1.0 Site Background

Abbreviated Timeline

1951 Construction of the Feed Materials Production Center 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. The Fernald site was placed on the National Priorities List, which is the list of CERCLA sites most in need of cleanup.

1990 As part of the Amended Consent Agreement, the site was divided into operable units for characterization and remedy determination.

1991 Uranium production formally ended. The site mission changed from uranium production to environmental remediation and site restoration.

1994 Decontamination and dismantling of the first building was completed under the Operable Unit 3 Interim Record of Decision.

1996 The last operable unit's record of decision was signed, signifying the end of the 10-year remedial investigation/feasibility study process. (The Operable Unit 4 Record of Decision was later re-opened.) Construction began in support of the Operable Unit 1selected remedy. Soil remedial excavation began as part of the Operable Unit 5 selected remedy.

1997 Construction of Cell 1 of the on-site disposal facility took place, and the first waste placement began in December. Environmental monitoring and reporting were consolidated under the IEMP to align with remediation efforts.

1998 Operable Unit 2 remedial excavations began.

1999 Excavation of the waste pits was initiated under the Operable Unit 1 Record of Decision and the first rail shipment of waste material was transported to Envirocare of Utah, Inc.

2000 The Record of Decision Amendment for Operable Unit 4 Silos 1 and 2 Remedial Actions was signed by EPA, thus establishing a new selected remedy for Operable Unit 4.

2001 Cell 1 of the on-site disposal facility was capped. Remediation of the southern waste units was completed.

2002 The Silos 1 and 2 Radon Control System began operations and successfully reduced radon levels within the silos. The off-site transfer of nuclear product material was completed. Wastes were placed into Cells 2 through 5 of the on-site disposal facility.

2003 All major Operable Unit 2 remedial actions were completed. In addition, approximately 412,000 cubic yards (yd^3) (315,015 cubic meters [m^3]) of waste were placed in Cells 3 through 6 of the on-site disposal facility.

2004 Removal of Silo 1 and 2 wastes from the silos to the holding tank facility was initiated. Plans to reduce the size of the site's wastewater treatment infrastructure were approved and implemented. The last of Fernald's 10 uranium production complexes, plus an additional 35 structures and 73 trailers, were demolished. Also, all eight cells of the on-site disposal facility were capped or received waste and approximately 513,000 yd^3 (392,240 m^3) were placed in Cells 4 through 8.

2005 Removal of Silo 3 waste was initiated and the first shipment of waste arrived at Envirocare of Utah. Remedial actions for Operable Unit 1 were completed in June. The first shipment of Silos 1 and 2 waste arrived at Waste Control Specialists, Inc., in Texas.

In 1951, the Atomic Energy Commission (predecessor of the U.S. Department of Energy [DOE]) began building the Feed Materials Production Center on a 1,050-acre (425-hectare) tract of land outside the small farming community of Fernald, Ohio. The facility's mission was to produce “feed materials” in the form of purified uranium compounds and metal for use by other government facilities involved in the production of nuclear weapons for the nation's defense.

Uranium metal was produced at the Feed Materials Production Center from 1952 through 1989. During that time, over 500 million pounds (227 million kilograms [kg]) of uranium metal products were delivered to other sites. Due to these production operations, releases to the surrounding environment occurred resulting in contamination of soil, surface water, sediment, and groundwater on and around the site.

In 1991, the mission of the site officially changed from uranium production to environmental cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. The site was renamed the Fernald Environmental Management Project (FEMP) in 1991. In 2003, the site name changed to the Fernald Closure Project (FCP) to reflect the current mission. Fluor Fernald, Inc. manages the remediation and restoration of the site under the terms of a prime contract with DOE. Regulatory oversight is provided by Region V of the U.S. Environmental Protection Agency (EPA) and the Southwest District Office of the Ohio Environmental Protection Agency (OEPA).

In the 1980s, the goal of environmental monitoring activities were to assess the impact of production operations and monitor the environmental pathways through which residents of the local community might be exposed to contaminants from the site (exposure pathways). The environmental monitoring program provided comprehensive on- and off-property surveillance of contaminant levels in surface water, groundwater, air, and biota. The goal was to measure the levels of contaminants associated with uranium production operations, and report this information to the regulatory agencies and stakeholders.

Exposure Pathways

An **exposure pathway** is a route by which materials could travel between the point of release (a source) and the point of delivering a radiation or chemical dose (a receptor). At the Fernald site, two **primary exposure pathways (liquid and air)** have been identified. A primary pathway is one that may allow pollutants to directly reach the public and/or the environment. Therefore, the liquid and air pathways provide a basis for environmental sampling and information useful for evaluating potential dose to the public and/or the environment.

Secondary exposure pathways have been thoroughly evaluated under previous environmental monitoring programs. Secondary exposure pathways represent indirect routes by which pollutants may reach receptors. An example of a secondary pathway is produce. Through the food chain, one organism may accumulate a contaminant and then be consumed by humans or other animals. The contaminant travels through the air to the soil, where it is absorbed into produce through the roots and is consumed by humans or animals. An evaluation of past monitoring data have shown that secondary exposure pathways at the Fernald site are insignificant routes of exposure to off-site receptors. Therefore, the main focus of the IEMP monitoring program is on the primary exposure pathways.

Refer to Chapter 6 of this report for information pertaining to 2005 dose calculations from all pathways.

Since the conclusion of the site's uranium production mission and completion of the CERCLA remedy selection process, the focus has been on the safe and efficient implementation of environmental remediation activities and facility decontamination and dismantling operations. In recognition of this shift in emphasis toward remedy implementation, the environmental monitoring program was revised in 1997 to align with the remediation activities planned for the Fernald site. The site's environmental monitoring program for 2005 is described in the Integrated Environmental Monitoring Plan (IEMP), Revision 4 (DOE 2005d). The IEMP is updated every two years to keep pace with the site's monitoring needs as remediation progresses and as the site mission changes. Monitoring under the IEMP will continue after site closure and the plan is a component of the Comprehensive Legacy Management and Institutional Controls Plan (LMICP) (DOE 2006a).

This 2005 Site Environmental Report summarizes the findings from the IEMP monitoring program and provides a status on the progress toward final site restoration. This report consists of the following:

Summary Report The summary report (Chapters 1 through 7) documents the results of environmental monitoring activities at the Fernald site in 2005. It includes a discussion of remediation activities and summaries of environmental data from groundwater, surface water and treated effluent, sediment, air, and natural resources monitoring programs. It also summarizes the information contained in the appendices.

Appendices The detailed appendices provide the 2005 environmental monitoring data for the various media, primarily in the form of graphs and tables. The National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61 Subpart H) compliance report (EPA 1985) is also included. The appendices are generally distributed only to the regulatory agencies. However, a complete copy of the appendices is available at the Public Environmental Information Center, which is located at 10995 Hamilton-Cleves Highway (Delta Building) in Cincinnati, Ohio, and is open Monday through Thursday, 9:00 a.m. to 4:00 p.m.

CERCLA Remedial Process

In broad terms, the process of cleaning up sites under CERCLA consists of the following general phases:

Site Characterization – During this phase, contaminants are identified and quantified, and the potential impacts of those contaminants on human health are determined. This phase includes the remedial investigation and the baseline risk assessment.

