4.0 Surface Water and Treated Effluent Pathway

Results in Brief: 2005 Surface Water and Treated Effluent Pathway

Surveillance Monitoring – No surface water or treated effluent analytical results from samples collected in 2005 exceeded the surface water FRL for total uranium, the primary site contaminant. In addition, there were no FRL exceedances for any other monitored parameter that can be attributable to the Fernald site.

Uranium Discharges – In 2005, 374 pounds (170 kg) of uranium were discharged in treated effluent to the Great Miami River. Approximately 75 pounds (34 kg) of uranium were released to the environment through uncontrolled storm water runoff. The estimated total pounds of uranium released through the surface water and treated effluent pathway (approximately 449 pounds [204 kg]) decreased 24 percent from the 2004 estimate.

Sediment – In 2005, there were no FRL exceedances for any sediment result. Certification against sediment FRLs was approved for the storm sewer outfall ditch.

This chapter presents the 2005 monitoring activities and results for surface water, treated effluent, and sediment to determine the effects of remediation activities on the surface water pathway.

In general, low levels of contaminants enter the surface water pathway at the Fernald site by two primary mechanisms: treated effluent that is monitored as it is discharged to the Great Miami River and uncontrolled runoff entering the site's drainages from areas with low levels of soil contamination. Because these discharges will continue throughout remediation, the surface water and sediment pathways will continue to be monitored. Effective use of the site's wastewater treatment capabilities and implementation of runoff and sediment controls, minimize the site's impact on the surface water pathway.

4.1 Summary of Surface Water and Treated Effluent Pathway

To assist in the understanding of this chapter, the following key definitions are provided:

- **Controlled runoff** is contaminated storm water that is collected and, under normal circumstances, treated and discharged to the Great Miami River as treated effluent.
- **Uncontrolled runoff** is storm water that is not collected for treatment, but enters the site's natural drainages.
- **Treated effluent** is water from numerous sources at the site, which is treated through one of the site's wastewater treatment facilities, then discharged to the Great Miami River.
- **Surface water** is water that flows within natural drainage features.

The treated effluent pathway is comprised of those flows discharged to the Great Miami River via the Parshall Flume (PF 4001). Discharges through this point are considered under the control of wastewater operations. Under normal operation this combined flow is comprised of:

- Storm water runoff collected from the former production area and the waste pit area
- Treated and untreated groundwater from the South Plume, South Field, and Waste Storage Area Modules
- Treated remediation wastewater, such as on-site disposal facility leachate, decontamination rinse water generated during building decontamination and dismantling activities, and wastewater generated from pit dewatering and the operation of the Waste Pits Project dryer facility
- Treated sanitary wastewater from the sewage treatment plant.

During periods of heavy or sequential rainfall events when the Storm Water Retention Basin is close to overflowing, untreated storm water is bypassed directly to the Great Miami River in order to minimize or prevent the Storm Water Retention Basin from overflowing into Paddys Run.

The volume and flow rate of uncontrolled runoff depends on the amount of precipitation within any given period of time. Figure 1-10 in Chapter 1 shows monthly precipitation totals for 2005. Figure 4-1 shows the site's natural drainage features and defines the areas from which runoff is either controlled or uncontrolled. The site's natural surface water drainages include several tributaries to Paddys Run (e.g., Pilot Plant drainage ditch and storm sewer outfall ditch) as well as the northeast drainage that flows to the Great Miami River. The arrows on Figure 4-1 indicate the general flow direction of uncontrolled runoff that is determined from the topography. Uncontrolled runoff from the Fernald site leaves the property via two drainage pathways: Paddys Run and the northeast drainage.

4.2 Remediation Activities Affecting Surface Water Pathway

Major remediation activities in 2005 that affected (or had the potential to affect) the surface water pathway include:

- Construction activities associated with the on-site disposal facility including excavation, screening, and hauling activities in the on-site disposal facility borrow area
- Waste hauling and placement activities associated with the on-site disposal facility
- Soil excavation activities conducted by the Environmental Closure, Soil, and Disposal Facility Project (refer to Chapter 2)
- Activities associated with the Waste Pits Project including dryer operation, pit excavation and waste material handling, and railcar loading
- Operational activities associated with the Accelerated Waste Retrieval, Radon Control System; Silos 1 and 2 Project, and Silo 3 Project.

To minimize the effects of remediation on the environment, engineered and administrative controls are used at the Fernald site to reduce the amount of sediment entering the surface water drainages during rainfall events. As water flows over soil, contaminants typically move with the water either by being adsorbed to the sediment eroded from the land surface or by being dissolved in the water itself. The chosen sediment control method varies based on the contaminants expected during excavation, the topography of the area, and the size and duration of the excavation.

Engineered sediment controls can include the construction of sedimentation basins (lined or unlined), silt fences, check dams, and permanent or temporary seeding. Diversion ditches are also constructed as an engineered control to divert clean water from areas of remediation. Ditches are sometimes lined with riprap (large rocks) and/or synthetic liners to control erosion. Administrative controls include limiting the duration of open excavations, as well as routinely inspecting each of the engineered controls used.

