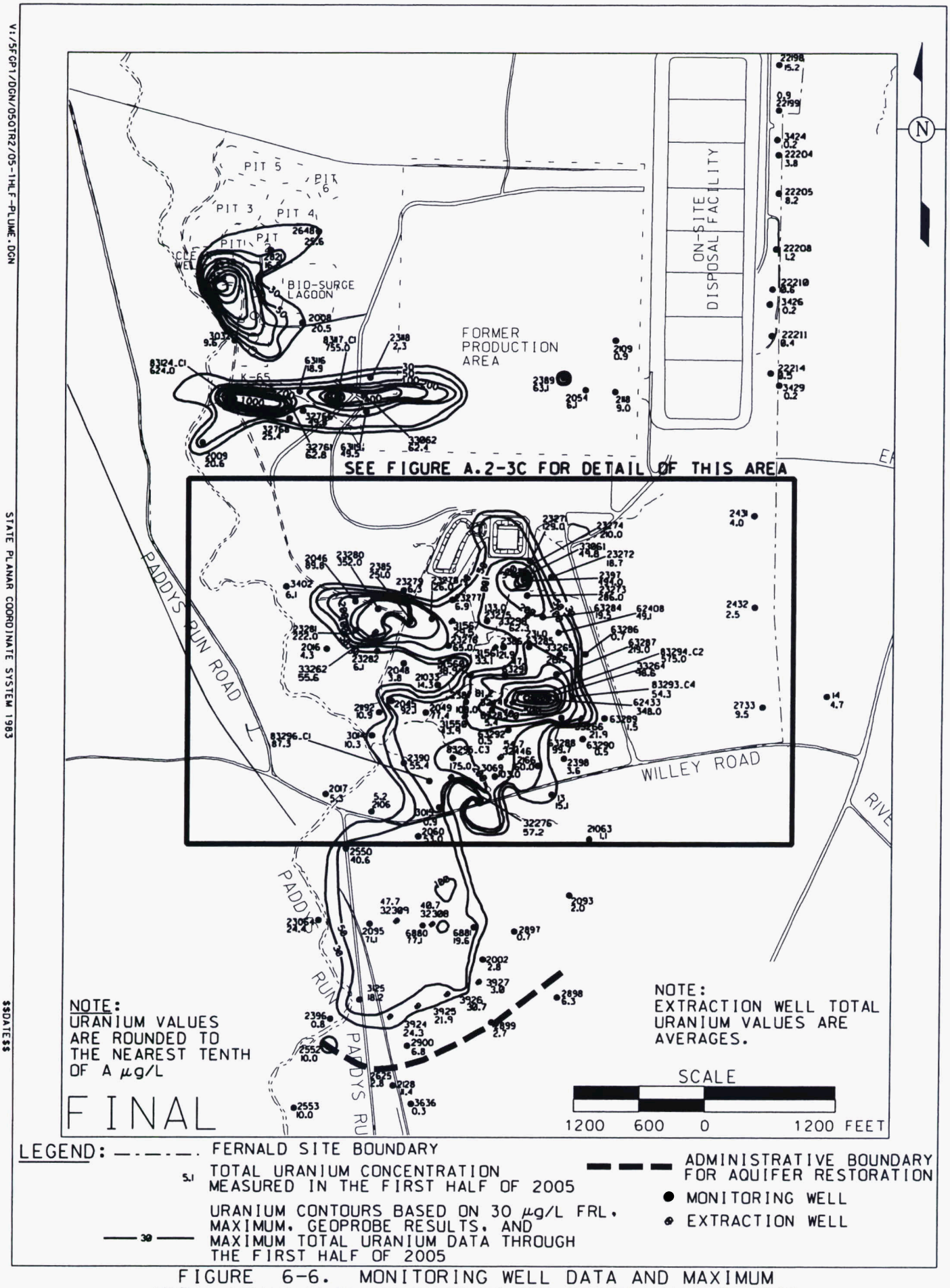
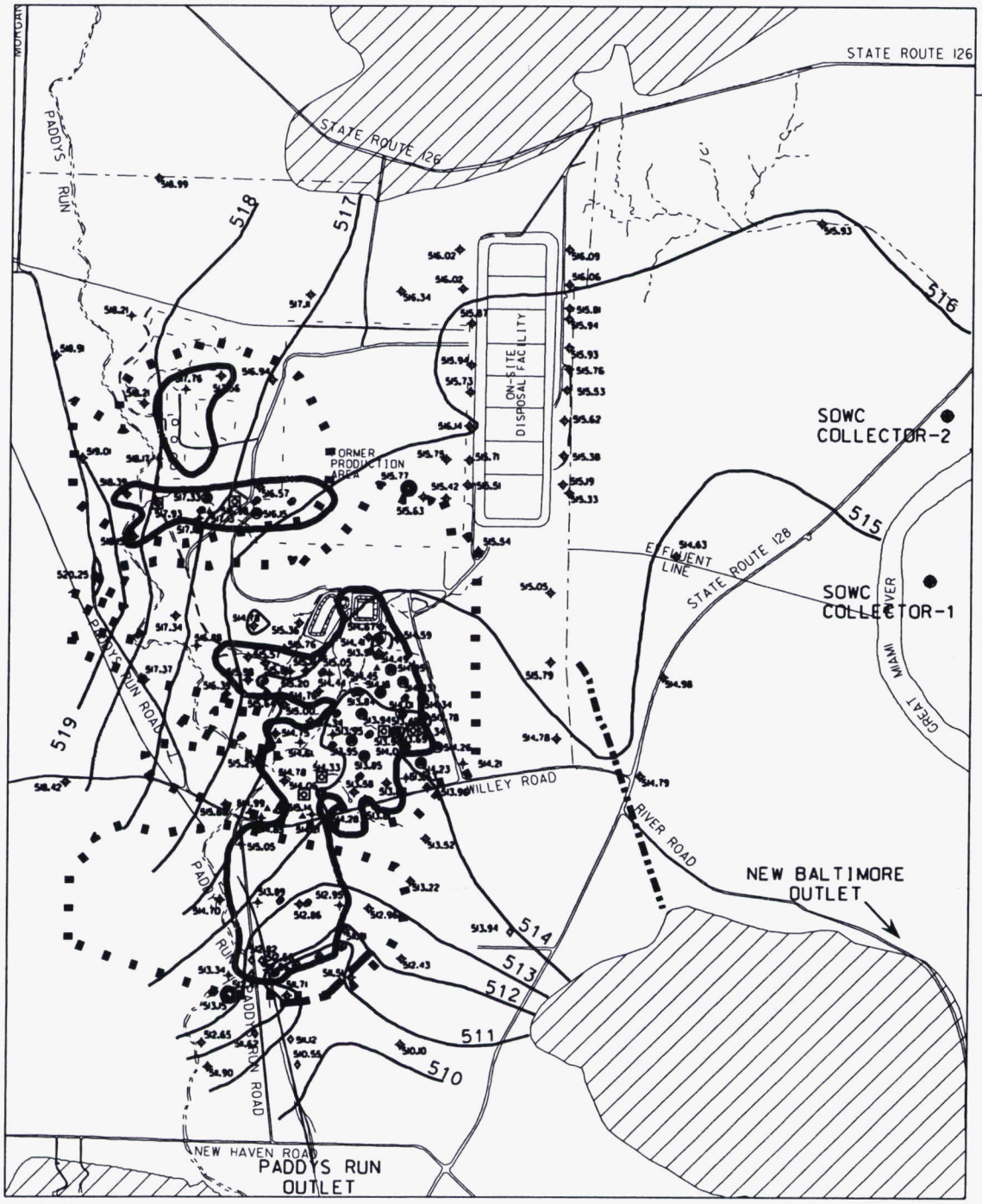


