Department of Energy

Portsmouth/Paducah Project Office
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December 3, 2021

DISTRIBUTION LIST

PPPO-03-10017008-22

Dear Madams/Messrs:

U.S. DEPARTMENT OF ENERGY PORTSMOUTH ANNUAL SITE ENVIRONMENTAL REPORT - 2020

Enclosed for your information is a copy of the *U.S. Department of Energy Portsmouth Annual Site Environmental Report – 2020.* The report includes the results of on-site and off-site environmental monitoring activities, describes the programs implemented to ensure compliance with environmental regulations, and discusses the overall environmental impacts of the U.S. Department of Energy (DOE) activities on the surrounding area. The report was prepared for distribution to the public, news media, as well as local, state and federal agencies by DOE's contractor, Fluor-BWXT Portsmouth LLC.

The monitoring data and subsequent data analyses have been collected and performed in accordance with controlled operating procedures. The detailed data underlying this summary environmental report have been compiled separately. The *U.S. Department of Energy Portsmouth Annual Site Environmental Report – 2020* and *U.S. Department of Energy Portsmouth Annual Site Environmental Data – 2020* are available online at https://eic.ports.pppo.gov/ or upon request from the U.S. Department of Energy Environmental Information Center. Requests for this data may be made by email at portseic@ports.pppo.gov or by telephone at (740) 648-0267.

If you have any questions or desire additional information, please contact Amy Lawson of my staff at (740) 897-2112.

Sincerely,

Jeffrie A. Bettinger
Portsmouth Site Lead
Portsmouth/Paducah Project Office

Enclosures:
Annual Site Environmental Report and Data Report – 2020

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Matt Brewster, Pike County Health Department

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Daniel Poneman, Centrus Energy Corp.
Zack Smith, Mid-America Conversion Services, LLC
Damon Detillion, Portsmouth Mission Alliance

Greenup County Library
Chillicothe & Ross County Library
Jackson City Library
Peebles Free Public Library
Portsmouth Public Library
The Garnet A. Wilson Public Library of Pike County
Wellston Public Library

Chillicothe Gazette
Portsmouth Daily Times
Pike County News Watchman
The Telegram (Jackson County)

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Randy Heath, Jackson Chamber of Commerce
Shirley Bandy, Pike County Chamber of Commerce
Lisa Carver, Portsmouth Area Chamber of Commerce

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David Zanni, Adena Pike Community Hospital
Ben Gill, Southern Ohio Medical Center

John Hemmings, Ohio Valley Regional Development Commission
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Steven Shepherd, Southern Ohio Diversification Initiative
Robert Horton, Southern Ohio Port Authority
Gary Arnett, Pike County Community and Economic Development
Sam Brady, Jackson County Economic Development

Vina Colley, P.R.E.S.S. (Stakeholder)
Geoffrey Sea, SONG (Stakeholder)

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Ryan Mapes, Director, OSU South Centers

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Pike County Board of Commissioners
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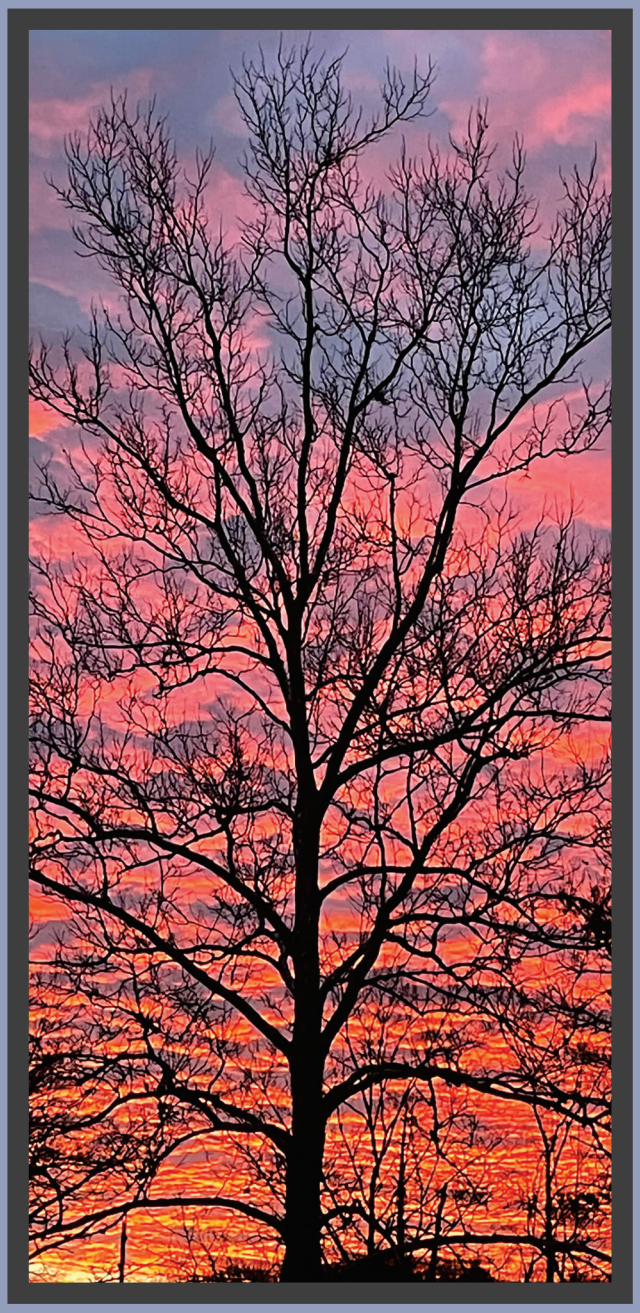
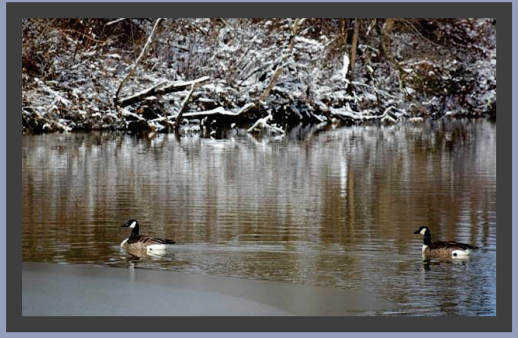
U.S. Department of Energy

Portsmouth Gaseous Diffusion Plant



Annual Site Environmental Report 2020



September 2021

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Report – 2020
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-1034&D1

September 2021

By
Fluor-BWXT Portsmouth LLC, under Contract DE-AC30-10CC40017

FBP-ER-RCRA-WD-RPT-0375, Revision 1

This document has been approved for public release:

Richard Henderson (signature on file)	9/8/2021
Classification Office	Date

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FIGURES

TABLES

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ACRONYMS AND ABBREVIATIONS

ACO	American Centrifuge Operating, LLC
ACP	American Centrifuge Plant
ALARA	as low as reasonably achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
Ci	curie
D&D	decontamination and decommissioning
DAS	Disposal Authorization Statement
D&D DFF&O	*The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (Ohio EPA 2012)
DOE	U.S. Department of Energy
dps	disintegration per second
DUF_6	depleted uranium hexafluoride
EMS	Environmental Management System
EPEAT	Electronic Product Environmental Assessment Tool
FBP	Fluor-BWXT Portsmouth LLC
IRM	interim remedial measure
kg	kilogram
lbs	pounds
LFRG	Low-level Waste Disposal Facility Review Group
LLW	low-level radioactive waste
µg/g	microgram per gram (equivalent to part per million)
µg/kg	microgram per kilogram (equivalent to part per billion)
µg/L	microgram per liter (equivalent to part per billion)
$\mu g/m^3$	microgram per cubic meter
MAGLC	maximum acceptable ground level concentration
MCS	Mid-America Conversion Services, LLC
mg/L	milligram per liter (equivalent to part per million)
mrem	millirem
NCRP	National Council on Radiation Protection
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRD DFF&O	*The July 30, 2018 Director's Final Findings and Orders for CERCLA Actions to Restore Natural Resources* (Ohio EPA 2018)
ODH	Ohio Department of Health
Ohio EPA	Ohio Environmental Protection Agency
OREIS	Oak Ridge Environmental Information System
OSWDF	on-site waste disposal facility
OVEC	Ohio Valley Electric Corporation
PCB	polychlorinated biphenyl
pCi/g	picocurie per gram
pCi/L	picocurie per liter
pCi/m^3	picocurie per cubic meter

PEGASIS	PPPO Environmental Geographic Analytical Spatial Information System
PEMS	Project Environmental Measurements System
PFAS	perfluoroalkyl and polyfluoroalkyl substances
PK	Peter Kiewit
PM2.5	particulate matter (2.5 microns or less)
PM10	particulate matter (10 microns or less)
PMA	Portsmouth Mission Alliance, LLC
PORTS	Portsmouth Gaseous Diffusion Plant
ppb	part per billion
ppm	part per million
PPPO	Portsmouth/Paducah Project Office
rad	radiation absorbed dose
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
SODI	Southern Ohio Diversification Initiative
TCE	trichloroethene
TLD	thermoluminescent dosimeter
TSCA	Toxic Substances Control Act
USEC	United States Enrichment Corporation
U.S. EPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant (PORTS) is located on a 5.8-square-mile site in a rural area of Pike County, Ohio. The site is 2 miles east of the Scioto River. PORTS, which produced enriched uranium via the gaseous diffusion process from 1954 to 2001, is one of three former uranium enrichment plants used for national security and the commercial sector.

Fox at the Portsmouth Site

Since 1989 DOE's Office of Environmental Management (EM) has been conducting environmental cleanup at PORTS. DOE and its contractors' activities at the site include:

- Environmental remediation, or the cleanup of soil, groundwater and other environmental media from past operations;
- Decontamination and demolition of gaseous diffusion process buildings and associated facilities;
- Disassembly and removal of equipment, removal of wastes including asbestos, PCBs, and hazardous waste, and deactivation of utilities and other systems;
- Reuse and recycling of excess equipment, clean scrap materials, and other items with priority given to transfer to the local community;
- Characterization and disposal of wastes stored or generated on site, including monitoring and maintenance of closed landfills; and
- Conversion of depleted uranium hexafluoride cylinders.

DOE conducts environmental monitoring to assess the impact, if any, that site activities may have on public health and the environment. In 2020, more than 10,000 samples of air, water, external radiation, soil, sediment, vegetation, fish, and wildlife were collected from on and around PORTS and analyzed for radioactive and nonradioactive contaminants.

Each year DOE PORTS prepares the Annual Site Environmental Report (ASER) according to the requirements of DOE Order 231.1B, Environment, Safety, and Health Reporting. The ASER is a key component of DOE's effort to keep the public informed about environmental conditions at PORTS. This report and previous ASERs can be found at www.energy.gov/pppo/downloads/portsmouth-annual-site-environmental-reports-0.

Chapters within the ASER provide a more detailed overview of the activities at PORTS, including:

Chapter 1: an introduction to the activities at the site;
Chapter 2: a summary of compliance with laws and regulations;
Chapter 3: details about environmental programs conducted on site;
Chapter 4: radiological environmental monitoring conducted at the site;
Chapter 5: non-radiological monitoring, such as metals and PCBs;
Chapter 6: groundwater monitoring; and
Chapter 7: a summary of the actions taken to ensure the quality of information collected from the monitoring programs.

Major components of the environmental monitoring completed by DOE in 2020 are summarized below:

- Discharges of radionuclides, chemicals, and other water quality parameters to Little Beaver Creek, the Scioto River, or other water bodies were measured at 11 locations called National Pollutant Discharge Elimination System (NPDES) outfalls.

- External radiation was measured continuously at 24 on and off-site locations. The measurements were collected quarterly.

- Ambient air was sampled at 19 locations on and off site and analyzed for radionuclides and/or fluoride. Five new ambient air monitoring stations began sampling in 2020 for non-radiological air pollutants that could be released due to decontamination and decommissioning (D&D) activities: particulate matter, metals, volatile organic compounds (VOCs) and asbestos.

- Surface water samples were collected semiannually from 14 locations on and off-site and analyzed for radionuclides.

- Sediment was sampled at 18 locations and analyzed for radionuclides, metals, and PCBs.

- Soil samples were collected at 15 locations, including on-site, fence line, off-site and background locations and analyzed for radionuclides.

- Biota samples, including vegetation, deer, fish, food crops, milk, and eggs, were analyzed for radionuclides. Fish were also analyzed for PCBs.

- Approximately 300 wells were sampled at varying frequencies to monitor remedial actions, movement of groundwater contaminants, and groundwater quality.

2020 Environmental Performance Summary

In 2020, DOE's monitoring performance at PORTS is summarized below:

- Environmental monitoring data collected in 2020 were similar to data collected in recent years indicating radionuclides, metals, and other chemicals released by PORTS would have a minimal effect on human health and the environment.

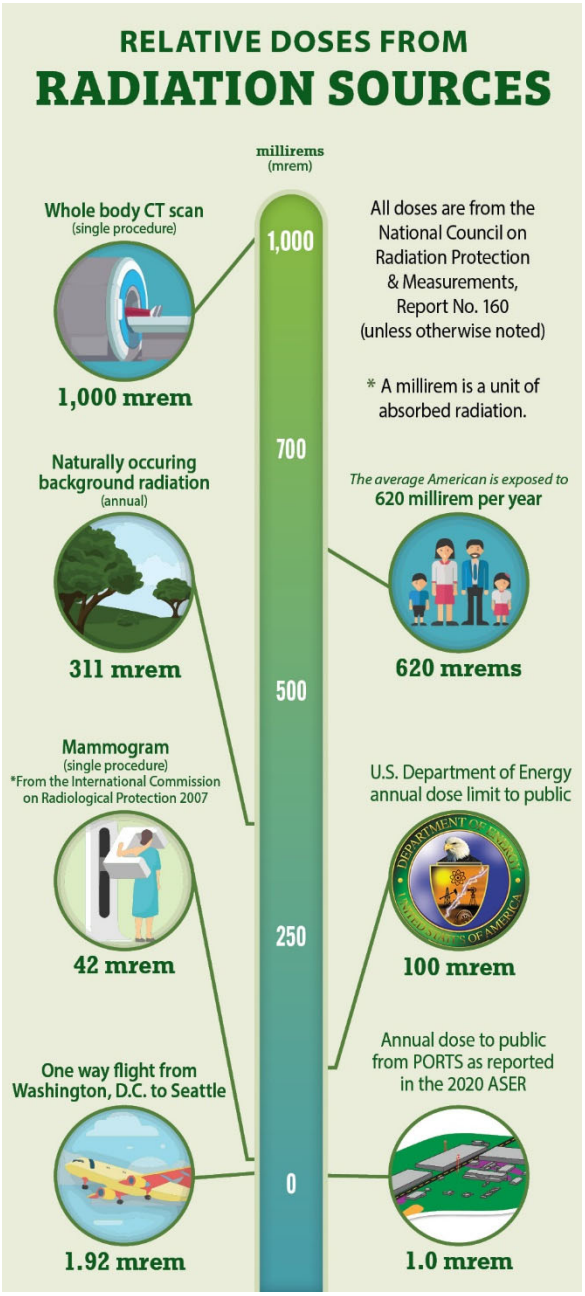
- The dose of radiation (based on calculations) that could be received by a member of the public from all pathways of exposure was 1.0 millirem (mrem)/year, which is less than 1% of the DOE annual dose limit of 100 mrem/year.

- Concentrations of most contaminants detected within the groundwater plumes at PORTS were stable or decreasing in 2020. Concentrations of trichloroethene (TCE) or metals were increasing in a few wells in the monitoring areas. These areas continue to be closely monitored. Changing TCE concentrations in the X-701B monitoring area and near the Little Beaver Creek are being further investigated.

- Results for the residential water supply monitoring program indicated that PORTS has not affected drinking water wells outside the site boundaries.

- Ambient air monitoring contaminant levels for both radionuclides and fluoride continued to be either not detected, detected below DOE standards, or within background levels.

- Ambient air monitoring at the stations installed in 2020 indicated that levels of particulate matter, metals, VOCs, and asbestos, if detectable, were within health-based standards.



- Surface water monitoring contaminant levels for radionuclides at on-site and off-site locations upstream and downstream from PORTS continued to be either not detected or below DOE standards.

- Sampling of sediment in 2020 for metals indicated that no appreciable differences were evident in the concentrations upstream and downstream from PORTS. Contaminant levels for radionuclides were within background levels or below DOE standards.

- Concentrations of PCBs in on-site and off-site sediment samples were below the level of concern established by regional screening levels of the U.S. Environmental Protection Agency (EPA) and Ohio EPA.

- Contaminant levels for radionuclides in soil and food crops were within background levels or below DOE standards.

- Contaminant levels for radionuclides in deer were below DOE standards.

- Radionuclides were not detected in samples of fish, milk, and eggs collected in 2020.

- In 2020, PCBs were detected in fish caught in off-site creeks within the range of concentrations detected in recent years. The detections were within the consumption advisory limits set by the Ohio Department of Health.

- PCBs detected in one sample of fish collected from an on-site creek contained PCBs above consumption advisory limits set by the Ohio Department of Health. PCBs are being addressed at PORTS as a part of the ongoing site cleanup mission.

During 2020, PORTS reported the following:

- Two water discharge locations called NPDES outfalls exceeded discharge limits set by Ohio EPA for total suspended solids, which are sediments and particulate matter in water that can make the water cloudy. These exceedances were caused by a combination of excessive rainfall and operational issues. Operational issues were corrected. One outfall exceeded discharge limits for mercury. These mercury exceedances are being addressed in accordance with the compliance schedule in the NPDES permit. One outfall had a single exceedance of a daily discharge limitation for chlorine. This exceedance lasted no longer than 4 hours based on samples collected before and after the exceedance.

- Four unplanned on-site releases were reported to Ohio EPA and other national, state, and/or local authorities (as required by the specific regulations pertaining to each release). Two releases were groundwater contaminated with TCE due to piping component failures in the on-site groundwater extraction systems, one release was sewage from an equipment blockage in a screen station at the site Sewage Treatment Plant, and one release was a transformer oil leak in the X-530 Switchyard. Equipment repairs were completed as needed to place the systems back in operation. The releases were cleaned up and no other actions were required by Ohio EPA.

DOE and its contractors at PORTS are committed to enhancing environmental stewardship and to reducing any impacts that site operations may cause to the environment. PORTS implements sound stewardship practices in the protection of land, air, water, and other natural or cultural resources potentially impacted by their operations. A report of progress in achieving specified Environmental Management System (EMS) goals is submitted annually to DOE Headquarters. The environmental stewardship scorecard for PORTS in fiscal year 2020 was green, which indicates standards for the Environmental Management System implementation were met.

A complete summary of the environmental programs can be found in the chapters following this Executive Summary.

1. INTRODUCTION

1.1 SUMMARY

The Portsmouth Gaseous Diffusion Plant (PORTS) is located on a 5.8-square-mile site in a rural area of Pike County, Ohio (see Figure 1.1). U.S. Department of Energy (DOE) activities at PORTS include decontamination and decommissioning (D&D) of the process buildings and associated facilities formerly used for the gaseous diffusion process of uranium enrichment, environmental restoration, waste management, and uranium operations. Fluor-BWXT Portsmouth LLC (FBP) is the DOE contractor that manages D&D of PORTS, which includes the three gaseous diffusion process buildings and other associated facilities. The Depleted Uranium Hexafluoride (DUF_6) Conversion Facility at PORTS began full scale operations in 2011 to manage the inventory of DUF_6, which was a product of the gaseous diffusion process. Mid-America Conversion Services, LLC (MCS) managed the DUF_6 Conversion Facility in 2020.

1.2 BACKGROUND INFORMATION

PORTS, which produced enriched uranium via the gaseous diffusion process from 1954 through 2001, is owned by DOE. In 1993, DOE leased the uranium production facilities at the site to United States Enrichment Corporation (USEC), which was established by the Energy Policy Act of 1992. USEC produced enriched uranium in the gaseous diffusion process facilities through 2001.

DOE is responsible for D&D of the gaseous diffusion process buildings and associated facilities, environmental restoration, waste management, and uranium operations. DOE contractors FBP, Portsmouth Mission Alliance, LLC (PMA), and MCS managed DOE programs at PORTS in 2020.

Figure 1.1 The Portsmouth Gaseous Diffusion Plant.
(looking from the north-northeast towards the south-southwest)

FBP managed the following activities:

- D&D of the former gaseous diffusion process building and associated facilities;
- environmental restoration of contaminated areas;
- environmental monitoring and reporting on environmental compliance;
- disposition of D&D waste, legacy radioactive waste, and hazardous waste;
- security forces;
- uranium management; and
- operation of the site's waste storage facilities.

PMA managed the following facility support services:

- computer and telecommunications services;
- security;
- training;
- records management;
- fleet management;
- non-nuclear facility preventive and corrective maintenance;
- grounds and road maintenance;
- snow removal; and
- janitorial services.

In 2020, MCS managed the DUF_6 Conversion Facility, including surveillance and maintenance of DUF_6 cylinders and environmental compliance and monitoring activities associated with operation of the facility. DUF_6, which is a product of the uranium enrichment process, is stored in cylinders on site. The DUF_6 Conversion Facility converts DUF_6 into uranium oxide and aqueous hydrogen fluoride. The uranium oxide is made available for beneficial reuse, storage, or disposal, and the aqueous hydrogen fluoride is sold for reuse.

USEC, Inc. (the parent company of USEC) became Centrus Energy Corp. (Centrus) in 2014 after a financial restructuring. A Centrus affiliate, American Centrifuge Operating, LLC (ACO), continues to lease facilities at PORTS that were intended for the development of gaseous centrifuge uranium enrichment technology. ACO currently has a U.S. Nuclear Regulatory Commission (NRC) materials license for a demonstration facility on the leased premises. In 2016, the American Centrifuge Lead Cascade Facility (Lead Cascade) was shut down and all Lead Cascade decommissioning activities completed. In 2018, a final status radiological survey demonstrated that the Lead Cascade areas met regulatory radiological criteria for unrestricted use and the more restrictive Lead Cascade License Application limits. In 2019, DOE awarded a contract to Centrus to demonstrate production of high-assay, low-enriched uranium for advanced nuclear reactors. At the end of 2020, the ACO NRC materials license remained active and no NRC-regulated materials were present at the Lead Cascade.

Centrus is responsible for environmental compliance, environmental monitoring, and management of wastes generated by current activities at the American Centrifuge Plant (ACP). Centrus operates independently of the DOE and is regulated by the NRC. The Centrus data and compliance information included in this report are provided for informational purposes only.

This report is intended to fulfill the requirements of DOE Order 231.1B, *Environment, Safety and Health Reporting*. This DOE Order requires development of an annual site environmental report that includes information on regulatory compliance, environmental programs, radiological and non-radiological monitoring programs, groundwater programs, and quality assurance. The Annual Site Environmental

Report also provides the means by which DOE demonstrates compliance with the radiation protection requirements of DOE Order 458.1 *Radiation Protection of the Public and the Environment*.

This report is not intended to present all of the monitoring data at PORTS. Additional data collected for other site purposes, such as D&D, environmental restoration, and waste management, are presented in other documents that have been prepared in accordance with applicable legal agreements and regulations. These data are presented in other reports, such as the *2020 Groundwater Monitoring Report* (DOE 2021), which are available at the PORTS Environmental Information Center.

1.3 DESCRIPTION OF SITE LOCALE

PORTS is located in a rural area of Pike County, Ohio, on a 5.8-square-mile site. The site is 2 miles east of the Scioto River in a small valley running parallel to and approximately 120 feet above the Scioto River floodplain. Figure 1.2 depicts the plant site within the State of Ohio and its immediate environs.

Pike County has approximately 27,772 residents (U.S. Census Bureau 2020). Scattered rural development is typical; however, the county contains a number of small villages such as Piketon and Beaver that lie within a few miles of the plant. The county's largest community, Waverly, is about 10 miles north of the plant and has a population of about 4,236 residents (U.S. Census Bureau 2020). The nearest residential center in this area is Piketon, which is 1 to 4 miles north of the plant and has a population of about 2,140 (U.S. Census Bureau 2020). A number of residences are located adjacent to the plant boundary.

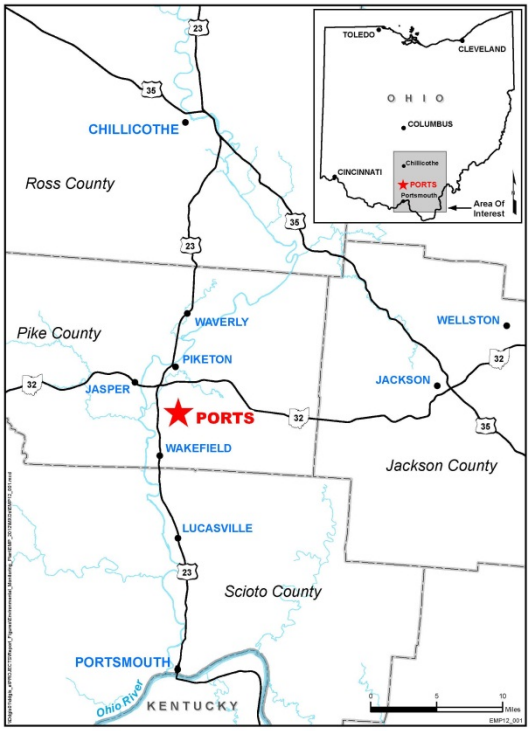


Figure 1.2. Location of PORTS.

Additional cities within 50 miles of the plant are Portsmouth (population 20,158), 22 miles south; Chillicothe (population 21,722), 27 miles north; and Jackson (population 6,230), 18 miles east (U.S. Census Bureau 2020). The total population within 50 miles of the plant is approximately 662,000 persons, which includes people on the outskirts of Cincinnati and Columbus, Ohio; Ashland, Kentucky; and Huntington, West Virginia.

1.4 DESCRIPTION OF SITE OPERATIONS

DOE, through its managing contractors, is responsible for D&D of the gaseous diffusion uranium enrichment buildings and associated facilities, environmental restoration, and waste management associated with DOE activities. DOE is also responsible for uranium management, which includes the DUF_6 Conversion Facility.

D&D includes the gaseous diffusion process buildings and associated facilities subject to *The April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action, including the July 16, 2012 Modification thereto* (D&D DFF&O) [Ohio Environmental Protection Agency (Ohio EPA) 2012]. D&D activities can consist of deactivation of equipment; removal and cleaning of process residues from equipment, structures, and piping; and dismantlement, demolition, and removal of equipment, structures, piping, and

concrete foundations. The D&D Program is also responsible for conducting an evaluation of alternatives for disposition of waste generated by D&D.

The goal of the Environmental Restoration Program is to verify that releases from past operations at PORTS are thoroughly investigated and that, if applicable, remedial actions are taken to protect human health and the environment. Environmental restoration is the investigation and remediation of environmental contamination associated with the past operation of the gaseous diffusion uranium enrichment facilities. Remedial investigations and remedial actions define the nature and extent of environmental contamination, evaluate the potential risk to public health and the environment, remediate areas of environmental contamination, and monitor/evaluate ongoing remedial actions.

Waste management includes managing wastes generated by DOE activities at PORTS, including wastes generated by D&D, environmental restoration, the DUF_6 Conversion Facility, and other DOE site activities. Wastes must be identified and stored in accordance with all environmental regulations. The responsible DOE contractor also arranges the transportation and disposal of wastes. The goal of the Waste Management Program is to manage waste from the time it is generated to its ultimate treatment, recycling, or disposal in accordance with all applicable regulations and DOE Orders.

DOE is also responsible for uranium management, which includes management of uranium product, coordination of the DUF_6 program, and warehousing of other uranium materials such as normal uranium hexafluoride, uranium oxides, and uranium metal.

2. COMPLIANCE SUMMARY

2.1 SUMMARY

In 2020, DOE and/or the responsible DOE contractor (FBP and MCS) held permits for discharge of water to surface streams, air emission permits, and a permit for the storage of hazardous wastes. FBP is responsible for the National Pollutant Discharge Elimination System (NPDES) outfalls and air emission permits that were associated with the gaseous diffusion plant. MCS is responsible for activities associated with the DUF_6 Conversion Facility. Centrus is responsible for compliance activities directly associated with the ACP.

FBP and MCS are responsible for preparing a number of reports for compliance with various applicable environmental regulations. These reports may include all or a subset of the following reports (for MCS): an annual groundwater monitoring report, a biennial hazardous waste report, an annual polychlorinated biphenyl (PCB) document log, an annual summary of radionuclide air emissions and the associated dose to the public from these emissions, annual or biennial reports of specified non-radiological air emissions, a monthly report of NPDES monitoring data, an annual hazardous chemical inventory, and an annual toxic chemical release inventory. Additional information on each of these reports is provided within this chapter.

