

## **6. GROUNDWATER PROGRAMS**

### **6.1 SUMMARY**

Groundwater monitoring at DOE PORTS is required by a combination of state and federal regulations, legal agreements with the Ohio EPA and U.S. EPA, and DOE Orders. More than 400 monitoring wells are used to track the flow of groundwater and to identify and measure groundwater contaminants. Groundwater programs also include on-site surface water monitoring and water supply monitoring.

In general, the contaminated groundwater plumes present at PORTS did not change significantly in 2005. One minor change of note is the decrease in concentrations of trichloroethene detected in three wells in the southern portion of the X-749/X-120 groundwater plume near the DOE property boundary. However, trichloroethene and several other volatile organics were detected in the X-749/X-120 plume at concentrations less than 3  $\mu\text{g/L}$  (3 ppb) in an off-site well approximately 45 feet south of the DOE property line. Trichloroethene has not been detected in groundwater beyond the DOE property boundary at concentrations that exceed the drinking water standard (called the maximum contaminant level [MCL]) of 5  $\mu\text{g/L}$ . The *2005 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides further details on the groundwater plumes at PORTS, specific monitoring well identifications, and analytical results for monitoring wells. This document and other documents referenced in this chapter are available in the PORTS Environmental Information Center.

### **6.2 INTRODUCTION**

This chapter provides an overview of groundwater monitoring at PORTS and the results of the groundwater monitoring program for 2005. The following sections provide an overview of the DOE PORTS groundwater monitoring program followed by a review of the history and 2005 monitoring data for each area.

This chapter also includes information on the groundwater treatment facilities at PORTS. These facilities receive contaminated groundwater from the groundwater monitoring areas and treat the water prior to discharge through the DOE PORTS permitted NPDES outfalls.

### **6.3 OVERVIEW OF GROUNDWATER MONITORING AT DOE PORTS**

This section provides an overview of the regulatory basis for groundwater monitoring at PORTS, groundwater use and geology, and monitoring activities and issues.

#### **6.3.1 Regulatory Programs**

Groundwater monitoring at PORTS was initiated in the 1980s. Groundwater monitoring has been conducted in response to state and/or federal regulations, regulatory documents prepared by DOE PORTS, agreements between the DOE and Ohio EPA or U.S. EPA, and DOE Orders.

Because of the numerous regulatory programs applicable to groundwater monitoring at PORTS, an *Integrated Groundwater Monitoring Plan* was developed to address all groundwater monitoring requirements for PORTS. The initial plan, dated November 1998, was reviewed and approved by the

Ohio EPA and implemented at PORTS starting on April 1, 1999. The *Integrated Groundwater Monitoring Plan* is periodically revised and approved by the Ohio EPA.

In 2005, groundwater monitoring at PORTS was performed under the *Integrated Groundwater Monitoring Plan* dated October 2004 and replacement pages dated May 2005 that resolved a minor issue with monitoring at the X-749A and X-735 Landfills. However, the results of two special studies at the X-749/X-120/PK Landfill Area in Quadrant I caused changes to the monitoring of this area during 2005 that are not part of the October 2004 *Integrated Groundwater Monitoring Plan*. The Ohio EPA approved the *Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Areas* in a letter dated March 14, 2005. Approval of this report discontinued sampling conducted solely for the report beginning in the second quarter of 2005. The Ohio EPA approved the *Evaluation of the Groundwater Monitoring Network for the X-749/X-120/PK Landfill Area* in a letter dated June 2, 2005, and the changes to the monitoring program for the X-749/X-120/PK Landfill area provided in this report were implemented beginning in the third quarter of 2005. Section 6.4.1 provides additional information about these changes.

Groundwater monitoring is also conducted to meet DOE Order requirements. Exit pathway monitoring assesses the effect of PORTS on off-site groundwater quality. DOE Orders are the basis for radiological monitoring of groundwater at PORTS.

### **6.3.2 Groundwater Use and Geology**

PORTS is the largest industrial user of water in the vicinity and obtains water from three water supply well fields that are next to the Scioto River south of Piketon. The wells tap the Scioto River Valley buried aquifer. In 2005, total groundwater production from the water supply well fields averaged approximately 3.2 million gallons per day for the entire site (including USEC activities). Groundwater directly beneath PORTS is not used as a domestic, municipal, or industrial water supply, and contaminants in the groundwater beneath PORTS do not affect the quality of the water in the Scioto River Valley buried aquifer. In addition, the DOE has filed a deed notification at the Pike County Auditor's Office that restricts the use of groundwater beneath the PORTS site.

Two water-bearing zones are present beneath PORTS: the Gallia and Berea formations. The Gallia is the uppermost water-bearing zone and contains most of the groundwater contamination at PORTS. The Berea is deeper than the Gallia and is usually separated from the Gallia by the Sunbury shale, which acts as a barrier to impede groundwater flow between the Gallia and Berea formations. Additional information about site hydrogeology is available in the PORTS Environmental Information Center.

### **6.3.3. Monitoring Activities and Issues**

Groundwater monitoring at PORTS includes several activities. Samples of water are collected from groundwater monitoring wells and analyzed to obtain information about contaminants and naturally-occurring compounds in the groundwater. Monitoring wells are also used to obtain other information about groundwater. When the level of water, or groundwater elevation, is measured in a number of wells over a short period of time, the groundwater elevations, combined with information about the subsurface soil, can be used to estimate the rate and direction of groundwater flow. The rate and direction of groundwater flow can be used to predict the movement of contaminants in the groundwater and to develop ways to control or remediate groundwater contamination.

In 2005, DOE PORTS contractors identified an issue with analytical data for some radionuclides. As discussed in Chapter 4, Section 4.2, analytical data for transuranic radionuclides and uranium (total uranium and uranium isotopes) analyzed by STL St. Louis in the third and/or fourth quarters of 2005 are

considered not reliable and therefore are not reported. These data include all groundwater and surface water samples collected in accordance with the *Integrated Groundwater Monitoring Plan* during the third quarter of 2005, thirteen surface water locations sampled in the fourth quarter, and samples associated with ten X-749/X-120/PK Landfill area wells sampled in the fourth quarter. All other fourth quarter radiological samples collected in accordance with the *Integrated Groundwater Monitoring Plan* were sent to the USEC Laboratory. Technetium-99 data provided by STL St. Louis are reported because no issues were identified with technetium-99 results in the performance evaluation. Chapter 4, Section 4.2., and the 2005 *Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provide additional information on this issue.

## 6.4 GROUNDWATER MONITORING AREAS

The *Integrated Groundwater Monitoring Plan* requires groundwater monitoring of 11 areas within the quadrants of the site designated by the RCRA Corrective Action Program. These areas (see Figure 6.1) are:

- X-749/X-120/PK Landfill,
- Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility,
- Quadrant II Groundwater Investigative Area,
- X-701B Holding Pond,
- X-633 Pumphouse/Cooling Towers Area,
- X-616 Chromium Sludge Surface Impoundments,
- X-740 Waste Oil Handling Facility,
- X-611A Former Lime Sludge Lagoons,
- X-735 Landfills,
- X-734 Landfills, and
- X-533 Switchyard Area.

The *Integrated Groundwater Monitoring Plan* also contains requirements for (1) surface water monitoring in creeks and drainage ditches at PORTS that receive groundwater discharge, and (2) water supply monitoring.

In general, samples are collected from wells (or surface water locations) at each area listed above and are analyzed for metals, volatile organic compounds, and radiological constituents. Table 6.1 lists the analytical requirements for each groundwater monitoring area and other monitoring programs described in this chapter. DOE PORTS then compares constituents detected in the groundwater to standards called preliminary remediation goals to assess the potential for each constituent to affect human health and the environment.

Five areas of groundwater contamination, commonly called groundwater plumes, have been identified at PORTS. Groundwater contamination consists of volatile organic compounds (primarily trichloroethene) and radionuclides such as uranium and technetium-99. The areas that contain groundwater plumes are X-749/X-120/PK Landfill, Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility, Quadrant II Groundwater Investigative Area, X-701B Holding Pond, and X-740 Waste Oil Handling Facility. Other areas are monitored to evaluate areas of groundwater contaminated with metals, to ensure past uses of the area (such as a landfill) have not caused groundwater contamination, or to monitor remediation that has taken place in the area.

The following sections describe the history of each groundwater monitoring area and groundwater monitoring results for each area in 2005.

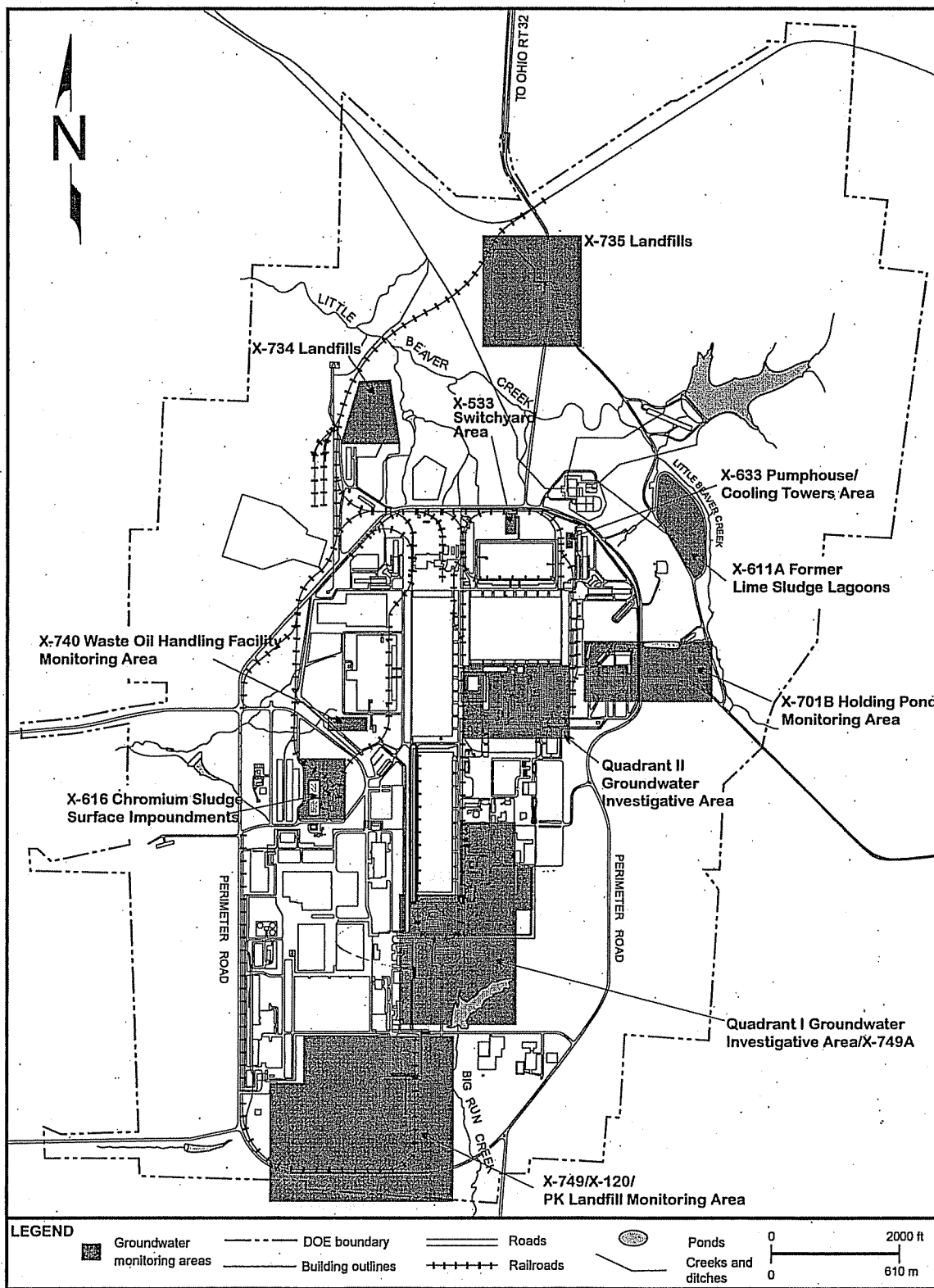


Figure 6.1. Groundwater monitoring areas at PORTS.