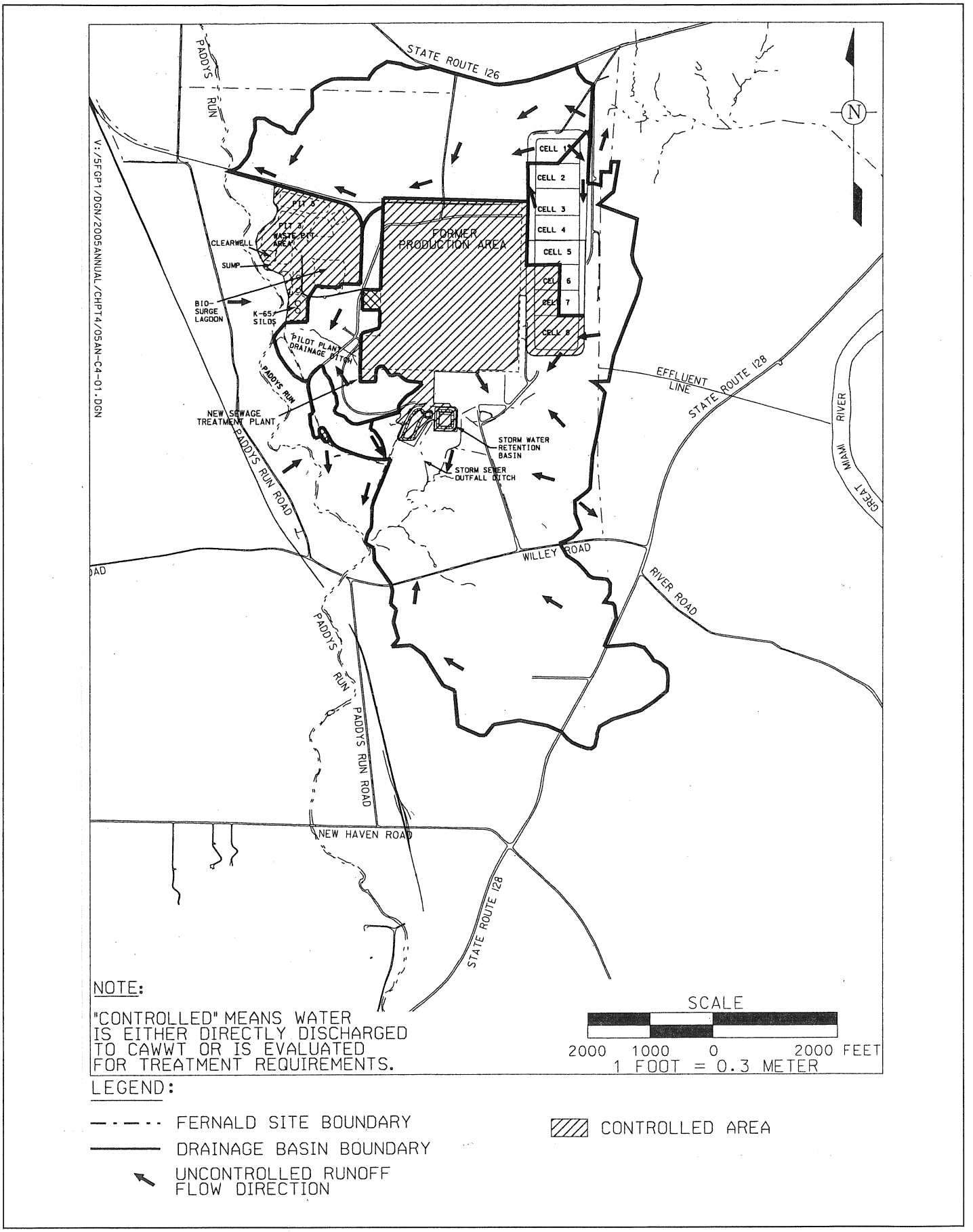

Figure 4-1. Controlled Surface Water Areas and Uncontrolled runoff Flow Directions