DOE activities at PORTS are inspected regularly by the federal, state, and local agencies responsible for enforcing environmental regulations at PORTS. FBP did not receive any Notices of Violation in 2020.

DOE had four unplanned on-site releases in 2020. Two releases of groundwater contaminated with trichloroethene (TCE) were due to piping component failures in the on-site groundwater extraction systems, one release was sewage from an equipment blockage in screen station at the site Sewage Treatment Plant, and one release was a transformer oil leak in the X-530 Switchyard. Ohio EPA and other national, state, and/or local authorities were notified as required. Equipment repairs were completed as needed to place the systems back in operation. The releases were remediated and no other actions were required by Ohio EPA.

2.2 COMPLIANCE INTRODUCTION

DOE is responsible for the D&D Program, Environmental Restoration Program, Waste Management Program, uranium operations, and maintenance of all facilities not leased to Centrus. FBP is responsible for air emission permits and NPDES outfalls associated with the former gaseous diffusion plant operations. MCS is responsible for activities associated with the DUF_6 Conversion Facility.

Centrus is responsible for compliance activities directly associated with the ACP including NPDES outfalls and management of wastes generated by their current operations.

DOE and/or DOE contractors (FBP and MCS) held two NPDES permits for discharge of water to surface streams, numerous air emission permits, and a Resource Conservation and Recovery Act (RCRA) Part B permit for the storage of hazardous wastes. Appendix A lists the active environmental permits and registrations held by DOE and/or DOE contractors (FBP and MCS) at the end of 2020.

Several federal, state, and local agencies are responsible for enforcing environmental regulations at PORTS. Primary regulatory agencies include Ohio EPA and the U.S. Environmental Protection Agency (U.S. EPA). These agencies issue permits, review compliance reports, conduct joint monitoring programs, inspect facilities and operations, and oversee compliance with applicable regulations.

DOE and/or DOE contractors conduct self-assessments to identify environmental issues and consult the regulatory agencies to identify the appropriate actions necessary to achieve and maintain compliance.

2.3 COMPLIANCE STATUS

This section discusses the DOE compliance status at PORTS with respect to environmental laws and regulations, DOE Orders, and Executive Orders.

2.3.1 Environmental Restoration and Waste Management

This section discusses the DOE compliance status at PORTS with Ohio EPA and U.S. EPA regulations pertaining to environmental restoration and waste management.

2.3.1.1 Comprehensive Environmental Response, Compensation, and Liability Act

PORTS is not on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List of sites. However, D&D of PORTS is proceeding in accordance with the D&D DFF&O and CERCLA. The D&D DFF&O describes the regulatory process for D&D of the gaseous diffusion process buildings and associated facilities that are no longer in use. Chapter 3, Section 3.2 of this report, provides additional information about the D&D Program.

Environmental remediation, or the cleanup of soil, groundwater and other environmental media contaminated by PORTS, has been conducted in accordance with the Consent Decree with the State of Ohio, issued on August 29, 1989 and the U.S. EPA Administrative Order by Consent, issued on September 29, 1989 (amended in 1994 and 1997 and terminated on February 13, 2017). Ohio EPA oversees environmental remediation activities at PORTS under the RCRA Corrective Action Program and CERCLA Program. Chapter 3, Section 3.3 of this report, provides additional information on the Environmental Restoration Program.

Section 103 of CERCLA requires notification to the National Response Center if hazardous substances are released to the environment in amounts greater than or equal to the reportable quantity. Reportable quantities are listed in CERCLA and vary depending on the type of hazardous substance released. During 2020, DOE contractors had no reportable quantity releases of hazardous substances subject to Section 103 notification requirements.

2.3.1.2 Emergency Planning and Community Right-To-Know Act

The Emergency Planning and Community Right-To-Know Act of 1986, also referred to as the Superfund Amendments and Reauthorization Act Title III, requires reporting of emergency planning information, hazardous chemical inventories, and releases to the environment. Emergency Planning and Community Right-To-Know Act reports are submitted to federal, state, and local authorities.

For emergency planning purposes, facilities must submit information on chemicals present on site above specified quantities (called the threshold planning quantity) to state and local authorities. When a new chemical is brought on site or increased to exceed the threshold planning quantity, information about the new chemical must be submitted to state and local authorities within three months.

Section 304 of the Emergency Planning and Community Right-To-Know Act requires reporting of off-site reportable quantity releases to state and local authorities**.** During 2020, FBP and MCS had no off-site reportable quantity releases subject to Section 304 reporting requirements.

The Hazardous Chemical Inventory Report includes the identity, location, storage information, and hazards of the chemicals present on site in amounts above the threshold planning quantities specified by U.S. EPA. This report is submitted annually to state and local authorities. Table 2.1 lists the chemicals reported by the PORTS site, which included DOE contractors or lessees (FBP, PMA, MCS, and Centrus) for 2020:

Table 2.1. Chemicals reported in the Hazardous Chemical Inventory Report for 2020

1,2-propanediol	hydrogen fluoride	sodium chloride
aluminum oxide	lime calcium oxide	sodium hydroxide
aluminum oxide hydrate	lubricating oils	sulfuric acid
argon	methanol	triuranium octaoxide
asbestos	mineral oils	uranium oxide
carbon dioxide	nitric acid	uranium hexafluoride
citric acid	nitrogen	uranium metal
diesel fuel #2 (ultralow sulfur)	PCBs	uranium tetrafluoride
ethylene glycol	perfluoro-1,3-dimethylcyclohexane	
fluorotrichloromethane (CFC-11)	petroleum distillates	
gasoline	potassium hydroxide	

The Toxic Chemical Release Inventory is sent annually to U.S. EPA and Ohio EPA. This report details releases to the environment of specified chemicals when they are manufactured, processed, or otherwise used by the entire site in amounts that exceed threshold quantities specified by U.S. EPA. For this report, U.S. EPA defines a release to include on-site treatment, off-site disposal, and recycling conducted in accordance with regulations.

For 2020, DOE contractors reported the permitted release and/or off-site treatment/disposal of two chemicals:

- hydrogen fluoride: approximately 47 pounds (lbs) transported off site for disposal or released to the air from the DUF_6 Conversion Facility; and

- nitrate compounds: approximately 30,000 lbs released to the Scioto River through permitted NPDES outfalls (from water treatment).

2.3.1.3 Resource Conservation and Recovery Act

RCRA regulates the generation, accumulation, storage, transportation, and disposal of solid and hazardous wastes. "Solid wastes," as defined by Ohio EPA, can be solids, liquids, sludges, or other materials. Hazardous wastes are a subset of solid wastes, and are designated as hazardous by Ohio EPA because of various chemical properties, including ignitability, corrosivity, reactivity, and toxicity.

Hazardous waste. DOE and FBP hold a permit to store hazardous waste at PORTS. The permit, often called a Part B Permit, was issued to DOE and the responsible DOE contractor in 1995, and renewed by Ohio EPA in 2001 and 2011. The permit governs the storage of hazardous waste and includes requirements for waste identification, inspections of storage areas and emergency equipment, emergency procedures, training requirements, and other information required by Ohio EPA.

Facilities such as PORTS that generate or store hazardous waste are required to submit a biennial report to Ohio EPA (in even-numbered years) that covers waste shipped in the previous odd-numbered year (i.e., waste shipped in even-numbered years no longer requires reporting). DOE submitted the report for calendar year 2019 to Ohio EPA in February 2020. This biennial report contains the name and address of each facility that waste was shipped to during the previous calendar year, the name and address of the transporter for each waste shipment, the description and quantity of each waste stream shipped off site, and a description of waste minimization efforts. Chapter 3, Section 3.4, Waste Management Program, provides additional information on wastes from DOE activities at PORTS that were recycled, treated, or disposed in 2020.

In 2020, DOE had two reportable releases of groundwater contaminated with TCE, which is regulated as a hazardous waste. Section 2.5 provides more information about these on-site releases.

RCRA also requires groundwater monitoring at certain hazardous waste management units. As discussed in Chapter 6, groundwater monitoring requirements at PORTS have been integrated into one document, the *Integrated Groundwater Monitoring Plan* (DOE 2017b). Hazardous waste management units monitored in accordance with the *Integrated Groundwater Monitoring Plan* include the X-749 Contaminated Materials Disposal Facility (northern portion), X-231B Southwest Oil Biodegradation Plot (Quadrant I Groundwater Investigative [5-Unit] Area), X-701C Neutralization Pit (Quadrant II Groundwater Investigative [7-Unit] Area), X-701B Former Holding Pond, X-701B retention basins, X-744Y Waste Storage Yard (X-701B area), X-230J7 Holding Pond (X-701B area), X-616 Former Chromium Sludge Surface Impoundments, and X-735 RCRA Landfill (northern portion). Chapter 6 discusses the groundwater monitoring requirements for these units.

A groundwater report that summarizes the results of monitoring completed in accordance with the *Integrated Groundwater Monitoring Plan* is submitted annually to Ohio EPA (DOE 2021). Chapter 6 discusses these monitoring results for 2020.

MCS is regulated as a small quantity hazardous waste generator. Small quantity hazardous waste generators are subject to requirements for generation and accumulation of hazardous waste. These requirements include proper waste identification, use of appropriate containers, availability of emergency equipment, and specified shipment information.

Solid waste disposal facilities. Groundwater monitoring may be required at closed solid waste disposal facilities, such as landfills. Groundwater monitoring requirements for the closed X-734 Landfills, X-735 Industrial Solid Waste Landfill, and X-749A Classified Materials Disposal Facility are included in the *Integrated Groundwater Monitoring Plan* (DOE 2017b). Chapter 6 discusses the groundwater monitoring results for these units in 2020. There are no solid waste landfills currently operating at PORTS.

2.3.1.4 Federal Facility Compliance Act

Waste that is a mixture of RCRA hazardous waste and low-level radioactive waste (LLW) is currently stored at PORTS. RCRA hazardous waste is subject to Land Disposal Restrictions, which with limited exceptions do not allow the storage of hazardous waste for longer than one year. The Federal Facility Compliance Act, enacted by Congress in 1992, allows for the storage of mixed hazardous/LLW for longer than one year because treatment for this type of waste is not readily available. The Act also requires federal facilities to develop and submit site treatment plans for treatment of mixed wastes. On October 4, 1995, Ohio EPA issued a Director's Final Findings and Orders allowing the storage of mixed waste beyond one year and approving the proposed Site Treatment Plan. An annual update to the Site Treatment Plan is required by these Director's Final Findings and Orders. The annual update to the Site Treatment Plan for fiscal year 2020 was submitted to Ohio EPA in December 2020.

2.3.1.5 Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) regulates the use, storage, and disposal of PCBs, which are most commonly found in older electrical power system components, such as transformers and capacitors. The PCB transformers and capacitors that were present in the gaseous diffusion process buildings have been removed from service. Eleven pole-mounted PCB transformers were in service within the PORTS facility at the end of 2020.

An annual document log is prepared to meet TSCA regulatory requirements. The document log provides an inventory of PCB items in use, in storage as waste, and shipping/disposal information for PCB items

disposed in 2020. The *2020 PCB Document Log for the Portsmouth Gaseous Diffusion Plant* was prepared in June 2021. Approximately 100 tons of PCB waste (gross weight) was generated in 2020. Approximately 0.6 tons of PCB waste (gross weight) was shipped for disposal in 2020. Waste contaminated with PCBs was generated during 2020 through D&D activities in the process buildings and other areas.

A Uranium Enrichment TSCA Compliance Agreement between DOE and U.S. EPA, effective in 1992 and modified in 2017, addresses PCB management issues at PORTS including:

- the use, management, storage, and disposal of PCBs in ventilation duct gaskets and its associated collection and containment system;
- a negotiated schedule for clean-up, removal, and management of PCB wastes and contaminated items; and
- on-going air monitoring and management of PCB spill clean-ups.

Annual reports of progress made toward milestones specified in the TSCA Compliance Agreement are submitted to U.S. EPA. DOE was in compliance with the requirements and milestones of this TSCA Compliance Agreement during 2020.

The DUF_6 Conversion Facility stores and processes cylinders containing DUF_6 that may have paint containing greater than 50 parts per million (ppm) of PCBs present on the outside of the cylinders. The cylinders are stored in the X-745C, X-745E and X-745G Cylinder Storage Yards. The cylinders are stored in accordance with an agreement with U.S. EPA that includes monitoring of PCBs in surface water and sediment in drainage basins downstream from the cylinder storage yards. Chapter 5, Sections 5.4.2 and 5.5.2 provide the results of this surface water and sediment sampling, respectively.

2.3.1.6 Federal Insecticide, Fungicide, and Rodenticide Act

No restricted-use pesticides were used by DOE contractors in 2020.

2.3.2 Radiation Protection

This section discusses the DOE compliance status with DOE Orders pertaining to radiation protection and management of radioactive waste.

2.3.2.1 DOE Order 458.1, *Radiation Protection of the Public and the Environment*

The purpose of DOE Order 458.1 is to establish requirements to protect the public and the environment against undue risk from radiation associated with radiological activities conducted under the control of the DOE pursuant to the Atomic Energy Act of 1954, as amended. The objectives of DOE Order 458.1 are:

- conduct DOE radiological activities so that exposure to members of the public is maintained within the dose limits established in the Order and are as low as reasonably achievable, and
- ensure that DOE sites have the capabilities, consistent with the types of radiological activities conducted, to monitor routine and non-routine radiological releases and assess the radiation dose to members of the public.

DOE Order 458.1 requires that off-site radiation doses do not exceed 100 millirem (mrem)/year above background for all exposure pathways. Chapter 4 provides the dose calculations or monitoring results that demonstrate compliance with this DOE Order.

2.3.2.2 DOE Order 435.1, *Radioactive Waste Management*

The objective of DOE Order 435.1 is to ensure that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment. DOE Order 435.1 applies to all high-level waste, transuranic waste, and LLW, including the radioactive component of mixed waste for which DOE is responsible. Only LLW and mixed LLW are found at PORTS. Chapter 3, Section 3.4 provides additional information about the DOE Waste Management Program at PORTS.

An on-site waste disposal facility (OSWDF) has been selected per the record of decision for waste disposition for disposal of waste generated by D&D that meets criteria for on-site disposal (see Chapter 3, Section 3.2.2). The DOE Low-level Waste Disposal Facility Review Group (LFRG) has completed an independent review of the design and planned operation of the OSWDF as presented in a Performance Assessment and Composite Analysis and determined compliance with performance objectives in DOE Order 435.1. PORTS received a Disposal Authorization Statement (DAS) for design and construction of the OSWDF from the DOE Office of Site Restoration in 2015. This DAS requires completion of the construction, along with a comparison of the as-built facility to that reviewed, and satisfaction of the conditions in the DAS, as verified by the LFRG, prior to issuance of the DAS for Operations.

2.3.3 Air Quality and Protection

This section discusses the DOE compliance status with U.S. EPA and Ohio EPA regulations pertaining to air emissions (both radionuclides and non-radiological pollutants) and stratospheric ozone protection. Figure 4.3 in Chapter 4 and Figure 5.1 in Chapter 5 are maps showing the PORTS ambient air monitoring locations.

2.3.3.1 Clean Air Act

FBP is responsible for numerous air emission sources associated with the former gaseous diffusion production facilities and support facilities. These sources, which included the boilers at the X-600 Steam Plant Complex (prior to demolition in 2013), emitted more than 100 tons per year of non-radiological air pollutants specified by Ohio EPA, which caused DOE to become a major source of air pollutants as defined in Title 40 of the *Code of Federal Regulations* (CFR) Part 70. Ohio EPA issued the final Title V Air Permit to FBP in 2014. The X-600 Steam Plant Complex has been demolished and is no longer operating.

FBP is required to submit quarterly Title V Deviation Reports that document any deviations from requirements of the Title V permit. These quarterly reports are summarized in an annual Title V Compliance Certification. In 2020, FBP did not have any deviations from the Title V Permit requirements.

Ohio EPA requires an annual report called the Ohio EPA Fee Emissions Report to report emissions of selected non-radiological air pollutants. U.S. EPA requires an annual report of greenhouse gas emissions. Chapter 5, Section 5.3.1 provides more information about these reports and the reported emissions for FBP in 2020.

In 2020, MCS was responsible for four permitted sources associated with the DUF_6 Conversion Facility. The Annual Permit Evaluation Report for the MCS air emission sources did not report any deviations from applicable emission limits or control requirements. Chapter 5, Section 5.3.1, provides more information about air emissions from MCS in 2020.

Appendix A lists the FBP and MCS air emission sources at PORTS. Radiological air emissions from the DOE air emission sources are discussed in Chapter 4 and non-radiological air emissions are discussed in Chapter 5.

2.3.3.2 Clean Air Act, Title VI, Stratospheric Ozone Protection

DOE has instituted a record-keeping system consisting of forms and labels to comply with the Title VI record-keeping and labeling requirements. These requirements affect all areas that use ozone-depleting substances, such as Freon. The service record and retrofit or retirement plan forms apply to units with a capacity of more than 50 lbs. The refrigeration equipment disposal log and associated appliance disposal label are used by all units regardless of capacity. The technicians who service equipment under DOE control are trained in accordance with U.S. EPA requirements.

2.3.3.3 National Emission Standards for Hazardous Air Pollutants

The National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart H, National Emission Standards for Emissions of Radionuclides Other Than Radon from DOE Facilities (40 CFR Part 61, Subpart H) requires DOE to submit an annual report for radiological emissions from DOE air emission sources.

DOE contractors FBP and MCS were both responsible for radiological air emission sources. Chapter 4, Section 4.3.2, provides the radiological dose calculations from these emissions.

FBP sources. In 2020, FBP was responsible for numerous air emission sources including 1) continuously monitored vents in the X-330 and X-333 Process Buildings and the X-344A Uranium Hexafluoride Sampling Building; 2) room ventilation exhausts and/or pressure relief vents associated with the X-710 Technical Services Building, X-705 Decontamination Facility, and the XT-847 Glove Box; and 3) the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities.

Radiological emissions from the vents in the X-330 and X-333 Process Buildings and the X-344A Uranium Hexafluoride Sampling Building were measured by continuous monitoring, if in use. Emissions from the room ventilation exhausts and vents (if in use) were estimated based on operating data and U.S. EPA emission factors. Emissions from the groundwater treatment facilities were estimated based on quarterly influent/effluent sampling and quarterly throughput. Total radiological airborne emissions from FBP sources in 2020 were 0.0358 curie (Ci) (3.58E-02 Ci).

MCS sources. In 2020, MCS was responsible for emissions from the DUF_6 Conversion Facility. The DUF_6 Conversion Facility did not operate from April through December 2020 due to the COVID-19 pandemic. Emissions from the DUF_6 Conversion Facility were based on continuous monitoring of the conversion building stack. Total radiological airborne emissions from the DUF_6 Conversion Facility in 2020 were 0.0000163 Ci (1.63E-05 Ci).

2.3.4 Water Quality and Protection

This section discusses the DOE compliance status with U.S. EPA and Ohio EPA regulations pertaining to water quality and protection.

2.3.4.1 Clean Water Act

DOE contractors FBP and MCS held NPDES permits during 2020 that allowed discharges of water to surface streams. FBP was responsible for 18 monitoring locations identified in the FBP NPDES permit. Nine outfalls discharge directly to surface water, six outfalls discharge to another outfall before leaving the site, and three other locations that are not outfalls were also monitored. Chapter 4, Section 4.3.4.1, and Chapter 5, Section 5.4.1.1, provide additional information on the FBP NPDES outfalls. Chapter 4, Figure 4.4 is a map of the PORTS NPDES outfalls.

The MCS NPDES permit allows the discharge of process wastewaters from the DUF_6 Conversion Facility. The MCS NPDES permit provides monitoring requirements for MCS Outfall 001 that are only effective when process wastewater is being discharged through the outfall. The permit also includes

requirements for MCS Outfall 602, which are effective when process wastewater is being discharged to the sanitary sewer system that flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). No process wastewater was discharged through MCS Outfall 001 in 2020. Chapter 4, Section 4.3.4, and Chapter 5, Section 5.4.1.2, provide additional information on the MCS NPDES outfalls.

Data required to demonstrate compliance with the NPDES permits are submitted to Ohio EPA in monthly discharge monitoring reports (see Chapter 5, Section 5.4.1.1). Fifteen permit limitations associated with the FBP NPDES permit were exceeded during 2020 (see Chapter 5, Section 5.4.1.1). The overall FBP NPDES compliance rate for 2020 was 99%.

There were no exceedances of MCS permit limitations in 2020; therefore, the overall MCS NPDES compliance rate for 2020 was 100%.

Most of the FBP NPDES outfalls are also monitored for radionuclides (see Chapter 4, Section 4.3.4). The MCS outfalls are not monitored for radionuclides.

Information about NPDES monitoring completed by Centrus is provided in Chapter 4, Section 4.3.4.2 and Chapter 5, Section 5.4.1.3.

Stormwater runoff, water from precipitation that flows over land and is not absorbed into the ground, is regulated under the Clean Water Act because it can accumulate debris, chemicals, or other pollutants that affect water quality. Stormwater Pollution Prevention Plans are prepared for the site industrial activities under the FBP NPDES permit. Construction activities are covered by the NPDES Construction Stormwater General Permit. The Stormwater Pollution Prevention Plans include descriptions of the activities and the controls to be used to minimize impacts to stormwater runoff.

Stormwater management and drainage design will be part of site redevelopment after D&D and remediation are completed.

2.3.4.2 Safe Drinking Water Act

In 2020, FBP was responsible for operation of the PORTS drinking water system. Drinking water systems are regulated by the Safe Drinking Water Act, which sets requirements for water testing, treatment, and disinfection, as well as distribution system maintenance and operator training. The Safe Drinking Water Act also sets health-based standards for naturally-occurring and man-made contaminants that may be found in drinking water.

PORTS obtains its drinking water from two water supply well fields west of PORTS in the Scioto River Valley buried aquifer near the Scioto River. Ohio EPA provides the parameters and schedule for sampling the drinking water for various parameters, for example: nitrate, lead, disinfection byproducts, total coliform, and chlorine. Sampling results are submitted to Ohio EPA in a monthly report.

The PORTS drinking water supply was sampled by Ohio EPA in June 2020 for perfluoroalkyl and polyfluoroalkyl substances (PFAS), which are a group of manmade chemicals used in non-stick products such as Teflon, in water and stain repellant fabrics, and firefighting foam, among many uses. No PFAS were detected in PORTS treated drinking water. One type of PFAS, perfluorooctane sulfonate (PFOS), was detected in the PORTS raw water supply at 5.4 nanograms per liter (ng/L), or parts per trillion. This detection is below the Ohio EPA action limit of 70 ng/L. Because there were no detections in PORTS treated drinking water, no further actions are currently planned.

2.3.5 Other Environmental Statutes

This section discusses the DOE compliance status with other applicable environmental statutes and regulations including underground storage tank regulations and the Endangered Species Act.

2.3.5.1 Underground storage tank regulations

The Underground Storage Tank Program is managed in accordance with the Ohio State Fire Marshal's Bureau of Underground Storage Tank Regulations. Underground storage tanks in the former gaseous diffusion plant buildings and associated facilities are owned by DOE. PMA and MCS have no underground storage tanks. In 2020, FBP was responsible for five tanks and Centrus was responsible for one tank. These tanks include five diesel fuel tanks ranging in size from 2500 to 20,000 gallons and a 20,000 gallon gasoline tank. The registrations for these tanks are renewed annually.

FBP removed one of its tanks in February 2020: a 5000-gallon diesel tank used for an emergency generator in the X-326 Process Building. A closure assessment was submitted to the Bureau of Underground Storage Tank Regulations and no further action was required. At the end of 2020, FBP was responsible for four tanks and Centrus was responsible for one tank.

2.3.5.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires evaluation of the environmental impacts of activities at federal facilities and of activities funded with federal dollars.

DOE has a formal program dedicated to compliance pursuant to DOE Order 451.1B*, National Environmental Policy Act Compliance Program*. Restoration actions, waste management, enrichment facilities maintenance, and other activities are evaluated to determine the appropriate level of evaluation and documentation. No environmental assessments or environmental impact statements were completed during 2020.

Routine operation and maintenance activities are also evaluated to assess potential environmental impacts. Activities not regulated under CERCLA may be covered under a categorical exclusion or other NEPA determination as defined in the regulations. These activities are considered routine and have no significant individual or cumulative environmental impacts. DOE has implemented a policy to post online specific classes of categorical exclusions as found in 10 CFR Part 1021, Appendix B to Subpart D. Categorical exclusions for PORTS are posted on the DOE PPPO website (energy.gov/pppo).

2.3.5.3 Endangered Species Act

The Endangered Species Act of 1973, as amended, provides for the designation and protection of endangered and threatened wildlife and plants, and the habitat on which such species depend. When appropriate, formal consultations are made with the U.S. Fish and Wildlife Service and the Ohio Department of Natural Resources.

A study was conducted in 2013 to identify the potential presence of the federally-endangered Indiana bat (*Myotis sodalis*) and the northern long-eared bat (*Myotis septentrionalis*), in the northeastern area of PORTS that is the location for the OSWDF (see Chapter 3, Section 3.2.2). The study did not identify the presence of the federally-endangered Indiana bat in the study area. Both foraging and roosting activities were identified for the northern long-eared bat, which is listed as a threatened species. In 2015, the U.S. Fish and Wildlife Service issued a Biological Opinion that the OSWDF is not likely to jeopardize the continued existence of the northern long-eared bat.

An additional study was conducted in 2019 to assess the potential presence of the Indiana bat and the northern long-eared bat in areas where tree clearing was proposed. No Indiana bats and one northern long-eared bat were identified during the study. DOE proposed additional tree-clearing activities in

September 2020, and the U.S. Fish and Wildlife Service concurred with DOE that the tree-clearing activities, as proposed, were not likely to adversely affect the northern long-eared bat. Measures continue to be implemented during construction and operation of the OSWDF and other D&D activities to minimize potential impacts to bats.

2.3.5.4 National Historic Preservation Act

The National Historic Preservation Act of 1966 (NHPA) is the primary law governing the protection of historic properties. NHPA reviews consider both architectural and archeological properties. Coordination and/or consultation with the State Historic Preservation Office and other stakeholders are made as a part of the reviews. The cultural resources of three broad time periods of occupation of the PORTS property have been assessed: the prehistoric era (occupation by Native Americans until approximately 1650), the historic era (occupation by Native Americans and early settlers from 1650 through 1952) and the DOE era (from 1952 to the present).

Fifty-four prehistoric archaeological sites have been identified on PORTS property. Each of these sites was investigated, and four of the sites included sufficient artifacts such as tools, earth ovens, and pottery to be determined eligible for inclusion on the National Register of Historic Places. One of the sites eligible for inclusion on the National Register of Historic Places was located in the northeast corner of PORTS in the support area for the OSWDF. DOE worked with the State Historic Preservation Office and Tribal Nations to develop a data recovery approach for this area so that artifacts and other information could be recovered from the area (approximately 1 acre) prior to construction activities. Field work, including hand excavation of selected areas, was completed in 2015. No significant artifacts were found. A technical report documenting the data recovery processes and results was submitted to the State Historic Preservation Office in 2017. A summary-level report intended for a general audience was submitted to the State Historic Preservation Office in 2019.

Sixty-one historic era sites have been identified on PORTS property. Most of these sites were farmstead/residential sites, and investigations of the farmstead/residential sites determined that the sites were not eligible for inclusion on the National Register of Historic Places. Two sites, the Holt Cemetery and Mount Gilead Church and Cemetery are treated as if they are eligible for the National Register.

DOE has worked with the State Historic Preservation Office, Advisory Council on Historic Preservation, Tribal Nations, and individual members of the public interested in historic preservation to determine how best to document the DOE era of site history, that is, the history associated with the buildings and other areas that are part of D&D. The NHPA review for site D&D was performed as a part of the CERCLA process. The PORTS Virtual Museum (portsvirtualmuseum.org) preserves photos, video, oral histories, and other information associated with operation, remediation, and D&D of PORTS. The records of decision for process buildings and waste disposition (see Chapter 3, Section 3.2) list the activities selected to preserve the history associated with the PORTS site.

The following activities selected to preserve the history of the PORTS site have been completed:

- a Comprehensive Summary Report summarizing all NHPA-related investigations (FBP 2014);
- a Historic Context Report that documents the history of operations and facilities at PORTS from 1952 through the end of the Cold War (DOE 2017d); and
- expansion of the PORTS virtual museum to include information on prehistoric activities.

Activities selected to preserve the history of the PORTS site and document ongoing activities are:

- collection and evaluation of items recovered from PORTS facilities for potential future display;
- public outreach to local school districts and others; and
- panoramic and aerial photographs taken at regular intervals.