**Table 6.1. Analytical parameters for monitoring areas and programs at PORTS**

Monitoring Area or Program		Analytes	
X-749/X-120/PK Landfill <sup>a,b</sup>			
X-749/X-120 plume	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity	chloride sulfate total metals <sup>d</sup> : transuranics <sup>d</sup> :	Ca, Fe, Mg, K, Na <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu
PK Landfill	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity chloride sulfate	total metals <sup>d</sup> :  transuranics <sup>d</sup> :	As, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Ni, K, Se, Na, V, Zn <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu
Quadrant I Groundwater Investigative Area <sup>a,b</sup>			
X-231B plume	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity chloride	sulfate total metals <sup>d</sup> :  transuranics <sup>d</sup> :	Ca, Fe, Mg, Mn, K, Na <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu
X-749A Classified Materials Disposal Facility	volatile organic compounds <sup>e</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>c</sup> alkalinity chloride sulfate nitrite nitrate ammonia	total metals <sup>d</sup> :  transuranics <sup>d</sup> :  chemical oxygen demand total dissolved solids	Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu
Quadrant II Groundwater Investigative Area <sup>a</sup>			
X-701B Holding Pond <sup>a,b</sup>	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity chloride	chloride sulfate total metals <sup>d</sup> : transuranics <sup>d</sup> :	Ca, Fe, Mg, K, Na <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu
X-633 Pumphouse/Cooling Towers Area	total metals <sup>d</sup> : Cr	sulfate total metals <sup>d</sup> :  transuranics <sup>d</sup> :	Ca, Cd, Co, Cr, Fe, Mg, Mn, K, Pb, Na, Ni, Tl <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu

**Table 6.1. Analytical parameters for monitoring areas and programs at PORTS (continued)**

Monitoring Area or Program	Analytes	
X-616 Chromium Sludge Surface Impoundments	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity	chloride sulfate total metals <sup>d</sup> : Ca, Fe, Mg, K, Na, Ba, Cd, Cr, Pb, Mn, Ni, Sb, Tl
X-740 Waste Oil Handling Facility <sup>a</sup>	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity	chloride sulfate total metals <sup>d</sup> : Ca, Fe, Mg, K, Na transuranics <sup>d</sup> : <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu
X-611A Former Lime Sludge Lagoons	total metals <sup>d</sup> : Be, Cr	
X-735 Landfills	volatile organic compounds <sup>e</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity chloride sulfate nitrite nitrate ammonia	total metals <sup>d</sup> : Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Hg, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn transuranics <sup>d</sup> : <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu chemical oxygen demand total dissolved solids
X-734 Landfills	volatile organic compounds <sup>e</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity chloride sulfate nitrite nitrate ammonia	total metals <sup>d</sup> : Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn transuranics <sup>d</sup> : <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu chemical oxygen demand total dissolved solids
X-533 Switchyard Area	total metals <sup>d</sup> : Cd, Co, Ni	
Surface Water	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity	chloride sulfate total metals <sup>d</sup> : Ca, Fe, Mg, K, Na transuranics <sup>d</sup> : <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu
Water Supply	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity	chloride sulfate total metals <sup>d</sup> : Ca, Fe, Mg, K, Na transuranics <sup>d</sup> : <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu

**Table 6.1. Analytical parameters for monitoring areas and programs at PORTS (continued)**

Monitoring Area or Program	Analytes	
Exit Pathway <sup>b</sup>	volatile organic compounds <sup>c</sup> technetium-99 total U, <sup>233/234</sup> U, <sup>235</sup> U, <sup>236</sup> U, <sup>238</sup> U <sup>d</sup> alkalinity	chloride sulfate total metals <sup>d</sup> : Ca, Fe, Mg, K, Na transuranics <sup>d</sup> : <sup>241</sup> Am, <sup>237</sup> Np, <sup>238</sup> Pu, <sup>239/240</sup> Pu

<sup>a</sup>Selected well(s) in this area are sampled once every two years for a comprehensive list of over 200 potential contaminants (Title 40, Code of Federal Regulations, Part 264 Appendix IX – Appendix to Ohio Administrative Code Rule 3745-54-98).

<sup>b</sup>Not all wells at this area are analyzed for all listed analytes.

<sup>c</sup>Acetone, benzene, bromodichloromethane, bromoform, carbon disulfide, carbon tetrachloride, chlorobenzene, chloroethane, chloroform, dibromochloromethane, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, bromomethane, chloromethane, methylene chloride, 2-butanone (methyl ethyl ketone), 4-methyl-2-pentanone (methyl isobutyl ketone), 1,1,2,2-tetrachloroethane, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, trichlorofluoromethane (CFC-11), vinyl chloride, xylenes (M+P xylenes).

<sup>d</sup>Appendix C lists the symbols for metals and transuranic radionuclides.

<sup>e</sup>Volatile organic compounds listed in footnote c plus: acrylonitrile, bromochloromethane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, trans-1,4-dichloro-2-butene, 1,2-dichloropropane, cis-1,3-dichloropropene, trans-1,3-dichloropropene, 2-hexanone (methyl butyl ketone), dibromomethane, iodomethane, styrene, 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane, and vinyl acetate.

#### **6.4.1 X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility/PK Landfill**

In the southernmost portion of PORTS, groundwater concerns focus on three contaminant sources: X-749 Contaminated Materials Disposal Facility, X-120 Old Training Facility, and PK Landfill.

##### **6.4.1.1 X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility**

The X-749 Contaminated Materials Disposal Facility is a landfill located in the south-central section of the facility. The landfill covers approximately 7.5 acres and was built in an area of highest elevation within the southern half of PORTS. The landfill operated from 1955 to 1990, during which time buried wastes were generally contained in metal drums or other containers compatible with the waste.

The northern portion of the X-749 landfill contains waste contaminated with industrial solvents, waste oils from plant compressors and pumps, sludges classified as hazardous, and low-level radioactive materials. The southern portion of the X-749 landfill contains non-hazardous, low-level radioactive scrap materials.

The initial closure of the X-749 landfill included installation of (1) a multimedia cap, (2) a barrier wall along the north side and northwest corner of X-749 landfill, and (3) subsurface groundwater drains on the northern half of the east side and the southwest corner of the landfill, including one sump within each of the groundwater drains. The barrier wall and subsurface drains extend down to bedrock. An additional barrier wall on the south and east sides of the X-749 landfill was constructed in 2002. The groundwater drain and sump on the east side of the landfill were removed for construction of this barrier wall. Groundwater from the remaining subsurface drain is treated at the X-622 Groundwater Treatment Facility and discharged through DOE NPDES Outfall 608, which flows to the USEC Sewage Treatment Plant.

The leading edge of the contaminated groundwater plume emanating from the X-749 landfill has been approaching the southern boundary of PORTS. In 1994, a subsurface barrier wall was completed across a portion of this southern boundary of PORTS. The X-749 South Barrier Wall was designed to inhibit migration of the plume off plant property prior to the implementation of a final remedial measure; however, volatile organics have moved beyond the wall. A project was begun in 2004 and continued in 2005 to remediate volatile organics in this area. Hydrogen release compounds, which act as an accelerant to the natural microbial process that breaks down volatile organics into nontoxic compounds, were injected into the soil in over 150 locations during March and April 2004. Additional monitoring took place after the injections to monitor the concentrations of volatile organics, gases, and other breakdown products in the groundwater.

The X-120 Old Training Facility covered an area of approximately 11.5 acres near the present-day XT-847 building. The X-120 facility, which no longer exists, included a machine shop, metal shop, paint shop, and several warehouses used during the construction of PORTS in the 1950s. Groundwater in the vicinity of this facility is contaminated with volatile organic compounds, primarily trichloroethene. In 1996, a horizontal well was installed along the approximate axis of the X-120 plume. Contaminated groundwater flows from this well to the X-625 Groundwater Treatment Facility. On July 9, 2003, operation of the X-625 Groundwater Treatment Facility and horizontal well was placed on stand-by with approval from Ohio EPA. The horizontal well and treatment facility did not operate during 2005.

The *Comprehensive Monitoring Program for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant* was developed in 2003 to evaluate the effect of the new X-749 barrier wall on groundwater quality and migration in the northern area of the X-749 plume and at the PK Landfill. Groundwater quality monitoring required by the program began in the fourth quarter of 2003

and continued through the first quarter of 2005. DOE submitted the *Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Areas* to Ohio EPA in February 2005. The report stated: “(d)ata collected to date is sufficient to determine the effectiveness of the remedial systems addressed by the Comprehensive Monitoring Program. Therefore, additional analytical sampling of monitoring wells, manholes, surface water, and sediment being conducted exclusively for the Comprehensive Monitoring Program is no longer necessary and should be discontinued.” Ohio EPA approved the report in a letter dated March 14, 2005, and sampling conducted solely for the Comprehensive Monitoring Program was discontinued starting in the second quarter of 2005. Chapter 3, Section 3.2.1.1 provides more information about the results of the Comprehensive Monitoring Program.

The *Evaluation of the Groundwater Monitoring Network for the X-749/X-120/PK Landfill Area*, approved by Ohio EPA in a letter dated June 2, 2005, and implemented in the third quarter of 2005, changed monitoring at the X-749/X-120/PK Landfill Area. In general, the evaluation decreased the number of parameters and frequency of monitoring at the X-749/X-120/PK Landfill wells, although the monitoring frequency and number of monitoring parameters increased at some wells. The *Evaluation of the Groundwater Monitoring Network for the X-749/X-120/PK Landfill Area* provides specific information on the changes made to the monitoring program.

Seventy-eight wells were sampled during 2005 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells in this area.

#### **6.4.1.2 PK Landfill**

The PK Landfill is located west of Big Run Creek just south of the X-230K Holding Pond. The landfill, which began operations in 1952, was used as a salvage yard, burn pit, and trash area during the construction of PORTS. After the initial construction, the disposal site was operated as a sanitary landfill until 1968, when soil was graded over the site and the area was seeded with native grasses.

During site investigations, intermittent seeps were observed emanating from the PK Landfill into Big Run Creek. In 1994, a portion of Big Run Creek was relocated approximately 50 feet to the east. A groundwater collection system was installed in the old creek channel to capture the seeps emanating from the landfill. A second collection system was constructed in 1997 on the southeastern landfill boundary to contain the groundwater plume migrating toward Big Run Creek from the southern portion of the PK landfill. A cap was constructed over the landfill in 1998.

In 2002, a 5-year review was completed for the PK Landfill to evaluate the effectiveness of the corrective measures implemented at this area (see the report entitled *X-611A Prairie and the X-749B Peter Kiewit Landfill Five-Year Evaluation Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*). In response to the findings of the 5-year review, the *Comprehensive Monitoring Program for the X-749 and Peter Kiewit Landfill Areas for the Portsmouth Gaseous Diffusion Plant* was developed to provide additional data to evaluate the effectiveness of the landfill cap and groundwater collection systems, to determine whether a barrier wall is needed on the north and west sides of the PK Landfill, and to monitor the effect of the new X-749 barrier wall as previously described (see Section 6.4.1.1). The *Annual (2004) Summary Report of the Comprehensive Monitoring Plan Data for the X-749/Peter Kiewit Landfill Areas* found that the landfill cap and groundwater collection systems are performing adequately and construction of a barrier wall on the upgradient (west and north) sides of the PK Landfill does not appear to be necessary. Chapter 3, Section 3.2.1.1, provides more information about the results of the Comprehensive Monitoring Program. Sampling conducted solely for the Comprehensive Monitoring Program was discontinued starting in the second quarter of 2005.

The *Evaluation of the Groundwater Monitoring Network for the X-749/X-120/PK Landfill Area*, approved by Ohio EPA in a letter dated June 2, 2005, and implemented in the third quarter of 2005, changed monitoring at the X-749/X-120/PK Landfill Area. In general, the evaluation decreased the number of parameters and frequency of monitoring at PK Landfill wells, although the monitoring frequency increased at some wells. The *Evaluation of the Groundwater Monitoring Network for the X-749/X-120/PK Landfill Area* provides specific information on the changes made to the monitoring program.

In 2005, 10 wells, 2 sumps, and 2 manholes were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells, sumps, and manholes in this area.

#### **6.4.1.3 Monitoring results for the X-749/X-120/PK Landfill in 2005**

A contaminated groundwater plume is associated with the X-749/X-120/PK Landfill groundwater monitoring area (see Figure 6.2). The most extensive and most concentrated constituents associated with the X-749/X-120 plume are volatile organic compounds, particularly trichloroethene. In the southern portion of the plume, concentrations of trichloroethene decreased in three wells, X745-45G, X749-PZ04G, and X749-97G. For well X749-45G, these decreases are due to the hydrogen release compounds injected in this area during 2004; decreases in trichloroethene concentrations in the other wells may be due to the hydrogen release compounds but may also reflect changes in groundwater levels or other variations within the plume that are unrelated to this project.

Concentrations of volatile organics are increasing in well X749-102G, which is in the southern portion of the plume immediately west of the South Barrier Wall. Concentrations of trichloroethene ranged from 6 to 6.3  $\mu\text{g/L}$  in samples collected during the second and fourth quarters of 2005. These are the first detections of trichloroethene in this well that are above the preliminary remediation goal and MCL of 5  $\mu\text{g/L}$ . Trichloroethene and several other volatile organics were detected at concentrations less than 3  $\mu\text{g/L}$  in one of the off-site wells installed in 2004 (WP-03, which is approximately 45 feet south of the property line). These concentrations are below the MCL for trichloroethene of 5  $\mu\text{g/L}$ .

A number of volatile organics, including trichloroethene, were detected in nine new wells installed to monitor the phytoremediation system in the northern and middle portion of the X-749/X-120 groundwater plume, upgradient (north) of the X-749 South Barrier Wall Area. Trichloroethene was detected at concentrations from 160 to 380  $\mu\text{g/L}$  in five of these wells (X749-106G, X749-107G, X749-108G, X749-110G, and X749-113G). These detections indicate that the 100-1000  $\mu\text{g/L}$  portion of the plume is farther to the west than previously thought. Additionally, the western plume perimeter expanded slightly in 2005 based on the fourth quarter detection of trichloroethene in well X749-PZ06G (12  $\mu\text{g/L}$ ).

In addition to volatile organic compounds, inorganics (metals) and radionuclides have also been detected in the groundwater beneath the X-749 area. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

Some of the wells associated with the PK Landfill also appear to be contaminated with low levels of volatile organic compounds, but usually at concentrations below preliminary remediation goals. Vinyl chloride, however, was detected in samples collected from wells PK-17B and PK-21B at concentrations ranging from 11 to 27  $\mu\text{g/L}$ , which is above the preliminary remediation goal of 2  $\mu\text{g/L}$ . Vinyl chloride is generally detected in these wells.