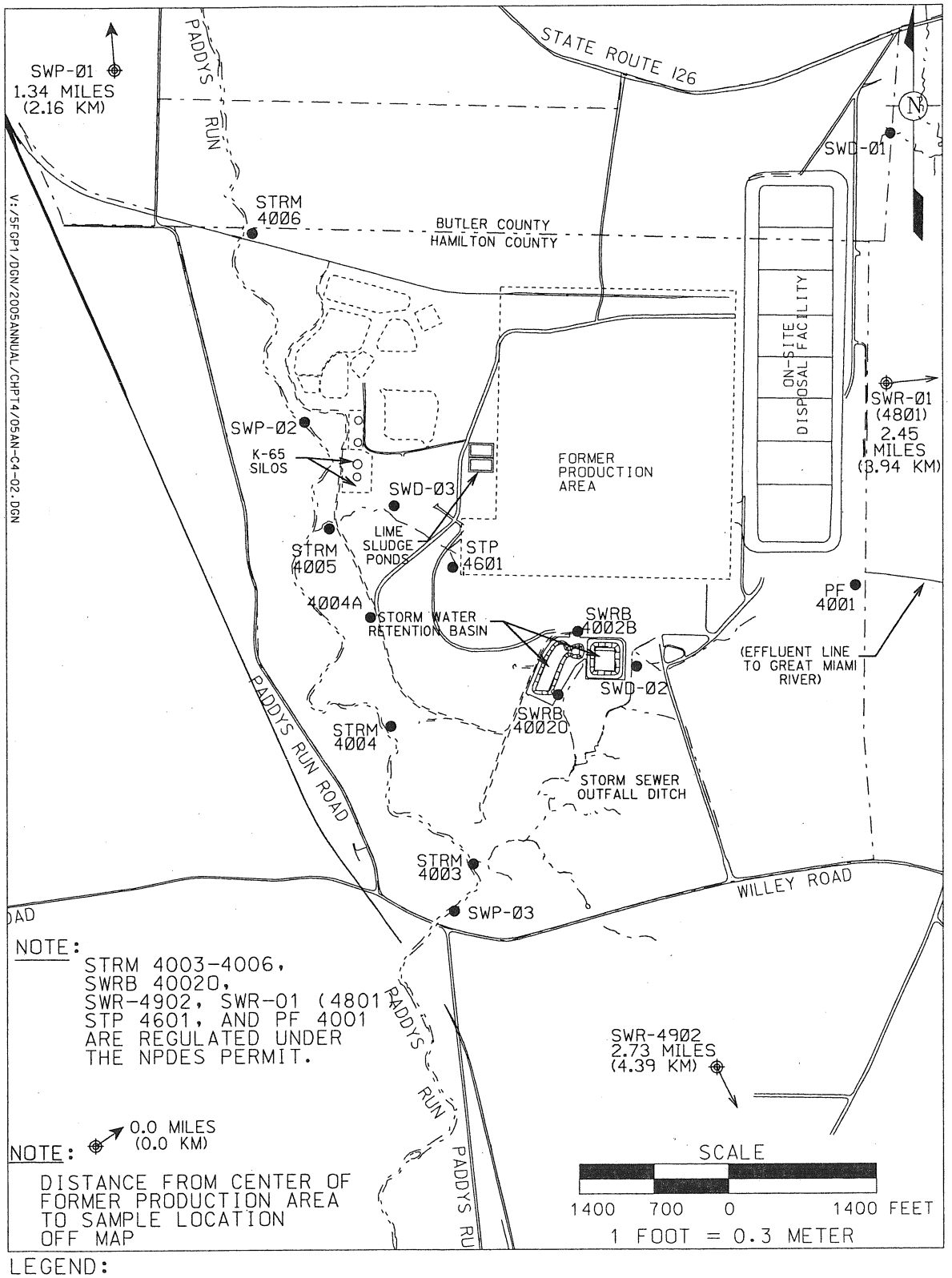

Figure 4-2. IEMP/NPDES Surface Water and Treated Effluent Sample Locations

Each remediation project is responsible for constructing and maintaining the engineered control structures required under its remedial design. All engineered sediment and surface water controls are inspected at least once a week and within 24 hours of any rain event measuring greater than 0.5 inch (1.3 cm) of rain in a 24-hour period. Discharge points for uncontrolled runoff to Paddys Run are also inspected periodically to assess the effectiveness of upgradient controls in preventing significant impacts to Paddys Run. Minor maintenance activities (e.g., silt fencing repairs and reseeding of eroded areas) were performed in 2005 as a result of these inspections. Though no new storm water controls were installed in 2005, many previously installed engineered controls continued to be used and maintained.

4.3 Surface Water, Treated Effluent, and Sediment Monitoring Program for 2005

Surface water, treated effluent, and sediment are sampled to determine the effect of the Fernald site's remediation activities on the environment. Surface water is sampled at several locations in the site's drainages and analyzed for various radiological and non-radiological constituents. Treated effluent is sampled prior to discharge into the Great Miami River. Sediment is sampled for total uranium in the Great Miami River. In 2005, certification sampling for sediment was completed in major site drainages (i.e., storm sewer outfall ditch).

Following is a description of the key elements of the surface water and treated effluent program design:

- **Sampling** – Sample locations, frequency, and constituents were selected to address the requirements of the NPDES Permit, Federal Facility Compliance Agreement (FFCA), and the Operable Unit 5 Record of Decision, and to provide a comprehensive assessment of surface water quality at 16 key locations including two background locations (refer to Figures 4-2 and 4-3). Surface water is monitored for 17 FRL constituents.

- **Data Evaluation** – The integrated data evaluation process focuses on tracking and evaluating data compared with background and historical ranges, FRLs, and NPDES limits. This information is used to assess impacts on surface water due to site remediation activities affecting uncontrolled runoff or treated effluent. The assessment also includes identifying the potential for impacts from surface water to the groundwater in the underlying Great Miami Aquifer. The ongoing data evaluation is designed to support remedial action decision-making by providing timely feedback to the remediation project organizations on the effectiveness of storm water runoff controls and treatment processes.

- **Reporting** – Surface water and treated effluent data are reported through the annual site environmental reports. Monthly discharge monitoring reports required by the NPDES Permit are submitted to OEPA.

The IEMP sediment monitoring program includes an annual sampling program with data reported through annual site environmental reports.