Remedy Selection – During this phase, cleanup alternatives are developed and evaluated. Activities include the feasibility study and proposed plan. After public comments are received, a remedy is selected and documented in a record of decision.

Remedial Design and Remedial Action – This phase of the CERCLA process includes the detailed design and implementation of the remedy. The CERCLA process ends with certification and site closure.

A five-year review process is triggered by the onset of construction for the first operable unit remedial action that will result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. Of all the operable units, the site preparation construction to support the Waste Pits Project under the Operable Unit 1 Record of Decision (DOE 1995b) was the first such action. This construction began on April 1, 1996. The First Five-Year Review Report for the site was submitted to and approved by the EPA in 2001. These reviews ensure that the remedy remains effective and continues to be protective of human health and the environment.

Long-Term Stewardship will take place at the Fernald site following site closure. Site closure is defined in the current contract between Fluor Fernald, Inc. and DOE as the physical completion of the scope of work required by the five Records of Decision with the exception of groundwater remedy. DOE's Office of Legacy Management will assume the long-term surveillance monitoring and maintenance of the Fernald site after site closure in order to ensure continued protection of human health and the environment, and continued operation of the groundwater remedy. The Comprehensive Legacy Management and Institutional Controls Plan will define the activities to be conducted with respect to long-term stewardship at the Fernald site. The previously mentioned five-year review process will continue in order to provide stakeholders with information on the remedy performance as well as long-term stewardship information.

The remainder of this introductory chapter provides:

- An overview of the current environmental remediation operations and a description of its current cleanup mission, organization, and major remediation activities.
- A description of environmental monitoring activities at the Fernald site.
- A description of the physical, ecological, and human characteristics of the area.

1.1 The Path to Site Closure

In 1986, the Fernald site began working through the CERCLA process to characterize the nature and extent of contamination at the site, establish risk-based cleanup standards, and select the appropriate remediation technologies to achieve those standards. To facilitate this process, the site was organized into five operable units in 1991. The purpose of the operable unit concept under CERCLA is to organize site components based on their location and/or the potential for similar technologies to be used for environmental remediation. The remedy selection process culminated in 1996 with the approval of the final Records of Decision for each of the five operable units. However, several of the Records of Decision (including those for Operable Units 1, 4, and 5) have subsequently been modified through issuance of Explanation of Significant Differences and/or Record of Decision Amendment documents. These documents were prepared, submitted for EPA and public review, and issued in accordance with CERCLA regulations.

Following approval of the initial records of decision, work began on the design and implementation of the operable unit remedies. In order to align site-wide responsibilities and regulatory obligations of each operable unit and to most efficiently execute remedial design and remedial action, the site established integrated project organizations in 1996. Realignment into project organizations reflected the actual work processes and operations necessary to complete remediation while meeting the requirements of the records of decision. Table 1-1 describes each operable unit and its associated remedy, and provides a crosswalk between each operable unit and the projects responsible for implementing each remedy. When a project is mentioned in this document, references to the applicable operable unit are included, as identified in the Table 1-1 description. It should be noted that several reorganizations have occurred during the past several years; Table 1-1 and text reflect a simplified project organization.

TABLE 1-1
OPERABLE UNIT REMEDIES AND ASSOCIATED PROJECT RESPONSIBILITIES

Operable Unit	Description	Remedy Overview	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 Remedial actions completed: June 2005 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 soil remediation/certification.	Waste Pits Project was responsible for rail upgrades; excavation of Operable Unit 1 waste units; pre-treatment of wastewater as necessary to meet Aquifer Restoration Project wastewater acceptance criteria; waste processing, drying, and loading; rail transport; and off-site disposal of all waste pit waste as well as any contaminated soil and debris that exceed the waste acceptance criteria for the on-site disposal facility. Remedial actions for Operable Unit 1 were completed in June 2005. (Note: Shaw Environmental performed some of the activities associated with this project.) Beginning in June 2005, the only project activity was continued rail shipping of soil and other material from other site projects that exceeded the on-site disposal facility waste acceptance criteria. Environmental Closure, Soil, and, Disposal Facility Project is responsible for the excavation and certification of contaminated soil beneath the waste pits, and at- and below-grade remediation facilities. The project is also responsible for field oversight of soil excavations, for reviewing and signing manifests for impacted material delivered to the on-site disposal facility for placement, and for rejecting any unacceptable shipments. Decontamination and Demolition Project was responsible for decontamination and dismantling of Operable Unit 1 remediation facilities. (Note: Shaw Environmental performed some of the activities associated with this project.) Aquifer Restoration/Wastewater Project is responsible for final treatment of contaminated runoff, perched water collected during waste pit excavation, and processing wastewater discharges. Each project is responsible for transporting remediation wastewater to the head works of the converted advanced wastewater treatment facility for treatment.
2	- Solid waste landfill - Inactive flyash pile - Active flyash pile (now inactive) - North and south Lime Sludge Ponds - Other South Field areas - Berms, liners, and soil within the operable unit boundary	Record of Decision Approved: May 1995 Post-Record of Decision Fact Sheet Approved: April 1999 Excavation of all materials with constituents of concern above FRLs, treatment for size reduction and moisture control as required, on-site disposal in the on-site disposal facility, and off-site disposal of excavated material that exceeds the waste acceptance criteria for the on-site disposal facility.	Environmental Closure, Soil, and Disposal Facility Project is responsible for excavating and disposing of waste from all Operable Unit 2 subunits and certifying the footprints. This project is also responsible for the ongoing design, construction, maintenance, and closure of the on-site disposal facility that will contain Operable Unit 2 subunit wastes, Operable Unit 5 soil and debris, and Operable Unit 3 debris. This project is responsible for field oversight of soil excavations, for reviewing and signing manifests for impacted material delivered to the on-site disposal facility for placement, and for rejecting any unacceptable shipments. Decontamination and Demolition Project is responsible for decontamination and dismantling of all above-grade portions of buildings and facilities at the Fernald site. Aquifer Restoration/Wastewater Project is responsible for treating contaminated runoff and perched water collected during excavation of Operable Unit 2 subunit wastes. This project is responsible for leachate and leak detection monitoring at the on-site disposal facility and for treating leachate from the on-site disposal facility. Each project is responsible for transporting remediation wastewater to the head works of the converted advanced wastewater treatment facility for treatment.