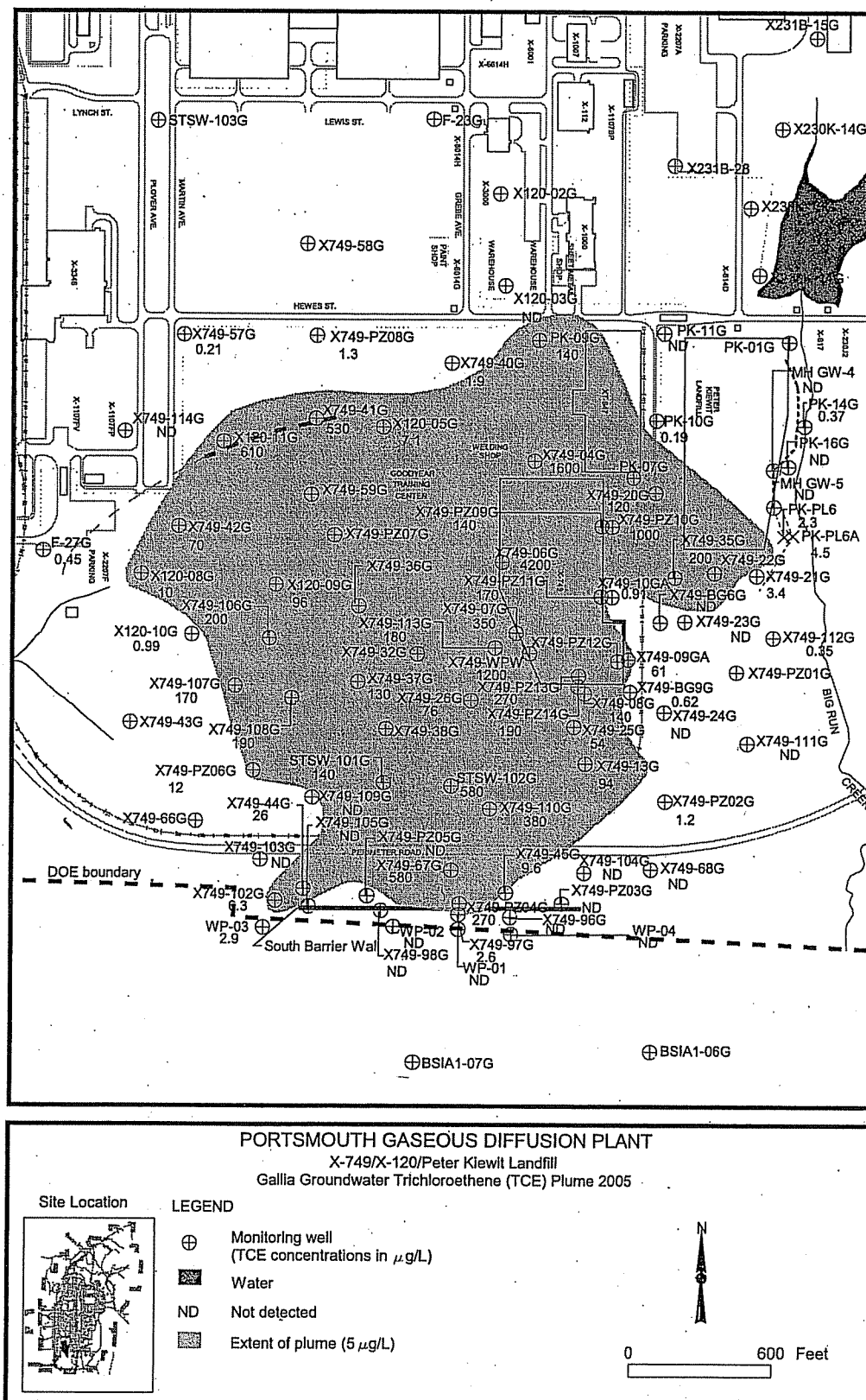


Figure 6.2. Trichloroethene-contaminated Gallia groundwater plume at the X-749/X-120/PK Landfill.

## **6.4.2 Quadrant I Groundwater Investigative Area/X-749A Classified Materials Disposal Facility**

In the northern portion of Quadrant I, groundwater concerns are focused on two areas, the Quadrant I Groundwater Investigative Area and the X-749A Classified Materials Disposal Facility. The X-231B Southwest Oil Biodegradation Plot is a part of the Quadrant I Groundwater Investigative Area and was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*. The X-749A was also monitored prior to implementation of the *Integrated Groundwater Monitoring Plan* under requirements for solid waste landfills.

### **6.4.2.1 X-231B Southwest Oil Biodegradation Plot**

The X-231B Southwest Oil Biodegradation Plot was used from 1976 to 1983 for land application of contaminated oil/solvent mixtures generated from the enrichment process and maintenance activities. The X-231B area, located west of the X-600 Steam Plant, consisted of two disposal plots, each surrounded by an elevated soil berm, that were periodically fertilized and plowed to enhance aeration and promote biological degradation of waste oil.

Three groundwater extraction wells were installed in the Gallia in 1991 as part of the X-231B interim remedial measure. Eleven additional groundwater extraction wells were installed in 2001-2002 and began operation in 2002. The extracted groundwater is treated at the X-622 Groundwater Treatment Facility and discharged through DOE NPDES Outfall 608, which flows into the USEC Sewage Treatment Plant. A multimedia landfill cap was installed over this area in 2000 to minimize water infiltration and control the spread of contamination.

Twenty-two wells are sampled semiannually as part of the monitoring program for the Quadrant I Groundwater Investigative Area. An additional 16 wells are sampled annually or biennially. Table 6.1 lists the analytical parameters for the wells in this area.

### **6.4.2.2 X-749A Classified Materials Disposal Facility**

The 6-acre X-749A Classified Materials Disposal Facility operated from 1953 through 1988 for the disposal of wastes classified under the Atomic Energy Act. Potential contaminants include PCBs, asbestos, radionuclides, and industrial waste. Closure of the landfill, completed in 1994, included the construction of a multilayer cap and the installation of a drainage system to collect surface water runoff. The drainage system discharges via a USEC NPDES-permitted outfall.

In 2005, the monitoring program for the X-749A Landfill was revised based on Ohio EPA comments on the *2004 Groundwater Monitoring Report*. The extraction wells in the Quadrant I Groundwater Investigative Area have caused a change in direction of groundwater flow at the X-749A Landfill, which changes the downgradient wells for the landfill. In 2005, nine wells were sampled as part of the routine monitoring program for the X-749A Landfill. Table 6.1 lists the analytical parameters for the wells in this area.

### **6.4.2.3 Monitoring results for the Quadrant I Groundwater Investigative Area/X-749A in 2005**

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the Quadrant I Groundwater Investigative Area (see Figure 6.3). Other volatile organic compounds are also present in the plume. The plume perimeter did not change significantly from 2004 to 2005.



Concentrations of trichloroethene detected in several wells within the plume have decreased when compared to data collected prior to 2002 because of the 11 new extraction wells in the Quadrant I Groundwater Investigative Area, which began operation in April 2002. For example, trichloroethene was detected at 12 and 13  $\mu\text{g/L}$  in samples collected during 2005 from well X231B-12G, which is in the middle western edge of the plume. Concentrations of trichloroethene detected in samples from this well in 1999-2001 ranged from 96 to 260  $\mu\text{g/L}$ .

Concentrations of trichloroethene detected in well X326-09G (on the western edge of the plume at the southwest corner of the X-326 building) increased to 7500  $\mu\text{g/L}$  in the third quarter of 2005. Concentrations of trichloroethene detected in this well have been increasing since the well was installed in 2002. These increasing concentrations could be due to the extraction wells, which may be causing groundwater with higher concentrations of trichloroethene to flow from beneath the X-326 building.

Inorganics (metals) and radionuclides have also been detected in the groundwater beneath the area. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

Statistical evaluations of data collected from wells at the X-749A landfill are also completed to monitor the landfill for releases. In 2005, none of the control limits for the statistical monitoring parameters were exceeded.

#### **6.4.3 Quadrant II Groundwater Investigative Area**

The Quadrant II Groundwater Investigative Area consists of an area of groundwater contamination with several potential sources. One of these sources, the X-701C Neutralization Pit, was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*. The X-701C Neutralization Pit was an open-topped neutralization pit that received process effluents and basement sump wastewater such as acid and alkali solutions and rinse water contaminated with trichloroethene and/or trichloroethane from metal cleaning operations. The X-701C Neutralization Pit was located within a trichloroethene plume centered around the X-700 and X-705 buildings. The pit was removed in 2001.

The natural groundwater flow direction in this area is to the east toward Little Beaver Creek. The groundwater flow pattern has been changed in this area by use of sump pumps in the basements of the X-700 and X-705 buildings. Thus, the groundwater plume in this area does not spread but instead flows toward the sumps where it is collected and then treated at the X-627 Groundwater Treatment Facility. This facility discharges through DOE NPDES Outfall 611, which flows to the USEC Sewage Treatment Plant. Eleven wells are sampled annually as part of the monitoring program for this area. An additional 14 wells are sampled biennially. Table 6.1 lists the analytical parameters for the wells in this area.

##### **6.4.3.1 Monitoring results for the Quadrant II Groundwater Investigative Area in 2005**

A contaminated groundwater plume consisting primarily of trichloroethene is associated with the Quadrant II Groundwater Investigative Area (see Figure 6.4). The plume perimeter did not change significantly from 2004 to 2005. Numerous other volatile organics were also detected within the plume. Inorganics (metals) and radionuclides were also detected in 2005. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

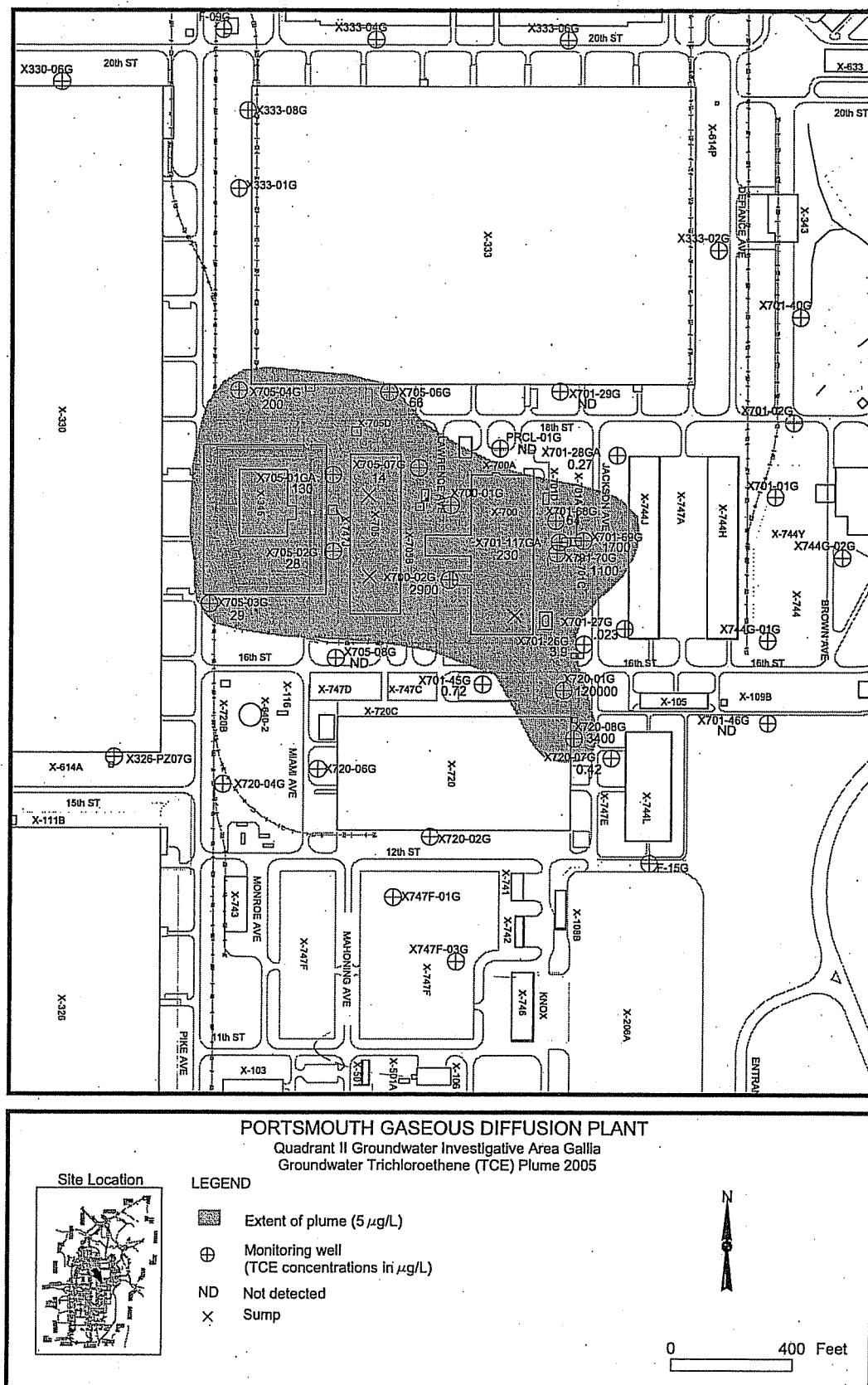


Figure 6.4. Trichloroethene-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative Area.

#### **6.4.4 X-701B Holding Pond**

In the eastern portion of Quadrant II, groundwater concerns focus on three areas: the X-701B Holding Pond, the X-230J7 Holding Pond, and the X-744Y Waste Storage Yard.

The X-701B Holding Pond was used from the beginning of plant operations in 1954 until November 1988. The pond was designed for neutralization and settlement of acid waste from several sources. Trichloroethane and trichloroethene were also discharged to the pond. Two surface impoundments (sludge retention basins) were located west of the holding pond. The X-230J7 Holding Pond received wastewater from the X-701B Holding Pond. The X-744Y Waste Storage Yard is south of the X-701B Holding Pond. The yard is approximately 15 acres and surrounds the X-744G Bulk Storage Building. RCRA hazardous waste was managed in this area.

A contaminated groundwater plume extends from the X-701B Holding Pond to Little Beaver Creek. Three groundwater extraction wells were installed southeast of the X-701B Holding Pond as part of the ongoing RCRA closure of the unit. These wells were designed to intercept contaminated groundwater emanating from the holding pond area before it could join the existing groundwater contaminant plume. Extracted groundwater is processed at the X-623 Groundwater Treatment Facility and discharged through DOE NPDES Outfall 610, which flows to the USEC Sewage Treatment Plant. This facility also processes water recovered from a shallow sump in the bottom of the X-701B Holding Pond.