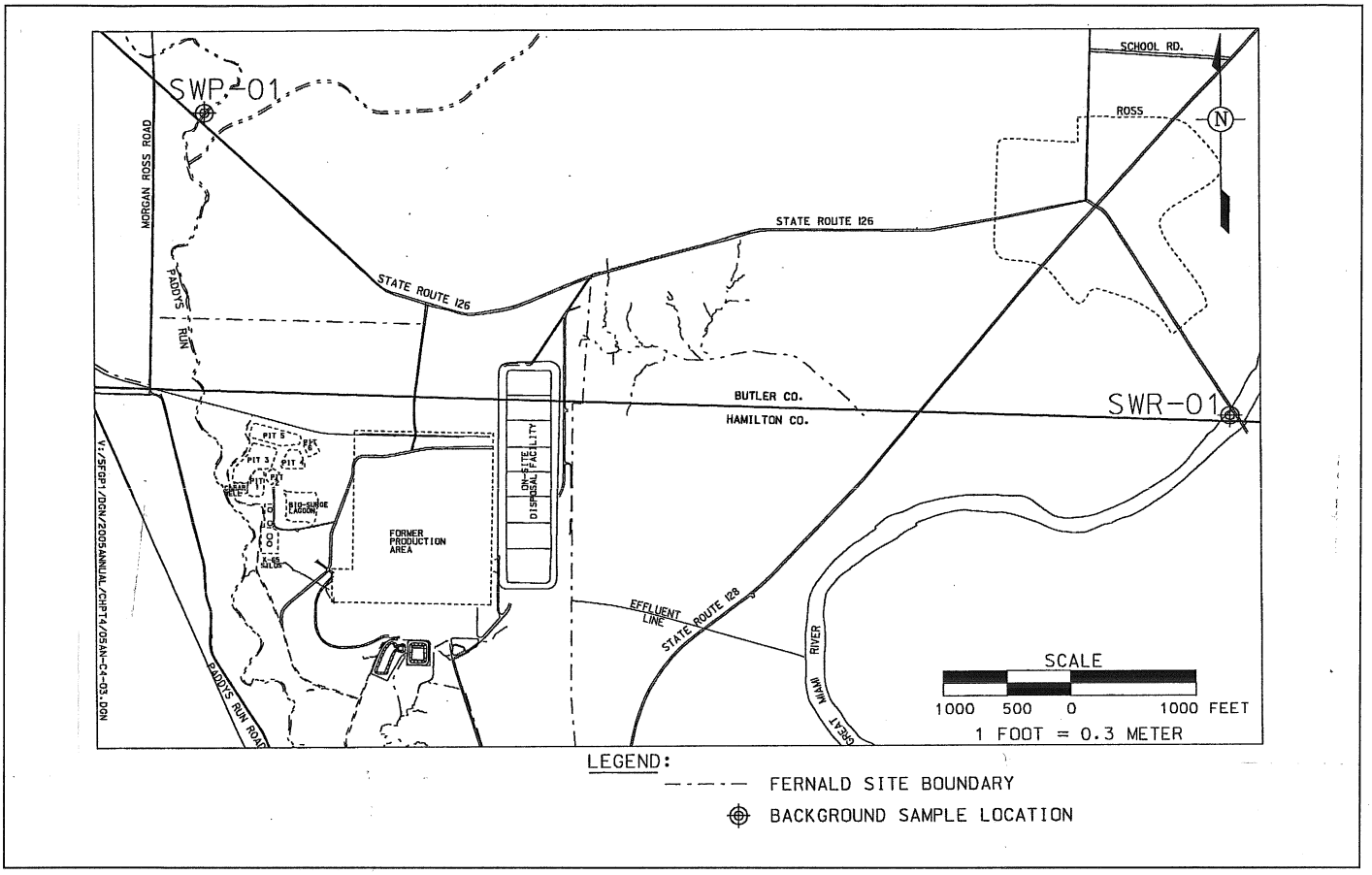

Figure 4-3. IEMP Background Surface Water Sample Locations

Data from samples collected under the IEMP are used to fulfill both surveillance and compliance monitoring functions. Surveillance monitoring results of the IEMP surface water and treated effluent program are used to assess the collective effectiveness of site storm water controls and wastewater treatment processes in preventing unacceptable impacts to the surface water and groundwater pathways. Compliance monitoring includes sampling at storm water and treated effluent discharge points, and is conducted to comply with provisions in the NPDES Permit, the FFCA, and the Operable Unit 5 Record of Decision. The data are routinely evaluated to identify any unacceptable trends and to trigger corrective actions when needed to ensure protection of these critical environmental pathways. Figure 4-2 depicts IEMP/NPDES surface water and treated effluent sample locations; Figure 4-3 shows IEMP background sample locations.

Treated effluent is discharged to the Great Miami River through the effluent line identified on Figure 4-1. Samples of the treated effluent are collected at the Parshall Flume (PF 4001). The resulting data are used to calculate the concentration of each FRL constituent after the effluent water mixes with the water in the Great Miami River.

4.3.1 Surveillance Monitoring

Data resulting from 2005 sampling efforts were evaluated to provide surveillance monitoring of remediation activities. This evaluation indicated that during 2005, there were no exceedances of any surface water FRLs including the total uranium FRL (530 µg/L) in any of the surface water and treated effluent samples.

The following two key sample locations represent points where surface water or treated effluent leaves the site:

- Paddys Run at the Willey Road property boundary (sample location SWP-03)
- Parshall Flume (PF 4001) located at the entry point of the effluent line leading to the Great Miami River.

Evaluation of the data from these locations is especially important because the locations represent points beyond which direct exposure to the public is possible. There were no FRL exceedances during 2005 at these two locations.

The maximum total uranium concentration at SWP-03 during 2005 was 2.4 µg/L, which is well below the surface water total uranium FRL of 530 µg/L. Figure 4-4 shows the annual average total uranium concentration in Paddys Run at Willey Road for the period 1985 through 2005. This figure illustrates the decrease of the total uranium concentration in Paddys Run from 1986, following completion of the Storm Water Retention Basin, which collects contaminated storm water from the former production area.

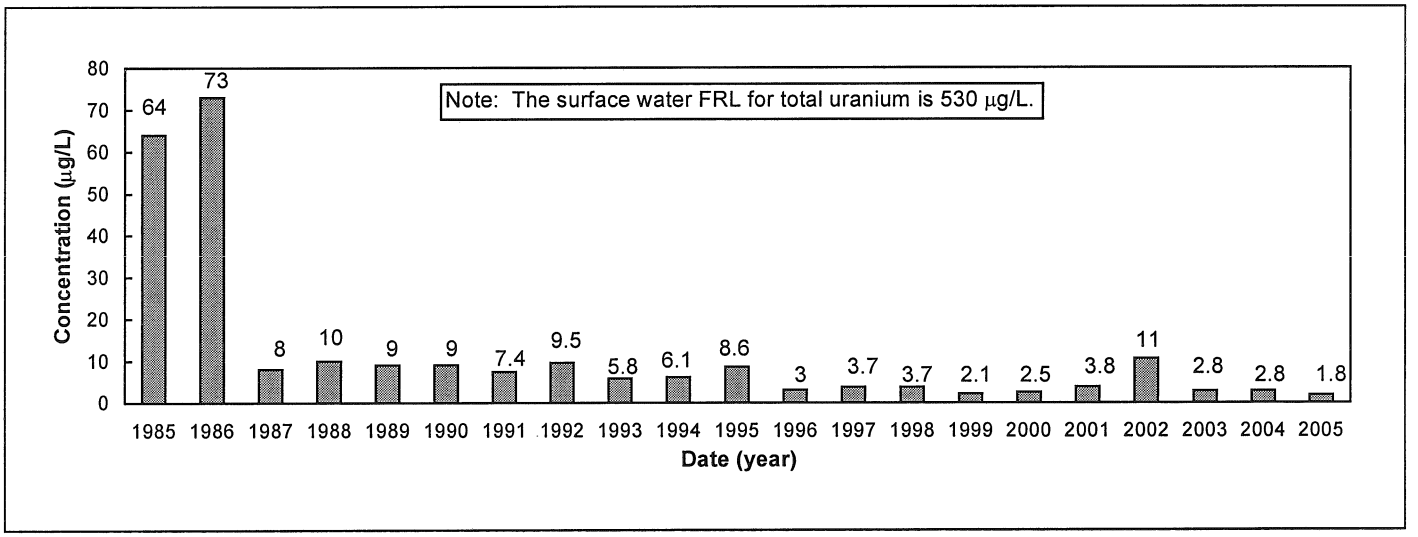

Figure 4-4. Annual Average Total Uranium Concentrations in Paddys Run at Willey Road (SWP-03) Sample Location, 1985-2005

Samples collected at the Parshall Flume (PF 4001) are used in the surveillance evaluation because this is the last point where treated effluent is sampled prior to discharge to the Great Miami River. Data collected from this location cannot directly be compared to the surface water FRL without considering the effect of the effluent waters mixing with the Great Miami River. This is done through the use of a mixing equation.