TABLE 1-1
(Continued)

Operable Unit	Description	Remedy Overview	Project Organization Responsibilities
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 Operable Unit 3 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 on-site disposal facility waste acceptance criteria; and on-site disposal for material that meets the on-site disposal facility waste acceptance criteria.	Decontamination and Demolition Project is responsible for decontamination and dismantling of all above-grade portions of buildings and facilities at the Fernald site. Environmental Closure, Soil, and Disposal Facility Project is responsible for excavation and certification of soil beneath facilities and for removal of at- and below-grade structures. This project is also responsible for design, construction, and closure of the on-site disposal facility that will contain Operable Unit 2 subunit wastes, Operable Unit 5 soil, and Operable Unit 3 debris. Additionally, this project is responsible for reviewing facility decontamination and dismantling planning documents. This organization is also responsible for field oversight of debris sizing, segregation of on-site disposal facility material categories and prohibited items; completing field tracking logs; completing manifests for material bound for the on-site disposal facility; and compiling final records of decontamination and dismantling debris placed in the on-site disposal facility. Aquifer Restoration/Wastewater Project is responsible for treating decontamination and other wastewater during decontamination and dismantling activities, and processing wastewater discharges. Each decontamination and dismantling project is responsible for transporting remediation wastewater to the head works of the converted advanced wastewater treatment facility for treatment.
4	- Silos 1 and 2 (containing K-65 residues) - Silo 3 (containing cold metal oxides) - Silo 4 (empty and never used; demolished in 2003) - Decant tank system - Berms and soil within the operable unit 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 Differences for Operable Unit 4 Approved: January 2005 Removal of Silo 3 materials for treatment 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; and decontamination and demolition, to the extent possible, of silos and remediation facilities. Excavation of silos area contaminated above the FRLs with on-site disposal for contaminated soils and debris that meet the on-site disposal facility waste acceptance criteria; and site restoration. Concrete from Silos 1 and 2, and contaminated soil and debris that exceed the on-site disposal facility waste acceptance criteria will be disposed of off-site.	Silos 1 and 2 Project is responsible for transfer of Silos 1 and 2 residues to temporary transfer tanks, treatment, and transport off-site. Waste treatment systems will be completed to support the final remediation of the silos. If wastewater is generated, it will be pre-treated as necessary by the Silos Project. Silo 3 Project is responsible for Silo 3 content removal, treatment, and transport off-site. Environmental Closure, Soil, and Disposal Facility Project is responsible for certification, excavation, and disposition of contaminated soil beneath the silos and for removal of subsurface structures (i.e., sub-grade silo decant system). The project is responsible for design, construction, and closure of the on-site disposal facility that will contain Operable Unit 2 subunit wastes, Operable Unit 5 soil, and Operable Unit 3 debris. Decontamination and Demolition Project is responsible for decontamination and dismantling of all Operable Unit 4 facilities (storage, processing, and remediation) and associated above-ground piping. Aquifer Restoration/Wastewater Project is responsible for the ultimate treatment and discharge of excess wastewater generated from Advanced Waste Retrieval activities and Silo 1, 2, and 3 remediation activities. Once silos projects are complete, this project will provide, as necessary, treatment of decontamination wastewater from demolition activities. Each project is responsible for capturing, pre-treating as necessary, and transporting remediation wastewater to the headworks of the converted advanced wastewater treatment facility for treatment.

TABLE 1-1
(Continued)

Operable Unit	Description	Remedy Overview	Project Organization Responsibilities
5	- Groundwater - Surface water and sediments - Soil not included in the definitions of Operable Units 1 through 4 - Flora and fauna	Record of Decision Approved: January 1996 Explanation of Significant Differences was approved in November 2001, formally adopting EPA's Safe Drinking Water Act Maximum Contaminant Level for uranium of 30 micrograms per liter (µg/L) as both the FRL for groundwater remediation and the monthly average uranium effluent discharge limit to the Great Miami River. 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 on-site disposal facility waste acceptance criteria. Soil and sediment that exceed the waste acceptance criteria for the on-site disposal facility will be treated, when possible, to meet the on-site disposal facility waste acceptance criteria or will be disposed of at an off-site facility. Also includes site restoration, institutional controls, and post-remediation maintenance.	Aquifer Restoration/Wastewater Project is responsible for designing, installing, and operating the systems needed to restore groundwater in the Great Miami Aquifer. This project is responsible for groundwater monitoring in the Great Miami Aquifer; reporting on the progress of aquifer restoration; designing, constructing, and operating all treated effluent discharge systems; and treating and discharging contaminated groundwater, storm water, and remediation wastewater at the Fernald site. This project is also responsible for operation, maintenance, and monitoring of the on-site disposal facility leachate collection system and leak detection system. Environmental Closure, Soil, and Disposal Facility Project is responsible for certification of site-wide soil; excavation and disposition of contaminated soil, sediment, perched groundwater and at- and below-grade structures; and final site restoration. The project is responsible for design, construction, maintenance, and closure of the on-site disposal facility that will contain Operable Unit 2 subunit wastes, Operable Unit 5 soil, and Operable Unit 3 debris. This project is also responsible for oversight of field excavations; segregating on-site disposal facility material categories and segregating prohibited items; completing field tracking logs; completing manifests for material bound for the on-site disposal facility; and compiling final records of soil and at- and below-grade debris placed in the on-site disposal facility. Decontamination and Demolition Project is responsible for decontamination and dismantling of all Operable Unit 5 remediation facilities through site closure.

1.2 Environmental Monitoring Program

In the 1980s, an environmental monitoring program was initiated to assess the impact of past operations on the environment and monitor potential exposure pathways to the local community. Additionally, characterization activities were conducted at the Fernald site for nearly 10 years through the remedial investigation phase of the CERCLA process. The initial environmental evaluations performed during the remedial investigation/feasibility study process were used to select the final remedy for Operable Unit 5, which addressed contamination in soil, groundwater, surface water, sediment, air, and biota (produce) – in short, all environmental media and contaminant exposure pathways affected by past uranium production operations at the site. The selected remedy for Operable Unit 5 defined the site's final contaminant cleanup levels and established the extent of on- and off-property remedial actions necessary to provide permanent solutions to environmental concerns posed by the site.

The Operable Unit 5 remedy included plans for both removing the contamination that might be released through these exposure pathways, and monitoring these pathways to measure the site's continuing impact on the environment as remediation progresses. The characterization data used to develop the final remedy were also used to focus on and develop the environmental monitoring program documented in the IEMP.

Following are descriptions of the IEMP's key elements:

- The IEMP defines monitoring activities for environmental media, such as groundwater, surface water and treated effluent, sediment, air (including air particulate, radon, and direct radiation), and natural resources. In general, the primary exposure pathways (liquid and air) are monitored and the program focuses on assessing the collective effect of site-wide emissions on the surrounding environment.

- The IEMP establishes a data evaluation and decision-making process for each environmental medium. Through this process, environmental conditions at the site as a whole are continuously evaluated. These evaluations sometimes affect decisions made about the implementation of remediation activities. For example, environmental data are routinely evaluated to identify any significant trends that may indicate the potential for an unacceptable future impact to the environment if action is not taken. This information is communicated to the appropriate remediation project organizations so that corrective actions can be taken before conditions become unacceptable.

- Recognizing that the type and pace of activities will change over the life of the cleanup effort, the IEMP allows for adjustment of the program as site remediation progresses and as the mission changes. At this time, the IEMP is reviewed annually and revised every two years to ensure that the monitoring program adequately addresses changing remediation activities.

- The IEMP consolidates routine reporting of environmental data into a comprehensive annual report.

1.3 Characteristics of the Site and Surrounding Area

The natural setting of the Fernald site and nearby human communities were important factors in selecting the final remedy, and remain important in the continuous evaluation of the environmental monitoring program. Land use and demography, local geography, geology, surface hydrology, meteorological conditions, and natural resources all impact monitoring activities and the implementation of the site remedy.

1.3.1 Land Use and Demography

Economic activities in the area rely heavily on the physical environment. Land in the area is used primarily for livestock and crop farming, and gravel pit excavation operations. There also is a private water utility that pumps groundwater, primarily for industrial use, approximately 2 miles (3.2 kilometers [km]) east of the Fernald site.