Two groundwater interceptor trenches (French drains) are used to intercept trichloroethene-contaminated groundwater emanating from X-701B. These interceptor trenches, called the X-237 Groundwater Collection System, have significantly reduced trichloroethene migration into Little Beaver Creek. The 660-foot-long primary trench has two sumps in the backfill, and a 440-foot-long secondary trench intersects the primary trench. The extracted groundwater is treated at the X-624 Groundwater Treatment Facility and discharges through DOE NPDES Outfall 015, which flows to Little Beaver Creek.

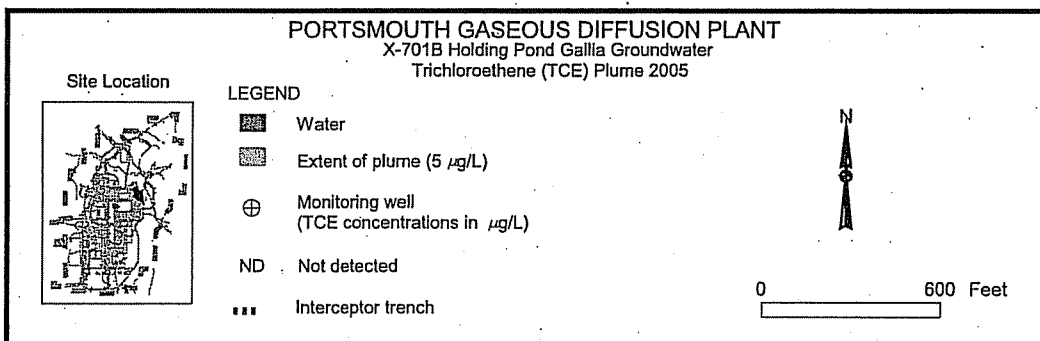
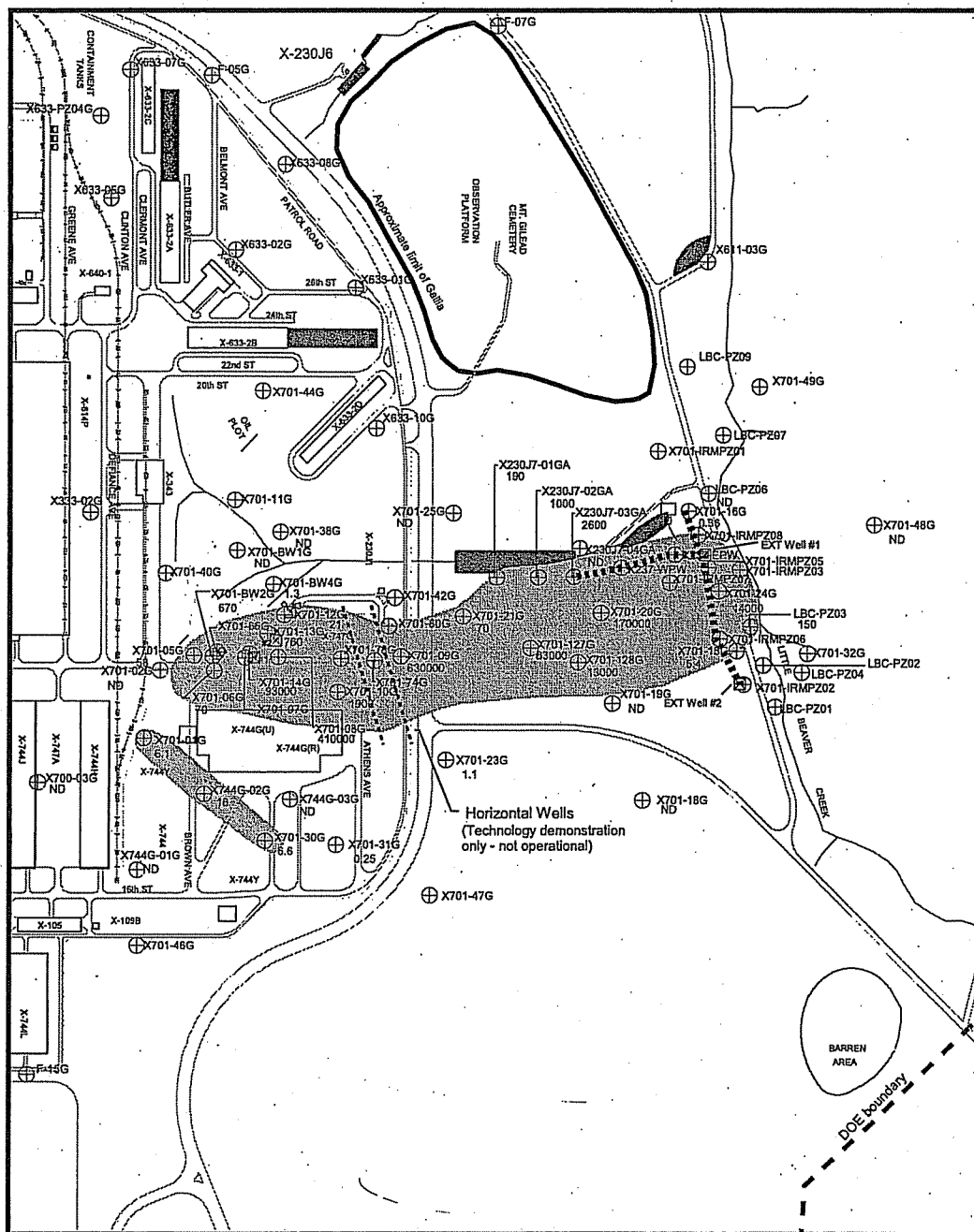
Thirty-four wells are sampled semiannually as part of the monitoring program for this area. An additional 11 wells are sampled annually or biennially. Table 6.1 lists the analytical parameters for the wells in this area.

##### **6.4.4.1 Monitoring results for the X-701B Holding Pond in 2005**

The trichloroethene plume at this groundwater monitoring area contains the highest concentrations of trichloroethene measured in groundwater at PORTS, approximately 600,000  $\mu\text{g/L}$  in one of the groundwater monitoring wells near the middle of the plume. Numerous other volatile organics are also detected in samples collected from the monitoring wells in this area. The plume perimeter did not change significantly from 2004 to 2005 (see Figure 6.5). Additionally, the second trichloroethene plume in the X-701B monitoring area (the plume southwest of the X-744G Bulk Storage Building) did not change significantly in 2005.

Samples from five wells in the western portion of the monitoring area were analyzed for selected metals (cadmium, chromium, cobalt, lead, manganese, nickel, and thallium). None of these metals were detected above the respective preliminary remediation goal in 2005. Samples from five wells in or near the X-744Y Storage Yard and X-744G Bulk Storage Building were analyzed for cadmium and nickel, which were detected above preliminary remediation goals in three of the five wells.

Radionuclides were also detected in the groundwater in this area. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.



**Figure 6.5. Trichloroethene-contaminated Gallia groundwater plume at the X-701B Holding Pond.**

#### **6.4.5 X-633 Pumphouse/Cooling Towers Area**

The X-633 Pumphouse/Cooling Towers Area consists of a recirculating water pumphouse and four cooling towers with associated basins. Chromium-based corrosion inhibitors were added to the cooling water until the early 1990s, when the system was converted to a phosphate-based inhibitor.

The X-633 Pumphouse/Cooling Towers Area was identified as an area of concern for potential metals contamination in 1996 based on historical analytical data for groundwater wells in this area. Samples from wells in this area were collected to assess the area for metals contamination. Based on the results of this study, this area was added to the PORTS groundwater monitoring program. Two wells (see Figure 6.6) are sampled semiannually for chromium as part of the monitoring program for this area.

##### **6.4.5.1 Monitoring results for the X-633 Pumphouse/Cooling Towers Area in 2005**

Chromium was detected in both of the X-633 monitoring wells in 2005. Samples collected from well X633-07G contained chromium at concentrations near or above the preliminary remediation goal of 100  $\mu\text{g/L}$ : 79  $\mu\text{g/L}$  (second quarter) and 270  $\mu\text{g/L}$  (fourth quarter). Samples collected from well X633-PZ04G also contained chromium but at levels well below the preliminary remediation goal. These results are typical for these wells.

#### **6.4.6 X-616 Chromium Sludge Surface Impoundments**

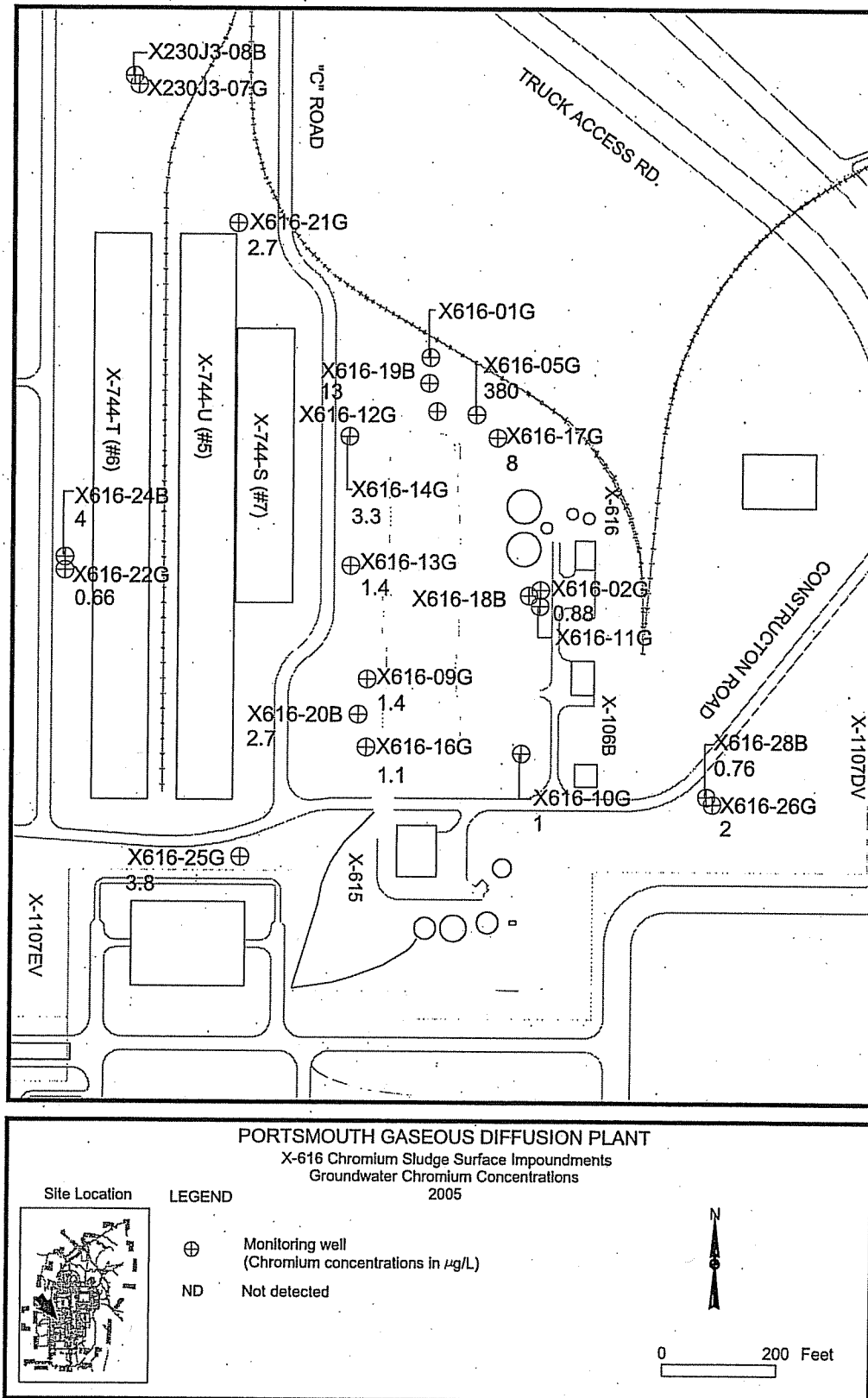
The X-616 Chromium Sludge Surface Impoundments were two unlined surface impoundments used from 1976 to 1985 for storage of sludge generated by the treatment of water from the PORTS process cooling system. A corrosion inhibitor containing chromium was used in the cooling water system. Sludge containing chromium was produced by the water treatment system and was pumped into and stored in the X-616 impoundments. The sludge was removed from the impoundments and remediated as an interim action in 1990 and 1991. The unit was certified closed in 1993. Seven wells are sampled annually and nine wells are sampled biennially as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

##### **6.4.6.1 Monitoring results for the X-616 Chromium Sludge Surface Impoundments in 2005**

Chromium is of special concern at the X-616 because of the previous use of the area. Chromium is routinely detected above the preliminary remediation goal (100  $\mu\text{g/L}$ ) in the samples collected from well X616-05G and was detected at 380  $\mu\text{g/L}$  in the sample collected in 2005. Chromium was not detected at concentrations above the preliminary remediation goal in any other X-616 well. Concentrations of chromium detected in well X616-05G have exceeded the preliminary remediation goal in previous years as well. Figure 6.7 shows the concentrations of chromium in wells at the X-616. Nickel was also detected above the preliminary remediation goal (100  $\mu\text{g/L}$  for Gallia wells) in two wells (X616-05G and X616-25G).