2.3.5.5 Archaeological and Historic Preservation Act and Archaeological Resources Protection Act
The Archaeological and Historic Preservation Act and the Archaeological Resources Protection Act require the Secretary of the Department of Interior to report to Congress on various federal archaeological activities. The Archaeological Resources Protection Act requires federal land managers to provide archaeology program information to the Secretary of the Interior for this report; information for PORTS is included in the overall DOE headquarters report.

2.3.6 DOE Order 436.1 *Departmental Sustainability*
DOE Order 436.1, *Departmental Sustainability*, requires development and implementation of an Environmental Management System (EMS) in order to protect air, water, land, and other natural or cultural resources potentially impacted by DOE operations.

FBP serves as the coordinating contractor for EMS implementation among the DOE site contractors (FBP, PMA, and MCS). A report of progress in achieving specified EMS goals is submitted annually to DOE Headquarters. These EMS goal areas, specified in Executive Order 13963 (see Section 2.3.7.2), include objectives related to the following:

- reduction of greenhouse gas emissions,
- reduction of energy consumption and intensity in site buildings,
- increased use of clean or renewable energy,
- enhanced water use efficiency and management,
- fleet management to reduce petroleum use and/or increase alternative fuel/vehicle use,
- sustainable acquisition, and
- pollution prevention and waste reduction.

In 2020, the environmental scorecard prepared for DOE PORTS (FBP, PMA, and MCS) was green, which indicates that standards for EMS implementation have been met with at least 80% of the goal areas for fiscal year 2020 addressed in the EMS. Some of the EMS goal areas are not applicable to PORTS because the facility is not operating and is preparing for D&D.

Chapter 3, Section 3.5, provides information about the DOE Environmental Sustainability Program at PORTS.

2.3.7 Executive Orders
Executive Orders are issued by the President to various federal agencies, including DOE. This section discusses the DOE compliance status at PORTS with Executive Orders pertaining to the environment.

2.3.7.1 Executive Order 11988, *Floodplain Management,* and Executive Order 11990, *Protection of Wetlands*
Title 10 of the CFR Part 1022 establishes policy and procedures for compliance with Executive Order 11988, *Floodplain Management*, and Executive Order 11990, *Protection of Wetlands*.

A site-wide wetland survey report was completed and submitted to the Corps of Engineers in 1996. The 1996 survey identified 41 jurisdictional wetlands and four non-jurisdictional wetlands totaling 34.36 acres at PORTS.

A wetland and stream assessment was completed in 2013 for the northeast area of PORTS where the OSWDF is being constructed. DOE is developing mitigation strategies for wetlands and streams that will be impacted by the construction of the OSWDF in accordance with CERCLA requirements.

2.3.7.2 Executive Order 13834, *Efficient Federal Operations*

Executive Order 13834, *Efficient Federal Operations*, prioritizes meeting energy and environmental statutory requirements in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment. Existing activities that are part of compliance with DOE Order 436.1 (see Section 2.3.6) and the DOE Environmental Sustainability Program at PORTS (see Chapter 3, Section 3.5) support this executive order. These existing activities include improving energy and water use efficiency; encouraging site-wide recycling and material reuse; and increasing the use of alternative fuel and alternative fuel vehicles.

Green and sustainable remediation is the abatement, cleanup, or use of methods to contain, remove, or destroy contaminants while seeking to minimize the environmental, economic, and social costs of the remediation. FBP is incorporating green and sustainable remediation into the D&D activities discussed in Chapter 3. Actions being taken to support green remediation include efficient movement of materials to reduce fuel usage, efforts to minimize water usage and control runoff, and recycling/reuse of materials.

2.4 OTHER MAJOR ENVIRONMENTAL ISSUES AND ACTIONS

This section summarizes environmental inspections of DOE activities at PORTS during 2020 and the results of these inspections.

2.4.1 Environmental Program Inspections

During 2020, five inspections of DOE activities at PORTS were conducted by federal, state, or local agencies. Table 2.2 lists these inspections.

Table 2.2. Environmental inspections of DOE activities at PORTS for 2020

Date	DOE contractor	Agency	Type	Notices of Violation
February 18-24 June 1-5	FBP/PMA	NERC[a]	Operations and security of the PORTS bulk power system (electrical grid)	None
September 30	FBP	Ohio EPA	RCRA compliance (virtual site visit)	None
September 30	FBP	Ohio EPA	Closed solid waste management units (virtual site visit)	None
October 15	FBP	U.S. EPA	RCRA compliance evaluation information request	None
November 19	FBP	Pike County Health District	Closed solid waste landfills	None

[a]North American Electric Reliability Corporation

2.4.2 Notices of Violation

No Notices of Violation were received by DOE or DOE contractors (FBP, PMA, and MCS) in 2020.

2.5 UNPLANNED RELEASES

DOE had four on-site unplanned releases in 2020.

On January 16, 2020, groundwater containing TCE was released when a mechanical failure occurred in an extraction well in the Quadrant I Groundwater Investigative (5-Unit) Area. This groundwater is regulated by Ohio EPA as a hazardous waste. Groundwater overflowed from the vault associated with the extraction well and flowed approximately 150 feet on the ground's surface to a ground opening that discharged into the X-230K South Holding Pond (FBP NPDES Outfall 002). Upon discovery of the release, the discharge point for the pond was closed, the groundwater collection system was shut down, and the area affected by the spill was flagged to define the extent of the spill and remediation efforts. Ohio EPA and the National Response Center were notified as required.

Soil was excavated in the area affected by the release and disposed as hazardous waste. Samples were collected from the excavation area and analytical results confirmed that TCE was not present in the soil above the PORTS preliminary remediation goal. Sampling also confirmed that TCE was not present above the detection limit in water discharged from the X-230K South Holding Pond. DOE estimated that approximately 120,000 gallons of groundwater were released from the well. DOE submitted a report summarizing the release to Ohio EPA, and Ohio EPA did not require any further activities.

On February 16, 2020, a blockage caused a release of sewage from an abandoned pipe at a screen station at the site Sewage Treatment Plant. Approximately 375 gallons of sewage was discovered pooled in a ditch near the X-230K South Holding Pond. The screen station was shut down, the blockage and released sewage were cleaned up, and the abandoned pipe was air-gapped from the force main to remove the source of the leak. Ohio EPA was notified of the release and did not require any further activities.

On February 16, 2020, a maximum of 1,000 gallons of groundwater containing TCE was released to the surrounding area when a piping component failed and groundwater overflowed from a vault and manhole near the X-230K South Holding Pond. This groundwater is regulated by Ohio EPA as a hazardous waste. The groundwater collection system was shut down and a failed pipe cap was determined to be the cause of the release. Ohio EPA and the National Response Center were notified as required. The piping was repaired, soil was excavated in the release area, and analytical results confirmed that TCE was not present in the soil above the PORTS preliminary remediation goal. DOE submitted a report summarizing the release to Ohio EPA, and Ohio EPA did not require any further activities.

On May 1, 2020, oil was discovered leaking from a transformer in the X-530 Switchyard. Personnel immediately began spill containment and control activities by placing absorbent pads at the spill site and using absorbent oil booms and line skimmers in the on-site drainage ditches and the X-230J5 Holding Pond, which is downstream from the location of the spill. The transformer was taken off line as soon as the electrical load could be transferred to the other operational transformer. An estimated 50-100 gallons of transformer mineral oil was released. Stone/ballast material in the vicinity of the spill was excavated, approximately 110 gallons of an oil/water mixture was collected from an on-site drainage ditch, and absorbent materials were used to remove small amounts of oil sheen in the on-site drainage ditch. The spill was reported as required to the Ohio EPA and Pike County local emergency planning committee. No impacts to the public were identified and no further actions were required.

2.6 SUMMARY OF PERMITS

Appendix A lists the permits held by DOE and/or DOE contractors in 2020.

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3. ENVIRONMENTAL PROGRAM INFORMATION

3.1 SUMMARY

Ohio EPA concurred with the records of decision for the process buildings and waste disposition in 2015. The record of decision for the process buildings and other facilities selected controlled removal of stored waste and materials, demolition of the buildings or structures, and characterization of materials for disposal or disposition (DOE 2015b). The record of decision for waste disposition selected a combination of on-site and off-site disposal (DOE 2015c), which includes construction of an OSWDF. The following activities continued throughout 2020: 1) removal of materials from the process buildings, 2) on-site staging or off-site reuse, recycling, or disposal of D&D materials in compliance with the records of decision, and 3) construction activities for the OSWDF.

Soil and groundwater is being investigated and remediated, if necessary, as part of the Environmental Restoration Program at PORTS. Ohio EPA approved the *Deferred Units RCRA Facility Investigation/Corrective Measures Study Work Plan for Solid Waste Management Units* in 2015 (DOE 2015a). This work plan was developed to investigate "deferred units" at PORTS. Deferred units are designated areas located in, or adjacent to, the gaseous diffusion production and operation areas. Remedial activities in these areas would have interrupted ongoing operations, or ongoing operations could have resulted in recontamination of the areas. Soil and groundwater sampling in the work plan started in 2015 and was completed in 2016. The initial *Deferred Units RCRA Facility Investigation/Corrective Measures Study Report* was submitted to Ohio EPA in 2017. Ohio EPA reviewed the report and submitted comments to DOE in December 2018. DOE worked to address these comments, which included additional sampling and installation of additional monitoring wells, throughout 2019 and the beginning of 2020. The revised report was submitted to Ohio EPA on August 21, 2020 (DOE 2020c).

Activities undertaken by the Environmental Sustainability and Public Awareness programs are also discussed in this chapter. Approximately 345 tons of recyclable or reusable materials were sent off site in 2020.

Chapter 2, Section 2.3.6, provides information on implementation of the DOE EMS at PORTS.

3.2 D&D PROGRAM

On April 13, 2010, Ohio EPA issued the D&D DFF&O, which is an enforceable agreement between Ohio EPA and DOE that governs the process for D&D of the gaseous diffusion process buildings and associated facilities that are no longer in use at PORTS. The D&D DFF&O was revised in 2011 and 2012 to add structures that were inadvertently omitted from the original orders. The D&D DFF&O, which applies to the D&D of buildings down to and including the building slab and disposal of wastes generated by D&D, uses the CERCLA framework for determining appropriate removal and remedial actions. Documents are submitted to Ohio EPA for either concurrence or approval. Chapter 2, Section 2.3.1.1, provides additional information about the D&D DFF&O.

Public open houses in neighboring communities are held to keep the public informed and to receive their questions and comments. The PORTS Site Specific Advisory Board, comprised of local citizens, provides recommendations to DOE based on the concerns of the communities surrounding PORTS. Section 3.6 provides additional information on the PORTS Public Awareness Program.

3.2.1 Process Buildings and Other Facilities

D&D of the process buildings and other facilities at PORTS is proceeding in accordance with the record of decision for process buildings concurred with by Ohio EPA in 2015 (DOE 2015b). The record of decision includes:

- Demolition of the buildings or structures;
- Characterization and demolition of underground man-made features;
- Treatment as needed to meet transportation and disposal requirements (either on-site or off-site disposal);
- Packaging of generated waste for final disposal (either on-site or off-site disposal); and
- Transportation and disposal of the waste in accordance with the waste disposition record of decision (either on-site or off-site disposal).

The Process Buildings Deactivation Remedial Design/Remedial Action Work Plan (RD/RA Work Plan) (DOE 2016b) was developed by DOE and concurred with by Ohio EPA in 2016. Another RD/RA Work Plan, the Comprehensive Deactivation, Demolition, and Disposition RD/RA Work Plan for the Process Buildings and Complex Facilities (DOE 2018a), was prepared by DOE and concurred with by Ohio EPA in 2018 which included deactivation, demolition, and waste disposition activities. These two RD/RA Work Plans provide the information to demonstrate that deactivation activities to prepare the three main process buildings along with their associated support structures and also the other complex facilities for demolition meet the requirements of the D&D DFF&O, the Process Buildings and Waste Disposition records of decision, and other applicable requirements. Activities underway in 2020 included disassembly and removal of equipment, removal of wastes including asbestos, PCBs, and RCRA hazardous waste, and deactivation of utilities and other systems. Materials that did not meet criteria for on-site disposal at the OSWDF are being shipped off site for disposal in accordance with applicable regulations.

3.2.2 Site-wide Waste Disposition

The record of decision for site-wide waste disposition was concurred with by Ohio EPA in 2015 (DOE 2015c). The record of decision selected a combination of on-site and off-site disposal, including construction of an OSWDF.

Figure 3.1 shows the location of the OSWDF in the northeast portion of PORTS. Site construction activities began in 2015. In 2020, work continued on installation of the liners and other infrastructure for the first landfill cell. Installation of the leachate transmission piping and valve houses as well as other support areas also continued as planned. The OSWDF Final (100%) Design Package, which consists of 11 separate documents, was concurred with by Ohio EPA in 2019 and 2020.

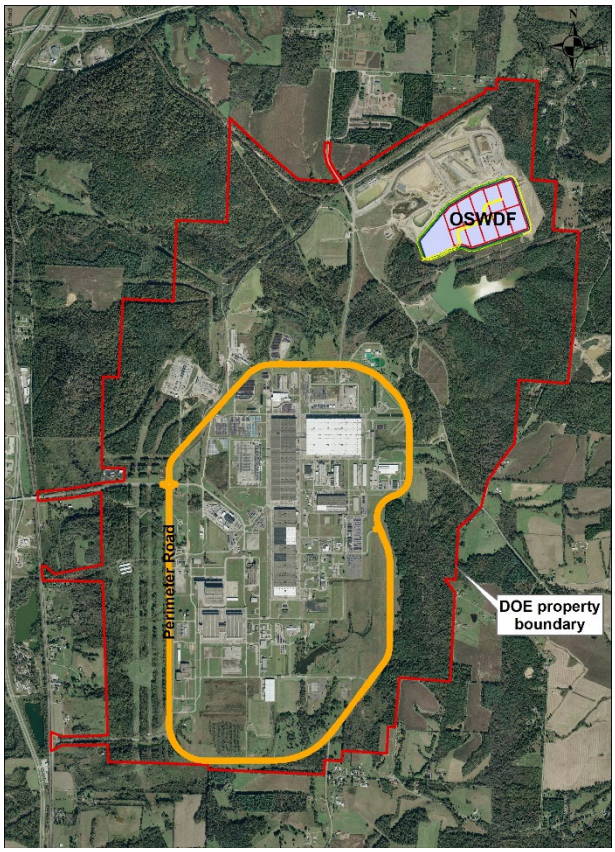

Figure 3.1. Location of the OSWDF at PORTS.

Activities in 2020 were performed in accordance with the OSWDF Final (100%) Design Package and the Comprehensive OSWDF RD/RA Work Plan (DOE 2018b).

3.3 ENVIRONMENTAL RESTORATION PROGRAM

DOE established the Environmental Restoration Program in 1989 to identify, control, and remediate environmental contamination at PORTS. Environmental restoration has been conducted in accordance with the RCRA corrective action process, under a Consent Decree with the State of Ohio, issued on August 29, 1989 and a U.S. EPA Administrative Order by Consent, issued on September 29, 1989 (amended in 1994 and 1997 and terminated on February 13, 2017). With implementation of D&D, removal of facilities and structures down to and including the building slab is controlled by the D&D process (see Section 3.2). Investigation and remediation of environmental contamination is completed under the RCRA corrective action process and in accordance with the Consent Decree with the State of Ohio.

In general, the RCRA corrective action process consists of the following:

1) an assessment to identify releases of hazardous waste and hazardous constituents and determine the need for further investigation (the RCRA facility assessment),

2) an investigation to determine the nature and extent of any contamination (the RCRA facility investigation), and

3) a study to identify and evaluate remedial alternatives to address contamination (the corrective measures study).

Following the approval of the final corrective measures study, Ohio EPA selects the remedial alternatives that will undergo further review to determine the final remedial actions (the statement of basis, formerly called the preferred plan). Upon completion of the public review and comment period, Ohio EPA selects the final remedial actions. Ohio EPA issues a decision document to select the final remedial actions and the remedial actions are implemented by DOE. Final remedial actions are reviewed by Ohio EPA on a schedule agreed upon by Ohio EPA and DOE (approximately every five years) to ensure that the remedial actions are performing as intended by the decision document and are protective of human health and the environment.

The initial assessment and investigation of PORTS under the RCRA corrective action process was completed in the 1990s. Because PORTS is a large facility, it was divided into quadrants (Quadrant I, II, III, and IV) to facilitate the cleanup process (see Chapter 6, Figure 6.1). Remedial actions have been implemented in each of the PORTS quadrants.

Some RCRA corrective action investigations were deferred to the start of D&D activities at PORTS and are now underway. When the RCRA corrective action process began at PORTS during the 1990s, deferred units were designated areas located in, or adjacent to, the gaseous diffusion production and operation areas. Remedial activities in these areas would have interrupted ongoing operations, or ongoing operations could have resulted in recontamination of the areas. Ohio EPA deferred investigation/remedial action of soil and groundwater associated with these units until D&D of PORTS (or until the area no longer met the requirements for deferred unit status). Ongoing environmental monitoring and on-site worker health and safety programs monitored the contaminants in these areas prior to D&D.

The *Deferred Units RCRA Facility Investigation/Corrective Measures Study Work Plan* was approved by Ohio EPA in 2015 (DOE 2015a). Soil and groundwater sampling in the work plan started in 2015 and was completed in 2016. The initial *Deferred Units RCRA Facility Investigation/Corrective Measures*

Study Report was submitted to Ohio EPA in 2017. Ohio EPA submitted comments to DOE in December 2018. DOE worked to address these comments, which included additional sampling and installation of additional monitoring wells, throughout 2019 and the beginning of 2020. The revised report was submitted to Ohio EPA on August 21, 2020 (DOE 2020c).

The following sections describe the remedial actions underway in each quadrant as well as ongoing activities at any formerly deferred units. Table 3.1 lists remedial activities for the groundwater monitoring areas at PORTS, which include remedial actions required by decision documents and other actions.

3.3.1 Quadrant I

The *Quadrant I Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 2000 (DOE 2000). Ohio EPA issued the Decision Document for Quadrant I in 2001, which provided the required remedial actions for the X-749/X-120 groundwater plume and the Quadrant I Groundwater Investigative (5-Unit) Area (the Five-Unit Groundwater Investigative Area and X-231A/X-231B Oil Biodegradation Plots) (Ohio EPA 2001).

Remedial actions required for the X-749B Peter Kiewit Landfill (PK Landfill) were provided in separate Decision Documents issued by Ohio EPA in 1996 (Ohio EPA 1996a) and U.S. EPA in 1997 (U.S. EPA 1997). The following sections discuss the remedial actions required for the X-749/X-120 groundwater plume, PK Landfill, and the Quadrant I Groundwater Investigative (5-Unit) Area. Chapter 6 provides 2020 groundwater monitoring results for the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, (Section 6.4.1.3 and Figure 6.2), PK Landfill (Section 6.4.2.1 and Figure 6.2) and Quadrant I Groundwater Investigative (5-Unit) Area (Section 6.4.3.1 and Figure 6.3).

3.3.1.1 X-749/X-120 groundwater plume

The remedial actions identified for X-749/X-120 groundwater plume (see Chapter 6, Figure 6.2) include phytoremediation of the groundwater plume, installation of a barrier wall around the eastern and southern portion of the X-749 Landfill, and continued operation of the groundwater collection trenches installed at the PK Landfill and X-749 Landfill. In addition, groundwater extraction wells were installed in 2007, 2008, and 2010 to control migration of the plume and remediate areas of higher TCE concentrations within the plume.

Phytoremediation is a process that uses plants to remove, degrade, or contain contaminants in soil and/or groundwater. Phytoremediation at the X-749/X-120 groundwater plume was installed in two phases during 2002 and 2003. The barrier wall around the eastern and southern portion of the X-749 Landfill was completed in 2002.

The *First Five-Year Review for the X-749/X-120 Groundwater Plume*, submitted to Ohio EPA in 2011, found that the remedial actions implemented for the X-749/X-120 groundwater plume (both the remedial actions required by the Decision Document and the extraction wells installed in 2007 and 2008) were achieving remedial action objectives by preventing migration of contaminants from the X-749 Landfill and controlling migration of the X-749/X-120 groundwater plume (DOE 2011c). However, Ohio EPA and DOE agreed that the phytoremediation system was not as successful as anticipated in reducing concentrations of TCE in groundwater. The extraction wells that began operating in 2007-2008 in the groundwater collection trench on the southwest side of the X-749 Landfill and the X-749 South Barrier Wall Area, as well as the barrier wall on the south and east sides of the landfill (completed in 2002), appeared to be primarily responsible for the reductions in TCE concentrations within the X-749/ X-120 groundwater plume. Maintenance of the phytoremediation system was discontinued with the approval of Ohio EPA in 2011.

Table 3.1. Remedial actions at PORTS in groundwater monitoring areas

Quadrant/monitoring area	Remedial action/year completed
Quadrant I X-749/X-120 groundwater plume	X-749 multimedia cap – 1992 X-749 barrier wall (north and northwest sides of landfill) – 1992 X-749 subsurface drains and sumps – 1992 South barrier wall – 1994 X-120 horizontal well – 1996 X-625 Groundwater Treatment Facility – 1996 X-749 barrier wall (east and south sides of landfill) – 2002 Phytoremediation (22 acres) – 2002 & 2003 Injection of hydrogen release compounds – 2004 X-749 South Barrier Wall Area extraction wells – 2007 Two additional extraction wells in the groundwater collection trench on the southwest side of the X-749 Landfill – 2008 X-749/X-120 groundwater plume extraction wells – 2010
Quadrant I Peter Kiewit (PK) Landfill (X-749B)	Relocation of Big Run Creek – 1994 Groundwater collection system – 1994 Groundwater collection system expansion – 1997 PK Landfill Subtitle D cap – 1998
Quadrant I Quadrant I Groundwater Investigative (5-Unit) Area	Groundwater extraction wells (3) – 1991 X-622 Groundwater Treatment Facility – 1991 (upgraded in 2001) Interim soil cover at X-231B – 1995 X-231A/X-231B multimedia caps – 2000 Groundwater extraction wells (11) – 2002 Groundwater extraction well (1) – 2009 Removal of contaminated soil at former X-770 Building – 2010
Quadrant I X-749A Classified Materials Disposal Facility	Cap – 1994
Quadrant II Quadrant II Groundwater Investigative (7-Unit) Area	Operation of X-700 and X-705 building sumps – 1989 X-622T Groundwater Treatment Facility – 1992 Removal of X-720 Neutralization Pit – 1998 Removal of X-701C Neutralization Pit – 2001 Removal of contaminated soil near X-720 Neutralization Pit – 2001 X-627 Groundwater Treatment Facility – 2004 (replaced the X-622T facility) Enhanced anaerobic bioremediation – 2011
Quadrant II X-701B Former Holding Pond	X-237 Groundwater Collection System – 1991 X-624 Groundwater Treatment Facility – 1991 (upgraded 2006) Extraction wells (3) – 1993 (removed 2009-2011) X-623 Groundwater Treatment Facility – 1993 X-701B sump – 1995 Groundwater remediation by oxidant injection – 2008 Groundwater and soil remediation by oxidant mixing – 2011

Table 3.1. Remedial actions at PORTS in groundwater monitoring areas (continued)

Quadrant/monitoring area	Remedial action/year completed
Quadrant III X-740 Former Waste Oil Handling Facility Area	Phytoremediation – 1999 Oxidant injections – 2008 Enhanced anaerobic bioremediation – 2011
Quadrant IV X-611A Former Lime Sludge Lagoons	Soil cover – 1996 Prairie vegetation planted – 1997
Quadrant IV X-735 Landfills	Cap on northern portion – 1994 Cap on southern portion – 1998
Quadrant IV X-734 Landfills	Cap on X-734B Landfill (Phase I) – 1999 Cap on X-734 and X-734A Landfills (Phase II) – 2000
Quadrant IV X-533 Former Switchyard Complex	Contaminated soil removal – 2010

The most recent five-year review for the X-749/X-120 groundwater plume found that the remedial actions were working effectively to meet the remedial action objectives for the X-749/X-120 groundwater plume (DOE 2016c). The next review of the remedial actions implemented for the X-749/X-120 groundwater plume will be submitted to Ohio EPA in 2021.

A potential source area to the X-749/X-120 groundwater plume was identified north of the X-749 Landfill. This area has been investigated as part of the Deferred Units RCRA Facility Investigation, and results for soil and groundwater samples collected from this area are included in the *Deferred Units RCRA Facility Investigation/Corrective Measures Study Report (*DOE 2020c).

Chapter 6, Section 6.4.1.3 and Figure 6.2, provide additional information about the 2020 groundwater monitoring results for the X-749/X-120 groundwater plume.

3.3.1.2 PK Landfill

The remedial actions required by the PK Landfill Decision Documents consisted of the continued operation of the eastern groundwater collection system installed in 1994 and construction of an engineered cap that meets the RCRA Subtitle D and related requirements (Ohio EPA 1996a and U.S. EPA 1997). In addition, the southeastern groundwater collection system was constructed in 1997 to contain surface seeps, groundwater from the southern slope of the PK Landfill, and the groundwater plume migrating toward Big Run Creek from the X-749 Landfill.

The most recent five-year review for the PK Landfill found that the corrective actions implemented at the PK Landfill (the groundwater collection systems, landfill cap, and institutional controls) were continuing to achieve corrective action objectives by eliminating exposure pathways and reducing the potential for contaminant transport (DOE 2018d). Concentrations of many of the contaminants detected in the PK Landfill wells, sumps, and manholes have decreased. The next review of the remedial actions implemented at the PK Landfill will be submitted to Ohio EPA in 2023.

Chapter 6, Section 6.4.2.1 and Figure 6.2, provide 2020 groundwater monitoring results for the PK Landfill area.

3.3.1.3 Quadrant I Groundwater Investigative (5-Unit) Area

Remedial actions identified for the Quadrant I Groundwater Investigative (5-Unit) Area (Chapter 6, Figure 6.3) are: 1) installation of multimedia caps over the X-231A and X-231B Oil Biodegradation Plots; and 2) installation of 11 additional groundwater extraction wells to extract contaminated groundwater for treatment in the X-622 Groundwater Treatment Facility (Ohio EPA 2001). The caps were constructed in 2000 and operation of the groundwater extraction wells began in 2002. In 2009, an additional extraction well was installed south of the X-326 Process Building to control and remediate a newly identified source of TCE beneath the building. Table 3.1 lists the remedial actions completed for the Quadrant I Groundwater Investigative (5-Unit) Area.

The most recent five-year review of both the groundwater extraction system for the Quadrant I Groundwater Investigative (5-Unit) Area and the multi-layered caps for the X-231A and X-231B Oil Biodegradation Plots found that the remedial actions implemented for the X-231A and X-231B Oil Biodegradation Plots and the Five-Unit Groundwater Investigative Area (the multimedia caps and groundwater extraction system) were continuing to eliminate potential exposure pathways to contaminants, control migration of the groundwater plume, and remove volatile organic compounds (VOCs) from groundwater (DOE 2018e). The next review of the remedial actions implemented at the Quadrant I Groundwater Investigative (5-Unit) Area and X-231A/B Oil Biodegradation Plots will be submitted to Ohio EPA in 2023.

The X-231A/B Oil Biodegradation Plots and surrounding area, as well as additional portions of the 5-Unit area, will be excavated in accordance with *The July 30, 2018 Director's Final Findings and Orders for CERCLA Actions to Restore Natural Resources* (NRD DFF&O) (Ohio EPA 2018). Ohio EPA and DOE entered into the NRD DFF&O to resolve all impacts to natural resources at PORTS by the State for natural resource damage through specific natural resource restoration actions and to enhance ongoing remediation efforts at PORTS in a manner that provides restorative benefits to the natural resources injured at the site by historic operations. In 2020, two wells that are part of the monitoring program for this area were removed due to pre-demolition activities at the X-326 Process Building.

Chapter 6, Section 6.4.3.1 and Figure 6.3, provide information on the groundwater monitoring completed in the Quadrant I Groundwater Investigative (5-Unit) Area during 2020.

3.3.2 Quadrant II

The *Quadrant II Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 2001 (DOE 2001). After approval of the document, however, Ohio EPA requested an amendment to the approved study to address additional remedial alternatives for the X-701B area. Amendments were submitted in 2001 and 2002. In 2003, Ohio EPA informed DOE that a separate Decision Document would be prepared for the X-701B area, and the X-701B Decision Document was issued in 2003 (Ohio EPA 2003).