The maximum daily total uranium concentration at the Parshall Flume (PF 4001) in 2005 prior to discharge through the effluent line to the Great Miami River was 114.8 µg/L. After the water from the Parshall Flume (PF 4001) mixed with the water in the Great Miami River, the concentration would have been approximately 1 mg/L. Both concentrations, those from the Parshall Flume (PF 4001) and after mixing with the Great Miami River, were well below the surface water total uranium FRL of 530 µg/L. Contaminant concentrations observed at the Parshall Flume (PF 4001) in 2005 are discussed further in the compliance monitoring section.

Evaluation of surface water data is also performed in order to provide an ongoing assessment of the potential for cross-media impacts from surface water to the underlying Great Miami Aquifer. In areas where there is no glacial overburden, a direct pathway exists for contaminants to reach the aquifer. This contaminant pathway to the aquifer was considered in the design of the groundwater remedy. The groundwater remedy includes placing groundwater extraction wells downgradient of these areas where direct infiltration occurs in order to mitigate any potential cross-media impacts during surface remediation. To provide this assessment, sample locations were selected to evaluate contaminant concentrations in surface water just upstream of, or within, those areas where site drainages have eroded through the protective glacial overburden. This includes locations SWP-02, SWD-02, SWD-03, STRM 4005, and the Storm Water Retention Basin overflow (SWRB 4002O).

During 2005, two of the five surface water locations evaluated (SWD-03 and STRM 4005) had results that exceeded the total uranium groundwater FRL of 30 µg/L. Table 4-1 summarizes these total uranium cross-media exceedances. Of the locations evaluated, only SWD-03 had a result that exceeded the groundwater FRL for a constituent other than uranium. This groundwater FRL exceedance was for zinc from a sample collected on October 24, 2005 (0.0367 mg/L versus groundwater FRL of 0.021 mg/L). Additional details of the FRL exceedances are presented in Appendix B, Attachment B.1, of this report.

TABLE 4-1
SURFACE WATER TOTAL URANIUM RESULTS EXCEEDING THE GROUNDWATER FRL AT CROSS-MEDIA IMPACT LOCATIONS DURING 2005

Location	Number of Surface Water Results Exceeding the Groundwater FRL for Total Uranium[a]	Total Number of Samples	Range of 2005 Data above FRL (µg/L)
STRM 4005	1	4	45.8
SWD-03	1	4	40.8

[a]The surface water result is compared to the groundwater FRL of 30 µg/L for the purpose of evaluating potential cross-media impacts.

4.3.2 Compliance Monitoring

4.3.2.1 FFCA and Operable Unit 5 Record of Decision Compliance

The FCP is required to monitor treated effluent discharges at the Parshall Flume (PF 4001) for total uranium mass discharges and total uranium concentrations. This requirement is identified in the July 1986 FFCA and the Operable Unit 5 Record of Decision. The Operable Unit 5 Record of Decision requires treatment of effluent so that the mass of total uranium discharged to the Great Miami River through the Parshall Flume (PF 4001) does not exceed 600 pounds (272 kg) per year. The Operable Unit 5 Record of Decision and subsequent approval of the Explanation of Significant Differences also require that the monthly average total uranium concentration in the effluent must be at or below 30 µg/L.

The Operable Unit 5 Record of Decision allows the Fernald site to discharge water from the Storm Water Retention Basin directly to the Great Miami River during periods of heavy precipitation. This is allowed in order to reduce the possibility of an overflow condition for the Storm Water Retention Basin. An overflow condition has the potential to generate cross-media impacts as described above.

To comply with the monthly average total uranium concentration limit during these types of bypasses, the FCP is allowed to deduct these uranium concentrations from the monthly average total uranium calculation at the Parshall Flume (PF 4001) for up to 10 significant precipitation bypass days per year. However, the mass of total uranium discharged during these 10 days per year is still considered in the total discharge mass in order to ensure the discharge limit of 600 pounds (272 kg) per year is not exceeded.

In addition to significant precipitation-related bypasses, the site is also allowed to bypass water from the Storm Water Retention Basin during certain scheduled wastewater treatment plant maintenance activities. These maintenance bypasses must be pre-approved by the regulatory agencies. The total uranium concentration in the discharge related to maintenance activities may be deducted from the monthly average calculation demonstrating compliance with the total uranium monthly average concentration limit. However, the mass of total uranium discharged during these maintenance bypasses is still considered in the total discharge mass to ensure the discharge limit of 600 pounds (272 kg) per year is not exceeded.

During 2005, there was one bypass event as a result of significant precipitation (January 5 through 7, 49 hours). Figure 4-5 shows that the cumulative mass of total uranium discharged to the Great Miami River during 2005 was 373.92 pounds (169.76 kg), which is below the annual discharge limit of 600 pounds (272 kg). Figure 4-6 shows that the total uranium monthly average concentration limit was met every month during 2005.