FIGURE 6-6. MONITORING WELL DATA AND MAXIMUM TOTAL URANIUM PLUME THROUGH THE FIRST HALF OF 2005



LEGEND:

- FERNALD SITE BOUNDARY
- GROUNDWATER ELEVATION CONTOUR (FEET AMSL)
- CAPTURE ZONE
- BEDROCK HIGHS
- 10-YEAR. TIME-OF-TRAVEL REMEDIATION FOOTPRINT (DEFINED IN ATTACHMENT A.3)
- APPROXIMATE LOCATION OF GROUNDWATER FLOW DIVIDE
- 516.22 GROUNDWATER ELEVATION (FEET AMSL)
- EXTRACTION WELL
- RE-INJECTION WELL
- EXTENT OF THE MAXIMUM TOTAL URANIUM 30 $\mu g/L$ CONTOUR FROM BRSR. MODIFIED AS NEEDED THROUGH SECOND HALF 2004

OCTOBER 4 THROUGH 6, 2004 OPERATIONAL STATUS:	ACTUAL PUMPING/ RE-INJECTION RATES (gpm)
SOUTH PLUME: 5 WELLS	1,600
RE-INJECTION: 0 WELLS	0
SOUTH FIELD EXTRACTION: 13 WELLS	2,580
WASTE STORAGE AREA: 0 WELLS	0

SCALE

1300 650 0 1300 FEET

FINAL

FIGURE 6-7. ROUTINE GROUNDWATER ELEVATION MAP. FOURTH QUARTER 2004 (OCTOBER 4 THROUGH 6. 2004)