Downtown Cincinnati is approximately 18 miles (29 km) southeast of the Fernald site, as shown in Figure 1-1. The cities of Fairfield and Hamilton are 6 and 8 miles (10 and 13 km) to the east and northeast, respectively, as shown in Figure 1-2. Scattered residences and several villages including Fernald, New Baltimore, New Haven, Ross, and Shandon are located near the site. Based on the 2000 U.S. Census, there is an estimated population of 20,000 within 5 miles (8 km) of the Fernald site and an estimated 2.8 million within 50 miles (80 km).

1.3.2 Geography

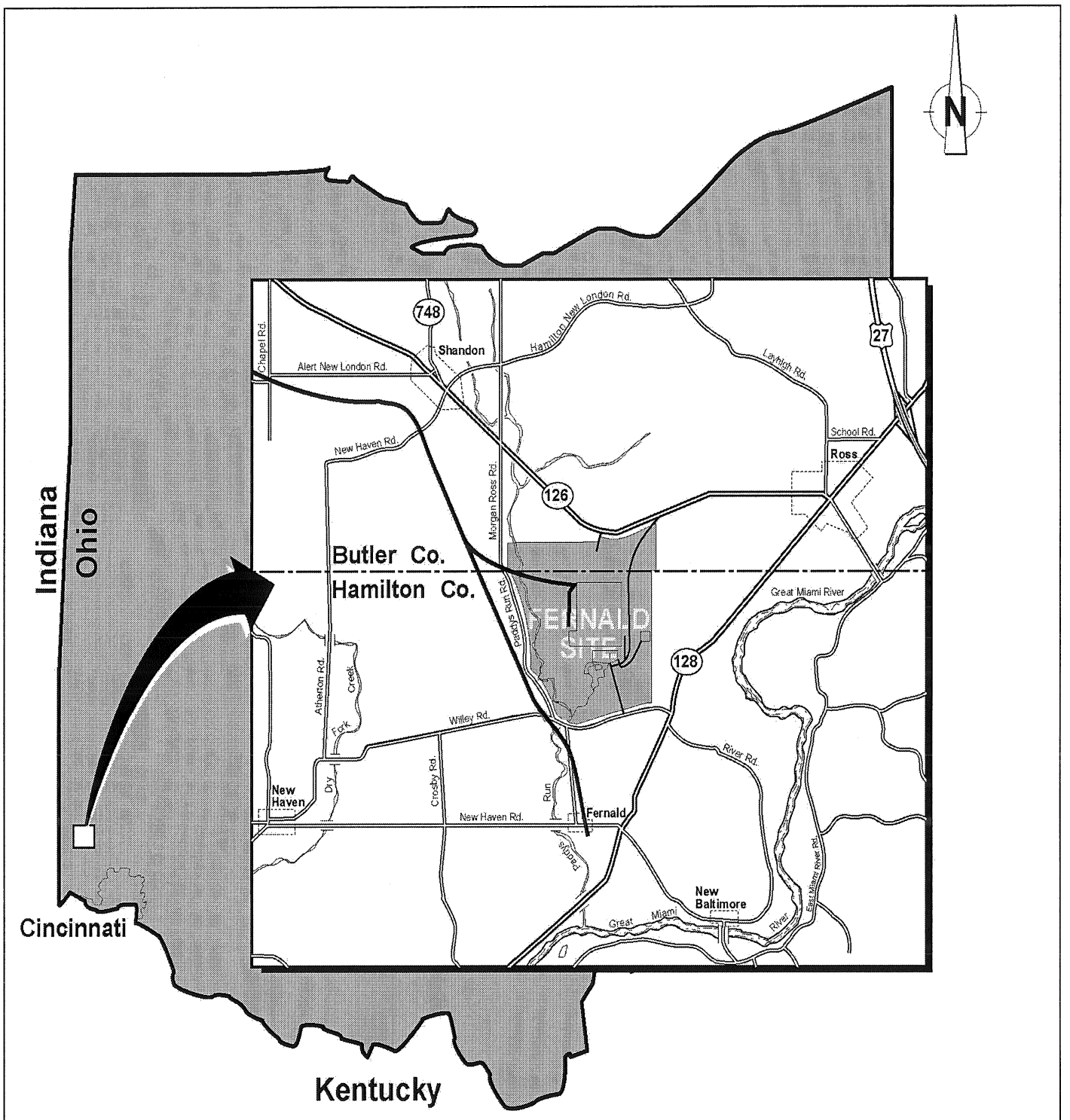
Figure 1-3 depicts the location of the major physical features of the site, such as the buildings and supporting infrastructure. The former production area and various administrative buildings dominate this view. The former production area occupies approximately 136 acres (55 hectares) in the center of the site. The waste pit area and K-65 Silos are located adjacent to the western edge of the former production area. The Great Miami River cuts a terraced valley to the east of the site, while Paddys Run (an intermittent stream) flows from north to south along the site's western boundary. In general, the site lies on a terrace that slopes gently between vegetated bedrock outcroppings to the north, southeast, and southwest.

1.3.3 Geology

Bedrock in the area indicates that approximately 450 million years ago a shallow sea covered the Cincinnati area. Sediments that later became flat-lying shale with interbedded limestone were deposited in the shallow sea as evidenced by the abundance of marine fossils in the bedrock. In the more recent geologic past, the advance and retreat of three separate glaciers shaped the southwestern Ohio landscape. A large river drainage system south of the glaciers created river valleys up to 200 feet (61 meters) deep, which were then filled with sand and gravel when the glaciers melted. These filled river valleys are called buried valleys.

The last glacier to reach the area left an impermeable mixture of clay and silt with minor amounts of sand and gravel deposited across the land surface, called glacial overburden. The site is situated on a layer of glacial overburden that overlies portions of a 2- to 3-mile-wide (3- to 5-km) buried valley. This valley, known as the New Haven Trough, makes up part of the Great Miami Aquifer. The impermeable shale and limestone bedrock that define the edges and bottom of the New Haven Trough confine the groundwater to the sand and gravel within the buried valley. Where present, the glacial overburden limits the downward movement of precipitation and surface water runoff into the underlying sand and gravel of the Great Miami Aquifer.

The Great Miami River and its tributaries have eroded significant portions of the glacial overburden and exposed the underlying sand and gravel of the Great Miami Aquifer. Thus, in some areas, precipitation and surface water runoff can easily migrate into the underlying Great Miami Aquifer, permitting contaminants to be transported to the aquifer as well. Natural and man-made breaches of the glacial overburden were key pathways where contaminated water entered the aquifer, causing the groundwater plumes that are being addressed by aquifer restoration activities. Figure 1-4 provides a glimpse into the structure of subsurface deposits in the region along an east-west cross section through the site, while Figure 1-5 presents the regional groundwater flow patterns in the Great Miami Aquifer.



The Fernald site covers about 1,050 acres (425 hectares).