Volatile organic compounds were detected at low levels in samples collected from seven wells in this area. The only volatile organic compounds detected above the preliminary remediation goals were 1,1-dichloroethene and trichloroethene. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

**Figure 6.6. Groundwater monitoring wells at the X-633 Pumphouse/Cooling Towers Area:**



**Figure 6.7. Chromium concentrations in groundwater at the X-616 Chromium Sludge Surface Impoundments.**

#### **6.4.7 X-740 Waste Oil Handling Facility**

The X-740 Waste Oil Handling Facility, which is located on the western half of PORTS south of the X-530A Switchyard, consists of two hazardous waste management units, the X-740 Waste Storage Facility and the X-740 Hazardous Waste Storage Tank (sump), which was located within the building. The X-740 facility, which operated from 1983 until 1991, was used as an inventory and staging facility for waste oil and waste solvents that were generated from various plant operational and maintenance activities. The tank/sump, which was operated until 1990, was used to collect residual waste oil and waste solvents from containers crushed in a hydraulic drum crusher at the facility. The facility and sump were initially identified as hazardous waste management units in 1991. The X-740 Waste Oil Handling Facility (both the facility and sump identified as hazardous waste management units) underwent closure, and closure certification was approved by Ohio EPA in 1998.

In 1999, poplar trees were planted in a 2.6-acre area above the groundwater plume near the X-740 Waste Oil Handling Facility. This remediation technique, called phytoremediation, uses plants to remove or degrade contaminants in soil and groundwater. The monitoring program for the X-740 area includes monitoring of water levels around the trees to evaluate water usage by the trees, in addition to routine monitoring of groundwater wells for contaminants.

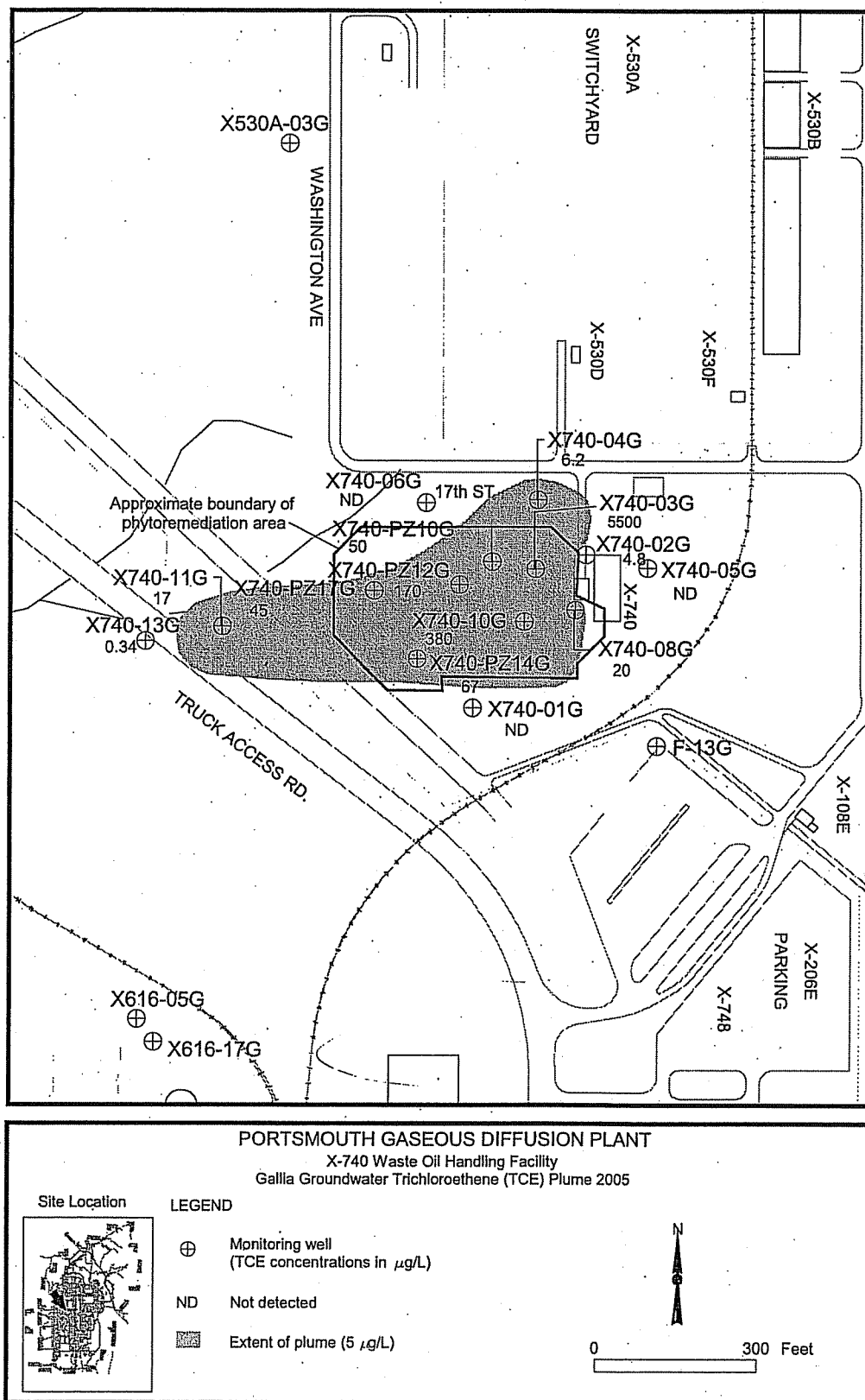
In 2005, two wells (X740-13G and X740-14B) were added to the monitoring program for this area. Eleven wells are sampled semiannually, three wells are sampled annually, and four wells are sampled biennially as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

##### **6.4.7.1 Monitoring results for the X-740 Waste Oil Handling Facility in 2005**

Water level measurements are collected on a frequent basis from the X-740 monitoring wells during the growing season to determine whether the poplar trees that comprise the phytoremediation system for this area are using water as intended. Hourly water level measurements collected at two X-740 Gallia wells from July 1 through July 31, 2005 indicated groundwater usage by the trees.

A contaminated groundwater plume consisting primarily of trichloroethene is located near the X-740 Waste Oil Handling Facility (see Figure 6.8). Trichloroethene was not detected in the sample collected from the new Gallia well (X740-13G) during the second quarter, which is west of the plume perimeter. This well was added to the X-740 monitoring program in 2005 to verify the western boundary of the Gallia plume. Trichloroethene was detected at an estimated concentration of 0.34  $\mu\text{g/L}$  in the sample collected from this well during the fourth quarter; however, trichloroethene was undetected in the duplicate sample (both a regular sample and a duplicate sample were collected). Both the trip blank and field blank associated with these samples contained trichloroethene at estimated concentrations of 0.3  $\mu\text{g/L}$  and 0.2  $\mu\text{g/L}$ , respectively; therefore, the detection in the regular sample may result from sample contamination. Trichloroethene was also detected within the new Berea well (X740-14B) at concentrations of 40 and 6  $\mu\text{g/L}$ ; however, this well is within the previously defined plume, approximately 40 feet west of well X740-PZ12G. Well X740-14B is not shown on Fig 6.8 because this figure shows only the Gallia groundwater plume and wells near the X-740.

Concentrations of trichloroethene detected in the other X-740 wells, as well as the plume perimeter, were similar to data collected in previous years. Inorganics (metals) and radionuclides were also detected in 2005. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.



**Figure 6.8. Trichloroethene-contaminated Gallia groundwater plume near the X-740 Waste Oil Handling Facility.**

#### **6.4.8 X-611A Former Lime Sludge Lagoons**

The X-611A Former Lime Sludge Lagoons were three adjacent unlined sludge retention lagoons constructed in 1954 and used for disposal of lime sludge waste from the site water treatment plant from 1954 to 1960. The lagoons cover a surface area of approximately 18 acres. The lagoons were constructed in a low-lying area that included Little Beaver Creek. As a result, approximately 1500 feet of Little Beaver Creek was relocated to a channel just east of the lagoons.

As part of the RCRA Corrective Action Program, a prairie habitat has been developed in this area by placing a soil cover over the north, middle, and south lagoons. A soil berm was also constructed outside the northern boundary of the north lagoon to facilitate shallow accumulation of water in this low-lying area. Six wells are sampled semiannually as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

##### **6.4.8.1 Monitoring results for the X-611A Former Lime Sludge Lagoons in 2005**

The six monitoring wells at X-611A (see Figure 6.9) are sampled and analyzed for beryllium and chromium. In 2005, chromium was detected in each well in this area at concentrations between 1.2 and 8.8  $\mu\text{g/L}$ . These results are below the preliminary remediation goal (100  $\mu\text{g/L}$ ).

Beryllium was detected in both samples collected from well F-07G at an estimated concentration of 4.5  $\mu\text{g/L}$  (first quarter), and 5.8  $\mu\text{g/L}$  (third quarter), both of which are below the preliminary remediation goal (6.5  $\mu\text{g/L}$  for Gallia wells). Samples collected from well F-07G routinely contain beryllium at concentrations just below or just above the preliminary remediation goal. The only other detection of beryllium in the X-611A wells sampled during 2005 was an estimated detection of 0.13  $\mu\text{g/L}$  in the third quarter sample collected from well X611-04BA.

#### **6.4.9 X-735 Landfills**

Several distinct waste management units are contained within the X-735 Landfills area. The main units consist of the hazardous waste landfill, referred to as the X-735 Landfill (Northern Portion), and the X-735 Industrial Solid Waste Landfill. The X-735 Industrial Solid Waste Landfill includes the industrial solid waste cells, asbestos disposal cells, and the closed chromium sludge monocells A and B. The chromium sludge monocells contain a portion of the chromium sludge generated during the closure of the X-616 Chromium Sludge Surface Impoundments.

Initially, a total of 17.9 acres was approved by the Ohio EPA and Pike County Department of Health for landfill disposal of conventional solid wastes. The landfill began operation in 1981. During operation of the landfill, PORTS investigations indicated that wipe rags contaminated with solvents had inadvertently been disposed in the northern portion of the landfill. The contaminated rags were considered a hazardous waste. Waste disposal in the northern area ended in December 1991, and Ohio EPA determined that the area required closure as a RCRA hazardous waste landfill. Consequently, this unit of the sanitary landfill was identified as the X-735 Landfill (Northern Portion).

A buffer zone was left unexcavated to provide space for groundwater monitoring wells and a space between the RCRA landfill unit and the remaining southern portion, the X-735 Industrial Solid Waste Landfill. Routine groundwater monitoring has been conducted at the X-735 Landfills since 1991.

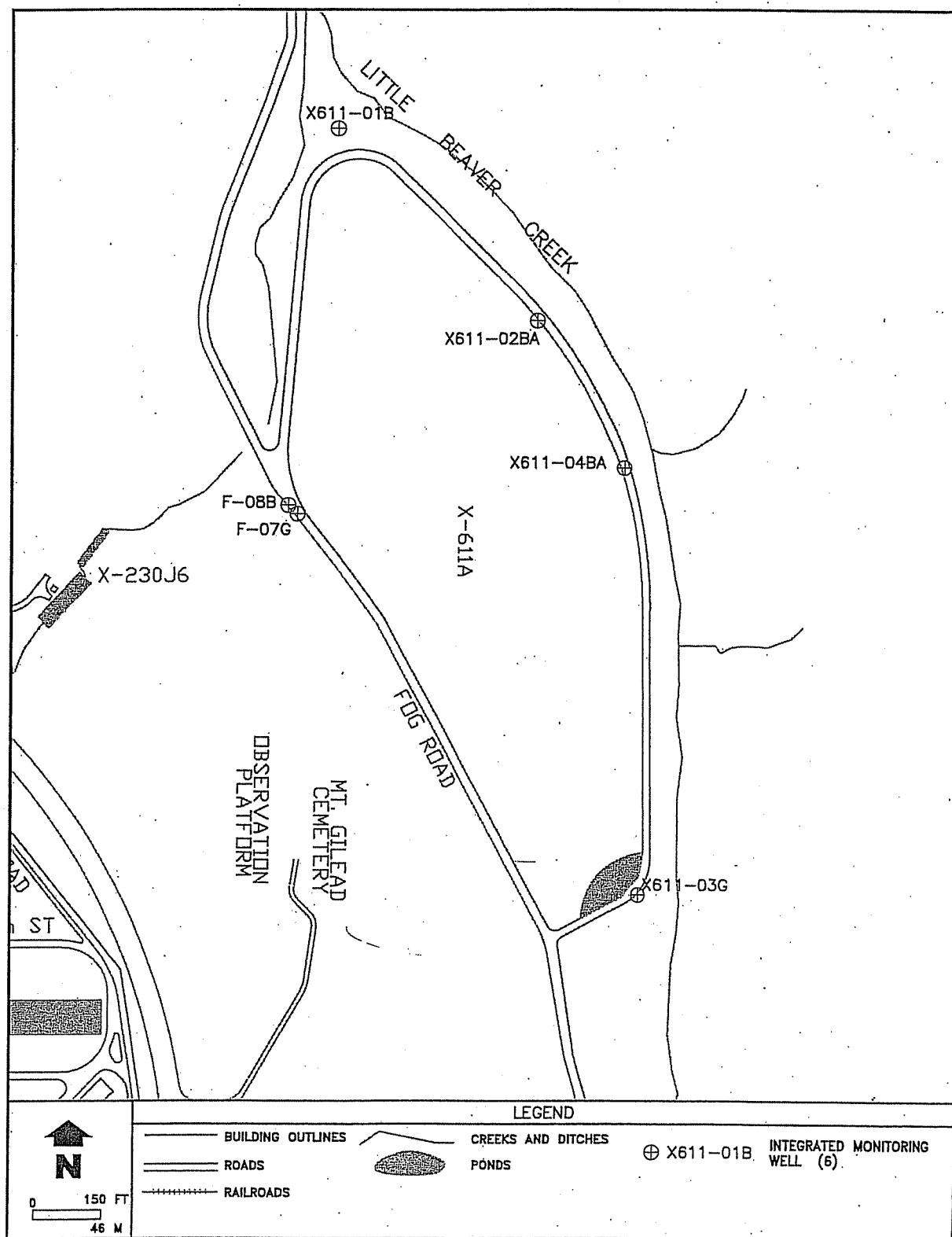


Figure 6.9. Monitoring wells at the X-611A Former Lime Sludge Lagoons.