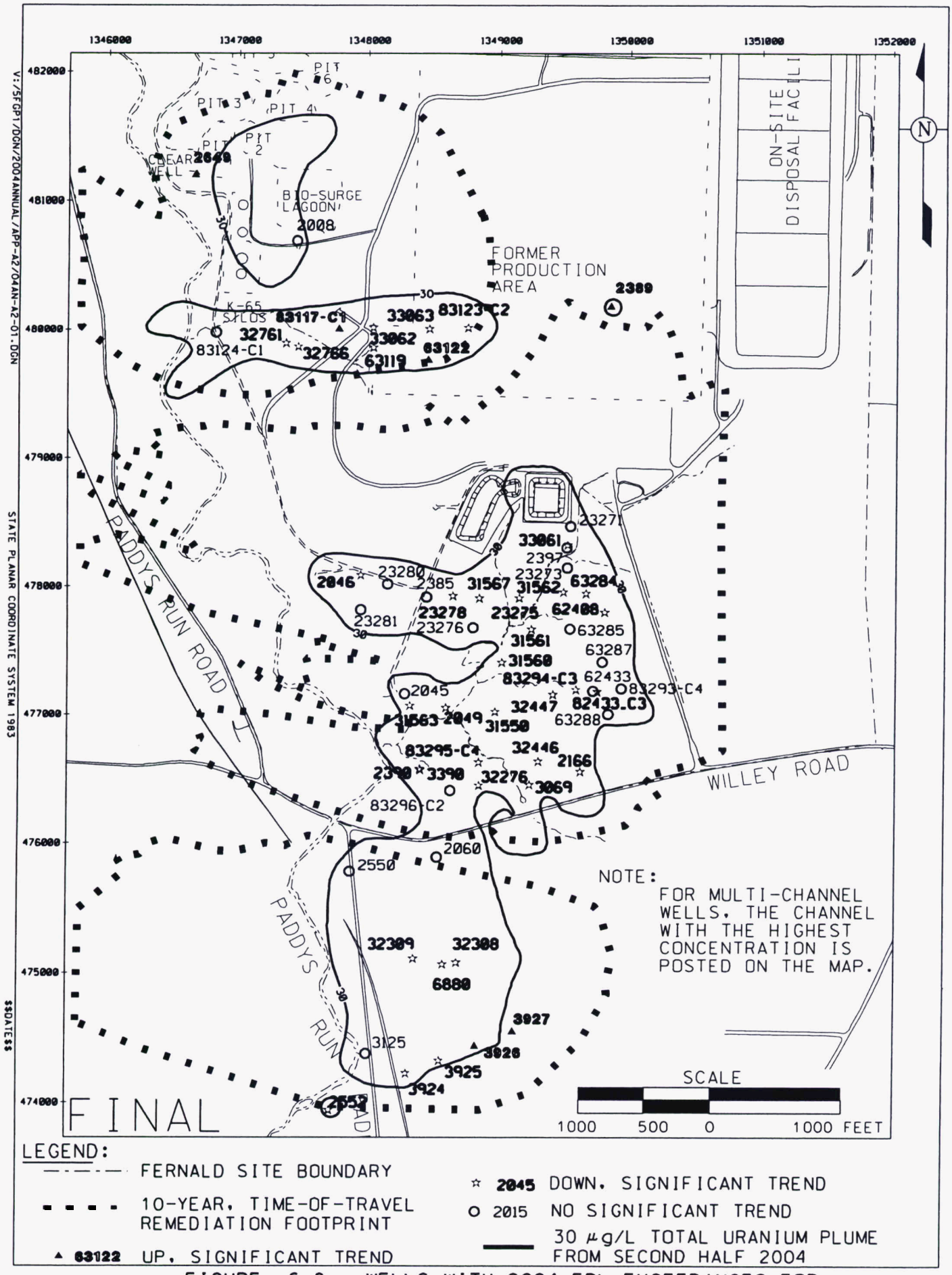
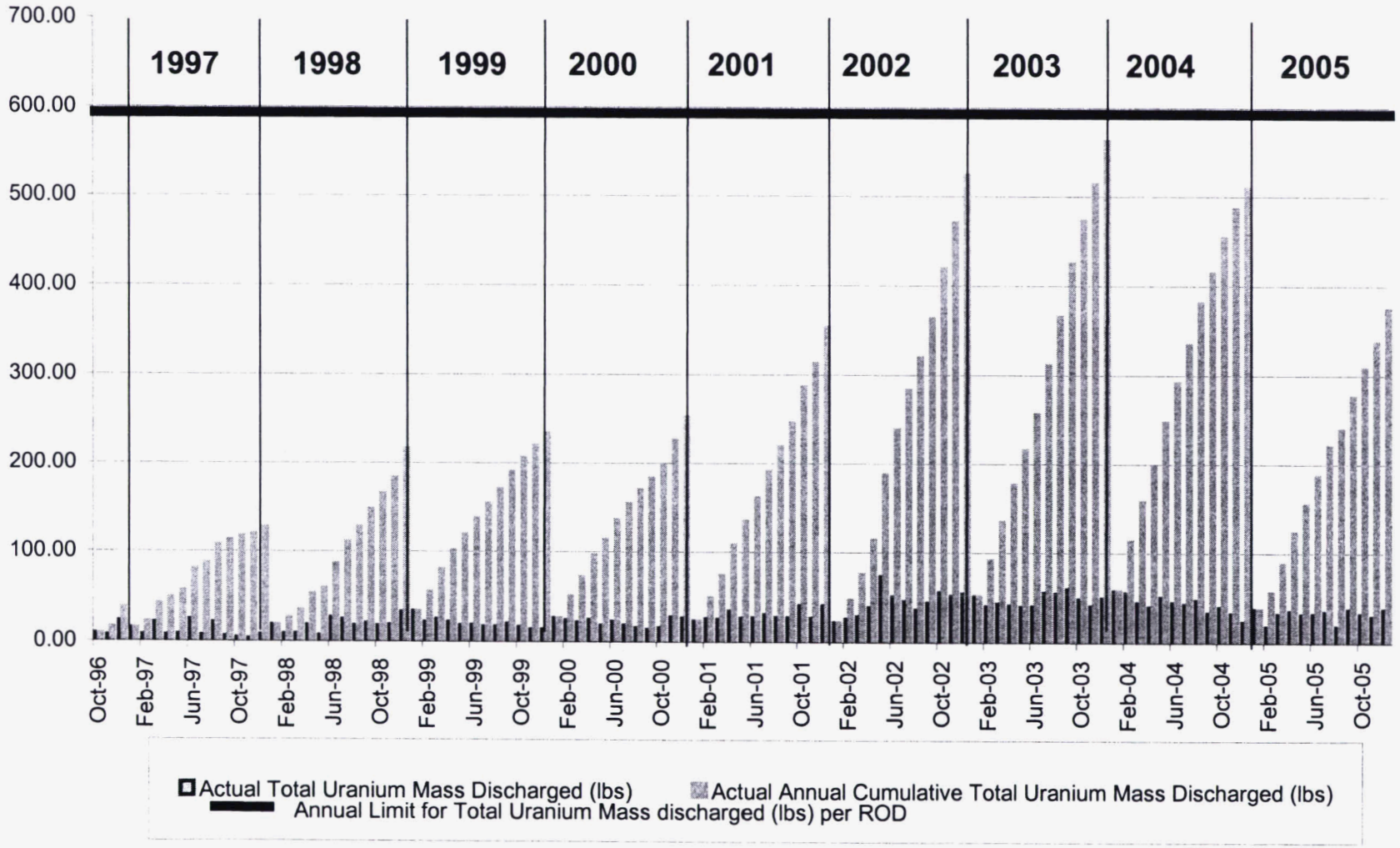


FIGURE 6-8. WELLS WITH 2004 FRL EXCEEDANCES FOR TOTAL URANIUM WITH UP, DOWN, OR NO SIGNIFICANT TRENDS

Figure 6-9
Pounds of Uranium to the Great Miami River at PF4001



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