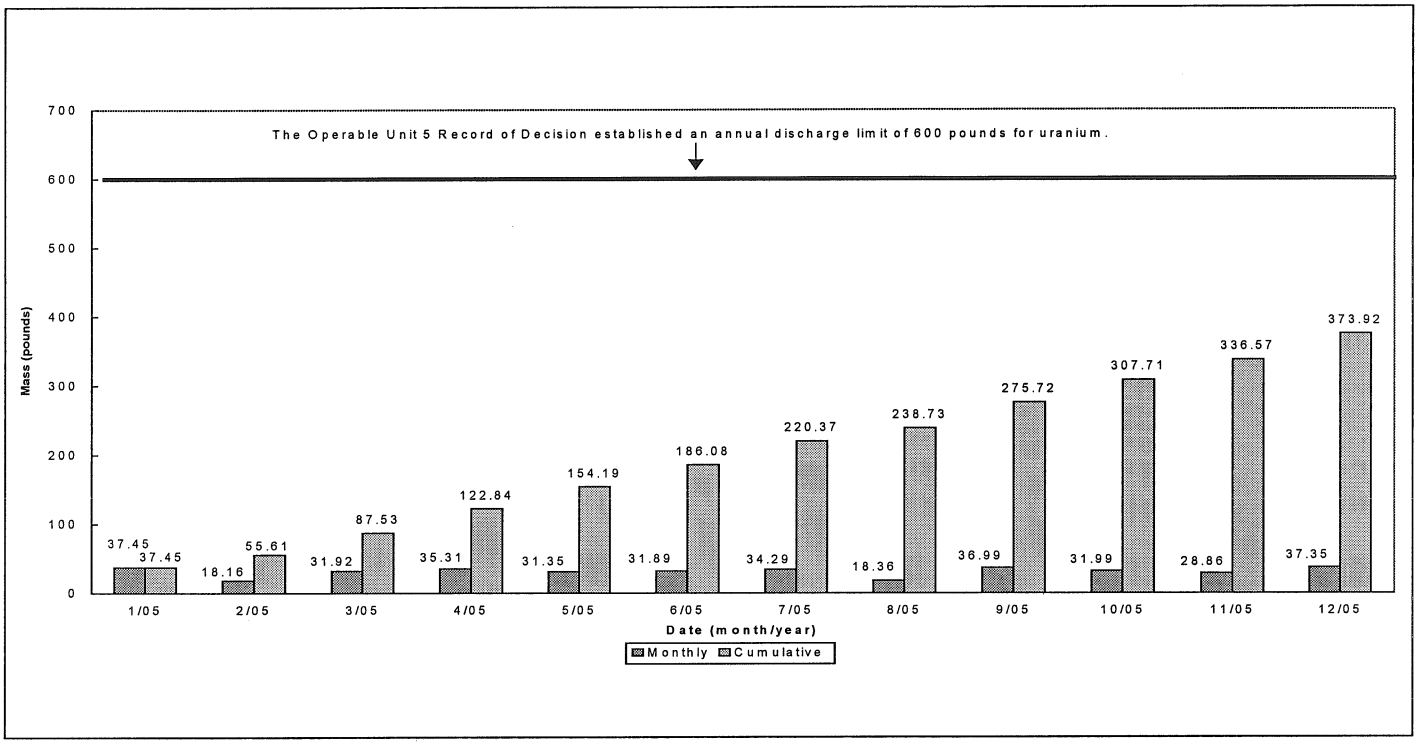

Figure 4-5. Pounds of Uranium Discharged to the Great Miami River from the Parshall Flume (PF 4001) in 2005

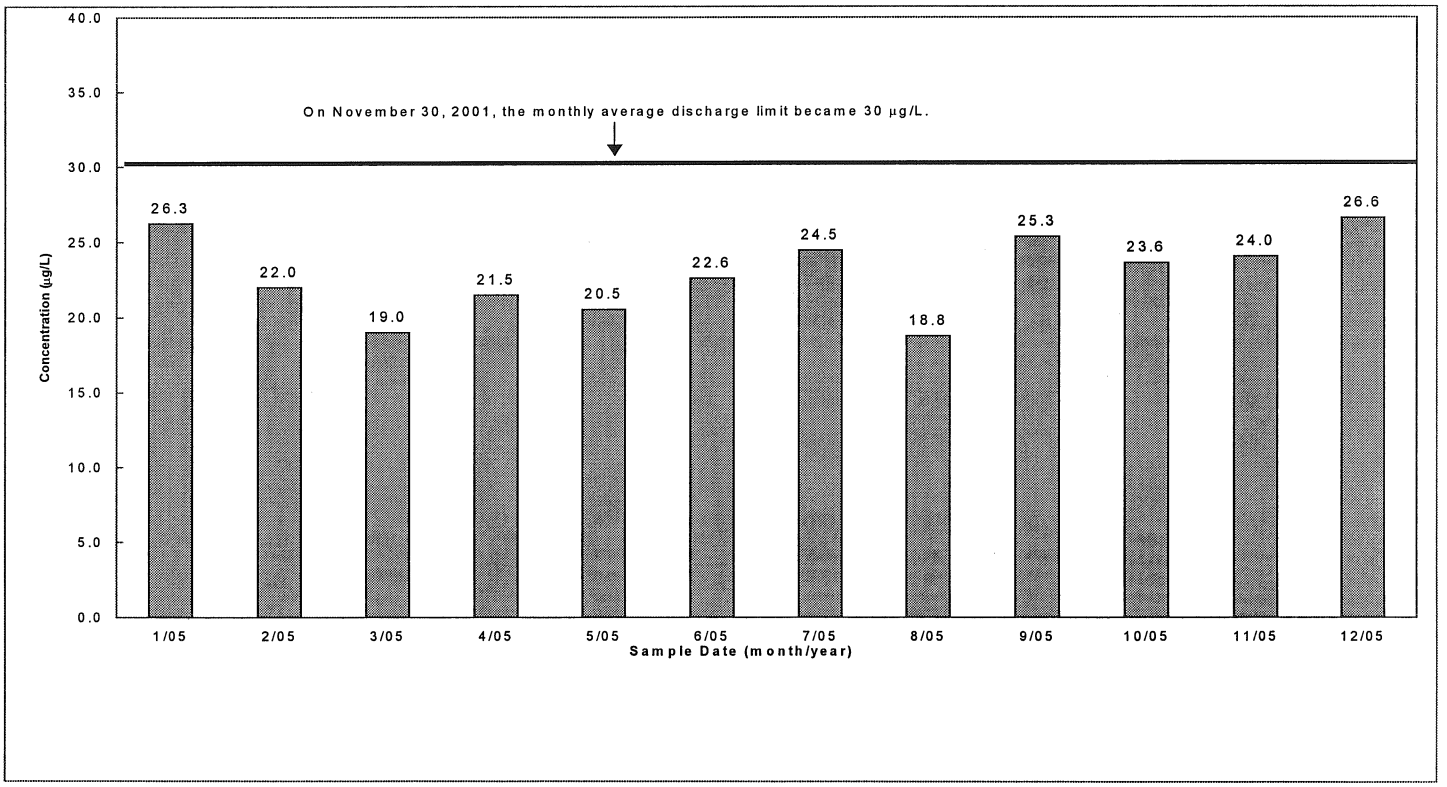

Figure 4-6. 2005 Monthly Average Total Uranium Concentration in Water Discharged from the Parshall Flume (PF 4001) to the Great Miami River