Chapter 6 provides 2020 groundwater monitoring results for the following areas in Quadrant II that require groundwater monitoring: Quadrant II Groundwater Investigative (7-Unit) Area (Section 6.4.5.1 and Figure 6.4), X-701B Former Holding Pond (Section 6.4.6.1 and Figure 6.5), and X-633 Former Recirculating Cooling Water Complex (Section 6.4.7.1 and Figure 6.6).

3.3.2.1 Quadrant II Groundwater Investigative (7-Unit) Area

A number of deferred units are in the groundwater plume in the Quadrant II Groundwater Investigative (7-Unit) Area (Chapter 6, Figure 6.4). A special investigation conducted in 2009, which sampled soil and groundwater, identified areas of higher TCE concentrations that appeared to be associated with continuing sources of groundwater contamination in the southeastern portion of the plume. In 2010, Ohio EPA approved an interim remedial measure (IRM) for this area called enhanced anaerobic bioremediation.

Enhanced anaerobic bioremediation utilizes injections of fermentable carbon compounds such as sodium lactate (a common ingredient in soaps and face creams) to provide additional food for naturally-occurring microorganisms in soil that degrade TCE to harmless substances. The project began in 2010 and was completed in 2013.

The *Final Report for the 7-Unit Interim Remedial Measure* was submitted to Ohio EPA in 2014 (DOE 2014a). Overall, the results indicated that appropriate conditions could be established at the site to degrade TCE despite the high TCE concentrations in soil and groundwater. Enhanced anaerobic bioremediation successfully reduced TCE to *cis*-1,2-dichloroethene, and with bioaugmentation, some of the *cis*-1,2-dichloroethene was converted to ethane. The report concluded that after the six injection events plus a bioaugmentation event (injection of additional microorganisms that degrade VOCs), overall there was not a measureable reduction in the average concentration of TCE in groundwater, most likely due to the potential presence of dense non-aqueous phase liquid TCE in the area, and the decision was made to conclude the IRM.

DOE and Ohio EPA have agreed that selection of a remedial action for the Quadrant II Groundwater Investigative (7-Unit) Area will be incorporated into the deferred units preferred plan and decision document.

Chapter 6, Section 6.4.5.1 and Figure 6.4, provide information about the groundwater monitoring completed at the Quadrant II Groundwater Investigative (7-Unit) Area during 2020.

3.3.2.2 X-701B Former Holding Pond

Remedial actions required by the Decision Document for X-701B, issued in 2003, include groundwater remediation by injection of a chemical oxidant (Ohio EPA 2003). The oxidant injections required by the Decision Document took place between 2006 and 2008. Following the end of the injections in 2008, an independent review of the X-701B project was completed by DOE Headquarters to evaluate remediation results and provide recommendations for a path forward.

The review of the X-701B oxidant injections determined that the method used to inject oxidant into the contaminated area was not able to address contaminants in the deepest portion of the contaminated soil. If contaminants remained in this portion of the soil, they would continue to be released into the groundwater plume. Therefore, DOE proposed an IRM to excavate soil in the western portion of the X-701B plume area and directly mix oxidant into the contaminated soil. The IRM began in December 2009 and was completed in January 2011. Chapter 6, Section 6.4.6.1 and Figure 6.5, provide information about the groundwater monitoring completed at the X-701B Former Holding Pond during 2020.

3.3.2.3 X-633 Former Recirculating Cooling Water Complex

The X-633 Recirculating Cooling Water Complex was demolished in 2010. A RCRA investigation of soil and groundwater in the area was implemented in 2011. Areas of soil potentially contaminated with metals were identified, but the higher concentrations of metals may have been present in these areas (15 to 20 ft below ground surface) due to naturally-occurring variations in the geology of the area.

Chromium and TCE were detected in groundwater at concentrations above the preliminary remediation goals during the 2011 RCRA investigation for the X-633 area. DOE agreed to sample eight wells around the area annually to continue evaluation of chromium and TCE in groundwater at this area. The *2020 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides the data for this monitoring (DOE 2021).

3.3.3 Quadrant III

The *Quadrant III Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 1998 (DOE 1998a). The Decision Document for Quadrant III, issued in 1999, required phytoremediation of the groundwater plume near the X-740 Waste Oil Handling Facility (Ohio EPA 1999a).

Over 700 hybrid poplar trees were planted on a 2.6-acre area above the X-740 groundwater plume (Chapter 6, Figure 6.8) in 1999. Evaluation reports for this remedial action were completed in 2003 and 2007. The reports concluded that the phytoremediation system had not performed as expected to remove TCE from groundwater in this area (DOE 2003 and DOE 2007b).

In response to Ohio EPA concerns about the performance of the phytoremediation system, DOE implemented additional remedial activities for the X-740 area. Three rounds of oxidant injections were completed in 2008 to remove TCE from the groundwater. Although the oxidant briefly reduced TCE concentrations detected in some of the wells, TCE concentrations in groundwater returned to typical levels in 2009.

In 2010, Ohio EPA approved a pilot study of enhanced anaerobic bioremediation for the X-740 area. Section 3.3.2.1 provides additional information about enhanced anaerobic bioremediation. Emulsified oil, a slow-acting fermentable carbon compound, was injected into the selected portions of the X-740 groundwater plume during December 2010 and January 2011. TCE has decreased in wells within the area of the groundwater plume that was treated during the pilot study (see Chapter 6, Section 6.4.9.1 and Figure 6.8).

The *Final Report for the X-740 Pilot Study* (DOE 2016a) was approved by Ohio EPA in 2016. A summary of the results of the pilot study is included in the *Deferred Units RCRA Facility Investigation/ Corrective Measures Study Report* (DOE 2020c).

The X-740 groundwater plume is being excavated in accordance with the NRD DFF&O (Ohio EPA 2018). Ohio EPA and DOE entered into the NRD DFF&O to resolve all impacts to natural resources at PORTS by the State for natural resource damage through specific natural resource restoration actions and to enhance ongoing remediation efforts at PORTS in a manner that provides restorative benefits to the natural resources injured at the site by historic operations. In 2020, all but three of the wells that are part of the X-740 monitoring program were removed to prepare for excavation of the groundwater plume in 2021.

Chapter 6 provides 2020 groundwater monitoring results for the following areas in Quadrant III that require groundwater monitoring: X-616 Former Chromium Sludge Surface Impoundments (Section 6.4.8.1 and Figure 6.7) and X-740 Former Waste Oil Handling Facility (Section 6.4.9.1 and Figure 6.8).

3.3.4 Quadrant IV

The *Quadrant IV Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 1998 (DOE 1998b). DOE received the Decision Document for Quadrant IV in 2000 (Ohio EPA 2000). No new remedial actions were required in Quadrant IV (remedial actions had already taken place at the X-344D Hydrogen Fluoride Neutralization Pit, X-735 Landfills, X-611A Former Lime Sludge Lagoons, and X-734 Landfills).

Chapter 6 provides 2020 groundwater monitoring results for the following areas in Quadrant IV that require groundwater monitoring: X-611A Former Lime Sludge Lagoons (Section 6.4.10.1 and Figure 6.9), X-735 Landfills (Section 6.4.11.1 and Figure 6.10), X-734 Landfills (Section 6.4.12.1 and Figure 6.11), X-533 Former Switchyard Complex (Section 6.4.13.1 and Figure 6.6), and X-344C Former Hydrogen Fluoride Storage Building (Section 6.4.14.1 and Figure 6.12).

3.3.4.1 X-611A Former Lime Sludge Lagoons

Ohio EPA and U.S. EPA issued a Decision Document for the X-611A area (Chapter 6, Figure 6.9) in 1996, which required a soil cover over the former lagoons and establishment of a prairie habitat (Ohio EPA 1996b). The soil cover and planting of the prairie were completed in 1997. The most recent five-year review found that the soil cover and prairie habitat were meeting the remedial action objectives for this unit by eliminating exposure pathways to the contaminants in the sludge at this area (DOE 2018c). The next review of the remedial actions implemented at the X-611A area will be submitted to Ohio EPA in 2023.

3.3.4.2 X-734 Landfills

Ohio EPA issued a Decision Document for the X-734 Landfills (Chapter 6, Figure 6.11) in 1999 (Ohio EPA 1999b). Remedial actions required by the Decision Document included construction of a multimedia cap over the northern portion of the landfills and a soil cap over the southern portion of the area. These caps were installed in 1999 and 2000.

The most recent five-year review found that the landfill caps have achieved remedial action objectives by isolating contaminants in soil and sediment from potential receptors (DOE 2018f). The caps were also preventing contaminants from migrating from soil to groundwater and from groundwater to surface water. The next review of the remedial actions implemented at the X-734 Landfills will be submitted to Ohio EPA in 2023.

3.3.4.3 X-630 Former Recirculating Cooling Water Complex

The X-630 Recirculating Cooling Water Complex, located in Quadrant IV within Perimeter Road and west of the X-533 Switchyard Complex, was removed during 2011 as part of D&D. A RCRA investigation of soil and groundwater at the X-630 Recirculating Cooling Water Complex was implemented in 2011.

Areas of soil potentially contaminated with metals were identified, but the higher concentrations of metals may have been present in these areas (15 to 20 ft below ground surface) due to naturally-occurring variations in the geology of the area.

Chromium and TCE were detected in groundwater at concentrations above the preliminary remediation goals during the 2011 RCRA investigation for the X-630 area. DOE agreed to sample four wells around the area annually to continue evaluation of chromium and TCE in groundwater at this area. The *2020 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides the data for this monitoring (DOE 2021).

3.4 ENVIRONMENTAL SUSTAINABILITY PROGRAM

DOE is committed to reducing potential environmental risks, costs, wastes, and future liability by effectively integrating environmental sustainability principles into DOE activities at PORTS in a cost effective and environmentally conscious manner. The DOE Environmental Sustainability Program is a balanced, holistic approach that links planning, budgeting, measuring, and improving PORTS overall environmental performance to specific goals and outcomes. The *Fiscal Year 2021 Site Sustainability Plan* describes the Environmental Sustainability Program and integrates the tenets of an EMS (see Chapter 2, Section 2.3.6) (DOE 2020d). The Environmental Sustainability Program includes elements of pollution prevention, waste minimization, affirmative procurement, sustainable design, and energy and water efficiency.

DOE is committed to minimizing and/or eliminating the amounts and types of wastes generated and to achieving reduced life cycle costs for managing and dispositioning property and wastes during all DOE projects and activities at PORTS.

Effective environmental sustainability management begins with an integrated strategy. In order to achieve the objectives and targets of the Environmental Sustainability Program, DOE has developed and implemented a well-defined strategy for setting, updating, and achieving objectives and targets in line with the EMS and in conjunction with DOE pollution prevention goals. The broad objectives are core elements of the Environmental Sustainability Program. These objectives, presented below, are both qualitative and quantitative and reduce the life cycle cost and liability of DOE programs and operations at PORTS:

- eliminating, minimizing, or recycling wastes that would otherwise require storage, treatment, disposal, and long-term monitoring and surveillance;

- eliminating or minimizing use of toxic chemicals and associated environmental releases that would otherwise require control, treatment, monitoring, and reporting;

- maximizing the use (procurement) of recycled-content materials and environmentally preferable products and services, thereby minimizing the economic and environmental impacts of managing by-products and wastes generated in the conduct of mission-related activities; and

- reducing the life-cycle cost of managing personal property at PORTS.

DOE continued energy reduction programs at PORTS that focused on accomplishing the goals of Executive Order 13834, *Efficient Federal Operations*. Executive Order 13834 provides goals for greenhouse gas emission reductions and environmental sustainability (including energy and water efficiency; waste and pollution prevention; and electronics stewardship).

In support of this Executive Order, the *Fiscal Year 2021 Site Sustainability Plan for the Portsmouth Gaseous Diffusion Plant* provides goals and progress through fiscal year 2020 for reductions in greenhouse gas emissions, water consumption, recycling/waste diversion, electronic stewardship, and other areas (DOE 2020d). The following accomplishments were listed for fiscal year 2020:

- A decrease of 82% in greenhouse gas emissions (primarily associated for electricity consumption) versus the fiscal year 2008 baseline emissions.

- Although water consumption increased by approximately 17% in fiscal year 2020 versus fiscal year 2019, water use intensity (gallons per gross square footage) has been reduced by 62% over the 2007 baseline. The increase in water usage was due in part to leaks at the DUF_6 Conversion Facility, which were repaired in 2020.

- Approximately 22% of nonhazardous waste was diverted from disposal at an off-site landfill (the waste was recycled). This diversion rate was less than the previous year due mainly to reduced operations resulting from the COVID response.

- Approximately 26% of construction and demolition materials were diverted from off-site disposal (the materials were recycled).

Approximately 345 tons of recyclable or reusable materials were sent off site in 2020 follows:

- aluminum cans: 1000 lbs
- aerosol cans: 50 lbs
- batteries: 64,974 lbs
- electronic materials (computer equipment, circuit boards, etc.): 14,027 lbs
- used oil: 1688 lbs
- light bulbs: 2375 lbs
- paper/cardboard: 77,500 lbs
- plastic bottles: 21,500 lbs
- spent toner cartridges: 2000 lbs
- recyclable materials to SODI (excess equipment and materials, recyclable metals, recyclable oil, etc.): 252 tons.

DOE is placing increased emphasis on the evaluation of materials generated by D&D for reuse or recycling. An agreement between DOE and the Southern Ohio Diversification Initiative (SODI) allows DOE to transfer excess equipment, clean scrap materials and other assets to SODI. SODI first attempts to reuse the excess equipment and property within the local community. Pursuant to the agreement, if SODI is unable to place the property for reuse in the local community, SODI may sell the property. When SODI sells the property, the proceeds are used to support economic development in the southern Ohio region. In 2020, SODI received approximately 252 tons of materials from PORTS, primarily recyclable metals, recyclable oil, refrigerant (Freon), and reusable equipment.

PORTS was recognized by the Green Electronics Council in May 2020 for excellence in sustainable procurement of information technology products with a 4-Star Electronic Product Environmental Assessment Tool (EPEAT) Purchasing Award.

3.5 PUBLIC AWARENESS PROGRAM

A comprehensive community relations and public participation program is in place at PORTS. The purpose of the program is to foster a spirit of openness and credibility between PORTS officials and local citizens, elected officials, business, media, and various segments of the public. The program also provides the public with opportunities to become involved in the decisions affecting environmental issues at PORTS. Contact information for the organizations that provide PORTS information to the public is listed below.

PORTS Environmental Information Center **740-289-8898** **Hours: 9-12 (Mon-Tue)** **12-4 (Wed-Thu)** **or by appt** **Email: portseic@ports.pppo.gov**	**energy.gov/pppo/portsmouth-environmental-information-center**
Online Document Repository	**eic.ports.pppo.gov**
DOE Site Office **740-897-5010**	**energy.gov/pppo**
FBP Public Affairs **740-897-2964**	**fbportsmouth.com**
PORTS Environmental Data (PEGASIS)	**pegasis.ports.pppo.gov**
PORTS Virtual Museum	**portsvirtualmuseum.org**

The Environmental Information Center provides public access to documents used to make decisions on remedial actions being taken at PORTS. The Information Center is located just north of PORTS at the Ohio State University Endeavor Center (Room 207), 1862 Shyville Road, Piketon, Ohio 45661.

The PORTS Site Specific Advisory Board, comprised of citizens from the local area, provides public input and recommendations to DOE on D&D, environmental remediation, waste management, and related issues at PORTS. Regularly scheduled meetings that are open to the public are held between DOE and the PORTS Site Specific Advisory Board. Additional information about the PORTS Site Specific Advisory Board can be obtained at energy.gov/pppo/ports-ssab or by calling 740-289-5249.

The PORTS Envoy Program matches employee volunteers with community stakeholders such as families living next to DOE property, community groups, and local government organizations. The envoys communicate information about PORTS D&D and other site issues to the stakeholders and are available to answer stakeholder questions about PORTS. The PORTS version of the PPPO Environmental Geographic Analytical Spatial Information System (PEGASIS) allows the user to obtain PORTS off-site environmental monitoring data and display it on a local map that shows the locations the data were collected. Data from 2013 through the current ASER are available in PEGASIS (pegasis.ports.pppo.gov).

Public open houses in neighboring communities are also held to keep the public informed and to receive their comments and questions. Periodically, fact sheets about major projects are written for the public. Additionally, notices of document availability and public comment periods, as well as other communications on the program, are regularly distributed to the local newspaper, the community relations mailing list, neighbors within 2 miles of the plant, and plant employees.

Helping to grow a science, technology, engineering, and math (STEM) environment for rural Appalachian schools is a primary activity for The Ohio University Voinovich School's PORTSfuture Program. Through a grant funded from the DOE Portsmouth/Paducah Project Office, PORTSfuture has been able to reach out to over 13,000 students in the four county area in Southern Ohio around PORTS. The PORTSfuture Program engages K-12 and college students in STEM activities focused on technology, energy, environment, entrepreneurship, and water quality issues. Outreach efforts have included in-class activities and curriculum, business pitch competitions, science fairs, summer STEM enrichment programs, and after school clubs.

The PORTSfuture Program includes a project in which local high school students produce a summary of the Annual Site Environmental Report for distribution to the public. The PORTS Annual Science Alliance event brings more than 1,500 high school juniors to PORTS for an interactive science fair that includes scientific demonstrations and information related to careers in STEM fields. DOE and PORTS contractors also support the annual South Central Ohio Regional Science Bowl, an academic competition for middle school and high school students. Student teams answer questions about biology, chemistry, earth sciences, math, and physics with the regional winners advancing to the National Science Bowl in Washington, D.C. The DOE PPPO web site at energy.gov/pppo and portsfuture.com provide additional information about these projects.

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4. ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

4.1 SUMMARY

Environmental monitoring at PORTS measures both radiological and chemical parameters in air, water, soil, sediment, and biota (animals, vegetation, and crops). This chapter discusses the radiological component of environmental monitoring programs at PORTS; Chapter 5 discusses the non-radiological parameters for the monitoring programs.

Environmental monitoring programs are required by state and federal regulations, permits, and DOE Orders. These programs may also be developed to address public concerns about plant activities. In 2020, environmental monitoring information was collected by DOE contractors (FBP and MCS) and Centrus. This chapter includes information about water discharges from Centrus to provide a more complete summary of environmental monitoring at PORTS.

Environmental monitoring data collected at PORTS are used to assess potential impacts to human health and the environment from radionuclides released by current and historical activities at PORTS. This impact, called a dose, can be caused by radionuclides released to air and/or water, or radiation originating directly from buildings or other objects at PORTS. U.S. EPA sets a 10 mrem/year limit for the dose from radionuclides released to the air in the NESHAP (40 CFR Part 61, Subpart H). DOE sets an annual dose limit in DOE Order 458.1 as low as reasonably achievable (ALARA)[1], but no more than 100 mrem/year above background for the total public annual dose from radionuclides from all potential pathways. A person living in the United States receives an average annual dose of approximately 311 mrem/year from natural sources of radiation (National Council on Radiation Protection [NCRP] 2009).

This chapter includes radiological dose calculations for the dose to the public from radionuclides released to the air and the Scioto River, from external radiation, and from radionuclides detected by environmental monitoring programs. The maximum annual dose a member of the public could receive from radiation released by PORTS in 2020 or detected by environmental monitoring programs in 2020 is 1.0 mrem/year and is considered ALARA. This summary of the dose calculations assumes that the same maximally exposed individual, or representative person, routinely drives on Perimeter Road past the cylinder yards and lives in the immediate vicinity of PORTS. The maximally exposed individual, or representative person, is assumed to be exposed to the maximum dose calculated from each pathway. Table 4.1 summarizes this dose information.

Table 4.1. Summary of potential annual doses to the public from PORTS in 2020

Source of dose	Dose (mrem/year)
Airborne radionuclides (off-site individual)	0.068[a]
Radionuclides released to the Scioto River	0.0016
External radiation near cylinder yards (northwest portion of Perimeter Rd)	0.74
Radionuclides detected by environmental monitoring programs	0.19
Total	1.0[b]

[a] 10 mrem/year is U.S. EPA limit for airborne radionuclides in the NESHAP (40 CFR Part 61, Subpart H).
[b] 100 mrem/year is the DOE limit for all potential pathways in DOE Order 458.1.

[1] "As low as reasonably achievable" is an approach to radiation protection to manage and control releases of radioactive material to the environment, the workforce, and members of the public so that levels are as low as reasonable, taking into account societal, environmental, technical, economic, and public policy considerations. As low as reasonably achievable is not a specific release or dose limit, but a process that has the goal of optimizing control and managing release of radioactive material to the environment and doses so they are as far below the applicable limits as reasonably achievable. This approach optimizes radiation protection.

The following sections provide the assumptions for the individual dose calculations: airborne radionuclides (Section 4.3.1), radionuclides released to the Scioto River (Section 4.3.5), external radiation (Section 4.3.6), and radionuclides detected by environmental monitoring programs (Section 4.3.7).

Figure 4.1 shows the maximum potential annual dose from all exposure pathways to the public from radiation associated with PORTS for the last ten years (2011 to 2020). The figure indicates that the maximum annual dose from radiation associated with PORTS is consistently approximately 1 mrem/year. This maximum annual dose of approximately 1 mrem/year is less than the total public annual dose limit of 100 mrem/year in DOE Order 458.1 for all radiological releases from a facility and is considered ALARA.

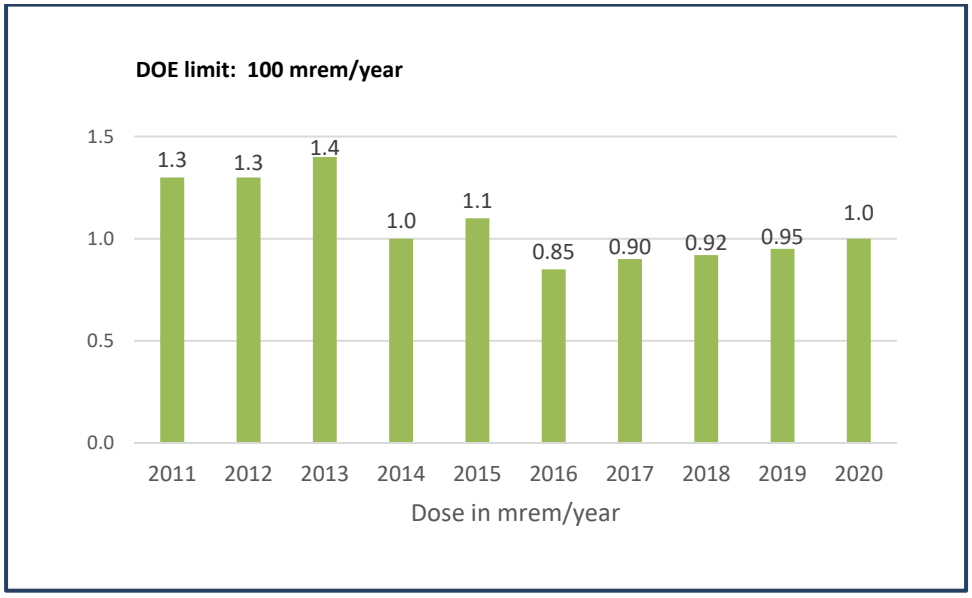

Figure 4.1. Maximum potential annual doses (all pathways) to the public, 2011 – 2020.

4.2 ENVIRONMENTAL RADIOLOGICAL PROGRAM INTRODUCTION

Environmental monitoring programs at PORTS are designed to detect the effects (if any) of activities at PORTS on human health and the environment. Multiple samples are collected throughout the year and analyzed for radionuclides that could be present from PORTS activities. The results of these monitoring programs are used to gauge the environmental impact of PORTS and to set priorities for environmental improvements.

4.2.1 Environmental Monitoring

Environmental regulations, permits, DOE Orders, and public concerns are all considered in developing environmental monitoring programs. State and federal regulations drive some of the monitoring conducted at PORTS such as limitations on discharges to air and water. DOE Orders 231.1B, *Environment, Safety and Health Reporting*, and 458.1, *Radiation Protection of the Public and the Environment,* also address environmental monitoring requirements.

The DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* describes the environmental monitoring programs for DOE activities at PORTS (DOE 2017a). Specific radionuclides monitored at PORTS are selected based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and isotopic uranium because of the uranium enrichment process. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 because these radionuclides are produced

during the fission process in nuclear reactors and were introduced to PORTS via the use of recycled uranium beginning in the late 1950s.

In 2020, environmental monitoring data were collected by DOE contractors (FBP and MCS) and Centrus. This chapter provides information on the Centrus NPDES monitoring. Centrus data are provided for informational purposes only; as Centrus operates independently of the DOE and is regulated by the NRC.

Data for the following environmental media are included in this chapter:

- airborne discharges
- ambient air
- external radiation
- discharges to surface water
- surface water
- sediment
- soil
- biota.

DOE also conducts an extensive groundwater monitoring program at PORTS. Chapter 6 provides information on the groundwater monitoring program, associated surface water monitoring, and water supply monitoring.

4.2.2 Introduction to Radiological Dose

As discussed in this chapter, dose is a measure of the potential biological damage that could be caused by exposure to and subsequent absorption of radiation to the body (in radiological terms, the effective dose). Because there are many natural sources of radiation, a person living in the United States receives an average annual dose of approximately 311 mrem/year from sources of natural radiation (NCRP 2009). Appendix B, Introduction to Radiation, provides additional information on radiation and dose.

A person can receive a radiation dose from radionuclides released to the air or water. Additionally, people can receive a radiation dose from external radiation (radiation originating from buildings or other objects such as the cylinders that store uranium in the cylinder storage yards at PORTS). Radiation exposure pathways describe how radiation exposures can reach and affect people. People can simply inhale radioactive material in the air or ingest it in water. Or, radioactive material in the air could fall on a pasture. The grass could then be eaten by cows, and the radioactive material on the grass would be present in the cow's milk. People drinking the milk would thus be exposed to this radiation. The same events could occur with radioactive material in water. Fish living in the water would be exposed; people eating the fish would then be exposed to the radioactive material in the fish. Figure 4.2 shows some of the potential radiation pathways.

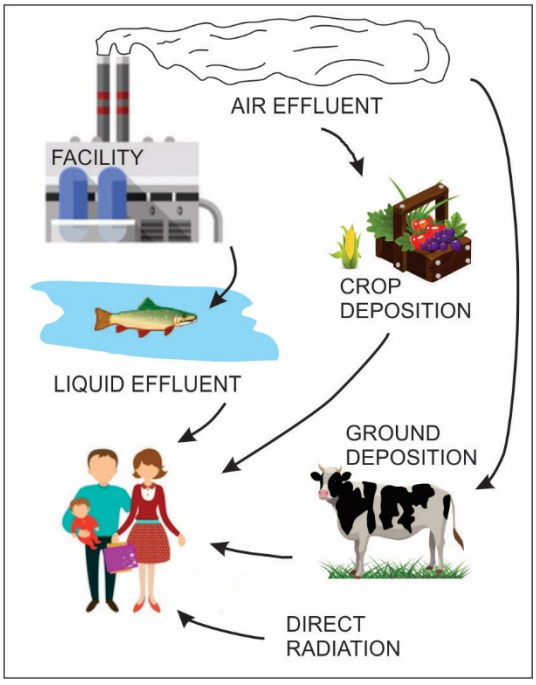

Figure 4.2. Potential radiation pathways.

Most consequences associated with radionuclides released to the environment are caused by interactions between human tissue and various types of radiation emitted by the radionuclides. These interactions involve the transfer of energy from radiation to tissue, potentially resulting in tissue damage. Radiation may come from radionuclides outside the body (in or on environmental media or objects) or from radionuclides deposited inside the body (by inhalation, ingestion, and, in a few cases, absorption through the skin). Exposures to radiation from radionuclides outside the body are called external exposures, and exposures to radiation from radionuclides inside the body are called internal exposures. This distinction is important because external exposure occurs only as long as a person is near the external radionuclide; simply leaving the area of the source will stop the exposure. Internal exposure continues as long as the radionuclide remains inside the body. Radiation from an x-ray machine that a person might find in a doctor's office is an example of external exposure because the source of radiation is outside the body. An example of an internal exposure is nuclear medicine, which is the use of small amounts of radioactive materials called radiotracers that are typically injected into the bloodstream, inhaled, or swallowed for a medical procedure.

The three naturally-occurring uranium isotopes (uranium-234, uranium-235, and uranium-238) and technetium-99 are the most commonly detected radionuclides in environmental media samples collected around PORTS. Other radioactive isotopes called transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) are occasionally detected at PORTS. Technetium-99 and transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) are present in the world-wide environment in very small amounts due to radioactive fallout in the atmosphere from nuclear weapons testing by various countries around the world (Argonne National Laboratory 2007). The transuranic radionuclides may be detected in the environment near PORTS because they are found in fallout or because they could have come from PORTS. Transuranic radionuclides from fallout or from PORTS operations, if detected, are present at extremely low levels.