Figure 1-1. Fernald Site and Vicinity

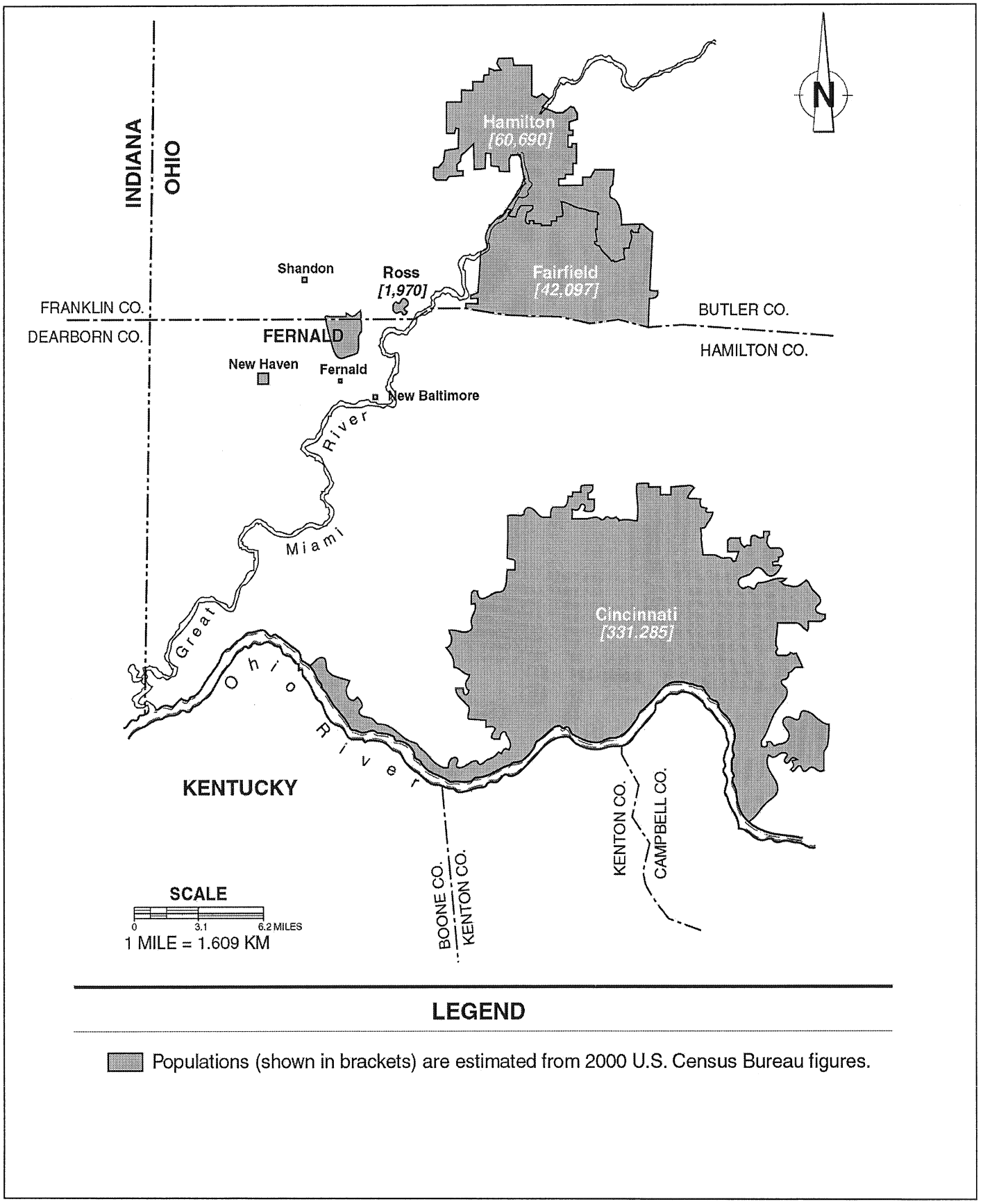


Figure 1-2. Major Communities in Southwestern Ohio

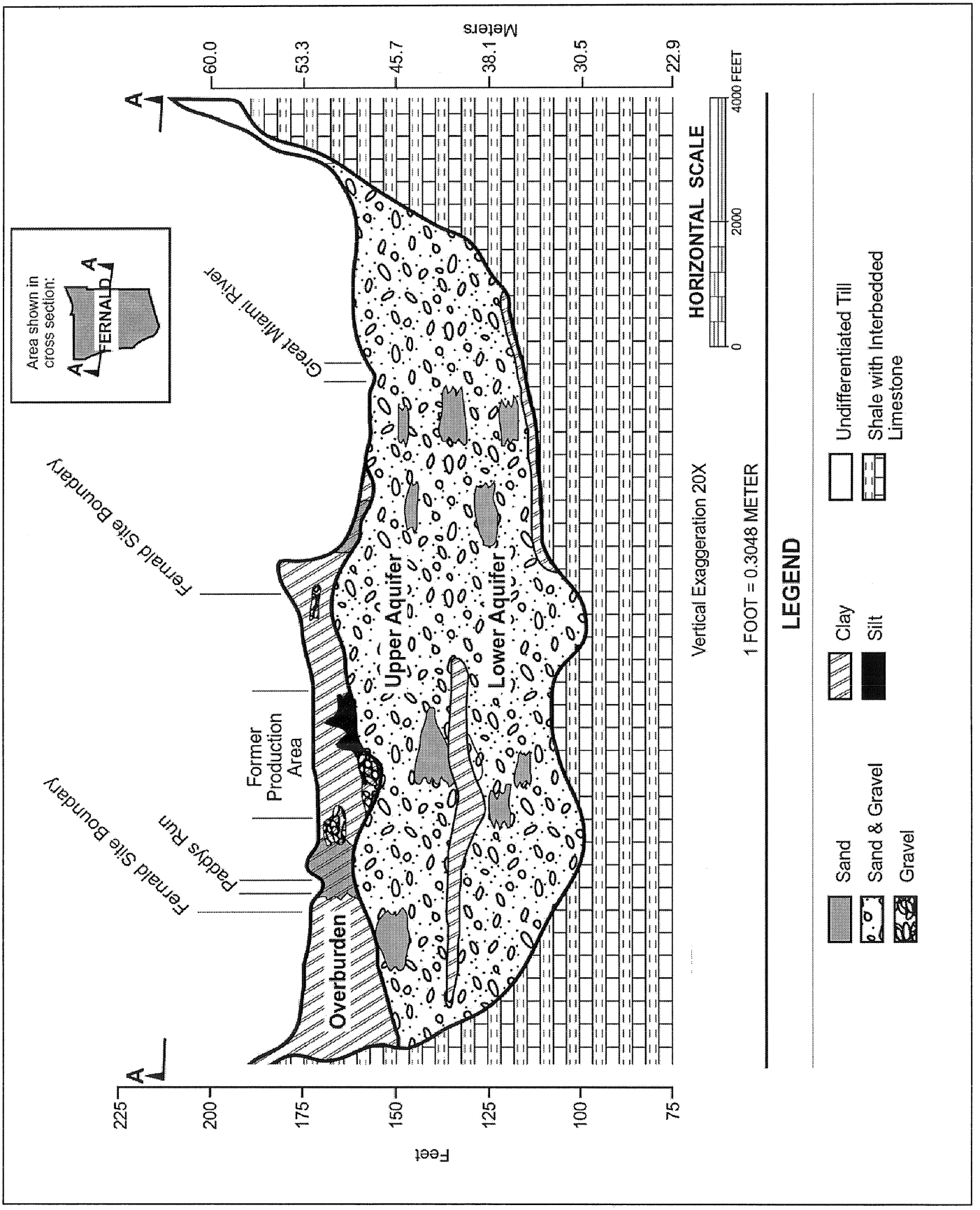


Figure 1-4. Cross Section of New Haven Trough, Looking North

Figure 1-5. Regional Groundwater Flow in the Great Miami Aquifer

1.3.4 Surface Hydrology

The site is located in the Great Miami River drainage basin (refer to Figure 1-6). Natural drainage from the site to the Great Miami River occurs primarily via Paddys Run. This intermittent stream begins losing flow to the underlying sand and gravel aquifer south of the waste pit area. Paddys Run empties into the Great Miami River 1.5 miles (2.4 km) south of the site.