4.3.2.2 NPDES Permit Compliance

Compliance sampling, consisting of sampling for non-radiological pollutants from uncontrolled runoff and treated effluent discharges from the Fernald site, is regulated under the state-administrated NPDES program. The current permit became effective on July 1, 2003 and expires on June 30, 2008. The permit specifies discharge and sample requirements, as well as discharge limits for several constituents. Figure 4-2 identifies NPDES sample locations. A total of three non-compliances were reported to OEPA pursuant to the terms of the NPDES Permit, as summarized in Table 4-2.

TABLE 4-2

EXCEEDANCES OF THE NPDES PERMIT DURING 2005

Date/Month	Location	Parameter	Permit Limit	Actual Result	Possible Cause	Corrective Action
6/13	STRM 4004	pH	6.5	6.38	Suspect data	None. Continue to monitor and observe
6/13	STRM 4005	pH	6.5	6.09	Suspect data	None. Continue to monitor and observe
6/13	STRM 4006	pH	6.5	6.36	Suspect data	None. Continue to monitor and observe

Note: Permit indicates pH must be between 6.5 and 9.0.

4.3.3 Uranium Discharges in Surface Water and Treated Effluent

As identified in Figure 4-5, 373.92 pounds (169.76 kg) of uranium in treated effluent were discharged to the Great Miami River through the Parshall Flume (PF 4001) in 2005. In addition to the treated effluent, uncontrolled runoff is also contributing to the amount of uranium entering the environment. Figure 4-7 presents the pounds of uranium from the uncontrolled runoff and controlled discharges from 1993 through 2005.

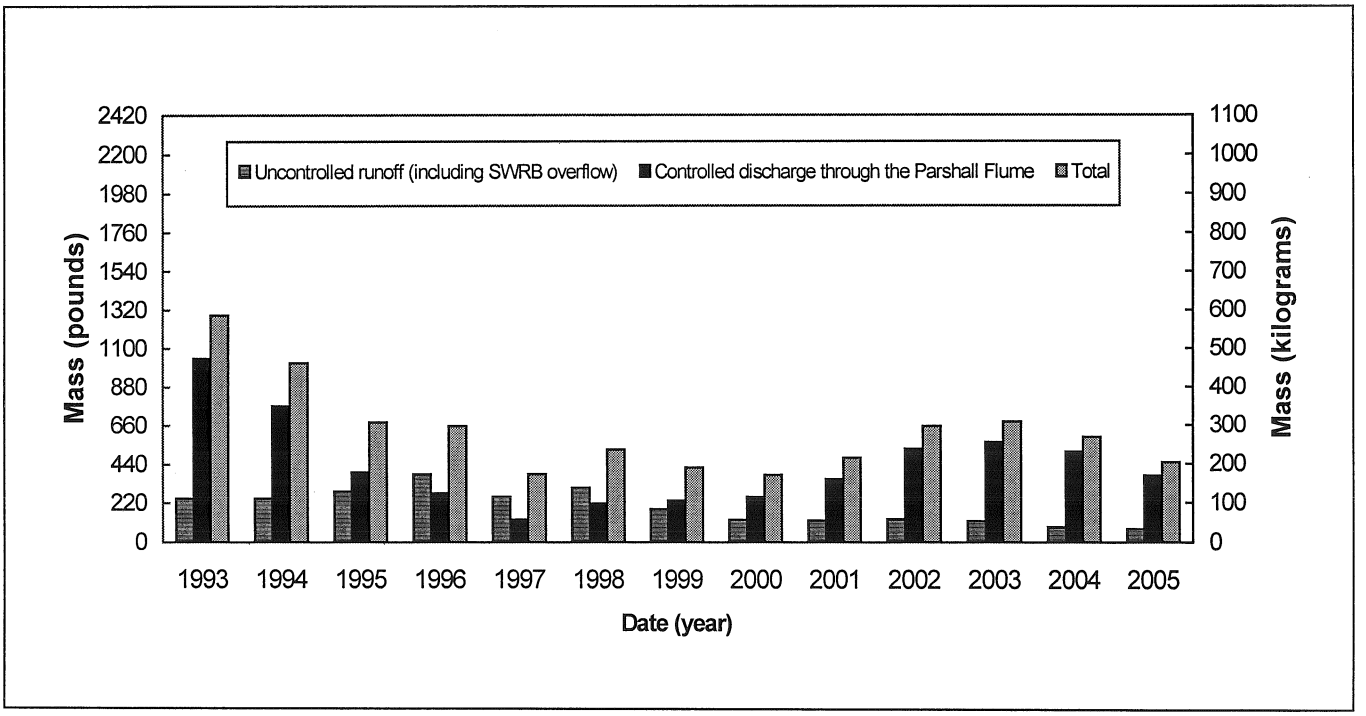

Figure 4-7. Uranium Discharged Via the Surface Water Pathway, 1993-2005

A loading term is used to estimate the pounds of uranium discharged to Paddys Run via uncontrolled runoff. This loading term was most recently revised and approved in August 2004 based on total uranium data, which reflect the decreasing total uranium concentrations measured at points discharging to Paddys Run. Total uranium concentrations measured in Paddys Run have been decreasing due to significant improvements in the capture of contaminated storm water and the progress and effectiveness of remediation activities. The loading term is 2.1 pounds uranium per inch of rainfall, a decrease from the previous loading term of 2.6 pounds of uranium per inch of rainfall.