4.3 RADIOLOGICAL EMISSIONS AND DOSES

Releases of radionuclides from PORTS activities can result in a dose to a member of the public in addition to the 311 mrem/year dose received from natural sources of radiation (NCRP 2009). PORTS activities that release radionuclides are regulated by U.S. EPA and DOE. Airborne releases of radionuclides from DOE facilities are regulated by U.S. EPA under the NESHAP (40 CFR Part 61, Subpart H). These regulations set an annual dose limit of 10 mrem/year to any member of the public as a result of airborne radiological releases.

DOE regulates radionuclide emissions to all environmental media through DOE Orders 436.1, *Departmental Sustainability,* and 458.1, *Radiation Protection of the Public and the Environment.* DOE Order 458.1 sets a total public annual dose limit as low as reasonably achievable, but no more than 100 mrem/year above background to any member of the public from all radionuclide releases from a facility. The annual dose limit in NESHAP (10 mrem/year) applies only to airborne radiological releases.

To aid in comparing sampling results for air and water to the 100 mrem/year dose limit, DOE has converted the 100 mrem/year limit into a derived concentration standard (DOE 2011b). The derived concentration standard is the concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (ingestion of water or inhalation of air) would result in a dose of 100 mrem/year.

Small quantities of radionuclides were released to the environment from PORTS during 2020. This chapter describes the methods used to estimate the potential doses that could result from radionuclides released from PORTS. In addition, this chapter assesses the potential doses that could result from radionuclides historically released by PORTS and detected in 2020 by environmental monitoring programs.

For 2020, annual doses are estimated for exposure to atmospheric releases, external radiation, and releases to the Scioto River. Annual doses are also estimated for exposure to radionuclides from PORTS that were detected in 2020 as part of the DOE environmental monitoring programs for sediment, soil, residential drinking water (well water – excluding naturally-occurring detections of uranium isotopes) and selected biota (vegetation, deer, fish, crops, milk, and eggs). Analytical data from the environmental monitoring programs are assessed to determine whether radionuclides were detected at locations accessible to the public. If radionuclides were detected at locations accessible to the public, a dose assessment is completed based on the monitoring data. Exposure to radionuclides detected in groundwater at PORTS is not included because contaminated groundwater at PORTS is not a source of drinking water.

In 2020, annual doses are estimated for exposure to radionuclides detected by the monitoring programs for sediment, soil, vegetation, and crops. Radionuclides were not detected in 2020 in samples of residential drinking water, deer, fish, milk, and eggs.

In addition, DOE Order 458.1 sets absorbed dose rate limits for aquatic animals, riparian animals, terrestrial plants, and terrestrial animals. This chapter discusses the dose calculations completed to demonstrate compliance with these limits.

DOE staff, DOE contractors, and visitors to DOE areas who may be exposed to radiation are also monitored. These results are also provided in this chapter.

4.3.1 Airborne Emissions

Airborne discharges of radionuclides from PORTS are regulated under the NESHAP (40 CFR Part 61, Subpart H). Releases of radionuclides are used to calculate an annual dose to members of the public, which is reported annually to U.S. EPA and Ohio EPA. Section 4.3.2 discusses the results of this dose calculation.

In 2020, FBP was responsible for air emission sources associated with the former gaseous diffusion plant operations, including continuously monitored vents in the X-330 and X-333 Process Buildings and the X-344A Uranium Hexafluoride Sampling Building. The vents in the X-330 and X-333 Process Buildings were in use to support D&D activities. The X-344A vents were in use for ongoing sampling of uranium product. Vents in the X-326 Process Building have been permanently shut down as part of D&D activities.

Other radionuclide air emission sources included room ventilation exhausts and/or pressure relief vents associated with the X-710 Technical Services Building, X-705 Decontamination Facility, and the XT-847 Glove Box (inactive). These emission sources were not continuously monitored; emissions from these sources (when in use) were estimated based on operating data and U.S. EPA emission factors. The X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities treated groundwater contaminated with radionuclides or other site water (in accordance with the FBP NPDES permit). Emissions from the groundwater treatment facilities were calculated based on quarterly influent and effluent sampling at each facility and quarterly throughput. Total emissions from the FBP airborne sources in 2020 were calculated to be 0.0358 Ci (3.58E-02 Ci).

MCS was responsible for air emission sources associated with the DUF_6 Conversion Facility. The DUF_6 Conversion Facility did not operate from April through December 2020 due to the COVID-19 pandemic. Emissions from the DUF_6 Conversion Facility were based on continuous monitoring of the conversion building stack. Total emissions from the MCS airborne sources in 2020 were calculated to be 0.0000163 Ci (1.63E-05 Ci).

The Centrus demonstration cascade was the only source of radionuclide air emissions from Centrus that was subject to NESHAP reporting. The demonstration cascade was shut down in 2016; therefore, there were no emissions from Centrus in 2020.

4.3.2 Dose Calculation Based on Airborne Emissions

An annual dose calculation for atmospheric, or airborne, radionuclides is required by U.S. EPA under NESHAP and is provided to U.S. EPA in an annual report. The effect of radionuclides released to the atmosphere by PORTS during 2020 was determined by calculating the effective annual dose to the maximally exposed individual (the individual who resides at the most exposed point near the plant) and to the entire population (approximately 662,000 residents) within 50 miles of the plant. Dose calculations were made using a computer program called CAP88-PC Version 4.1, which was developed under sponsorship of U.S. EPA for use in demonstrating compliance with the radionuclide NESHAP. The program uses models to calculate levels of radionuclides in the air, on the ground, and in food (e.g., vegetables, meat, and milk) and subsequent intakes by individuals. The program also uses meteorological data collected at PORTS such as wind direction, wind speed, atmospheric stability, rainfall, and average air temperature.

Radionuclide emissions were modeled for each of the air emission sources discussed in Section 4.3.1. The dose calculations assumed that each person remained unprotected, resided at home (actually outside the house) during the entire year, and obtained food according to the rural pattern defined in the NESHAP background documents. This pattern specifies that 70% of the vegetables and produce, 44% of the meat, and 40% of the milk consumed by each person are produced in the local area (e.g., in a home garden). The remaining portion of each food is assumed to be produced within 50 miles of PORTS. In reality, the majority of the foodstuffs consumed locally are purchased at supermarkets that receive foodstuffs from all over the world. These assumptions most likely result in an overestimate of the dose received by a member of the public, since it is unlikely that a person spends the entire year outside at home and consumes food from the local area as described above.

The maximum potential annual dose to an off-site individual from radiological releases from PORTS air emission sources in 2020 was 0.068 mrem/year. This annual dose is below the 10-mrem/year limit applicable to PORTS and the approximate 311-mrem/year annual dose that the average individual in the United States receives from natural sources of radiation (NCRP 2009).

The collective annual dose (or population dose) is the sum of doses to all individual members of the public within 50 miles of PORTS. In 2020, the population dose from PORTS emissions was 0.35 person-rem/year. As a comparison, the average population dose to all people within 50 miles of PORTS from the ingestion of naturally-occurring radionuclides in water and food was approximately 19,630 person-rem/year based on an average dose of approximately 29 mrem/year to an individual (NCRP 2009).

4.3.3 Dose Calculation Based on Ambient Air Monitoring

Ambient air monitoring measures pollutants in surrounding, outdoor air. DOE collects samples from 18 ambient air monitoring stations (see Figure 4.3) and analyzes them for the radionuclides that could be present in ambient air due to PORTS activities. These radionuclides are isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238), technetium-99, and selected transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Thorium isotopes (thorium-228, thorium-230, and thorium-232) were added to the ambient air monitoring program in 2020 because these radionuclides are present in the gaseous diffusion process buildings and could be released during D&D. These thorium isotopes are also naturally present in the environment.

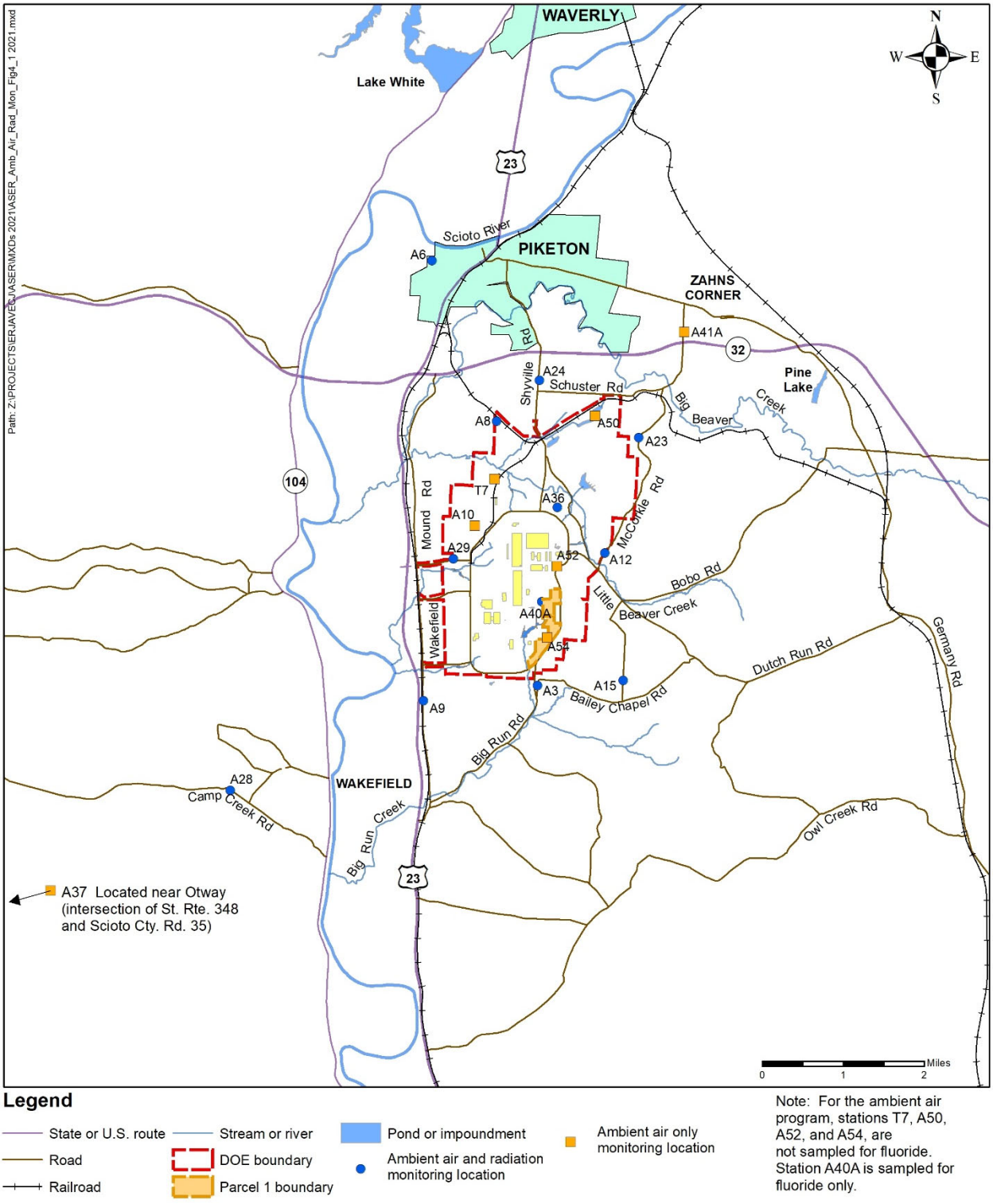

Figure 4.3. DOE ambient air and radiation monitoring locations.

The ambient air monitoring stations measure radionuclides released from DOE point sources (the sources described in Section 4.3.1), fugitive air emissions (emissions that are not associated with a specific release point such as a stack), and background levels of radiation (radiation that occurs naturally in the environment and is not associated with PORTS).

The CAP88 model generates a dose conversion factor that was used to calculate an annual dose for a given level of each radionuclide in air (mrem/pCi/m^3). The following assumptions were made to calculate the annual dose at each station: 1) the highest level of each radionuclide detected in 2020 was assumed to be present for the entire year; or 2) if a radionuclide was not detected, the radionuclide was assumed to be present for the entire year at half the highest undetected result. This approach may overestimate the annual dose because it assumes an individual resides at the location of the monitoring station breathing the highest levels of radionuclides in air at that location for 24 hours/day, 365 days/year. Additionally, the annual dose associated with the background station is not subtracted from the locations near PORTS, which means that the low levels of radionuclides that are naturally-occurring or present due to worldwide fallout are not removed from the dose calculation for stations near PORTS.

The highest annual dose calculation for off-site ambient air monitoring stations near PORTS is 0.049 mrem/year at station A29, which is on the west side of PORTS at the Ohio Valley Electric Corporation (OVEC) (see Figure 4.3). This hypothetical dose (0.049 mrem/year) is below the 10 mrem/year limit applicable to PORTS in NESHAP (40 CFR Part 61, Subpart H).

4.3.4 Discharges of Radionuclides from NPDES Outfalls

FBP, MCS, and Centrus were responsible for NPDES outfalls at PORTS during 2020. The MCS NPDES outfall is not monitored for radionuclides; therefore, it is not discussed in this section. A description of the FBP and Centrus outfalls and the discharges of radionuclides from these outfalls during 2020 are included in this section.

4.3.4.1 FBP outfalls

In 2020, FBP was responsible for 18 monitoring locations identified in the FBP NPDES permit. Nine outfalls discharge directly to surface water, six outfalls discharge to another outfall before leaving the site, and three other locations that are not outfalls are also monitored (see Figure 4.4). A brief description of each FBP outfall or monitoring location at PORTS follows.

FBP NPDES Outfall 001 (X-230J7 East Holding Pond) – The X-230J7 East Holding Pond receives non-contact cooling water, steam condensate, foundation drainage, storm runoff, hydro-testing water from cylinders, groundwater infiltration, fire suppression system water, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, oil can be diverted/contained, and pH can be adjusted. Water from this holding pond is discharged to a tributary that flows to Little Beaver Creek.

FBP NPDES Outfall 002 (X-230K South Holding Pond) – The X-230K South Holding Pond receives non-contact cooling water, steam condensate, foundation drainage, storm runoff, fire-fighting training and fire suppression system water, boiler blowdown, water softener regeneration, groundwater infiltration, sanitary water for eyewash/shower station testing and flushing, and treated runoff from the former coal pile area. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, oil can be contained, and pH can be adjusted. Water from this holding pond is discharged to Big Run Creek.

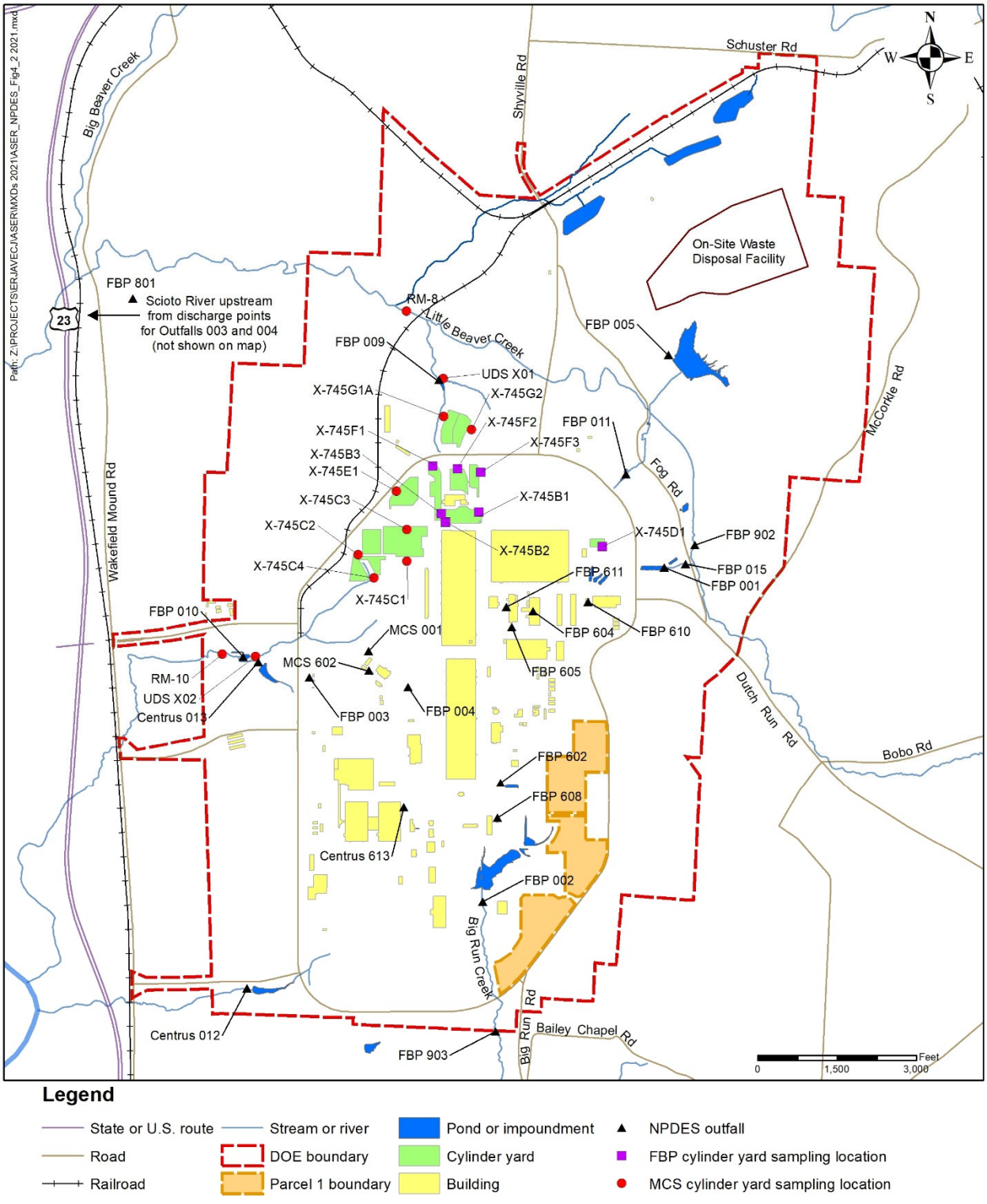

Figure 4.4. PORTS NPDES outfalls/monitoring points and cylinder storage yards sampling locations.

FBP NPDES Outfall 003 (X-6619 Sewage Treatment Plant) – The X-6619 Sewage Treatment Plant treats PORTS sewage, some Pike County sewage, and process wastewater from MCS as well as water discharged from PORTS groundwater treatment facilities, the X-700 Biodenitrification Facility, the X-705 Decontamination Microfiltration System, X-670A cooling tower blowdown, fire-fighting training and fire suppression system waters, non-contact cooling water, steam condensate, storm water, and other miscellaneous waste streams. The X-6619 Sewage Treatment Plant uses screening, aeration, clarification, and filtering followed by disinfection to treat wastewater prior to release to the Scioto River.

FBP NPDES Outfall 004 (Cooling Tower Blowdown) – Outfall 004 is located within the X-680 Blowdown Sample and Treatment Building at PORTS. It monitors blowdown water from cooling towers on site and discharges from water treatment associated with D&D (modular treatment trains A, C, and D) prior to being discharged to the Scioto River.

FBP NPDES Outfall 005 (X-611B Lime Sludge Lagoon) – The X-611B Lime Sludge Lagoon is used to settle lime sludge used in a water-softening process. The X-611B also receives stormwater runoff. Water is discharged to Little Beaver Creek.

FBP NPDES Outfall 009 (X-230L North Holding Pond) – The X-230L North Holding Pond receives non-contact cooling water, stormwater runoff, steam condensate, fire suppression system water, groundwater infiltration, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, oil can be contained, and pH can be adjusted. Water from this holding pond is discharged to a tributary that flows to Little Beaver Creek.

FBP NPDES Outfall 010 (X-230J5 Northwest Holding Pond) – The X-230J5 Northwest Holding Pond receives non-contact cooling water, stormwater runoff, steam condensate, fire-fighting training and fire suppression system water, groundwater infiltration, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, oil can be diverted/contained, and pH can be adjusted. Water from this holding pond is discharged to a tributary commonly referred to as the Western Drainage Ditch, which flows to the Scioto River.

FBP NPDES Outfall 011 (X-230J6 Northeast Holding Pond) – The X-230J6 Northeast Holding Pond receives non-contact cooling water, stormwater runoff, steam condensate, fire suppression system water, groundwater infiltration, and sanitary water for eyewash/shower station testing and flushing. The pond provides an area where materials suspended in the influent can settle, chlorine can dissipate, oil can be diverted/contained, and pH can be adjusted. Water from this holding pond is discharged to a tributary that flows to Little Beaver Creek.

FBP NPDES Outfall 015 (X-624 Groundwater Treatment Facility) – The X-624 Groundwater Treatment Facility removes VOCs from contaminated groundwater collected in the X-237 Groundwater Collection System in the X-701B Holding Pond area. This collection system was constructed to control the migration of groundwater contaminated with VOCs toward Little Beaver Creek. Treated water is released to a tributary that flows to Little Beaver Creek.

FBP NPDES Outfall 602 (X-621 Coal Pile Runoff Treatment Facility) – Prior to D&D of the X-600 Steam Plant Complex, the X-621 Coal Pile Runoff Treatment Facility treated storm water runoff from the coal pile at the X-600 Steam Plant Complex. The X-600 Steam Plant Complex was removed in 2013. The X-621 Treatment Facility currently operates intermittently to treat precipitation runoff from the area of the former facility. The treated water is discharged to the X-230K South Holding Pond (FBP NPDES Outfall 002).

FBP NPDES Outfall 604 (X-700 Biodenitrification Facility) – The X-700 Biodenitrification Facility receives solutions from plant operations that are high in nitrate. At the X-700, these solutions are diluted and treated biologically using bacteria prior to being discharged to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

FBP NPDES Outfall 605 (X-705 Decontamination Microfiltration System) – The X-705 Decontamination Microfiltration System treats process wastewater using microfiltration and pressure filtration technology. The treated water is discharged to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). There were no discharges from Outfall 605 in 2020.

FBP NPDES Outfall 608 (X-622 Groundwater Treatment Facility) – The X-622 Groundwater Treatment Facility removes VOCs from contaminated groundwater originating from site remediation activities in the southern portion of the site, which is Quadrant I in the RCRA Corrective Action Program (see Chapter 3, Section 3.3.1). Treated water is discharged to the sanitary sewer and then through FBP NPDES Outfall 003.

FBP NPDES Outfall 610 (X-623 Groundwater Treatment Facility) – The X-623 Groundwater Treatment Facility formerly treated contaminated groundwater from extraction wells in the X-701B groundwater plume. The groundwater extraction wells were removed between 2009 and 2011. Currently, the facility removes VOCs from miscellaneous water associated with site activities (in accordance with the FBP NPDES permit). Treated water is discharged to the sanitary sewer and then through FBP NPDES Outfall 003.

FBP NPDES Outfall 611 (X-627 Groundwater Treatment Facility) – The X-627 Groundwater Treatment Facility removes VOCs from groundwater collecting in sumps located in the basements of the X-700 and X-705 buildings, which are part of Quadrant II. Treated water is discharged to the sanitary sewer and then through FBP NPDES Outfall 003.

FBP is also responsible for three additional monitoring points that are not discharge points as described in the previous paragraphs. FBP NPDES Station Number 801 is a surface water background monitoring location on the Scioto River upstream from FBP NPDES Outfalls 003 and 004 that is used for biotoxicity studies. FBP NPDES Station Number 902 is a monitoring location on Little Beaver Creek downstream from FBP NPDES Outfall 001, and FBP NPDES Station Number 903 is a monitoring location on Big Run Creek downstream from FBP NPDES Outfall 002. Water temperature is the only parameter measured at FBP NPDES Station Numbers 902 and 903.

FBP NPDES Outfalls 001, 002, 003, 004, 005, 009, 010, 011, 015, 608, 610, and 611 were monitored for radiological discharges by collecting water samples and analyzing the samples for uranium, uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238), technetium-99, and transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240).

No transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) were detected in samples collected from the external FBP outfalls (Outfalls 001, 002, 003, 004, 005, 009, 010, 011, and 015) during 2020.

Discharges of radionuclides to surface water were calculated using monthly monitoring data from the NPDES outfalls. Analytical results below the detection limit were assigned a value of zero in the calculations to determine the quantities of uranium and technetium-99 discharged through the outfalls. In 2020, uranium discharges from the FBP external outfalls (Outfalls 001, 002, 003, 004, 005, 009, 010, 011, and 015) were estimated at 8.4 kilograms (kg). Total radioactivity (technetium-99 and isotopic uranium) released from the same outfalls was estimated at 0.058 Ci.

Discharges of radionuclides from the outfalls are used in the dose calculation for releases to surface water (Section 4.3.5). The annual dose calculated with these data (0.0016 mrem/year) is less than the 100 mrem/year limit in DOE Order 458.1 for all radiological releases from a facility.

4.3.4.2 Centrus outfalls

In 2020, Centrus was responsible for three NPDES outfalls through which water is discharged from the site (see Figure 4.4). Two outfalls discharge directly to surface water, and one discharges to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003) before leaving the site. A brief description of each Centrus NPDES outfall follows.

Centrus NPDES Outfall 012 (X-2230M Southwest Holding Pond) – The X-2230M Southwest Holding Pond accumulates precipitation runoff, non-contact cooling water, and steam condensate from the southwestern portion of PORTS. The pond provides an area where solids can settle, chlorine can dissipate, and oil can be separated from the water prior to its release to an unnamed stream that flows to the Scioto River.

Centrus NPDES Outfall 013 (X-2230N West Holding Pond) – The X-2230N West Holding Pond accumulates precipitation runoff, non-contact cooling water, and steam condensate from the western portion of PORTS. The pond provides an area where solids can settle, chlorine can dissipate, and oil can be separated from the water prior to its release to a tributary commonly referred to as the Western Drainage Ditch, which flows to the Scioto River.

Centrus NPDES Outfall 613 (X-6002 Particulate Separator) – The X-6002 Particulate Separator removes suspended solids from water used in the X-6002 Recirculating Hot Water Plant, which provides heat to a number of buildings at PORTS. The treated water is discharged to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

Centrus Outfalls 012 and 013 were monitored for radiological discharges by collecting water samples and analyzing the samples for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, and uranium. Transuranic radionuclides and technetium-99 were not detected in any of the samples collected from Centrus NPDES outfalls in 2020.

Uranium discharges in 2020 from external Centrus NPDES outfalls (Outfalls 012 and 013) were estimated at 0.68 kg. These values were calculated using quarterly discharge monitoring reports for the Centrus NPDES outfalls. Analytical results below the detection limit were assigned a value of zero in the calculations to determine the quantities of uranium discharged through the Centrus NPDES outfalls.

Discharges of radionuclides from Centrus Outfalls 012 and 013 are used in the dose calculation for releases to surface water (Section 4.3.5). The annual dose calculated with these data and data from external FBP outfalls (0.0016 mrem/year) is less than the 100 mrem/year limit in DOE Order 458.1 for all radiological releases from a facility.

4.3.5 Dose Calculation for Releases to Surface Water

Radionuclides are measured at the FBP and Centrus NPDES external outfalls (nine FBP outfalls and two Centrus outfalls). Water from these external outfalls is either directly discharged to the Scioto River or eventually flows into the Scioto River from Little Beaver Creek, Big Run Creek, or unnamed tributaries to these water bodies. A hypothetical annual dose to a member of the public was calculated using the measured radiological discharges and the annual flow rate of the Scioto River.

Activity (in picocuries per liter [pCi/L]) for americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, and isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238) were measured in the water discharged from the FBP outfalls. Uranium mass (in micrograms per liter [µg/L]) and activity (in pCi/L) for americium-241, neptunium-237, plutonium-238, plutonium-239/240, and technetium-99 were measured in the water discharged from the Centrus outfalls. Radionuclides that were not detected were assumed to be present at the detection limit. Uranium measured at the Centrus outfalls was assumed to be 5.2% uranium-235, 94% uranium-238, and 0.8% uranium-234 based on the highest enrichment of uranium produced by PORTS in the years prior to shutdown of the gaseous diffusion uranium enrichment operations. The maximum individual annual dose was calculated using the above-mentioned measured radionuclide discharges from the plant outfalls and the annual flow rate of the Scioto River.