In addition to natural drainage through Paddys Run, surface water runoff from the former production area, the waste pit area, and other selected areas is collected, treated, and discharged to the Great Miami River. Since January 1995, the majority of this runoff has been treated for uranium removal in the advanced wastewater treatment facility before being discharged. The Great Miami River, 0.6 mile (1 km) east of the Fernald site, runs in a southerly direction and flows into the Ohio River about 24 miles (39 km) downstream of the site. The segment of the river between the Fernald site and the Ohio River is not used as a source of public drinking water.

The average flow volume for the Great Miami River in 2005 was 5,338 cubic feet per second (ft^3/sec) (151.2 cubic meters per second [m^3/sec]). This is based on daily measurements collected at the United States Geologic Survey (USGS) Hamilton stream gauge (USGS 3274000) approximately 10 river miles (16 river km) upstream of the site's effluent discharge.

1.3.5 Meteorological Conditions

Meteorological data are gathered at the Fernald site and used to evaluate site-specific climatic conditions. The environmental monitoring program uses atmospheric models to determine how airborne effluents are mixed and dispersed. These models are then used to assess the impact of operations on the surrounding environment, in accordance with DOE requirements. Airborne pollutants are subject to weather conditions. Wind speed and direction, precipitation, and atmospheric stability play a key role in predicting how pollutants are distributed in the environment and in interpreting environmental data.

Figures 1-7 and 1-8 illustrate the average wind speed and general direction for 2005 measured at the 33-foot (10-meter) and 197-foot (60-meter) levels, respectively, in wind rose format. The prevailing winds were from the southwest 45 percent of the time at the 10-meter height and 38 percent of the time from the 60-meter height. Tables in Appendix C, Attachment C.4, of this report present meteorological data for 2005, including wind direction and average speed.

In 2005, 35.55 inches (90.3 centimeters [cm]) of precipitation were measured at the Fernald site. This is lower than the average annual precipitation of 41.22 inches (104.7 cm) for 1951 through 2004. Figure 1-9 shows the average precipitation recorded at the Fernald site for each year from 1994 through 2005 and the annual average precipitation for the Cincinnati area from 1951 through 2004. Figure 1-10 shows 2005 precipitation by month at the site compared to the Cincinnati area average precipitation by month from 1951 through 2004.