The industrial solid waste portion of the X-735 Landfills included a solid waste section and an asbestos waste section. The X-735 Industrial Solid Waste Landfill, not including the chromium sludge monocells, encompasses a total area of approximately 4.1 acres. Operation of the X-735 Industrial Solid Waste Landfill ceased in 1997; this portion of the landfill was capped in 1998.

The *Integrated Groundwater Monitoring Plan* incorporates monitoring requirements for the hazardous and solid waste portions of the X-735 Landfills. Eighteen wells are sampled semiannually under the routine monitoring program for this area. Table 6.1 lists the analytical parameters and Figure 6.10 shows the monitoring wells in this area.

#### **6.4.9.1 Monitoring results for the X-735 Landfills in 2005**

Samples collected from the X-735 Landfill wells during the second quarter of 2005 were analyzed for volatile organic compounds. The sample collected from well X737-08B contained benzene and toluene at estimated concentrations of 0.19 and 0.4  $\mu\text{g/L}$ , respectively. The presence of these two hydrocarbons may be due to development of small amounts of natural gas migrating from deeper shales into the Berea Sandstone. No other volatile organics were detected in the X-735 samples collected in the second quarter of 2005, with the exception of acetone, which is a common laboratory contaminant and not indicative of a release.

Statistical evaluations of data collected from wells at the X-735 Landfills are also completed to monitor the landfill for releases. In general, analytical results from previous sampling events are used to calculate control limits for selected monitoring parameters at designated X-735 monitoring wells. For example, analytical results for alkalinity from eight sampling events at well X735-05GA between 1998 and 2001 are used to calculate two control limits for alkalinity at this well (these data are considered the baseline data). Results for samples analyzed for alkalinity from this well in 2005 are evaluated against these limits. If the limits are exceeded, it is possible that a release from the landfill has occurred, although exceedences can also happen due to variations in groundwater quality and other reasons.

One or both of the control limits for several statistical monitoring parameters are being exceeded in well X735-21G. These exceedences began in the fourth quarter of 2003 and continued in 2004 and 2005. Control limits were also exceeded for one or more monitoring parameters in wells X735-02GA, X735-04GA, and X735-05GA during 2005.

These continuing exceedences have required assessment monitoring at the X-735 Landfill to determine the concentration, rate, and extent of migration of contaminants in the groundwater. Data for assessment monitoring at the X-735 Landfills in 2005 are provided in the following reports: *Groundwater Quality Assessment Report for the X-735 Landfill at the Portsmouth Gaseous Diffusion Plant (Second Quarter 2005)* and *Groundwater Quality Assessment Report for the X-735 Landfill at the Portsmouth Gaseous Diffusion Plant (Fourth Quarter 2005)*.

Technetium-99 was detected at 9.23 pCi/L in the second quarter sample collected from well X735-20B; however, technetium-99 was also detected at 9.81 pCi/L in the field blank associated with this sample, which indicates that the detection is most likely not due to a release from the landfill.

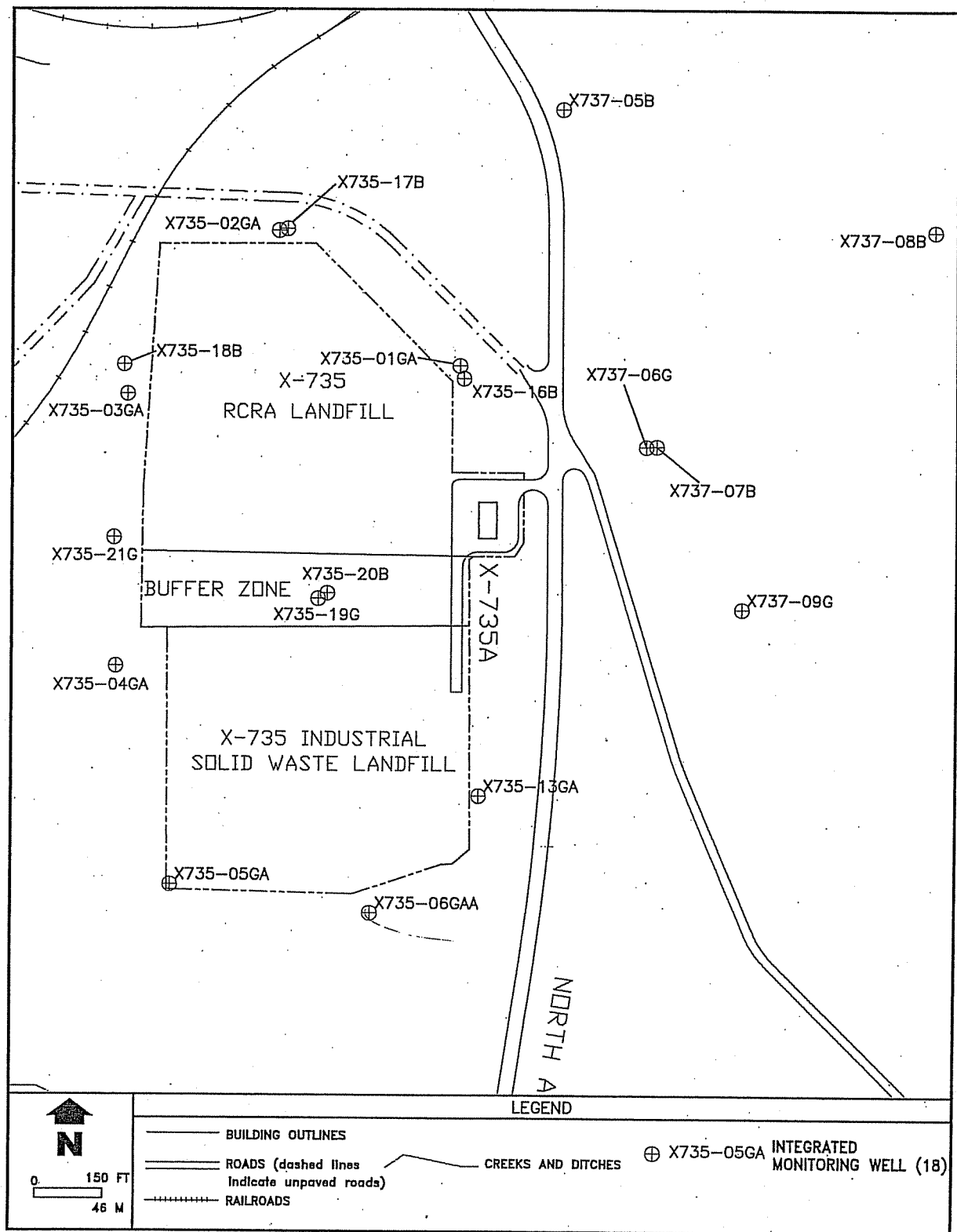


Figure 6.10. Monitoring wells at the X-735 Landfills.

#### **6.4.10 X-734 Landfills**

The X-734 Landfills consisted of three landfill units that were used until 1985. Detailed records of materials disposed in the landfills were not kept. However, wastes known to be disposed at the landfills include trash and garbage, construction spoils, wood and other waste from clearing and grubbing, and empty drums. Other materials reportedly disposed in the landfills may have included waste contaminated with metals, empty paint cans, and uranium-contaminated soil from the X-342 area.

The X-734 Sanitary Landfill was closed in accordance with the solid waste regulations in effect at that time, and no groundwater monitoring of the unit was required. The X-734 Landfills were capped in 1999-2000 as part of the remedial actions required for Quadrant IV.

Fifteen wells (see Figure 6.11) are sampled semiannually as part of the monitoring program for this area. Well X734-16G could not be sampled in 2005 because the well was dry. Additionally, well X734-23G replaced well X734-21B in 2005. Table 6.1 lists the monitoring parameters for the wells in this area.

##### **6.4.10.1 Monitoring results for the X-734 Landfills in 2005**

Volatile organic compounds were detected in samples collected from five wells in the X-734 monitoring area in 2005; however, vinyl chloride is the only compound that exceeded the preliminary remediation goal (2  $\mu\text{g/L}$ ). In the second quarter and fourth quarter samples collected from well X734-23G, vinyl chloride was detected at 3.5 and 6.1  $\mu\text{g/L}$ , respectively. The presence of vinyl chloride, *cis*-1,2-dichloroethene, and *trans*-1,2-dichloroethene, along with the absence or low concentrations of trichloroethene in well X734-23G (non-detected in the second quarter and detected at an estimated concentration of 0.21  $\mu\text{g/L}$  in the fourth quarter) may indicate that natural reductive dechlorination of the trichloroethene is occurring beneath the X-734B Construction Spoils Landfill.

Cobalt is also monitored in the X-734 Landfills area. Cobalt was detected in three wells in 2005 (X734-06G, X734-15G, and X734-23G) at concentrations equal to or exceeding the preliminary remediation goal of 13  $\mu\text{g/L}$  for Gallia wells. These detections ranged from 31 to 97  $\mu\text{g/L}$ . Additional inorganics (metals) and radionuclides were also detected in 2005. Control and monitoring of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

#### **6.4.11 X-533 Switchyard Area**

The X-533 Switchyard Area consists of a switchyard containing electrical transformers and circuit breakers, associated support buildings, and a transformer cleaning pad. The groundwater area of concern is located north of the switchyard and associated support buildings near the transformer cleaning pad.

The X-533 Switchyard Area was identified as an area of concern for potential metals contamination in 1996 based on historical analytical data for groundwater wells in this area. Samples from wells in this area were collected to assess the area for metals contamination. The area was added to the PORTS groundwater monitoring program because the study identified three metals (cadmium, cobalt, and nickel) that may have contaminated groundwater in this area. Three wells are sampled semiannually for cadmium, cobalt, and nickel.



#### 6.4.11.1 Monitoring results for the X-533 Switchyard Area in 2005

Two Gallia wells that monitor the X-533 Switchyard Area (see Figure 6.12) were sampled in the second and fourth quarters of 2005 and analyzed for cadmium, cobalt, and nickel. Each of the well samples contained these metals at concentrations above the preliminary remediation goals (6.5  $\mu\text{g/L}$  for cadmium, 13  $\mu\text{g/L}$  for cobalt, and 100  $\mu\text{g/L}$  for nickel). Concentrations of cadmium detected in the wells ranged from 8 to 42  $\mu\text{g/L}$ , concentrations of cobalt detected in the wells ranged from 25 to 93  $\mu\text{g/L}$ , and concentrations of nickel detected in the wells ranged from 150 to 560  $\mu\text{g/L}$ . These results are typical for these wells.

#### 6.4.12 Surface Water Monitoring

Surface water monitoring is conducted in conjunction with groundwater assessment monitoring to determine if contaminants present in groundwater are detected in surface water samples. Surface water is collected quarterly from 15 locations (see Figure 6.13). Surface water samples are analyzed for the parameters listed in Table 6.1. The purpose for each surface water monitoring location is described as follows:

- Little Beaver Creek and East Drainage Ditch sample locations LBC-SW01, LBC-SW02, and EDD-SW01 assess possible X-701B area plume groundwater discharges.
- Little Beaver Creek sample location LBC-SW03 assesses potential contamination from the Former X-611A Lime Sludge Lagoons.
- Big Run Creek sample locations BRC-SW01 and BRC-SW02 assess potential groundwater discharges related to the X-231B Southwest Oil Biodegradation Plot, the Quadrant I Groundwater Investigative Area plume, and the X-749/X-120/PK Landfill area plume, all of which discharge into the X-230K Holding Pond and Big Run Creek.
- As required by the *Comprehensive Monitoring Program*, Big Run Creek sample locations BRC-SW03 and BRC-SW04 assessed for potential groundwater discharges from the X-749/X-120/PK Landfill area into Big Run Creek. Monitoring of these locations was discontinued after the first quarter of 2005 (see Sects 6.4.1.1 and 6.4.1.2).
- Southwestern Drainage Ditch sample locations UND-SW01 and UND-SW02 assess potential groundwater releases to this creek and the X-2230M Holding Pond from the western portion of the X-749/X-120 groundwater plume.
- North Holding Pond sample location NHP-SW01 and Little Beaver Creek sample location LBC-SW04 assess potential groundwater discharges from the X-734 Landfill and other Quadrant IV sources.
- Western Drainage Ditch sample locations WDD-SW01, WDD-SW02, and WDD-SW03 assess potential groundwater discharges from the X-616 and X-740 areas to the Western Drainage Ditch and the X-2230N Holding Pond.