The dose calculations were derived from the procedures developed for a similar DOE facility: *LADTAP XL: An Improved Electronic Spreadsheet Version of LADTAP II* (Hamby 1991) and *LADTAP-PA: A Spreadsheet for Estimating Dose Resulting from E-Area Groundwater Contamination at the Savannah River Site* (Jannik and Dixon 2006), which updates the 1991 LADTAP XL. Specific exposure scenarios provided in the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017c) were also used when available. Environmental pathways considered were ingestion of water, ingestion of fish, swimming, boating, and shoreline activities. This exposure scenario overestimates the dose to the public because the Scioto River is not used for drinking water downstream of PORTS (97% of the hypothetical dose from liquid effluents is from drinking water). The annual dose from radionuclides released to the Scioto River in 2020 (0.0016 mrem/year) is less than the total public annual dose limit of 100 mrem/year DOE in DOE Order 458.1.

4.3.6 Radiological Dose Calculation for External Radiation

Radiation is emitted from DUF_6 cylinders stored on site at PORTS in the cylinder storage yards located in the northwest portion of the site near Perimeter Road. External radiation is measured at five locations along Perimeter Road near the boundaries of the cylinder storage yards in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a). External radiation is measured using thermoluminescent dosimeters (TLDs), which measure both external background radiation and radiation originating from the DUF_6 cylinders. Section 4.6.2 and Figure 4.5 provide more information about the external radiation monitoring program.

Data from radiation monitoring at the cylinder yards are used to assess potential exposure to a representative on-site member of the public that drives on Perimeter Road. The radiological exposure to an on-site member of the general public is estimated as the time that a person drives on Perimeter Road past the cylinder yards, which is calculated at 8.7 hours per year (1 minute per trip, 2 trips per day, 5 work-days per week, and 52 weeks per year). In 2020, the average annual dose recorded by TLDs at the cylinder yards near Perimeter Road was 744 mrem/year, based on TLD measurements for an entire year at locations #41, #868, #874, #882, and #890 (see Section 4.6.2 and Figure 4.5). Although the total annual external radiation dose near the cylinder yards is high, a person would only receive this dose if they were present at the cylinder yards for 24 hours/day, 365 days/year. Access to the cylinder yard area is controlled by PORTS security forces so that a member of the public could not be continuously exposed to this level of radiation from the cylinder yards. External radiation levels associated with the cylinder yards diminish quickly to background levels with distance from the cylinder yards as demonstrated by radiation measurements at other on-site and all off-site monitoring locations. Based on the estimated time that a person would drive on Perimeter Road near the cylinder yards, the dose to an on-site member of the public from radiation from the cylinder yards is approximately 0.74 mrem/year.

External radiation is also measured using TLDs at 19 locations that include 12 of the ambient air monitoring stations and seven additional on-site locations in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a). The total annual dose measured in 2020 at station A29, near OVEC, was 91 mrem/year (see Section 4.6.2 and Figure 4.5). The total annual dose measured at eight of the off-site or background monitoring stations averaged 89 mrem/year. A dose calculation was completed for a representative off-site member of the public, such as a worker at OVEC, based on the 2 mrem/year difference between the average off-site background dose (89 mrem/year) and the dose at station A29 (91 mrem/year). Assuming that the worker was exposed to this radiation for 250 days/year, one hour outdoors and 8 hours indoors, the dose to this worker is 0.24 mrem/year.

A person living in the United States receives an average annual dose of approximately 311 mrem/year from natural sources of radiation (NCRP 2009). The higher potential estimated dose from external radiation to a member of the public (0.74 mrem/year to a delivery person on Perimeter Road versus 0.24 mrem/year to a worker near station A29) is approximately 0.2 percent of the average yearly natural radiation exposure for a person in the United States and is less than the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

4.3.7 Radiological Dose Calculations for Off-site Environmental Monitoring Data

Environmental monitoring at PORTS includes collecting samples at off-site locations around PORTS and analyzing the samples for radionuclides that could be present due to PORTS. Radiological monitoring programs at PORTS include ambient air, surface water, sediment, soil, residential drinking water (well water), and biota (vegetation, deer, fish, crops, milk, and eggs).

Samples are analyzed for the following radionuclides of potential concern: uranium, uranium isotopes, technetium-99, and/or selected transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Uranium occurs naturally in the environment; therefore, detections of uranium cannot necessarily be attributed to PORTS. Technetium-99 and transuranics could come from PORTS because they were present in recycled uranium processed by PORTS during the Cold War. Technetium-99 and transuranic radionuclides could also come from sources other than PORTS because they are generally present in the world-wide environment in very small amounts due to radioactive fallout in the atmosphere from nuclear weapons testing by various countries around the world (Argonne National Laboratory 2007).

Dose calculations for ambient air and surface water were presented in Sections 4.3.3 and 4.3.5, respectively. Dose calculations are also completed for detections of radionuclides in sediment, soil, residential drinking water (well water – excluding naturally-occurring detections of uranium isotopes), and biota (vegetation, deer, fish, crops, milk, and eggs) at off-site sampling locations. If radionuclides are not detected in the samples, a dose of 0 is assigned. Off-site sampling locations are selected based on detections of radionuclides that could cause the highest dose to a member of the public. Detections of radionuclides in sediment and soil on the PORTS facility are not used to assess potential risk because the public does not have access to the sampled areas of the facility.

The summary of these dose calculations assumes that the same individual is exposed to the maximum dose calculated from each pathway. In 2020, dose calculations were completed for public exposure to radionuclides detected in sediment, soil, vegetation, and crops. Radionuclides were not detected in 2020 in samples of residential drinking water, deer, fish, milk, and eggs.

The following sections provide brief descriptions of the dose calculations for sediment, soil, and vegetation. Methodologies used to complete each risk calculation are based on information developed and approved by U.S. EPA including the *Exposure Factors Handbook* (U.S. 2011) and *Federal Guidance*

Report No. 11 (FGR 11) Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Immersion, and Ingestion (U.S. EPA 1988).

In addition, specific exposure scenarios provided in the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017c) were used when available. This document integrates the results of technical meetings between Ohio EPA and DOE and provides methods for completing risk analyses at PORTS to promote consistency in the risk approach.

Table 4.2 summarizes the results of each dose calculation. Potential annual doses to the public from radionuclides detected by the PORTS environmental monitoring program in 2020 are less than the 100 mrem/year limit in DOE Order 458.1 and are considered ALARA.

Table 4.2. Summary of potential annual doses to the public from radionuclides detected by DOE environmental monitoring programs in 2020

Source of dose	Dose (mrem/year)[a]
Sediment	0.013
Soil	0.014
Vegetation	0.00038
Crops (beans)	0.16
Total	0.19

[a]100 mrem/year is the limit for all potential pathways in DOE Order 458.1.

4.3.7.1 Dose calculation for sediment

The dose calculation for sediment is based on the following detections of radionuclides in the samples collected in 2020 from monitoring locations RM-5 and RM-15, off-site sampling locations on Big Beaver Creek (see Section 4.6.5 and Figure 4.6):

	RM-5 (duplicate sample)	RM-15
• Neptunium-237:	not detected	0.038 picocurie per gram (pCi/g)
• Uranium-233/234:	1.3 pCi/g	1.1 pCi/g
• Uranium-238:	1.2 pCi/g	0.74 pCi/g.

Based on an incidental ingestion rate of 200 milligrams (mg)/day (0.007 ounces/day) and an exposure frequency of 100 days/year, which are consistent with the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017c), and exposure factors in U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 2011), the annual dose that could be received by an individual from sediment contaminated at these levels is 0.013 mrem/year. Section 4.6.5 provides additional information on the sediment monitoring program as well as a map of sediment sampling locations.

4.3.7.2 Dose calculation for soil

The dose calculation for soil is based on the detections of the following uranium isotopes in the soil samples collected at off-site ambient air monitoring stations A6 (north of PORTS in Piketon), A41A (northeast of PORTS at Zahns Corner), and A28 (southwest of PORTS on Camp Creek Road) (see Section 4.6.7 and Figure 4.3):

	A6	A41A	A28
• Uranium-233/234:	0.326 pCi/g	0.387 pCi/g	0.432 pCi/g
• Uranium-235/236:	0.0227 pCi/g	not detected	0.0202 pCi/g
• Uranium-238:	0.421 pCi/g	0.369 pCi/g	0.267 pCi/g.

Based on an incidental ingestion rate of 200 mg/day (0.007 ounces/day) and an exposure frequency of 350 days/year, which are consistent with the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017c), and exposure factors in U.S. EPA's *Exposure Factors Handbook* (U.S. 2011), the annual dose that could be received by an individual from soil contaminated at these levels is 0.014 mrem/year. Section 4.6.7 provides additional information on the soil monitoring program.

4.3.7.3 Dose calculation for vegetation

The dose calculation for vegetation is based on the following detections of radionuclides in vegetation (primarily grass) and soil at ambient air monitoring station A6 in Piketon (see Section 4.6.8.1 and Figure 4.3):

Vegetation
- Uranium-238: 0.0177 pCi/g

Soil
- Uranium-233/234: 0.326 pCi/g
- Uranium-235/236: 0.0227 pCi/g
- Uranium-238: 0.421 pCi/g.

The dose calculation is based on human consumption of beef cattle that would eat grass (and soil) containing these radionuclides. Based on an ingestion rate for beef of 2 ounces/day and an exposure frequency of 100 days/year, which are consistent with the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017c) and U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 2018), the annual dose that could be received by an individual eating beef from cattle that grazed on vegetation and soil contaminated at these levels is 0.00038 mrem/year. Section 4.6.8.1 provides additional information on the vegetation monitoring program.

4.3.7.4 Dose calculation for crops

The dose calculation for crops is based on uranium-233/234 detected at 0.032 pCi/g in a sample of beans collected at off-site sampling location #9. Based on an ingestion rate for home-produced vegetables from the U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 2011) and an exposure frequency of 100 days/year [*Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017c)], the annual dose that could be received by an individual eating home-produced beans contaminated at this level is 0.16 mrem/year. Section 4.6.8.4 provides additional information on the crops monitoring program.

4.4 PROTECTION OF BIOTA

DOE Order 458.1 sets absorbed dose rate limits for aquatic animals, riparian animals (animals that live on the banks of a river or in wetlands adjacent to a body of water), terrestrial plants, and terrestrial animals. DOE Technical Standard *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2019) was used to demonstrate compliance with these limits.

4.4.1 Aquatic and Riparian Animals

Analytical data for surface water and sediment samples collected during 2020 from the east side of the PORTS reservation [surface water sampling location EDD-SW01 (see Chapter 6, Section 6.4.15 and

Figure 6.13) and sediment sampling location RM-11 (see Section 4.6.5 and Figure 4.6)] were used to assess the dose limits for aquatic and riparian animals (1 rad/day to aquatic animals and 0.1 rad/day to riparian animals). These locations were selected because levels of radionuclides detected in surface water and sediment from these locations were among the highest detected in samples collected in 2020. Section 4.6.5 and Chapter 6, Section 6.4.15 provide more information about these sediment and surface water sampling programs, respectively.

The maximum levels of radionuclides (plutonium-239/240, technetium-99, and uranium isotopes) were as follows:

Radionuclide	EDD-SW01	RM-11 (regular sample)
Technetium-99	41.5 pCi/L	not detected
Uranium-233/234	8.71 pCi/L	0.68 pCi/g
Uranium-235/236	0.166 pCi/L	not detected
Uranium-238	1.58 pCi/L	0.68 pCi/g.

These values were entered into the RESRAD-BIOTA software that is designed to implement the DOE Technical Standard (DOE 2019). The software provides a screening method with generic limiting concentrations of radionuclides in environmental media. If the measured maximum levels of radionuclides detected at the selected PORTS sampling locations result in an output from the software calculations of less than 1, the doses to aquatic and riparian animals are within the dose limits (1 rad/day to aquatic animals and 0.1 rad/day to riparian animals).

In 2020, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations EDD-SW01 (surface water) and RM-11 (sediment) was 0.0515, which is less than 1. Therefore, the assessment indicates that the levels of radionuclides detected in water and sediment at these locations did not result in a dose of more than 1 rad/day to aquatic animals and 0.1 rad/day to riparian animals.

4.4.2 Terrestrial Plants and Animals

Analytical data for surface water and soil samples collected during 2020 from the northern side of the PORTS reservation [surface water sampling location RW-8 (see Figure 4.6) and soil sampling location A8 (see Figure 4.3)] were used to assess the dose limits for terrestrial plants and animals. These locations were selected because levels of radionuclides detected in surface water and soil from these locations were among the highest detected in samples collected in 2020. Section 4.6.7 and Section 4.6.4 provide additional information about these soil and surface water sampling programs, respectively.

No transuranic radionuclides or technetium-99 were detected in 2020 from samples collected at RW-8 (surface water) and A8 (soil). The maximum levels of uranium isotopes were as follows:

Radionuclide	RW-8	A8
Uranium-233/234	2.97 pCi/L	0.99 pCi/g
Uranium-235/236	0.12 pCi/L	0.034 pCi/g
Uranium-238	0.745 pCi/L	0.86 pCi/g.

These values were entered into the RESRAD-BIOTA software that is designed to implement the DOE Technical Standard (DOE 2019). The software provides a screening method with generic limiting concentrations of radionuclides in environmental media. If the measured maximum levels of radionuclides detected at the selected PORTS sampling locations result in an output from the software calculations of less than 1, the doses to terrestrial plants and animals are within the dose limits (1 rad/day to terrestrial plants and 0.1 rad/day to terrestrial animals).

In 2020, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations RW-8 (surface water) and A8 (soil) was 0.00076, which is less than 1. Therefore, the assessment indicates that the levels of radionuclides detected in water and soil at these locations did not result in a dose of more than 1 rad/day to terrestrial plants and 0.1 rad/day to terrestrial animals.

4.5 UNPLANNED RADIOLOGICAL RELEASES

No unplanned releases of radionuclides took place at PORTS in 2020.

4.6 ENVIRONMENTAL RADIOLOGICAL MONITORING

This section discusses the radiological monitoring programs at PORTS: ambient air monitoring, external radiation, surface water, sediment, settleable solids, soil, vegetation, and biota (deer, fish, crops, milk, and eggs).

4.6.1 Ambient Air Monitoring

Ambient air monitoring measures pollutants in surrounding, outdoor air. The ambient air monitoring stations measure radionuclides released from 1) DOE point sources (the sources discussed in Section 4.3.1), 2) fugitive air emissions (emissions from PORTS that are not associated with a stack or pipe such as remediation sites or normal building ventilation), and 3) background levels of radionuclides (radionuclides that occur naturally, such as uranium). These radionuclides are isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238), technetium-99, and selected transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Thorium isotopes (thorium-228, thorium-230, and thorium-232) were added to the ambient air monitoring program in 2020 because these radionuclides are present in the gaseous diffusion process buildings and could be released during D&D. These thorium isotopes are also naturally present in the environment.

In 2020, samples were collected from 18 ambient air monitoring stations located within and around PORTS (see Section 4.3.3, Figure 4.3), including a background ambient air monitoring station (A37) located approximately 13 miles southwest of the plant. Three new on-site ambient air monitoring stations that monitor radionuclides (A50, A52, and A54) were added in October 2020. The analytical results from air sampling stations closer to the plant are compared to the background measurements.

In 2020, the Ohio Department of Health (ODH) began collecting air samples at the same air monitoring locations sampled by DOE. ODH is conducting this sampling using separate sampling equipment and analytical laboratories to independently measure airborne radioactivity levels around PORTS. Use of separate sampling equipment and analytical laboratories means that analytical results for samples collected at the same location can be different. Data collected by ODH is available at https://data.ohio.gov/wps/portal/gov/data/view/doe-portsmouth-facility_-radiological-air-sampling-results. Data collected by DOE is available in PEGASIS (pegasis.ports.pppo.gov). DOE also provides a summary of DOE and ODH monitoring data in the Environmental Reports portion of PEGASIS.

Ambient concentrations of uranium and uranium isotopes at the monitoring stations in 2020 were likely impacted (i.e., elevated) by the presence of uranium isotopes in filters used in sampling. Uranium and uranium isotopes were detected in quality control samples associated with the ambient air samples and subsequently in unused filters obtained from the manufacturer that are placed at the ambient air stations to collect samples. The presence of uranium and uranium isotopes in the unused filters may have caused slightly elevated analytical results for uranium and uranium isotopes.

No transuranic radionuclides were detected in ambient air in 2020. The highest levels of uranium isotopes, thorium isotopes, and technetium-99 detected in air were 0.05%, or less, of the DOE derived concentration standards (DOE 2011b)[1]. Maximum activities of uranium isotopes were detected at station A24 (off site north of PORTS on Shyville Road). Maximum activities of technetium-99 and thorium isotopes were detected at on-site stations A36 and A29 and off-site station A23 (northeast of PORTS).

The maximum activities of detected radionuclides (in picocurie per cubic meter [pCi/m^3]) are listed below:

Radionuclide	Maximum activity (pCi/m^3)	Location	Derived concentration standard (DOE 2011b) (pCi/m^3)[a]	Percentage of derived concentration standard (DOE 2011b)
Technetium-99	0.00077	A36	920	0.0001%
Thorium-228	0.000043	A29	0.094	0.05%
Thorium-232	0.0000052	A23	0.16	0.003%
Uranium-233/234	0.000085	A24	1.1	0.008%
Uranium-235/236	0.0000042	A24	1.2	0.0004%
Uranium-238	0.000089	A24	1.3	0.007%

[a]The derived concentration standard has been converted to pCi/m^3 from units of microcurie per milliliter provided in the *Derived Concentration Technical Standard* (DOE 2011b).

To confirm that air emissions from PORTS are within regulatory requirements and are not harmful to human health, the ambient air monitoring data were used to calculate an annual dose to a hypothetical person living at the monitoring station. The highest annual dose calculation for off-site ambient air monitoring stations near PORTS is 0.018 mrem/year at station A24, which is north of PORTS on Shyville Road (see Figure 4.3). This hypothetical annual dose (0.018 mrem/year) is below the 10 mrem/year limit applicable to PORTS in NESHAP (40 CFR Part 61, Subpart H). Section 4.3.3 provides additional information about this dose calculation.

4.6.2 External Radiation

External radiation is measured continuously with TLDs at five locations near the DUF_6 cylinder storage yards (see Figure 4.5), 19 locations that include 12 of the ambient air monitoring stations (see Section 4.3.3, Figure 4.3), and seven additional on-site locations (see Figure 4.5). TLDs are placed at the monitoring locations at the beginning of each quarter, remain at the monitoring location throughout the quarter, and are removed from the monitoring location at the end of the quarter and sent to the laboratory for processing. A new TLD replaces the removed device. Radiation is measured in millirems as a whole body dose, which is the dose that a person would receive if they were continuously present at the monitored location.

External radiation is measured by TLDs at five locations around the northwest corner of PORTS just inside Perimeter Road near the cylinder storage yards (see Figure 4.5). The average annual dose for these five locations (#41, #868, #874, #882, and #890) is 744 mrem/year. Section 4.3.6 provides a dose calculation for the representative on-site member of the public, such as a delivery person, that is allowed on the portion of Perimeter Road near the cylinder storage yards (the general public is not allowed on the portion of Perimeter Road near the cylinder storage yards). The potential estimated annual dose from the cylinder yards to a delivery person (0.74 mrem/year) is less than the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

[1]The derived concentration standard is the concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (ingestion of water or inhalation of air) would result in a dose of 100 mrem. A concentration that is 100% of the derived concentration standard would equate to a dose at the DOE limit of 100 mrem/year (DOE 2011b).

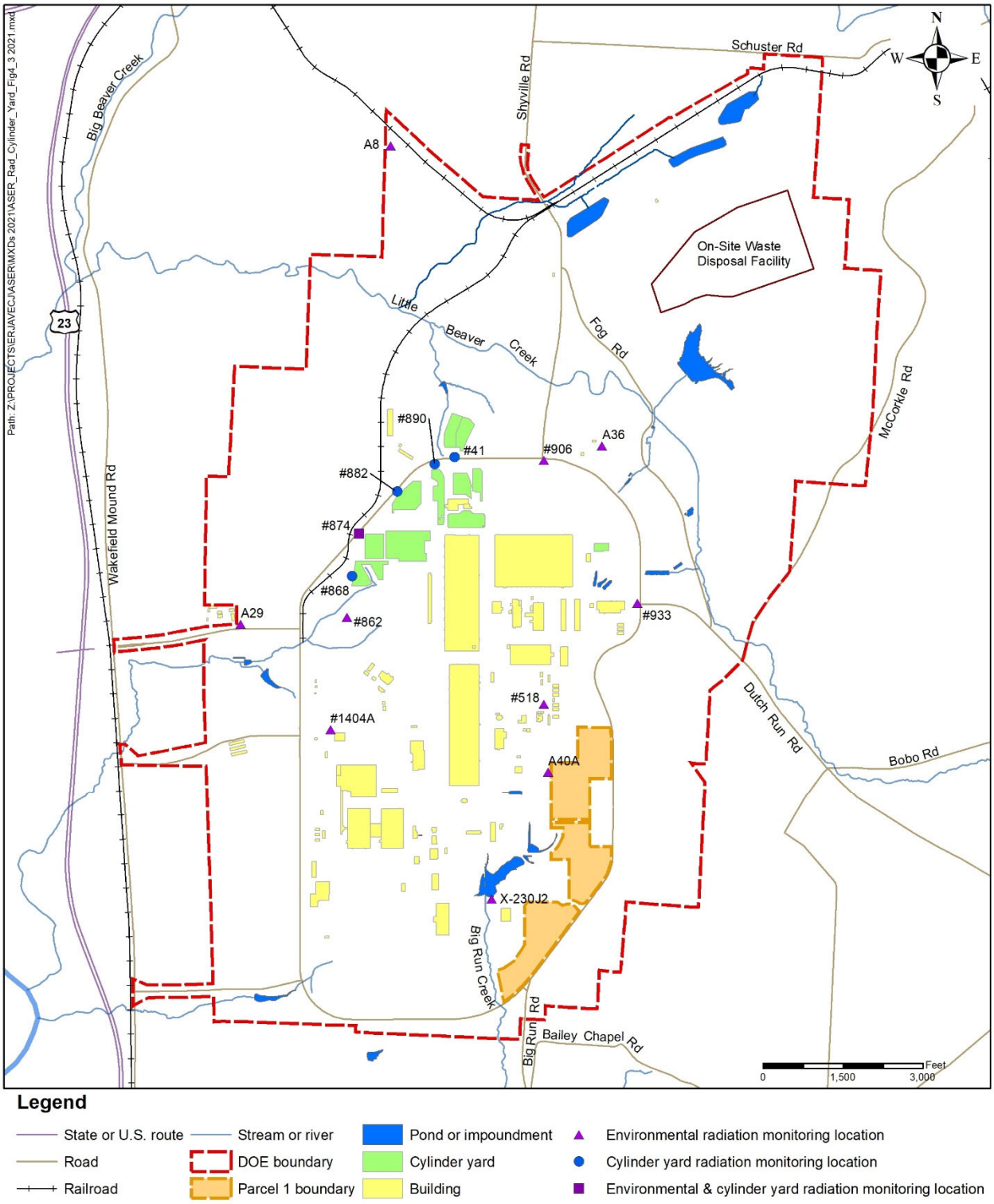

Figure 4.5. On-site radiation and cylinder yard dose monitoring locations.

In 2020, the average annual dose measured at eight off-site or background locations (A3, A6, A9, A12, A15, A23, A24, and A28) was 89 mrem/year. Two locations within PORTS measured levels of radiation approximately 50% higher or more than the average off-site radiation (89 mrem/year): location #874 (629 mrem/year) near the X-745C Cylinder Storage Yard and location #862 (120 mrem/year) south of the cylinder yards and west of the X-530A Switchyards. Three other on-site locations (X-230J2, A8, and A29) measured radiation at levels slightly higher than the average background (ranging from 2 mrem/year to 11 mrem/year above average).

The on-site locations with higher doses than the off-site average are not used by the general public, with the exception of location #874 near the cylinder yards and station A29, near OVEC. The dose calculation for the representative on-site member of the public exposed to the cylinder yards is discussed above and in Section 4.3.6. Section 4.3.6 also includes a dose calculation for the representative off-site member of the public who works at OVEC near station A29. The potential estimated annual dose to this off-site worker (0.24 mrem/year) is less than the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

Section 4.3.7 provides dose results for DOE workers, including workers in the cylinder yards. No administrative guidelines or regulatory dose limits were exceeded in 2020.

4.6.3 Surface Water from Cylinder Storage Yards

In 2020, FBP collected surface water samples from the X-745B, X-745D, and X-745F Cylinder Storage Yards. MCS collected surface water samples at the cylinder yards associated with the DUF_6 Conversion Facility (X-745C, X-745E, and X-745G Cylinder Storage Yards). Sections 4.6.3.1 and 4.6.3.2 provide the results of sampling completed in 2020 by FBP and MCS, respectively.

4.6.3.1 FBP cylinder storage yards

In 2020, FBP collected surface water samples from seven locations at the on-site X-745B, X-745D, and X-745F Cylinder Storage Yards. Figure 4.4 shows the sampling locations. Samples were analyzed for alpha activity, beta activity, and uranium. Samples were collected monthly if water was available.

Maximum levels of alpha activity, beta activity, and uranium were detected as follows:

Alpha activity: 182 pCi/L (X-745B2, July 2020)
Beta activity: 138 pCi/L (X-745B3, July 2020)
Uranium: 115 µg/L (X-745B2, December 2020).

Surface water from the cylinder storage yards flows to FBP NPDES outfalls prior to discharge from the site; therefore, releases of radionuclides from the cylinder yards are monitored by sampling conducted at the FBP outfalls. Radionuclides detected at FBP outfalls (see Section 4.3.4.1) are used in the dose calculation for releases to surface water (see Section 4.3.5). The annual dose from radionuclides released to the Scioto River in 2020 (0.0016 mrem/year) is less than the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

4.6.3.2 MCS cylinder storage yards

Ohio EPA requires monthly collection of surface water samples from seven locations at the on-site X-745C, X-745E, and X-745G Cylinder Storage Yards. Figure 4.4 shows the sampling locations. Samples were analyzed for alpha activity, beta activity, and uranium.

Maximum levels of alpha activity, beta activity, and uranium were detected as follows:

Alpha activity: 9.08 pCi/L (X-745C1, October 2020)
Beta activity: 9.71 pCi/L (X-745E1, April 2020)
Uranium: 7.11 µg/L (X-745C2, August 2020).

Surface water from the cylinder storage yards flows to FBP NPDES outfalls prior to discharge from the site; therefore, releases of radionuclides from the cylinder yards are monitored by sampling conducted at the FBP outfalls. Radionuclides detected at FBP outfalls (see Section 4.3.4.1) are used in the dose calculation for releases to surface water (see Section 4.3.5). The annual dose from radionuclides released to surface water (the Scioto River) in 2020 (0.0016 mrem/year) is less than the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

4.6.4 Local Surface Water

Local surface water samples are collected from 14 locations upstream and downstream from PORTS surface water discharges. These samples were taken from the Scioto River, Little Beaver Creek, Big Beaver Creek, and Big Run Creek (see Figure 4.6). As background measurements, samples were also collected from local streams approximately 10 miles north, south, east, and west of PORTS.

Samples were collected semiannually and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a).

No transuranic radionuclides were detected in the local surface water samples collected during 2020. Maximum detections of technetium-99 and uranium isotopes in local surface water samples are listed below:

Radionuclide	Maximum activity (pCi/L)	Location	Derived concentration standard (DOE 2011b)[a] (pCi/L)	Percentage of derived concentration standard (DOE 2011b)
Technetium-99	106	RW-13	44,000	0.24%
Uranium-233/234	2.97	RW-8	680	0.44%
Uranium-235/236	0.12	RW-8	720	0.02%
Uranium-238	0.745	RW-8	750	0.10%

[a]The derived concentration standard has been converted to pCi/L from units of microcurie per milliliter provided in the *Derived Concentration Technical Standard* (DOE 2011b).

These detected concentrations of radionuclides were 0.44%, or less, of the DOE derived concentration standards (DOE 2011b)[1]. This derived concentration standard is based upon direct use of the surface water as drinking water. This comparison is likely to overestimate the dose because surface water around PORTS is not used for drinking water.

[1]The derived concentration standard is the concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (ingestion of water or inhalation of air) would result in a dose of 100 mrem. A concentration that is 100% of the derived concentration standard would equate to a dose at the DOE limit of 100 mrem/year (DOE 2011b).