Based on the approval date for the loading term, 2.1 should have been used to calculate pounds of uranium from uncontrolled runoff in the 2004 Site Environmental Report; however, the loading term of 2.6 was used. Approximately 104 pounds (47 kg) of uranium from uncontrolled runoff was reported in the 2004 Site Environmental Report (DOE 2005i). Using the loading term of 2.1, pounds of uranium discharged from uncontrolled runoff should have been 84 pounds (38 kg) in 2004 for a total of 593 pounds (269 kg) of uranium discharged to the surface water pathway for the year.

During 2005, 35.55 inches (90.3 cm) of precipitation fell at the Fernald site; therefore, an estimated 75 pounds (34 kg) of uranium entered the environment through uncontrolled runoff.

The estimated total amount of uranium discharged to the surface water pathway for the year, including both controlled treated effluent discharges and uncontrolled runoff, was approximately 449 pounds (204 kg).

4.4 Sediment Monitoring

Sediment is a secondary exposure pathway and is monitored annually to assess the impact of remediation activities on sediments deposited along surface water drainages. For the IEMP, sediment samples were collected at strategic locations in the Great Miami River (i.e., upgradient and downgradient of the effluent line). Sediment samples analyzed for total uranium were collected in October 2005 at two locations in the Great Miami River (refer to Figure 4-8). Table 4-3 presents the 2005 results, which show that all uranium results (approximately 3 mg/kg) were below the sediment FRL (210 mg/kg).

Certification against sediment FRLs was also conducted on-site in 2005 (i.e., storm sewer outfall ditch) as identified in Chapter 2. Final certification for the storm sewer outfall ditch, an on-site drainage way, was approved by the OEPA in November and by EPA in December. Appendix B, Attachment B.2, of this report contains additional details of the IEMP and certification sediment monitoring results. Sediment certification for all major on-site drainages should be completed during 2006.

TABLE 4-3
2005 SUMMARY STATISTICS FOR SEDIMENT MONITORING PROGRAM

Radionuclide	Sediment FRL	No. of Samples	2005 Results Concentration (dryweight) pCi/g	(mg/kg)
Great Miami River, North of the Effluent Line (G2)				
Total Uranium	210 mg/kg	1	2.23	(3.30)
Great Miami River, South of the Effluent Line (G4)				
Total Uranium	210 mg/kg	1	2.05	(3.03)

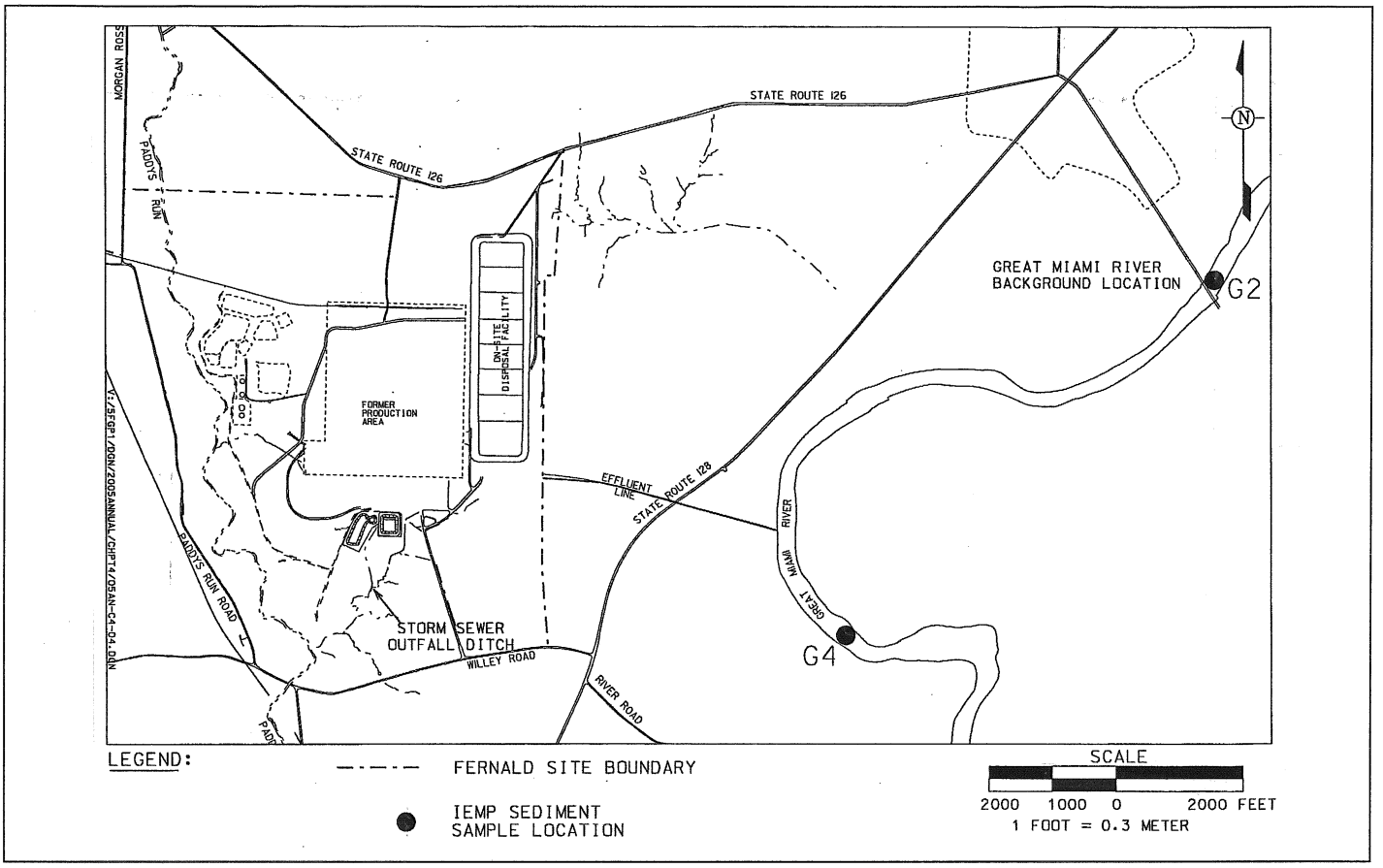

Figure 4-8. 2005 Sediment Sample Locations

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