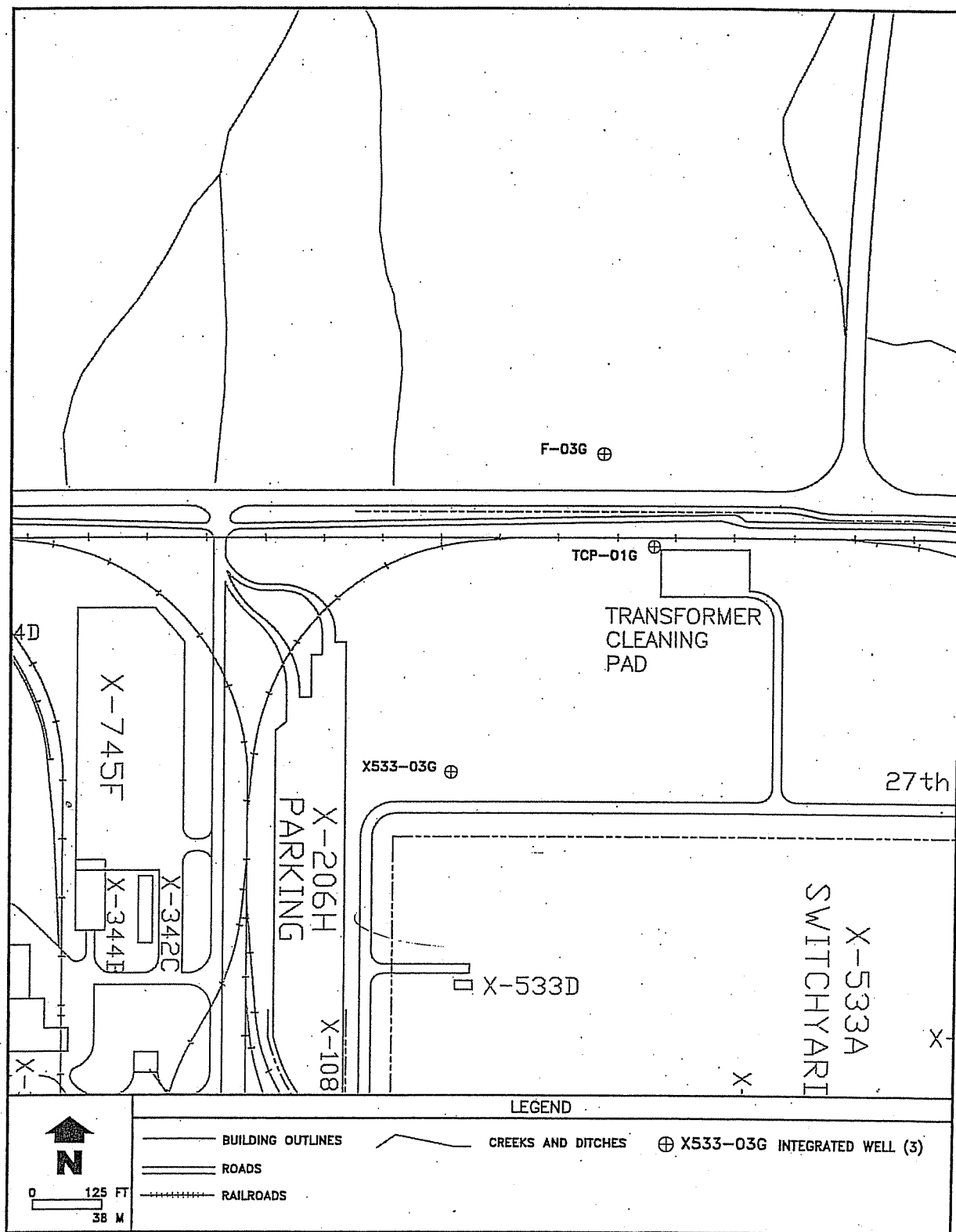


Figure 6.12. Monitoring wells at the X-533 Switchyard Area.

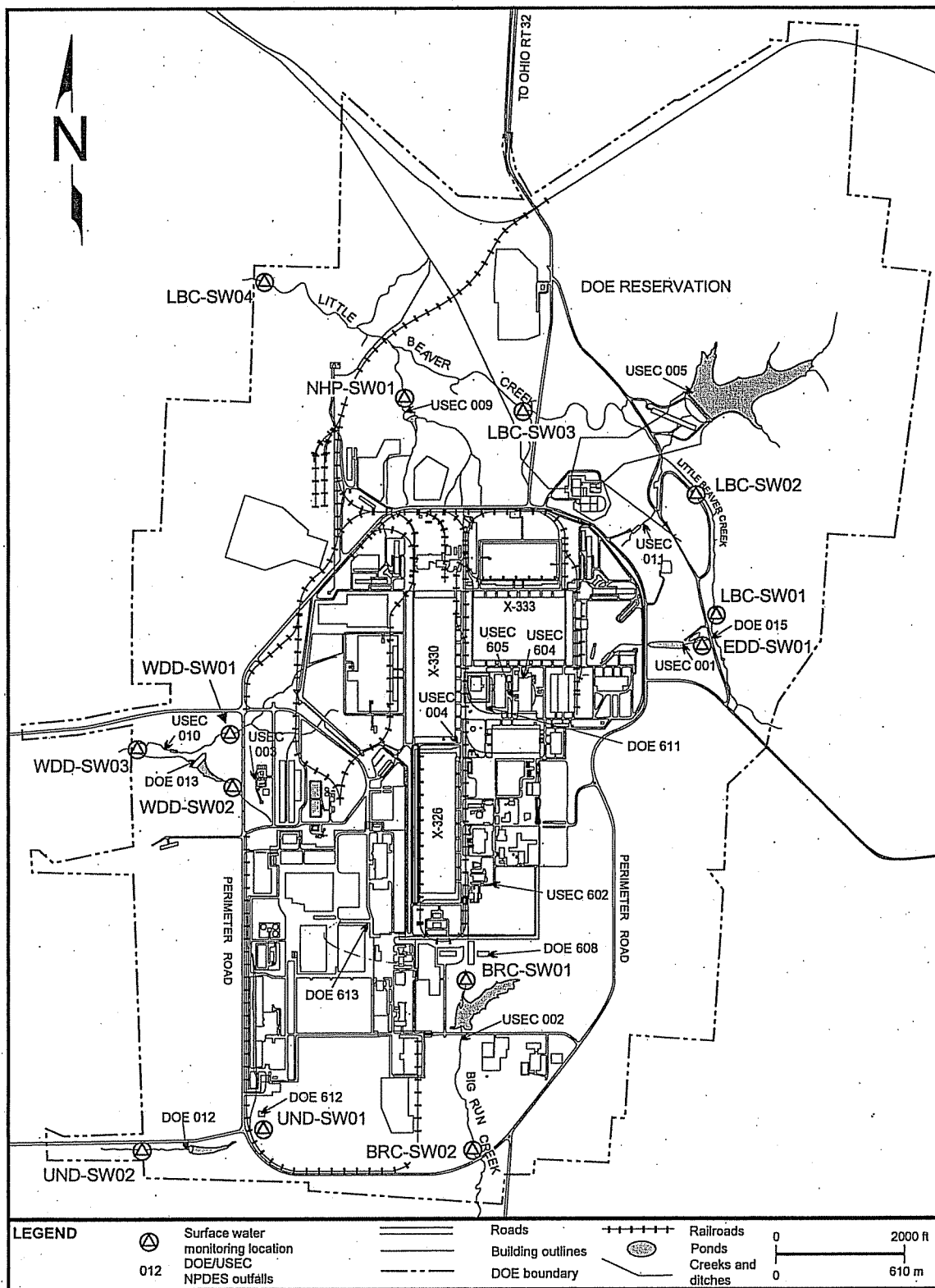


Figure 6.13. Surface water monitoring locations.

#### 6.4.12.1 Monitoring results for surface water in 2005

Since 1990, trichloroethene has been detected regularly at low levels in samples collected from the Southwestern Drainage Ditch (UND-SW01, located inside the perimeter road). Trichloroethene was detected at 0.38 to 7.6  $\mu\text{g/L}$  in 2005. Several other volatile organic compounds were detected at estimated concentrations less than 1  $\mu\text{g/L}$  in the third and/or fourth quarter samples collected from UND-SW01 (*cis*-1,2-dichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, and trichlorofluoromethane). Concentrations of volatile organic compounds detected at the Southwestern Drainage Ditch sampling location UND-SW01 (trichloroethene, *cis*-1,2-dichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, and trichlorofluoromethane) were below applicable Ohio EPA water quality criteria (if available) for the protection of human health in the Ohio River drainage basin. These criteria are 810  $\mu\text{g/L}$  for trichloroethene and 32  $\mu\text{g/L}$  for 1,1-dichloroethene. None of these compounds were detected in samples collected at the sampling location downstream from UND-SW01 (UND-SW02), which indicates that these volatile organics are not present in the surface water exiting the PORTS site.

Trichloroethene and/or *cis*-1,2-dichloroethene were also detected at estimated concentrations less than 0.5  $\mu\text{g/L}$  in samples collected during the first and second quarters from East Drainage Ditch sampling location EDD-SW01 and Little Beaver Creek sampling locations LBC-SW01 and LBC-SW02. The detections of trichloroethene were well below the applicable Ohio EPA water quality criterion of 810  $\mu\text{g/L}$  for trichloroethene for the protection of human health in the Ohio River drainage basin.

Discharges of trichloroethene from DOE NPDES Outfall 015 in 2005 were all below the discharge limitation set by Ohio EPA. None of the compounds detected in these samples were detected at sampling location LBC-SW04, which monitors Little Beaver Creek at the PORTS boundary. Therefore, these compounds were not present in the surface water exiting the PORTS site.

Carbon disulfide was detected at an estimated concentration of 0.88  $\mu\text{g/L}$  in the third quarter sample collected from Big Run Creek sampling location BRC-SW02. By way of reference, this detection is well below the Ohio EPA screening value for carbon disulfide (100  $\mu\text{g/L}$ ) and poses no threat to human health.

Trihalomethanes are a category of volatile organic compounds that are byproducts of water chlorination and include bromodichloromethane, bromoform, chloroform, and dibromochloromethane. These compounds are detected at most of the surface water sampling locations because the streams receive discharges that contain chlorinated water from the PORTS NPDES outfalls. These detections were well below the applicable Ohio EPA water quality criteria for the protection of human health in the Ohio River drainage basin (bromodichloromethane – 460  $\mu\text{g/L}$ ; bromoform – 3600  $\mu\text{g/L}$ ; chloroform – 4700  $\mu\text{g/L}$ ; and dibromochloromethane – 340  $\mu\text{g/L}$ ).

Surface water samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, or plutonium-239/240). Data for transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), total uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238) collected in the third and fourth quarters are not reported due to laboratory error as discussed in the beginning of this chapter and in Chapter 4, Section 4.2. No transuranics were detected in the surface water samples collected during the first and second quarters of 2005.

Technetium-99 was not detected in any of the surface water samples collected during the first, second, or third quarters of 2005. Technetium-99 was detected at low concentrations ranging from 1.36 to 7.8 pCi/L in 10 of 13 surface water samples collected during the fourth quarter of 2005. These

detections are well below the EPA drinking water standard for technetium-99 (900 pCi/L, based on a 4 mrem/year dose from beta emitters).

Uranium was routinely detected in surface water samples at concentrations similar to those detected in 2004. Because uranium occurs naturally in rocks and soil, some or all of the uranium detected in these samples may be due to naturally-occurring uranium. Detections of uranium and uranium isotopes in surface water samples in 2005 were well below the DOE derived concentration guide for the respective uranium isotope in drinking water (500 pCi/L for uranium-233/234 and 600 pCi/L for uranium-235 and uranium-238).

#### **6.4.13 Water Supply Monitoring**

Routine monitoring of residential drinking water sources is completed at PORTS in accordance with the requirements of Section VIII of the September 1989 Consent Decree between the State of Ohio and DOE and the Residential Groundwater Monitoring Requirements contained in the *Integrated Groundwater Monitoring Plan*.

The purpose of the program is to determine whether residential drinking water sources have been adversely affected by plant operations. Although this program may provide an indication of contaminant transport off site, it should not be interpreted as an extension of the on-site groundwater monitoring program, which bears the responsibility for detection of contaminants and determining the rate and extent of contaminant movement. Data from this program will not be used in environmental investigations due to the lack of knowledge of how residential wells were constructed and due to the presence of various types of pumps (which may not be ideal equipment for sampling).

Seven residential drinking water sources participated in the program in 2005 (see Figure 6.14). Wells are sampled semiannually with two samples collected from each well: a regular sample and a duplicate sample. Each sample is analyzed for the parameters listed in Table 6.1. The PORTS water supply (RES-012 on Figure 6.14) is also sampled as part of this program. Sampling locations may be added or deleted if requested by a resident and as program requirements dictate. Typically, sampling locations are deleted when a resident obtains a public water supply.

No volatile organic compounds were detected in the water supply samples collected during 2005, with the exception of the common sample contaminants acetone and methylene chloride, which were also detected in some of the laboratory blanks and trip blanks associated with the samples and do not indicate any water quality problems.

In the first quarter of 2005, plutonium-238 was detected in the regular sample collected from the PORTS water supply (RES-012) but was not detected in the duplicate sample collected from this location. This detection was 0.04327 pCi/L with a detection limit of 0.02345 pCi/L and total propagated uncertainty of 0.03933 pCi/L. This detection is likely a false positive and not indicative of contamination. The detection is well below the DOE derived concentration guide for plutonium-238 in drinking water (40 pCi/L). No other transuranics were detected in any of the water supply samples collected during the first quarter. Data for transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), total uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238) collected in the third quarter are not reported as discussed in the beginning of this chapter and in Chapter 4, Section 4.2. No technetium-99 was detected in any of the water supply samples collected in 2005.

Metals detected in the water supply samples were within naturally-occurring concentrations found in the area. Low levels of uranium and uranium isotopes detected in some of the wells are consistent with naturally-occurring concentrations found in common geologic materials.