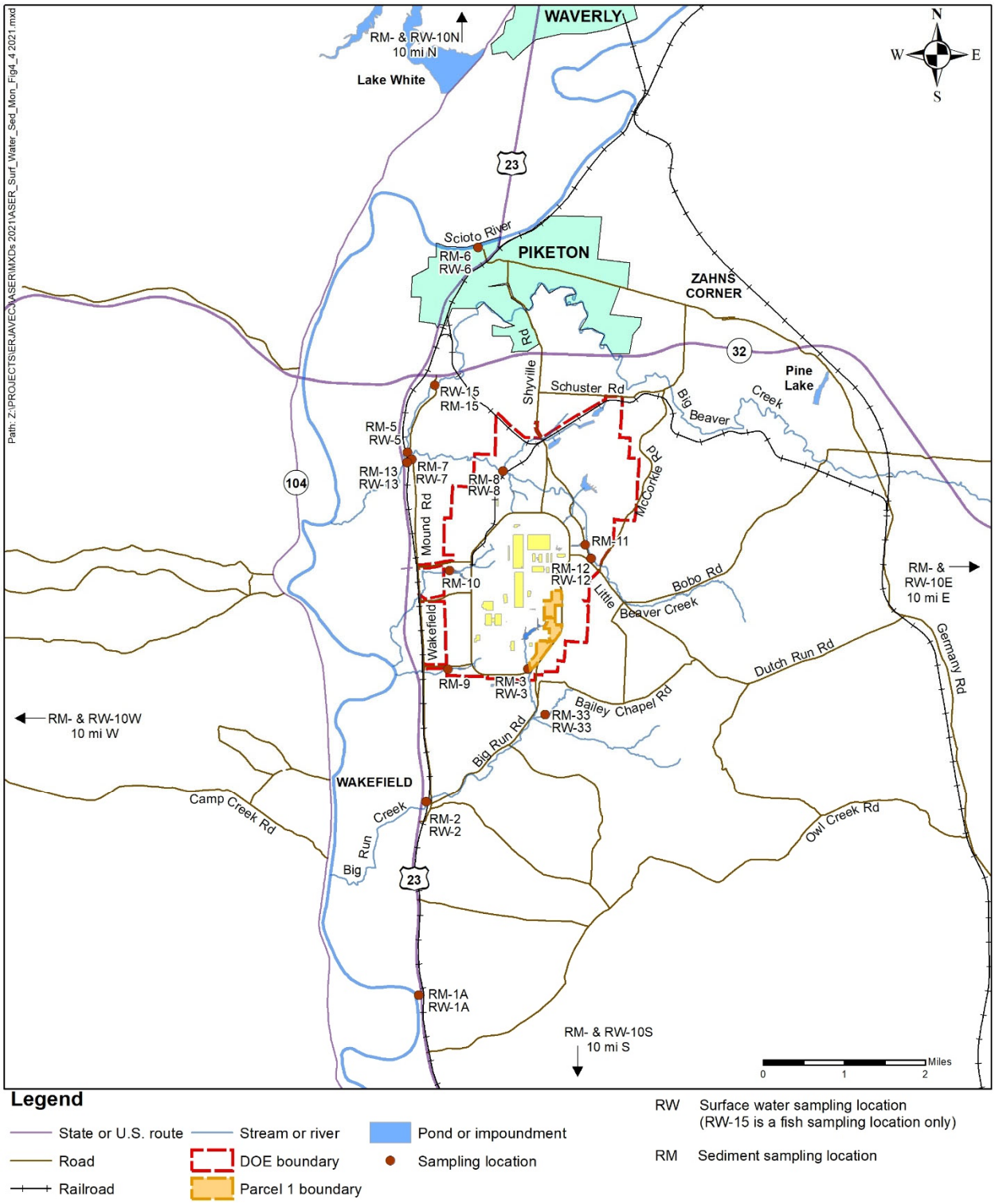

Figure 4.6. Local surface water and sediment monitoring locations.

4.6.5 Sediment

Sediment samples are collected from the same locations upstream and downstream from PORTS where local surface water samples are collected, at the NPDES outfalls on the east and west sides of PORTS, and at a location on Big Beaver Creek upstream from the confluence with Little Beaver Creek (see Figure 4.6). Samples are collected annually and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a).

Neptunium-237 was detected at 0.038 pCi/g in the sample collected from the off-site upstream sampling location on Big Beaver Creek (RM-15). No other transuranics were detected in the sediment samples collected in 2020.

Technetium-99 is often detected in sediment samples collected at locations downstream from PORTS surface water discharges; however, technetium-99 was not detected in any of the sediment samples collected in 2020.

Uranium and uranium isotopes are naturally occurring, but may also be present due to PORTS activities. Maximum detections of uranium and uranium isotopes in sediment samples were detected at on-site sampling locations on Big Run Creek or the West Drainage Ditch (locations RM-3 and RM-10, respectively) as follows:

Uranium: 4.51 micrograms per gram (μg/g) (RM-3)
Uranium-233/234: 2.4 pCi/g (RM-3)
Uranium-235/236: not detected
Uranium-238: 1.5 pCi/g (RM-3 and RM-10).

Uranium and uranium isotopes detected in the 2020 samples have been detected at similar levels in previous sampling events from 2005 through 2019.

Section 4.3.7.1 provides a dose assessment at the off-site sediment sampling locations with the detections of radionuclides that could cause the highest dose to a member of the public: RM-5 and RM-15 on Big Beaver Creek. The total potential annual dose to a member of the public resulting from PORTS (1.0 mrem/year), which includes this dose calculation (0.013 mrem/year), is below the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

4.6.6 Settleable Solids

DOE collects semiannual water samples from nine effluent locations and three background locations (see Figure 4.7) to determine the concentration of radioactive material that is present in the sediment suspended in the water sample. The data are used to determine compliance with DOE Order 458.1, *Radiation Protection of the Public and the Environment*, which states that operators of DOE facilities discharging or releasing liquids containing radionuclides from DOE activities must ensure that the discharges do not exceed an annual average (at the point of discharge) of either of the following:

- 5 pCi/g above background of settleable solids for alpha-emitting radionuclides, and
- 50 pCi/g above background for beta-gamma-emitting radionuclides.

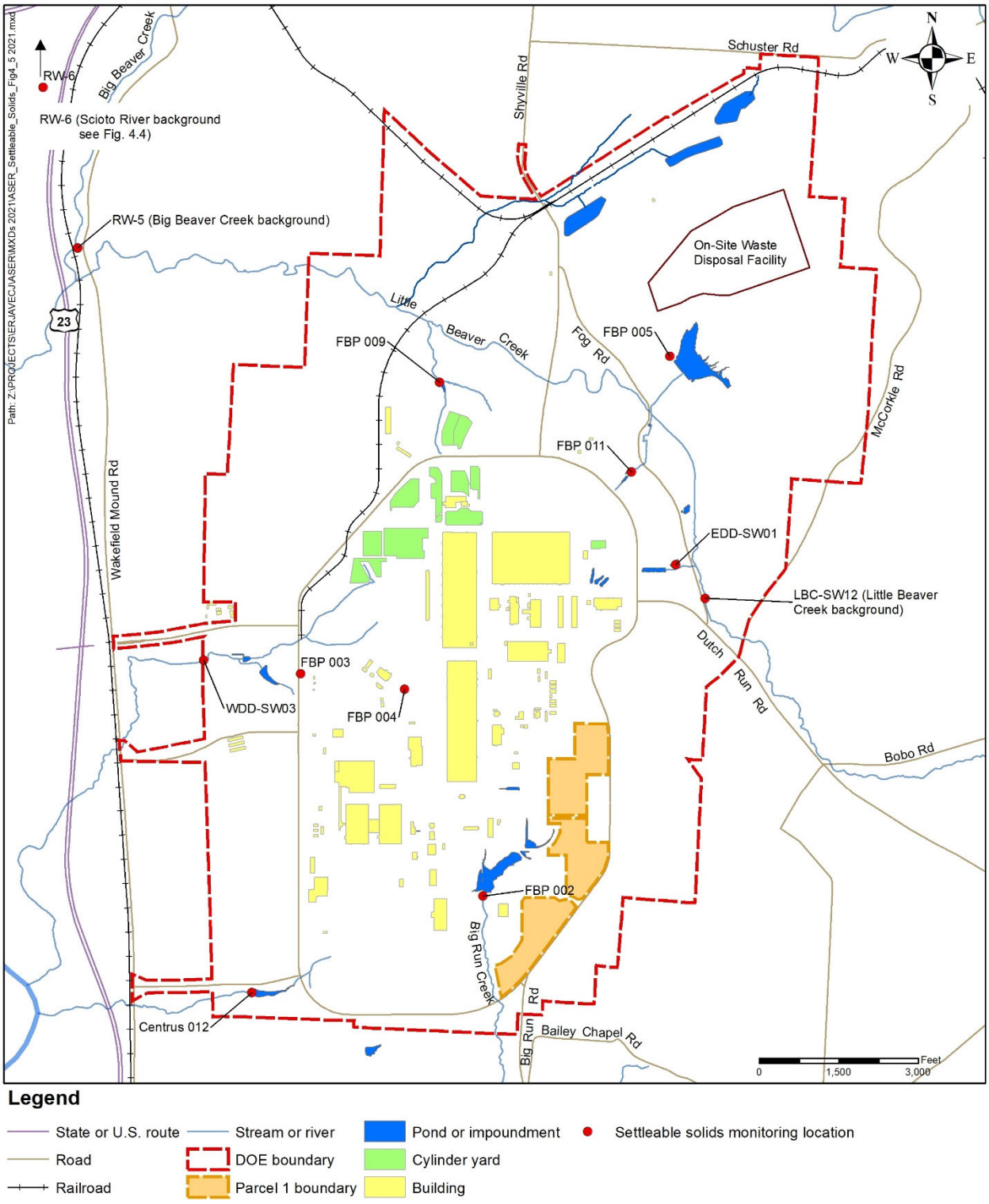

Figure 4.7. DOE settleable solids monitoring locations.

When a low concentration of settleable solids is detected in a water sample, accurate measurement of the alpha and beta-gamma activity in the settleable solids portion of the sample is not practical due to the small sample size. A DOE memo (DOE 1995) states that settleable solids of less than 40 milligrams per liter (mg/L) are in *de facto* compliance with the DOE Order 458.1 limits (5 pCi/g annual average above background for alpha activity and 50 pCi/g annual average above background for beta-gamma activity).

In August 2020, settleable solids were detected above 40 mg/L in the sample collected from a background location: RW-5 in Big Beaver Creek. Alpha activity was detected at 56.9 pCi/g in the settleable solids portion of the sample. This result is not due to radionuclides released from PORTS because the sampling location is upstream from PORTS discharges to Big Beaver Creek. The result shows that naturally-occurring radiation is present in the environment. Beta-gamma activity was not detected. DOE discharge limits do not apply to background locations. Settleable solids were not detected in the December 2020 sample collected from background location RW-5.

Settleable solids were not detected at concentrations above 40 mg/L at any of the other monitoring locations; therefore, monitoring results for the settleable solids monitoring program are in compliance with DOE Order 458.1.

4.6.7 Soil

Soil samples are collected annually from 15 ambient air monitoring locations (see Figure 4.8). Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a).

No transuranic radionuclides or technetium-99 were detected at the soil sampling locations in 2020. Uranium, uranium-233/234, uranium-235/236, and/or uranium-238 were detected at each of the sampling locations. Uranium and uranium isotopes are usually detected at similar levels at the off-site soil sampling locations, including the background location (A37), which suggests that the uranium detected in these samples is due to naturally-occurring uranium.

Section 4.3.7.2 provides a dose assessment based on the detections of uranium isotopes in soil at the off-site ambient air stations with the detections of radionuclides that could cause the highest dose to a member of the public: A6 (north of PORTS in Piketon), A41A (northeast of PORTS at Zahns Corner), and A28 (southwest of PORTS on Camp Creek Road). The total potential annual dose to a member of the public resulting from PORTS (1.0 mrem/year), which includes this dose calculation (0.014 mrem/year), is below the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

4.6.8 Biological Monitoring

The DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a) requires biological monitoring to assess the uptake of radionuclides into selected local biota (vegetation, deer, fish, crops, milk, and eggs).

4.6.8.1 Vegetation

To assess the uptake of radionuclides into plant material, vegetation samples (primarily grass) are collected in the same areas where soil samples are collected at the ambient air monitoring stations (see Figure 4.8). Samples are collected annually and analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238).

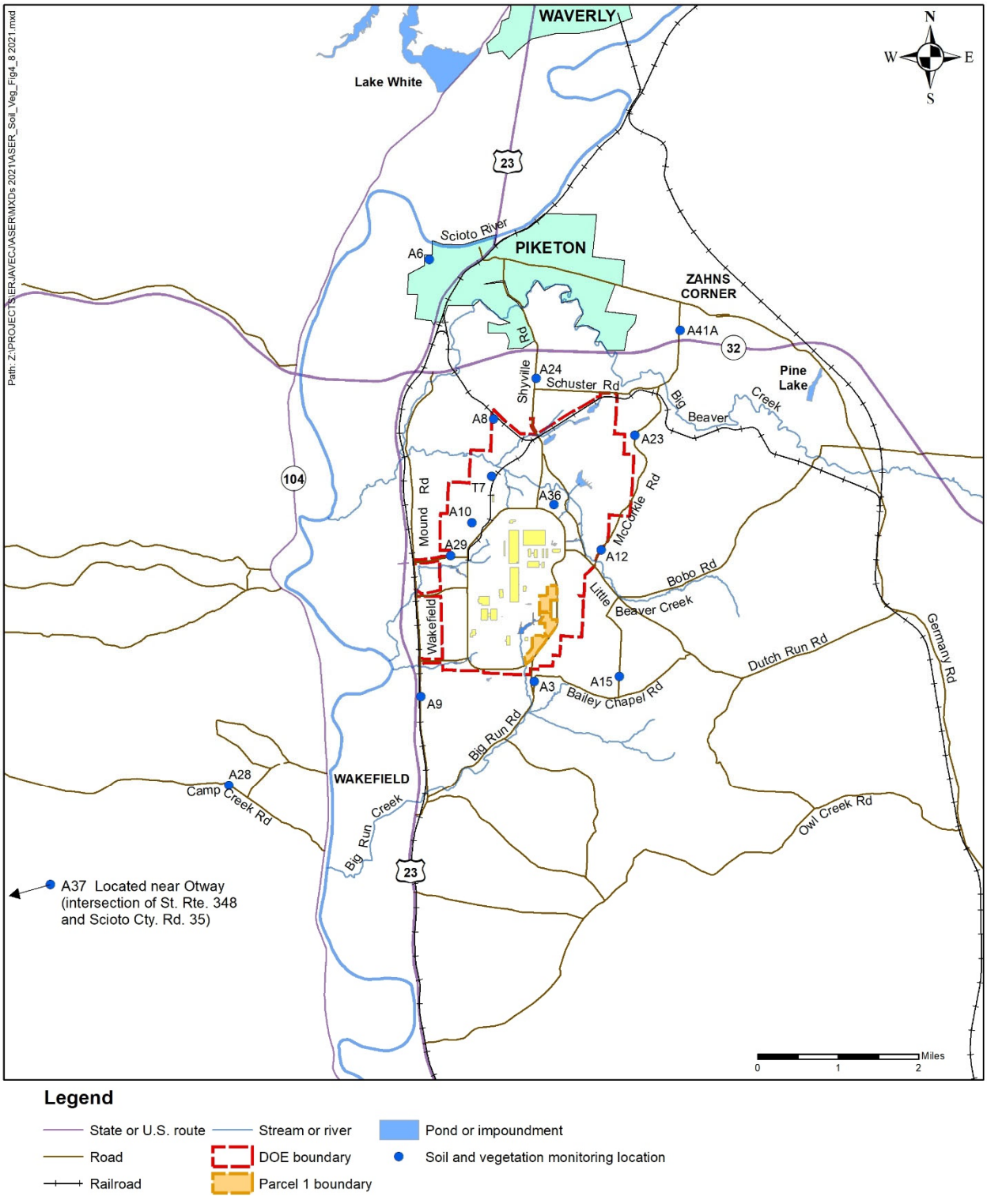

Figure 4.8. DOE soil and vegetation monitoring locations.

Uranium, uranium-233/234, and/or uranium-238 were detected in the vegetation samples collected at on-site sampling locations A10, A29, A36, A8, and T7, as well as off-site sampling locations A6 (north of PORTS in Piketon), A9 (southwest of PORTS on old US Route 23), and A37 (the background station in Otway). Uranium and uranium isotopes are detected occasionally in vegetation samples, and have been detected at similar levels in previous sampling. Section 4.3.7.3 provides a dose assessment for a member of the public based on consumption of beef cattle that would eat grass contaminated with radionuclides at station A6 in Piketon. The total potential annual dose to a member of the public resulting from PORTS (1.0 mrem/year), which includes this dose calculation (0.00038 mrem/year), is below the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

4.6.8.2 Deer

Samples of liver, kidney, and muscle from deer killed on site in motor vehicle collisions are collected annually, if available. Samples are analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). Deer samples were collected in February (two deer) and November of 2020 (one deer).

Technetium-99 was detected at 0.495 pCi/g in the liver sample collected from the deer in November 2020. Technetium-99 was not detected in the muscle and kidney samples collected from this deer. A dose assessment is only completed when radionuclides are detected in deer muscle samples because people do not typically eat deer liver or kidneys. No other radionuclides were detected in the deer samples collected during 2020.

4.6.8.3 Fish

Fish samples are collected annually (if available) from locations on Little Beaver Creek (RW-8), Big Beaver Creek (RW-13 and RW-15), and the Scioto River (RW-1A and RW-6) as shown on Figure 4.6. In 2020, fish were caught at each of these locations. The samples were analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). No radionuclides were detected in the fish samples collected during 2020.

4.6.8.4 Crops

In 2020, crop samples, including corn, tomatoes, and peppers, were collected from five off-site locations near PORTS. The samples were analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). Uranium-233/234 was detected at 0.032 pCi/g in a sample of beans collected from off-site location #9. Uranium isotopes are occasionally detected in crop samples. No other radionuclides were detected in the crop samples collected during 2020.

Section 4.3.7.4 provides a dose assessment for a member of the public based on uranium-233/234 detected at 0.032 pCi/g in home-grown beans. The total potential annual dose to a member of the public resulting from PORTS (1.0 mrem/year), which includes this dose calculation (0.16 mrem/year), is below the total public annual dose limit of 100 mrem/year in DOE Order 458.1.

4.6.8.5 Milk and eggs

Samples were collected in 2020 of milk and eggs produced near PORTS. The samples were analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). No radionuclides were detected in the milk and egg samples collected during 2020.

4.7 RELEASE OF PROPERTY CONTAINING RESIDUAL RADIOACTIVE MATERIAL

DOE Order 458.1 establishes limits for unconditional release of personal and real property from DOE facilities. Real property is defined as land and anything permanently affixed to the land such as buildings, fences, and those things attached to the buildings, such as light fixtures, plumbing, and heating fixtures, or other such items, that would be personal property if not attached.

Personal property is defined as property of any kind, except for real property. Release criteria for surface contamination limits as specified in DOE Order 458.1 are used for clearance of objects with the potential for surface contamination, while specific authorized limits have been derived to control whether items with potential volumetric contamination are released.

Sections 4.7.1 and 4.7.2 provide information about property released from FBP (and PMA) and MCS, respectively.

4.7.1 FBP Property Releases

FBP uses pre-approved authorized limits established by DOE Orders to evaluate and release materials defined as personal property. In 2020, FBP authorized approximately 1151 release requests for materials/items of personal property, which includes vehicles, equipment, waste/recyclables (such as batteries, light bulbs, used oil, and construction debris), and other materials.

DOE has approved authorized limits for real property release at PORTS. These authorized limits are as low as reasonably achievable and allow DOE to transfer land intended for industrial use. Table 4.3 provides the approved authorized limits.

Table 4.3. Approved authorized limits for real property transfer at PORTS

Nuclide	Outdoor Worker (pCi/g)[a]
Americium-241	54
Neptunium-237+D[b]	2
Plutonium-238	164
Plutonium-239	143
Plutonium-240	144
Technetium-99	885
Uranium-234	329
Uranium-235	3
Uranium-238+D[b]	16

[a]Source: Authorized limits letter (Bradburne May 2, 2018).
[b]"+D" indicates consideration of short-lived decay products of a principal radionuclide down to, but not including, the next principal radionuclide or the final nonradioactive nuclide in the chain.

DOE did not transfer any real property at PORTS in 2020.

4.7.2 MCS Property Releases

In 2020, MCS authorized approximately 106 release requests for materials to be released off site. These released included vehicles, equipment, waste/recyclables (such as batteries, light bulbs, used oil, and construction debris), contractor equipment, equipment being sent out for calibration, and various other items that met the criteria for release off site.

MCS authorized approximately 226 items that met the criteria for exemption in 2020. These items included contractor equipment that received an inbound survey prior to coming on site and that were here for a short time that never entered into an area controlled for radioactive material, new and unused items that were sent to MCS by mistake, new unused items that had expired or needed to be returned to the vender for repair or calibration, and various other items that met the criteria for exemption. All of these items had a thorough evaluation prior to determination.

In 2020, MCS continued off-site shipment of aqueous hydrogen fluoride produced by the DUF_6 Conversion Facility, which converts DUF_6 into uranium oxide and aqueous hydrogen fluoride. Each shipment meets the release limit of less than 3 picocuries/milliliter (0.003 pCi/L) of total uranium activity. Approximately 266,937 gallons of aqueous hydrogen fluoride were shipped off site in 2020.

5. ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

5.1 SUMMARY

Non-radiological environmental monitoring at PORTS includes air, water, sediment, and fish. Monitoring of non-radiological parameters is required by state and federal regulations and/or permits, but is also performed to reduce public concerns about plant operations.

In 2020, DOE and Ohio EPA began a joint ambient air monitoring program at PORTS to monitor non-radiological air pollutants that could be present due to D&D activities at PORTS: particulate matter, metals, VOCs, and asbestos. Five ambient air monitoring stations located on site began operating in November/December of 2020. Monitoring data for these new locations showed low levels of particulate matter, metals, and VOCs that are within health-based standards. Asbestos was not detected. Other non-radiological data collected in 2020 are similar to data collected in previous years.

5.2 ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INTRODUCTION

Environmental monitoring programs at PORTS usually monitor both radiological and non-radiological constituents that could be released to the environment as a result of PORTS activities. The radiological components of each monitoring program were discussed in the previous chapter. The DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a) specifies non-radiological monitoring requirements for ambient air, surface water, sediment, and fish. Non-radiological data are not collected for all sampling locations or all monitoring programs.

Environmental permits issued by Ohio EPA to FBP, MCS, or Centrus specify discharge limitations, monitoring requirements, and/or reporting requirements for air emissions and water discharges. Centrus data for NPDES water discharges are included in this section to provide a more complete picture of environmental monitoring at PORTS. Centrus data for water discharges are provided for informational purposes only; as Centrus operates independently of the DOE and is regulated by the NRC.

Data for the following environmental media are included in this chapter:

- air
- surface water
- sediment
- biota (fish).

DOE also conducts an extensive groundwater monitoring program at PORTS that includes both radiological and non-radiological constituents. Chapter 6 provides information on the groundwater monitoring program, associated surface water monitoring, and water supply monitoring.

5.3 AIR

Permitted air emission sources at PORTS emit non-radiological air pollutants. Section 5.3.1 discusses airborne discharges of non-radiological air pollutants. DOE also monitors ambient air for non-radiological air pollutants that could be present due to D&D activities at PORTS. In 2020, DOE and Ohio EPA began a joint ambient air monitoring program at PORTS to monitor particulate matter, metals, VOCs, and asbestos at five ambient air monitoring stations. In addition, the ambient air monitoring program measures fluoride at monitoring stations within PORTS boundaries and in the surrounding area.

5.3.1 Airborne Discharges

FBP is responsible for numerous air emission sources associated with the former gaseous diffusion production facilities and support facilities. These sources, which included the boilers at the X-600 Steam

Plant Complex (prior to demolition in 2013), emitted more than 100 tons per year of non-radiological air pollutants specified by Ohio EPA, which caused FBP air emission sources to become a major source of air pollutants as defined in 40 CFR Part 70.

FBP is required to submit an annual report called the Ohio EPA Fee Emissions Report to report emissions of selected non-radiological air pollutants. FBP reported the following emissions of non-radiological air pollutants for 2020: 8.81 tons of particulate matter and 1.18 tons of organic compounds. Emissions for 2020 are associated with the X-627 Groundwater Treatment Facility and plant roads/parking areas.

The DUF_6 Conversion Facility emits only a small quantity of non-radiological air pollutants. Because of these small emissions, Ohio EPA requires a Fee Emissions Report only once every two years (in odd-numbered years). MCS reported less than 10 tons/year of specified non-radiological air pollutants in 2019 (the report requires reporting in increments of emissions: zero, less than 10 tons, 10-50 tons, more than 50 tons, and more than 100 tons).

U.S. EPA also requires annual reporting of greenhouse gas emissions (carbon dioxide, methane, and nitrous oxide). In 2020, FBP reported emissions of 12,287.8 metric tons of carbon dioxide, 0.24 metric ton of methane, and 0.024 metric ton of nitrous oxide. These emissions are from burning natural gas at the X-690 Boilers, which provide steam to portions of the plant.

Another potential air pollutant present at PORTS is asbestos released by D&D of plant facilities. Asbestos emissions are controlled by a system of work practices. The amount of asbestos removed and disposed is reported to Ohio EPA. In 2020, approximately 1,000 lbs of asbestos-containing materials (net weight) were shipped from PORTS. Asbestos was not detected in ambient air samples collected as part of the ambient air monitoring program in 2020 (see Section 5.3.2.4).

5.3.2 Ambient Air Monitoring

In November/December of 2020, DOE and Ohio EPA began a joint ambient air monitoring program at PORTS to monitor non-radionuclides that may be released to the environment during D&D at PORTS. Ohio EPA began reporting selected data in November 2020 and DOE began reporting data in December 2020.

Five air monitoring stations were installed on site to monitor particulate matter, metals, VOCs, and fibers/asbestos. Figure 5.1 shows the locations of the joint DOE and Ohio EPA air monitors. Both DOE and Ohio EPA collect samples from each location. Ohio EPA provides air monitoring data to the public at epa.ohio.gov/dapc/ams/amsmain/amsspecsam-DOE. DOE provides data at pegasis.ports.pppo.gov.

DOE also operates 15 ambient air monitoring stations that measure fluoride (see Chapter 4, Figure 4.3). Fluoride detected at the ambient air monitoring stations could be present due to background concentrations (fluoride occurs naturally in the environment), activities associated with the former gaseous diffusion process, and operation of the DUF_6 Conversion Facility.

5.3.2.1 Particulate matter

Particulate matter is a mixture of very small solid particles and liquid droplets in air. Particulate matter is the dust produced at construction sites, on unpaved roads or fields, or the smoke produced by fires.

Particulate matter is also emitted by numerous industrial processes and is produced by coal or gas-burning power plants and gasoline and diesel fuel burned by cars and trucks. Particulate matter can be a health hazard when people inhale it.

DOE and Ohio EPA measure two sizes of particulate matter called PM10 and PM2.5. The 10 and 2.5 refer to the size of the particles, which are 10 microns or less and 2.5 microns or less. These particles are very small; in comparison, the typical diameter of a human hair is about 70 microns. Air monitors at each of the five sampling locations (Figure 5.1) continuously measure PM10 and PM2.5.

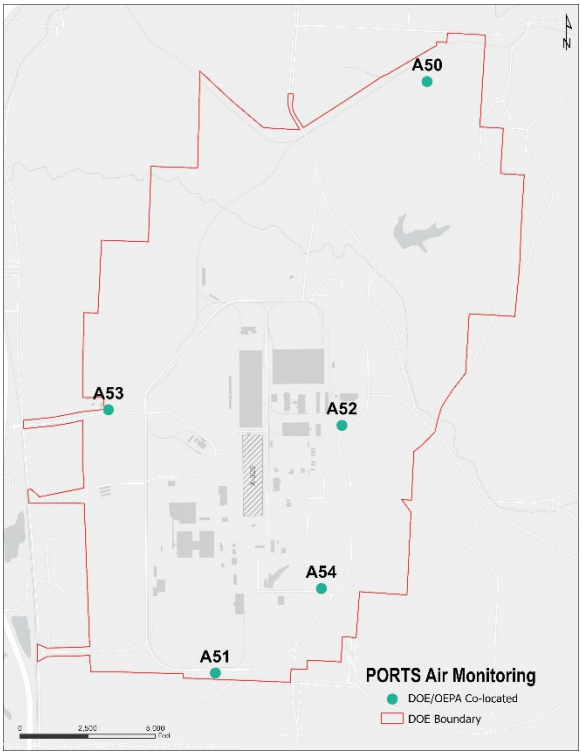

Figure 5.1. DOE/Ohio EPA air monitoring stations.