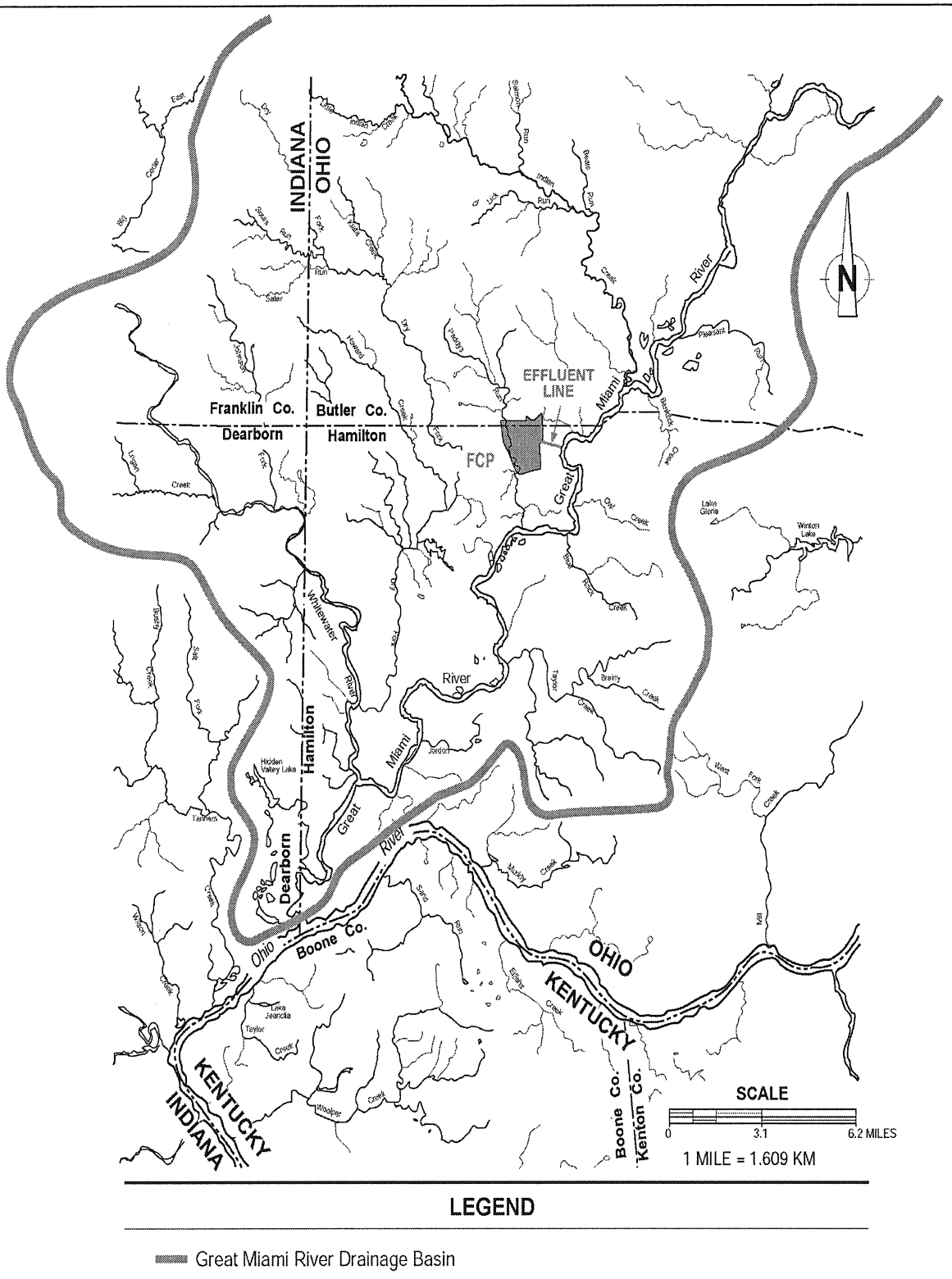


Figure 1-6. Great Miami River Drainage Basin

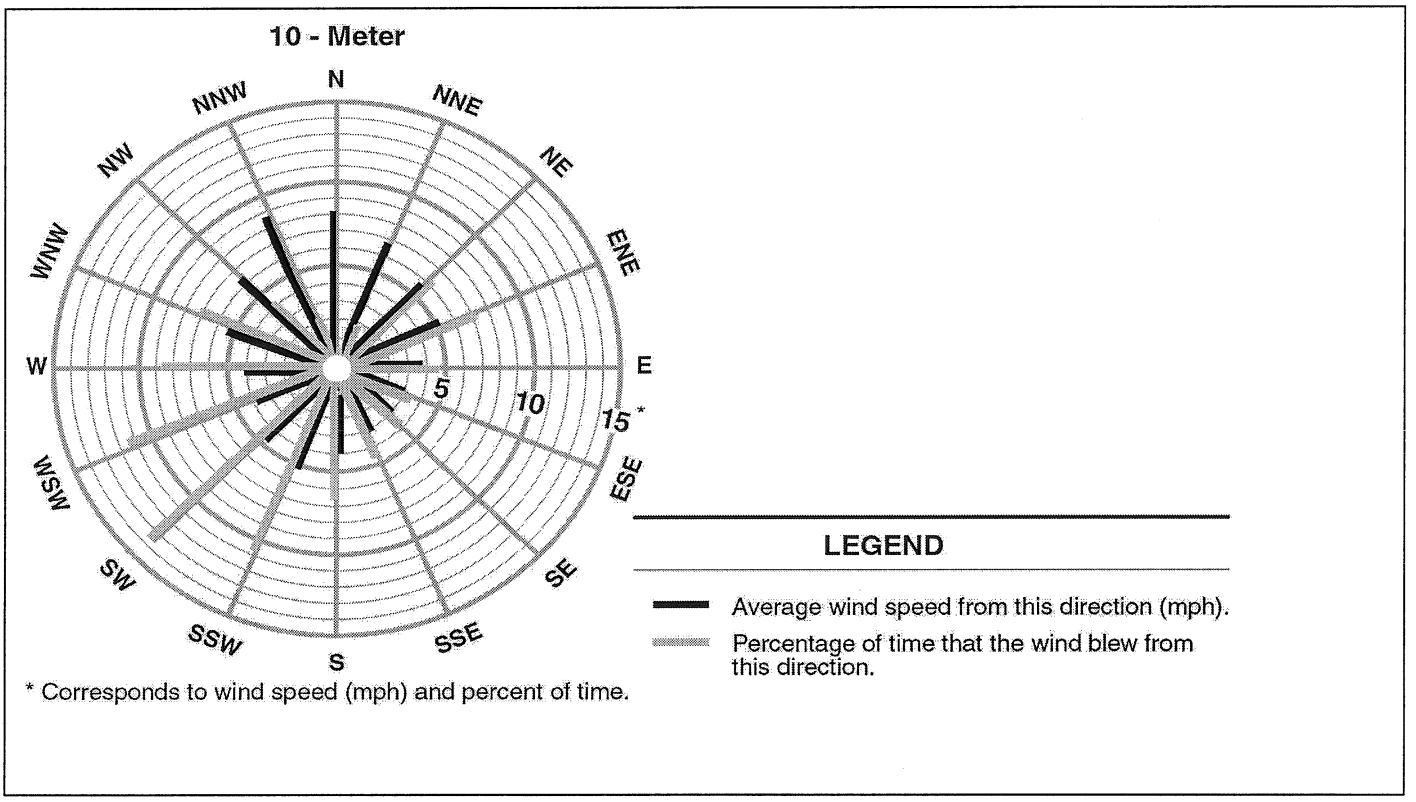


Figure 1-7. 2005 Wind Rose, 33-Foot (10-Meter) Height

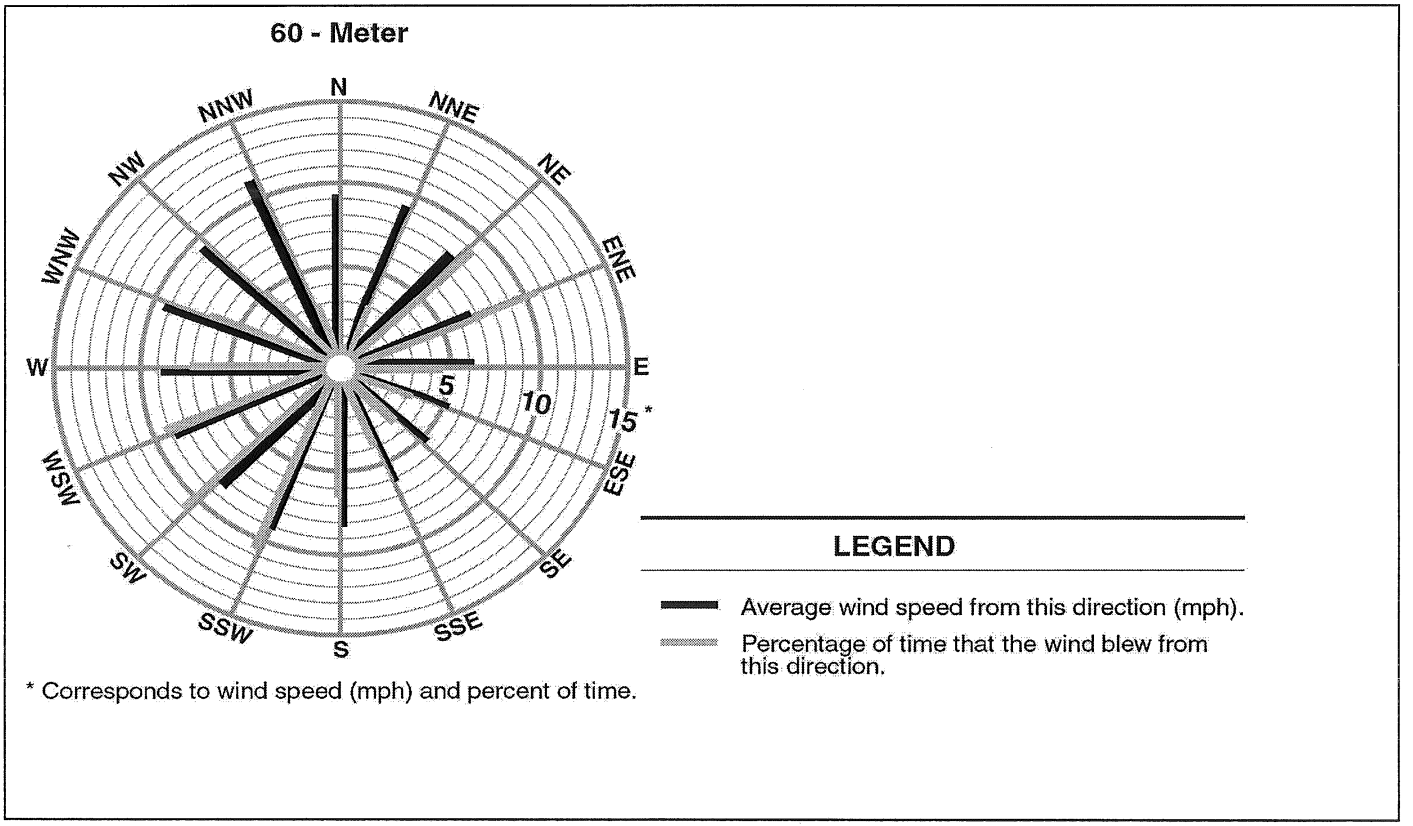


Figure 1-8. 2005 Wind Rose, 197-Foot (60-Meter) Height

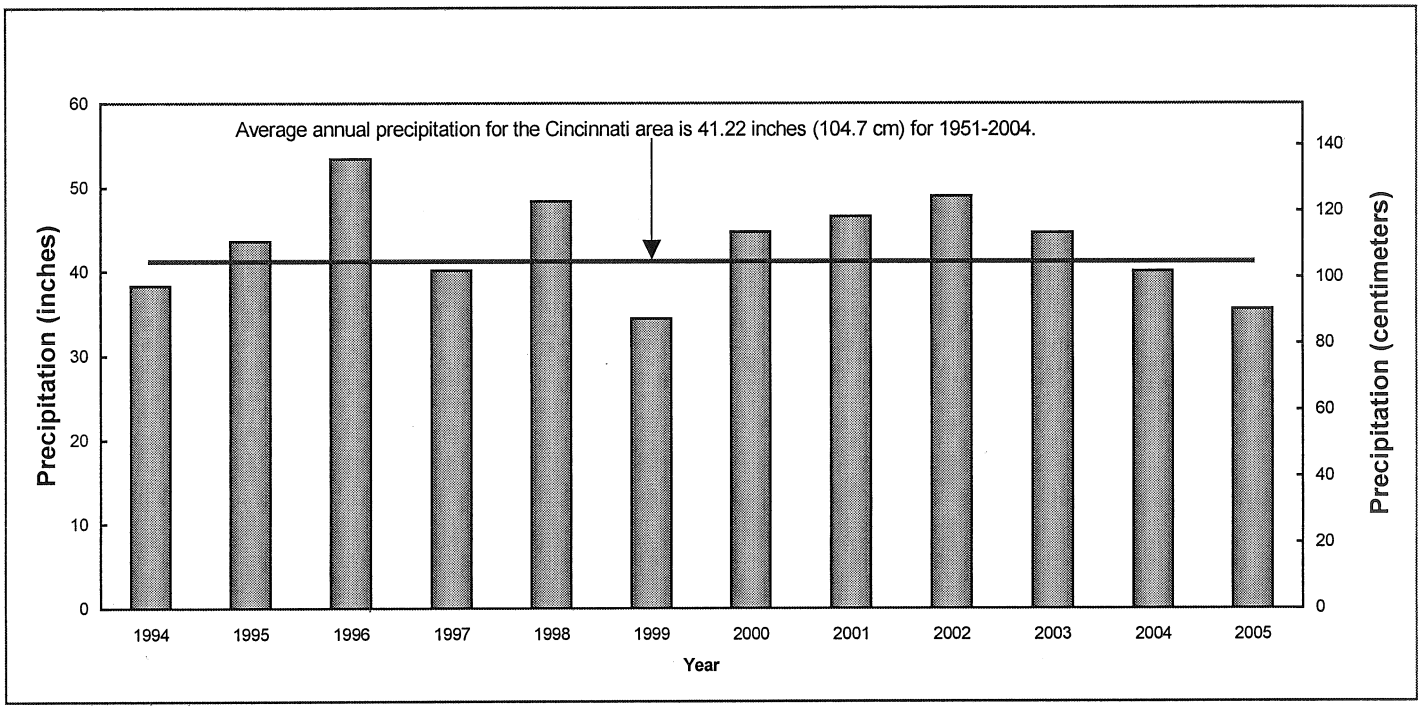


Figure 1-9. Average Annual Precipitation, 1991-2005

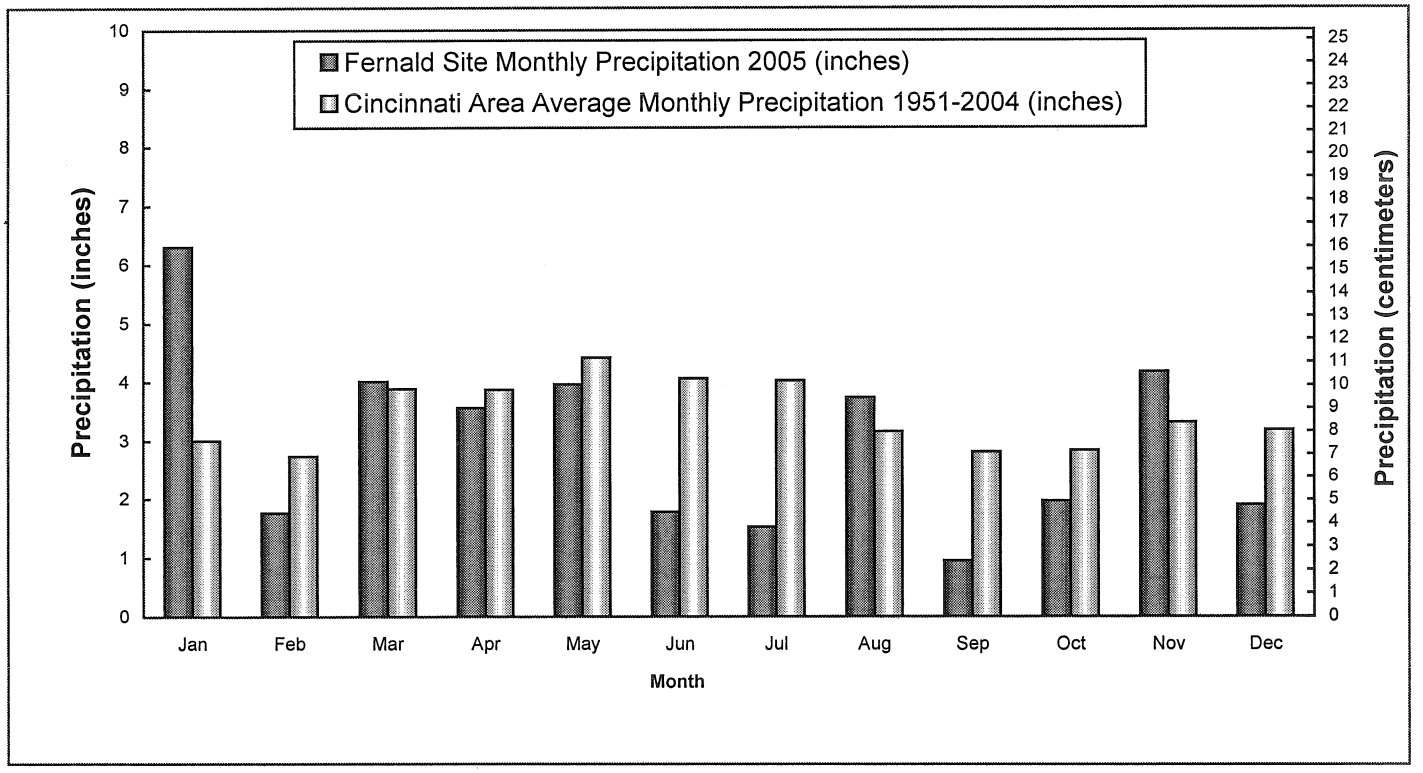


Figure 1-10. Monthly Precipitation for 2005 and Average Monthly Precipitation for 1951-2004

1.3.6 Natural Resources

Natural resources have important aesthetic, ecological, economic, educational, historical, recreational, and scientific value to the United States. Their protection will be an ongoing process at the Fernald site. Studies such as wildlife surveys (Facemire 1990) and the Operable Unit 5 Ecological Risk Assessment (provided as Appendix B of the Remedial Investigation Report for Operable Unit 5 [DOE 1995d]) show that terrestrial and aquatic flora and fauna at the site are diverse, healthy, and similar in abundance and species composition to those populations of surrounding ecological communities. Chapter 7 provides a discussion of the site's diverse ecological habitats and cultural resources.

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