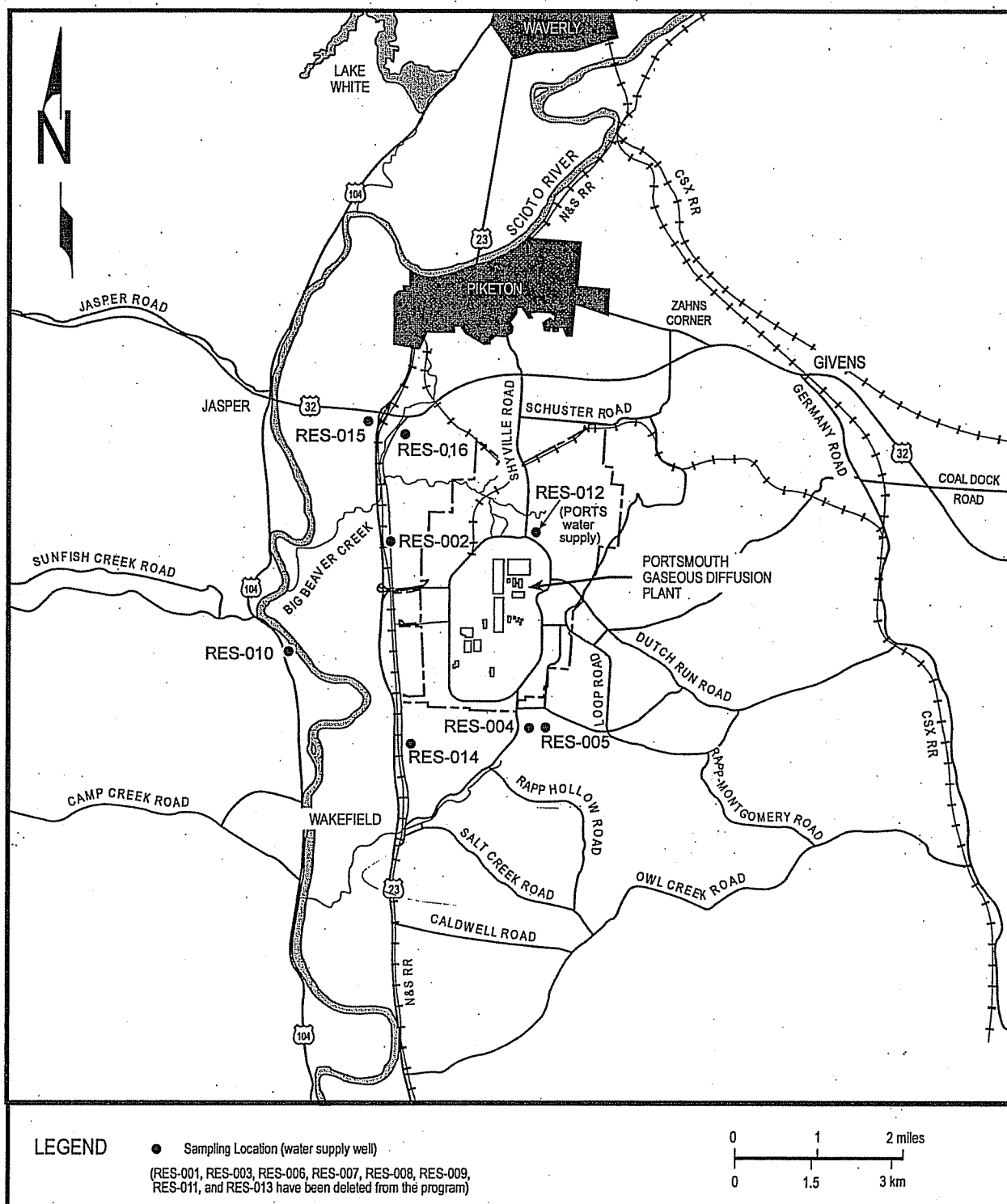


Figure 6.14. Water supply monitoring locations.

## 6.5 DOE ORDER MONITORING PROGRAMS

The surveillance monitoring program at DOE PORTS consists of exit pathway monitoring. Exit pathway monitoring assesses the effect of the facility on off-site groundwater quality.

### 6.5.1 Exit Pathway Monitoring

Selected locations on local streams and drainage channels near the PORTS boundary are sampling points of the exit pathway monitoring program because groundwater discharges to these surface waters. Monitoring wells near the PORTS boundary are also used in the exit pathway monitoring program. Figure 6.15 shows the sampling locations for exit pathway monitoring and Table 6.1 lists the analytical parameters.

Surface water sampling points on Big Run Creek (BRC-SW02), Little Beaver Creek (LBC-SW04), Southwestern Drainage Ditch (UND-SW02), and Western Drainage Ditch (WDD-SW03) are part of the exit pathway monitoring program. Sample contaminants acetone, methylene chloride, and toluene were detected in a few of the samples collected from these locations in 2005. Carbon disulfide was detected at an estimated concentration of 0.88  $\mu\text{g/L}$  in the third quarter sample collected from BRC-SW02. By way of reference, the Ohio EPA uses preliminary remediation goals developed by U.S. EPA Region 9 as screening values to assess whether concentrations of contaminants detected in the environment could pose a threat to human health. Concentrations of contaminants below these screening values are not considered a threat to human health. The screening value for carbon disulfide in tap water is 100  $\mu\text{g/L}$ ; the concentration of carbon disulfide detected in surface water at Big Run Creek sampling location BRC-SW02 is well below the screening value and poses no threat to human health.

Trihalomethanes, which are common residuals in chlorinated drinking water, were detected in samples collected from Little Beaver Creek and the Western Drainage Ditch at concentrations well below Ohio EPA nondrinking water quality criteria for trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane) for the protection of human health in the Ohio River drainage basin. Metals, including uranium, were detected at concentrations consistent with background concentrations for these parameters. Section 6.4.12.1 provides additional information for these monitoring results.

In 2005, volatile organic compounds, including trichloroethene, were detected in three of the exit pathway groundwater monitoring wells (X749-44G, X749-45G, and X749-97G) that monitor the X-749 South Barrier Wall and are part of the monitoring program for the X-749/X-120/PK Landfill monitoring area (see Figure 6.2 and Section 6.4.1.3). Concentrations of trichloroethene detected in the samples from these wells were 26 to 31  $\mu\text{g/L}$  in well X749-44G, 9.6 to 59  $\mu\text{g/L}$  in well X749-45G, and 2.6 to 6.3  $\mu\text{g/L}$  in well X749-97G. Most of these detections exceed the MCL for trichloroethene (5  $\mu\text{g/L}$ ); however, these monitoring wells are located within the PORTS boundary. Remediation of groundwater is being accomplished in accordance with the RCRA Corrective Action Program.

Plutonium-238 was detected at 0.04372 pCi/L in the sample collected from well F-29B with a detection limit of 0.02369 pCi/L and total propagated uncertainty of 0.04016 pCi/L. This detection is well below the DOE derived concentration guide for plutonium-238 in drinking water (40 pCi/L). No transuranics were detected in any of the other exit pathway groundwater samples collected in the second quarter of 2005. Technetium-99 was detected at concentrations less than 20 pCi/L in both samples collected from well X749-44G. These detections are significantly less than the EPA drinking water standard for technetium-99 (900 pCi/L, based on a 4 mrem/year dose from beta emitters).

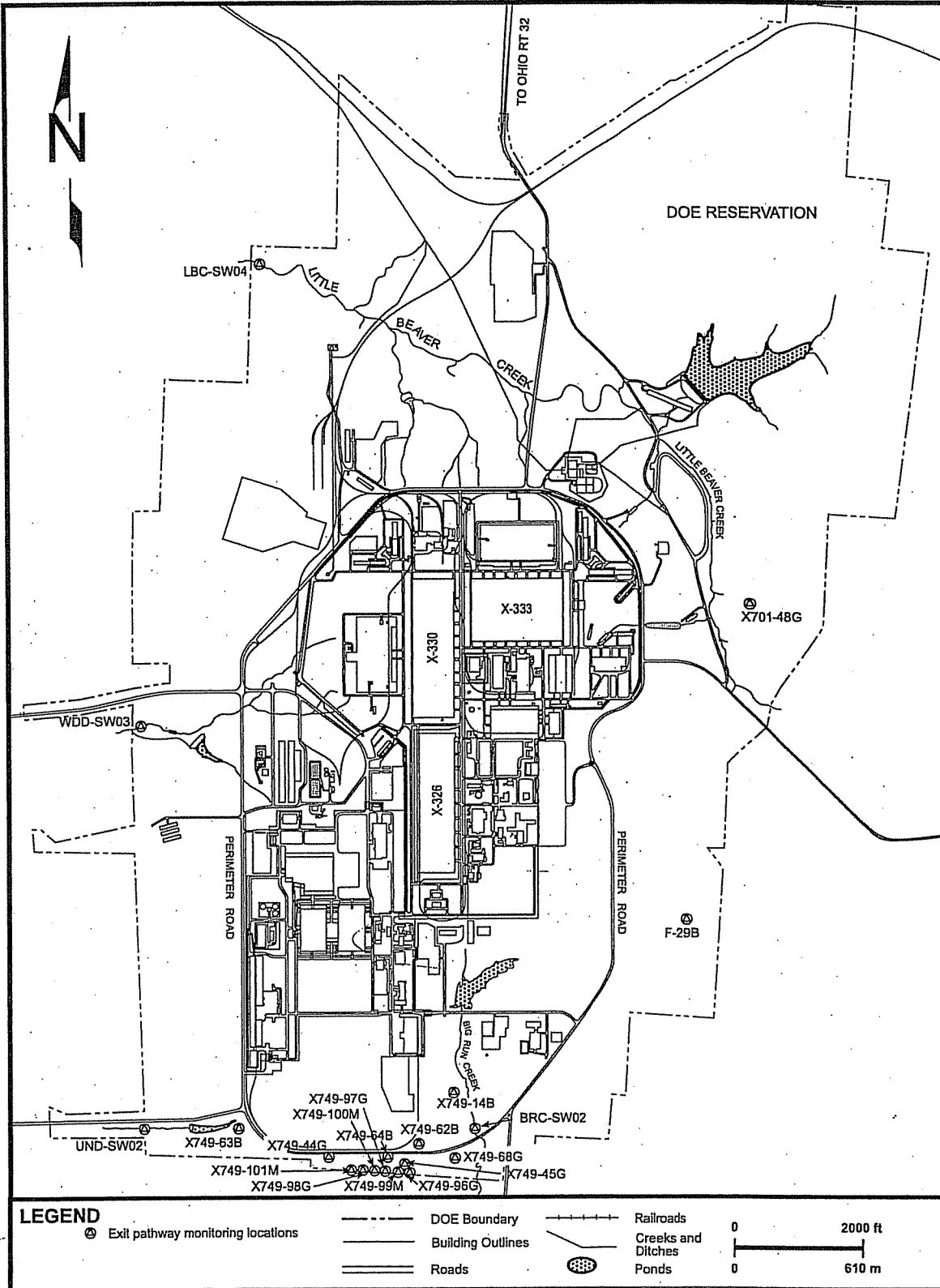


Figure 6.15. Exit pathway monitoring locations.

## 6.6 GROUNDWATER TREATMENT FACILITIES

In 2005, a combined total of approximately 28.2 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 208 gallons of trichloroethene were removed from the water. All processed water is discharged through NPDES outfalls before exiting PORTS. Facility information is summarized in Table 6.2.

**Table 6.2. Summary of trichloroethene removed by DOE PORTS groundwater treatment facilities in 2005**

Facility	Gallons of water treated	Gallons of TCE removed
X-622	13,512,190	2
X-623	4,413,569	171
X-624	2,498,932	15
X-627	7,780,995	20

### 6.6.1 X-622 Groundwater Treatment Facility

The X-622 Groundwater Treatment Facility consists of an air stripper with aqueous-phase activated carbon filtration. This facility processes groundwater from the following systems in Quadrant I:

- Groundwater collection system and associated sump (X749-WPW) on the southwest boundary of the X-749 Landfill;
- Groundwater collection system and associated sumps (PK-PL6 and PK-PL6A) on the eastern boundary of the PK Landfill; and
- Fourteen extraction wells located in the Quadrant I Groundwater Investigative Area.

The facility processed approximately 13.5 million gallons of groundwater, thereby removing approximately 2 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 608, which flows to the USEC Sewage Treatment Plant. No NPDES permit limitations were exceeded at Outfall 608 in 2005.

### 6.6.2 X-623 Groundwater Treatment Facility

The X-623 Groundwater Treatment Facility consists of an air stripper with offgas activated carbon filtration and aqueous-phase activated carbon filtration. The X-623 Groundwater Treatment Facility treats trichloroethene-contaminated groundwater from a sump in the bottom of the X-701B Holding Pond and three groundwater extraction wells (#1, #2, and #3) east of the holding pond

The facility treated approximately 4.4 million gallons of water during 2005, thereby removing approximately 171 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 610, which flows to the USEC Sewage Treatment Plant. No NPDES permit limitations were exceeded at Outfall 610 in 2005.

### 6.6.3 X-624 Groundwater Treatment Facility

At the X-624 Groundwater Treatment Facility, groundwater is treated via an air stripper with offgas activated carbon filtration and aqueous-phase activated carbon filtration. This facility processes trichloroethene-contaminated groundwater from the X-701B groundwater plume, specifically the X-237

Groundwater Collection System, which consists of north-south and east-west collection trenches and sumps #1 and #2.

The X-624 Groundwater Treatment Facility treated approximately 2.5 million gallons of water in 2005, thereby removing approximately 15 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 015, which discharges to Little Beaver Creek. No NPDES permit limitations were exceeded at Outfall 015 in 2005.

#### **6.6.4 X-625 Groundwater Treatment Facility**

On July 9, 2003, the X-625 Groundwater Treatment Facility was placed on stand-by with approval from Ohio EPA. The X-625 Groundwater Treatment Facility did not operate in 2005.

#### **6.6.5 X-627 Groundwater Treatment Facility**

The X-627 Groundwater Treatment Facility consists of an air stripper with offgas activated carbon filtration and aqueous phase activated carbon filtration. The X-700 and X-705 buildings are located above the Quadrant II Groundwater Investigative Area plume, and contaminated groundwater is extracted from sumps located in the basement of each building.

Approximately 7.8 million gallons of groundwater were processed during 2005, thereby removing 20 gallons of trichloroethene from the water. Treated water from the facility discharges through DOE NPDES Outfall 611, which flows to the USEC Sewage Treatment Plant. No NPDES permit limitations were exceeded at Outfall 611 in 2005.