The National Ambient Air Quality Standards set a 24-hour average of 150 micrograms per cubic meter ($\mu g/m^3$) for PM10 in ambient air. Although this standard applies to geographic areas, not to individual industrial facilities, the standard is useful to evaluate PORTS monitoring data. DOE began reporting PM10 data at stations A51, A52, and A53 on December 1, 2020. Reporting for stations A50 and A54 began on December 9, 2020. For data collected by DOE in December 2020, the maximum 24-hour average for PM10 was 30.8 $\mu g/m^3$ at station A50, which is below the 150 $\mu g/m^3$ standard.

The National Ambient Air Quality Standards set a 24-hour average of 35 $\mu g/m^3$ for PM2.5 in ambient air and a primary annual average standard of 12 $\mu g/m^3$. Although these limits apply to geographic areas, not to individual industrial facilities, the standards are useful to evaluate PORTS monitoring data. DOE began reporting PM2.5 data at stations A51, A52, and A53 on December 1, 2020. Reporting for stations A50 and A54 began on December 9, 2020. For data collected by DOE in December 2020, the maximum 24-hour average for PM2.5 was 19 $\mu g/m^3$ at station A53, which is below the 35 $\mu g/m^3$ standard. The annual averages measured at the stations were 10 $\mu g/m^3$, which are also below the 12 $\mu g/m^3$ standard.

Hourly measurements for PM10 and PM2.5 from the Ohio EPA stations are available in real time at epa.ohio.gov/dapc/ams/amsmain/amsspecsam-DOE. Summaries of data collected by Ohio EPA are also available at the Ohio EPA website.

5.3.2.2 Metals

Metals are a component of particulate matter. Metals are present in particulate matter because metals are naturally present in soil. Metals are also released to the air from fuel combustion (burning coal, natural gas, diesel fuel, or gasoline) and numerous industrial processes. DOE and Ohio EPA monitor ambient air for 11 metals designated by Ohio EPA as hazardous air pollutants. These metals could be present in

excavated soil and demolition debris at PORTS. Samples are collected weekly (24-hour samples collected once every six days). DOE began sampling in December 2020.

DOE completed an air dispersion modeling evaluation in 2020 to assess potential off-site concentrations of pollutants dispersing from D&D activities and operation of the OSWDF (DOE 2020b). As part of this modeling, DOE developed a screening level for each contaminant called a maximum acceptable ground level concentration (MAGLC). The MAGLC is a screening level containing a safety factor that Ohio EPA believes will not cause significant adverse human or environmental impacts. Table 5.1 summarizes the metals monitored at PORTS, the maximum detected concentration of each metal in 2020, and the screening level (MAGLC). All metals detected in ambient air were less than the associated screening level.

Table 5.1. Metals monitored by DOE in PORTS ambient air

Metal	Maximum detected concentration (µg/m^3)	MAGLC (µg/m^3)	% of MAGLC
Antimony	0.00302	11.9	0.025%
Arsenic	not detected	0.238	-
Beryllium	not detected	0.00119	-
Cadmium	not detected	0.0476	-
Chromium	not detected	1.19	-
Cobalt	0.00171	0.476	0.36%
Lead	not detected	1.19	-
Manganese	0.0721	0.476	15%
Mercury	not detected	0.595	-
Nickel	0.0448	2.38	1.9%
Selenium	0.000679	4.76	0.014%

DOE data for the ambient air monitoring program are available on line at pegasis.ports.pppo.gov. Ohio EPA provides air monitoring data to the public at epa.ohio.gov/dapc/ams/amsmain/amsspecsam-DOE.

5.3.2.3 Volatile organic compounds

Volatile organic compounds (VOCs) are also present in ambient air, primarily due to exhaust from cars and trucks (especially diesel-powered vehicles), but also from power plants that burn coal or natural gas and from other industrial activities. DOE and Ohio EPA monitor ambient air for 20 VOCs designated by Ohio EPA as hazardous air pollutants. These VOCs are monitored because they may be present in soil from areas that will be excavated within the X-231A/B Oil Biodegradation Plots and X-740 groundwater plume (see Chapter 3, Sections 3.3.1.3 and 3.3.3). These VOCs could be released to the air during soil excavation, treatment of water collected during the soil excavation, and other D&D activities. Samples are collected weekly or biweekly (24-hour samples collected once every 6 or 12 days). DOE began sampling in December 2020.

Table 5.2 summarizes the VOCs monitored at PORTS and the maximum detected concentration of each VOC in 2020. Since soil excavation and water treatment associated with D&D had not begun in 2020, these low levels of VOCs detected in ambient air are likely present primarily due to vehicle exhaust. Benzene and other VOCs are detected worldwide due to fuel combustion and other industrial activities. Methylene chloride and 2-butanone are also common laboratory contaminants and may have been detected in ambient air samples due to laboratory contamination.

Table 5.2. VOCs monitored by DOE in PORTS ambient air

VOC	Maximum detected concentration (ppbv)	Maximum detected concentration (µg/m^3)
1,1,1-Trichloroethane	not detected	-
1,1,2-Trichloroethane	not detected	-
1,1-Dichloroethane	not detected	-
1,1-Dichloroethene	not detected	-
1,2-Dichloroethane	0.061	0.25
1,4-Dioxane	not detected	-
2-Butanone	0.848	2.5
4-Methyl-2-pentanone	0.400	1.6
Benzene	0.287	0.92
Carbon disulfide	0.071	0.22
Carbon tetrachloride	0.085	0.53
Chloroethane	0.079	0.21
Chloroform	0.032	0.16
cis-1,2-Dichloroethene	not detected	-
Methylene chloride	3.59	12
Tetrachloroethene	0.105	0.71
Toluene	0.441	1.7
trans-1,2-Dichloroethene	not detected	-
Trichloroethene	0.071	0.38
Vinyl chloride	0.196	0.50

ppbv – parts per billion by volume. µg/m3 – microgram per cubic meter.

The air dispersion modeling evaluation in 2020 also assessed potential off-site concentrations of VOCs dispersing from D&D activities and operation of the OSWDF (DOE 2020b) and developed a screening level for VOCs (the MAGLC). The VOC MAGLC is based on protective values established for TCE, which is the predominant VOC contaminant for the site. The MAGLC for total VOCs is 1334 µg/m^3. Concentrations of VOCs detected in ambient air in 2020 are less than the screening level.

5.3.2.4 Fibers/asbestos

Asbestos fibers could be present in ambient air due to removal of asbestos-containing materials from D&D at PORTS. Asbestos may also be present due to its use in vehicle brakes and clutches and from demolition or renovation of older homes or other buildings that have materials containing asbestos (such as siding, insulation, and floor tile).

Because asbestos fibers are not typically detected in outdoor ambient air, DOE and Ohio EPA monitor ambient air for fibers, which can be asbestos or non-asbestos. If fibers are detected in the sample, the sample is then analyzed for asbestos fibers. Samples are collected weekly (24-hour samples collected once every six days). DOE began sampling in December 2020. No fibers, including asbestos fibers, were detected in the samples collected by DOE in 2020.

5.3.2.5 Fluoride

In 2020, samples for fluoride were collected weekly from 15 ambient air monitoring stations in and around PORTS (see Chapter 4, Figure 4.3), including a background ambient air monitoring station (A37) located approximately 13 miles southwest of the plant.

In 2020, fluoride was not detected in 76 percent of the samples collected for the ambient air monitoring program. The average ambient concentration of fluoride measured in samples collected at background station A37 was 0.0032 µg/m^3, which was calculated using the assumption that the concentration of

fluoride in air was zero for samples in which fluoride was not detected. This assumption ensures that the average concentration of fluoride in ambient air at the background location is not overestimated. Concentrations of fluoride measured in samples collected at the background station ranged from zero (below the analytical detection limit) to 0.014 µg/m^3.

For the locations around PORTS, if fluoride was not detected in a sample, the ambient concentration of fluoride was calculated assuming fluoride was present at the detection limit (instead of using zero as discussed for the background location). This assumption ensures that the average concentration of fluoride in air around PORTS is not underestimated because the fluoride was actually present at a concentration less than could be detected. Average ambient concentrations of fluoride measured at the stations around PORTS ranged from 0.0091 µg/m^3 at on-site stations A10 and A36 to 0.019 µg/m^3 at station A12 (east of PORTS on McCorkle Road). These concentrations are similar to the concentrations detected in 2019 (the highest average ambient concentration in 2019 was 0.019 µg/m^3 at station A10).

Concentrations of fluoride measured in samples collected at the off-site stations near PORTS ranged from below analytical detection limits to an ambient concentration of 0.097 µg/m^3 at station A12 (east of PORTS on McCorkle Road). The maximum concentration of fluoride in ambient air in 2020 (0.097 µg/m^3) is less than the maximum concentration detected in 2019 (0.16 µg/m^{3}at station A24 — north of PORTS on Shyville Road). Concentrations of fluoride in ambient air around PORTS are within ambient background concentrations measured in the United States (Agency for Toxic Substances and Disease Registry 2003). There is no standard for fluoride in ambient air.

5.4 WATER

Surface water and groundwater are monitored at PORTS. Groundwater monitoring is discussed in Chapter 6, along with surface water monitoring conducted as part of the groundwater monitoring program. Non-radiological surface water monitoring primarily consists of sampling water discharges associated with the FBP, MCS, and Centrus NPDES-permitted outfalls. PCBs are monitored in on-site surface water downstream from the cylinder storage yards.

5.4.1 Water Discharges (NPDES Outfalls)

In 2020, DOE contractors (FBP and MCS) were responsible for 20 NPDES discharge points (outfalls) or sampling points at PORTS. Centrus was responsible for three outfalls. This section describes non-radiological discharges from these outfalls during 2020.

5.4.1.1 FBP NPDES outfalls

In 2020, FBP was responsible for 18 outfalls or sampling points. Nine outfalls discharge directly to surface water, and six outfalls discharge to another outfall before leaving the site. FBP also monitors three additional sampling points that are not discharge locations. Chapter 4, Section 4.3.4.1, provides a brief description of each FBP outfall or sampling point and provides a site diagram showing each FBP NPDES outfall/sampling point (see Chapter 4, Figure 4.4).

Ohio EPA selects the chemical parameters that must be monitored at each outfall based on the chemical characteristics of the water that flows into the outfall and sets discharge limitations for some of these parameters. For example, some of the FBP outfalls discharge water from the groundwater treatment facilities; therefore, the outfalls are monitored for selected VOCs (*trans*-1,2-dichloroethene and/or TCE) because the groundwater treatment facilities treat water contaminated with VOCs. Chemicals and water quality parameters monitored at each FBP outfall in 2020 are as follows:

- FBP NPDES Outfall 001 (X-230J7 East Holding Pond) – cadmium, chlorine, copper, total filterable residue (dissolved solids), fluoride, mercury, oil and grease, pH, silver, total suspended solids, and zinc.

- FBP NPDES Outfall 002 (X-230K South Holding Pond) – bis(2-ethylhexyl)phthalate, cadmium, fluoride, mercury, ammonia-nitrogen, oil and grease, pH, selenium, silver, total suspended solids, and thallium.

- FBP NPDES Outfall 003 (X-6619 Sewage Treatment Plant) – acute toxicity, ammonia-nitrogen, carbonaceous biochemical oxygen demand, copper, E. coli (May-October only), mercury, nitrite + nitrate, oil and grease, pH, silver, thallium, total suspended solids, and zinc.

- FBP NPDES Outfall 004 (Cooling Tower Blowdown) – acute toxicity, beryllium, cadmium, chlorine, chromium, cobalt, copper, total filterable residue (dissolved solids), fluoride, mercury, nickel, oil and grease, total PCBs, pH, selenium, silver, total suspended solids, vanadium, and zinc.

- FBP NPDES Outfall 005 (X-611B Lime Sludge Lagoon) – lead, mercury, pH, selenium, and total suspended solids.

- FBP NPDES Outfall 009 (X-230L North Holding Pond) – bis(2-ethylhexyl)phthalate, chromium, copper, fluoride, iron, mercury, oil and grease, total PCBs, pH, silver, thallium, TCE, total suspended solids, and zinc.

- FBP NPDES Outfall 010 (X-230J5 Northwest Holding Pond) – chromium, copper, iron, lead, mercury, oil and grease, total PCBs, pH, selenium, thallium, total suspended solids, TCE, and zinc.

- FBP NPDES Outfall 011 (X-230J6 Northeast Holding Pond) – cadmium, chlorine, chromium, copper, fluoride, oil and grease, total PCBs, pH, selenium, total suspended solids, thallium, TCE, and zinc.

- FBP NPDES Outfall 015 (X-624 Groundwater Treatment Facility) – arsenic, barium, total PCBs, pH, silver, and TCE.

- FBP NPDES Outfall 602 (X-621 Coal Pile Runoff Treatment Facility) – iron, manganese, pH, and residue (settleable), total suspended solids.

- FBP NPDES Outfall 604 (X-700 Biodenitrification Facility) – copper, iron, nickel, nitrate-nitrogen, pH, and zinc.

- FBP NPDES Outfall 605 (X-705 Decontamination Microfiltration System) – ammonia-nitrogen, chromium, hexavalent chromium, copper, Kjeldahl nitrogen, nickel, nitrate-nitrogen, nitrite-nitrogen, oil and grease, pH, sulfate, total suspended solids, TCE, and zinc.

- FBP NPDES Outfall 608 (X-622 Groundwater Treatment Facility) – TCE, pH, and *trans*-1,2-dichloroethene.

- FBP NPDES Outfall 610 (X-623 Groundwater Treatment Facility) – TCE, pH, and *trans*-1,2-dichloroethene.

- FBP NPDES Outfall 611 (X-627 Groundwater Treatment Facility) – pH and TCE.

The FBP NPDES Permit also identifies additional monitoring points that are not discharge points as described in the previous paragraphs. FBP NPDES Station Number 801 is a surface water background monitoring location on the Scioto River upstream from FBP NPDES Outfalls 003 and 004. Samples are

collected from this monitoring point to measure toxicity to minnows and another aquatic organism, *Ceriodaphnia*.

FBP NPDES Station Number 902 is a monitoring location on Little Beaver Creek downstream from FBP NPDES Outfall 001. FBP NPDES Station Number 903 is a monitoring location on Big Run Creek downstream from FBP NPDES Outfall 002. Water temperature is the only parameter measured at each of these monitoring points.

The monitoring data detailed in the previous paragraphs are submitted to Ohio EPA in a monthly discharge monitoring report. These monthly discharge monitoring reports are provided to the public by DOE at pegasis.ports.pppo.gov. In 2020, discharge limitations at the FBP NPDES monitoring locations were exceeded on 15 occasions (see Table 5.3).

Table 5.3 FBP NPDES exceedances in 2020

Outfall	Parameter	Limit	Number of Exceedances	Date and Result[a]
001	Chlorine, total residual	0.05 mg/L (maximum daily)	1	September 2: 0.052 mg/L
003	Mercury	27 ng/L (monthly average)	4	September: 37 ng/L October: 45 ng/L November: 50 ng/L December: 30 ng/L
		0.00004 kg/day (monthly average loading)	2	October: 0.000055 kg/day November: 0.000065 kg/day
	Total suspended solids	18 mg/L (maximum daily)	1	December 28: 19 mg/L
005	pH	9.0 SU (maximum daily)	1	August 11: 9.19 SU
	Total suspended solids	15 mg/L (maximum daily)	5	Jan 2: 16 mg/L Jan 20: 17 mg/L February 17: 17 mg/L April 14: 20.2 mg/L August 7: 20.2 mg/L
		10 mg/L (monthly average)	1	January: 13.55 mg/L

[a]Units: kilogram per day (kg/day). milligram per liter (mg/L). nanogram per liter (ng/L). standard unit (SU).

Exceedances of the discharge limitations for total suspended solids were generally caused by a combination of excessive rainfall and operational issues at the outfall. Operational issues that contributed to the exceedances were corrected. The exceedance of the limit for pH at Outfall 005 was caused by a temporary under-dose of the chemical used to control pH and was found to be compliant within 50 minutes. The cause of the chlorine exceedance at Outfall 001 was not determined, however, operational samples collected 1.75 hours before and 2.5 hours after the non-compliant sample did not contain detectable amounts of chlorine.

The rolling annual average (12 ng/L) set by Ohio EPA for mercury at Outfall 003 was exceeded for the period of May 2019 through April 2020. The annual average for this time period was 15.9 ng/L. Exceedances of the rolling annual average and monthly limits for mercury at Outfall 003 are being addressed in accordance with the compliance schedule in the FBP NPDES permit that became effective on July 1, 2020.

In 2020, the overall FBP NPDES compliance rate with the NPDES permit was 99%.

5.4.1.2 MCS NPDES outfalls

MCS is responsible for the NPDES permit for the discharge of process wastewaters from the DUF_6 Conversion Facility. The MCS NPDES permit provides monitoring requirements for two outfalls: MCS Outfall 001 and MCS Outfall 602. Chapter 4, Figure 4.4 shows the location of the MCS NPDES outfalls. Monitoring requirements for MCS Outfall 001 are only effective when process wastewater is being discharged through the outfall. No process waste water was discharged through Outfall 001 in 2020; therefore, no monitoring was required.

MCS Outfall 602 monitors the discharge of MCS process wastewater to the sanitary sewer, which flows to the X-6619 Sewage Treatment Plant that discharges through FBP NPDES Outfall 003. Process wastewater discharged from MCS Outfall 602 was monitored for pH and total flow.

The monitoring data collected in accordance with the MCS permit are submitted to Ohio EPA in a monthly discharge monitoring report. No exceedances of permit limitations at MCS Outfall 602 occurred during 2020; therefore, the overall MCS compliance rate with the NPDES permit was 100%.

5.4.1.3 Centrus NPDES outfalls

Centrus is responsible for three NPDES outfalls through which water is discharged from the site (see Chapter 4, Figure 4.4). Two outfalls discharge directly to surface water, and one outfall discharges to FBP NPDES Outfall 003 before leaving the site. Chapter 4, Section 4.3.4.2, provides a brief description of each Centrus NPDES outfall. Chemicals and water quality parameters monitored at each Centrus outfall are as follows:

- Centrus NPDES Outfall 012 (X-2230M Southwest Holding Pond) – chlorine, mercury, oil and grease, pH, suspended solids, and total PCBs.

- Centrus NPDES Outfall 013 (X-2230N West Holding Pond) – barium, cadmium, chlorine, copper, mercury, oil and grease, pH, suspended solids, total PCBs, and zinc.

- Centrus NPDES Outfall 613 (X-6002A Recirculating Hot Water Plant particle separator) – chlorine and suspended solids.

The monitoring data are submitted to Ohio EPA in a monthly discharge monitoring report. No exceedances of permit limitations at Centrus Outfalls 012, 013, and 613 occurred during 2020; therefore, the overall Centrus compliance rate with the NPDES permit was 100%.

5.4.2 Surface Water Monitoring Associated with MCS Cylinder Storage Yards

Surface water samples (filtered and unfiltered) are collected quarterly from four locations in the drainage basins downstream from the MCS X-745C, X-745E, and X-745G Cylinder Storage Yards (UDS X01, RM-8, UDS X02, and RM-10 – see Chapter 4, Figure 4.4). These locations are on site at PORTS and not accessible to the public. Samples are analyzed for PCBs.

PCBs were not detected in any of the surface water samples (filtered or unfiltered) collected during 2020. Section 5.5.2 presents the results for sediment samples collected as part of this program.

5.5 SEDIMENT

In 2020, sediment monitoring at PORTS included local streams and the Scioto River upstream and downstream from PORTS and drainage basins downstream from the MCS cylinder storage yards.

5.5.1 Local Sediment Monitoring

Sediment samples are collected annually at the same locations upstream and downstream from PORTS where local surface water samples are collected, at the NPDES outfalls on the east and west sides of PORTS, and at a location on Big Beaver Creek upstream from the confluence with Little Beaver Creek (see Chapter 4, Figure 4.6). In 2020, samples were analyzed for 20 metals and PCBs, in addition to the radiological parameters discussed in Chapter 4.

PCBs were detected at three on-site and five off-site sampling locations. Samples collected on site from Big Run Creek (RM-3), Little Beaver Creek (RM-8) and West Drainage Ditch (RM-10) contained PCBs at concentrations ranging from 9.73 to 24.2 micrograms per kilogram (µg/kg) or parts per billion (ppb). PCBs were also detected at the off-site sampling locations on Little Beaver Creek (RM-7), Big Beaver Creek (RM-5 and RM-15), and the Scioto River (RM-6 and RM-1A) at concentrations ranging from 5.13 to 14.6 µg/kg. The concentrations of PCBs detected in the samples are less than the risk-based regional screening level for PCB-1254/1260 developed by U.S. EPA and utilized by Ohio EPA: 240 µg/kg (U.S. EPA 2020).

The results of metals sampling conducted in 2020 indicate that no appreciable differences are evident in the concentrations of metals present in sediment samples taken upstream from PORTS and downstream from PORTS. Metals occur naturally in the environment. Accordingly, the metals detected in the samples most likely did not result from activities at PORTS.

5.5.2 Sediment Monitoring Associated with MCS Cylinder Storage Yards

Sediment samples are collected quarterly from four locations in the drainage basins downstream from the MCS X-745C, X-745E, and X-745G Cylinder Storage Yards (UDS X01, RM-8, UDS X02, and RM-10) and analyzed for PCBs. These locations are on site at PORTS and not accessible to the public (see Chapter 4, Figure 4.4).

In 2020, PCBs were detected in at least one of the sediment samples collected at each location. The maximum concentration of PCBs (92.5 µg/kg) was detected in the first quarter sample collected at sampling location UDS X01. The concentrations of PCBs detected in 2020 are below the 1 ppm (1000 µg/kg) reference value set forth in the U.S. EPA Region 5 *TSCA Approval for Storage for Disposal of PCB Bulk Product (Mixed) Waste,* which applies to the storage of DUF_6 cylinders at PORTS that may have paint on the exterior of the cylinders that contains more than 50 ppm PCBs. None of the samples contained PCBs above the risk-based regional screening level for PCB-1254/1260 developed by U.S. EPA and utilized by Ohio EPA: 240 µg/kg (ppb) (U.S. EPA 2020).

Section 5.4.2 presents the results for surface water samples collected as part of this program.

5.6 BIOLOGICAL MONITORING - FISH

Fish samples are collected annually (if available) from the following locations:

- Little Beaver Creek (RW-8): on site at PORTS
- Big Beaver Creek (RW-15): off site upstream from the confluence with Little Beaver Creek
- Big Beaver Creek (RW-13): off site downstream from the confluence with Little Beaver Creek
- Scioto River (RW-1A): off site downstream from PORTS water discharges
- Scioto River (RW-6): off site upstream from PORTS water discharges (Piketon).

In 2020, fish were caught at each of these locations. In the Scioto River, a catfish was caught at RW-6 and a drum was caught at RW-1A. Bass were caught in Little Beaver and Big Beaver Creeks. Chapter 4, Figure 4.6, shows the surface water monitoring locations where the fish were caught.

Fish samples were analyzed for PCBs, in addition to the radiological parameters discussed in Chapter 4. Fish samples collected for this program included only the fish fillet, that is, only the portion of the fish that would be eaten by a person. Two samples of fish were analyzed from the bass caught at RW-8.

Table 5.4 summarizes the results of the PCB sampling in off-site fish for 2020 and compares the results to suggested consumption limits from the State of Ohio.

Table 5.4. PCB results in fish and Ohio advisory consumption limits

	Ohio advisory consumption limits for PCBs in fish[a]		
	Unrestricted Less than 50 µg/kg	1 meal/week 50-220 µg/kg	1 meal/month 220-1000 µg/kg
PORTS 2020 off site fish samples		RW-15 PCBs:124 µg/kg RW-1A PCBs: 63.1 µg/kg RW-6 PCBs: 63.3 µg/kg	RW-13 PCBs: 862 µg/kg

[a]Source: *State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program* (Ohio EPA 2010).

PCBs were also detected in the fish samples collected on site from Little Beaver Creek (RW-8). One sample contained PCBs at 149 µg/kg, and the second sample contained PCBs at 3170 µg/kg. Ohio EPA recommends that fish containing PCBs above 1900 µg/kg should not be eaten. These samples consisted of several fish, which indicates that concentrations of contaminants in fish can vary even among similar fish. The fish collected on site from Little Beaver Creek are not at a location that would be accessible to the public.

The Ohio Sport Fish Consumption Advisory, available from the Ohio Department of Health, advises the public on consumption limits for sport fish caught from all water bodies in Ohio and should be consulted before eating any fish caught in Ohio waters (Ohio Department of Health 2021). The advisory recommends a limit of one meal per month for white bass (12 inches and over), common carp, and channel or flathead catfish caught in the Scioto River in Pike and Scioto Counties due to mercury and/or PCB contamination. The Ohio Department of Health advises that everyone limit consumption of sport fish caught from all waterbodies in Ohio to one meal per week, unless there is a more or less restrictive advisory.

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6. GROUNDWATER PROGRAMS

6.1 SUMMARY

Groundwater monitoring at PORTS is required by a combination of state and federal regulations, legal agreements with Ohio 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.

Groundwater plumes that consist of VOCs, primarily TCE, are found at five of the PORTS monitoring areas: X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, Quadrant I Groundwater Investigative (5-Unit) Area, Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Former Holding Pond, and X-740 Former Waste Oil Handling Facility. In general, concentrations of most contaminants detected within these plumes were stable or decreasing during 2020. However, a few contaminants increased in 2020 as discussed below and in the remaining sections of this chapter.

The groundwater plume at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility is near the southern boundary of PORTS. Three years ago, in 2018, concentrations of VOCs increased in several of the wells that monitor the X-749 South Barrier Wall area (the southern portion of the plume near the property boundary). In 2020, average annual concentrations of TCE in two on-site wells (X749-45G and X749-97G) are still higher than in 2015-2017. TCE concentrations ranged from 2.93 to 14 µg/L in well X749-45G and from undetected to 2.9 µg/L in well X749-97G. Several factors may have contributed to these increases including the high levels of precipitation in 2018 and 2019 and the 2018 pipeline break near the X-749 equalization tank that transfers water from the X-749 extraction wells to the X-622 Groundwater Treatment Facility. The pipeline break resulted in reduced pumping rates during the outage (from January 25 to May 25, 2018), which caused higher than typical water levels in the X-749 South Barrier Wall area monitoring wells in combination with the above average precipitation.

In the fourth quarter of 2020, TCE and *cis*-1,2-dichloroethene were detected in the sample collected from off-site well WP-01G at 0.827 and 1.17 µg/L, respectively. VOCs have occasionally been detected in well WP-01G, but not since 2008 (DOE 2009a). Well WP-01G is approximately 60 feet south of well X749-97G, and is slightly upgradient, although the change in groundwater elevation between the wells was less than 0.1 ft in 2019 (DOE 2020a) and 2020 (DOE 2021). Concentrations of VOCs detected in well X749-97G were higher than typical in 2019-2020. It appears that VOCs in the area of well X749-97G may be affecting well WP-01G. DOE will continue to monitor this area in 2021.

VOCs were not detected in off-site well WP-03G in 2020. In 2018 and 2019, TCE and other VOCs were detected in well WP-03G at concentrations less than 0.5 µg/L. Prior to 2018, VOCs had not been detected in well WP-03G since 2012 (DOE 2013a), although these VOCs were routinely detected in the well from its installation in 2004 to 2012 (DOE 2011a, DOE 2012, DOE 2013a). No other VOCs were detected in 2020 in any of the off-site monitoring wells. TCE has not been detected in groundwater beyond the DOE property boundary at concentrations that exceed the Ohio EPA drinking water standard of 5 µg/L.

The *2020 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 (DOE 2021). This document and other documents referenced in this chapter are available in the PORTS Environmental Information Center.

6.2 GROUNDWATER PROGRAMS INTRODUCTION

This chapter provides an overview of groundwater monitoring at PORTS and the results of the groundwater monitoring program for 2020. The following sections provide an overview of the PORTS groundwater monitoring program followed by a review of the history and 2020 monitoring data for each area. Chapter 3, Section 3.3, provides additional information about the remedial actions implemented at a number of the areas discussed in this chapter to reduce or eliminate groundwater contamination.

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 permitted FBP NPDES outfalls.

6.3 OVERVIEW OF GROUNDWATER MONITORING AT PORTS

This section provides an overview of the regulatory basis for groundwater monitoring at PORTS, groundwater use and geology, and monitoring activities and issues. Section 6.3.4 provides information on federal and state emerging contaminants of concern.

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, agreements between 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 was approved by Ohio EPA and implemented at PORTS starting in April 1999. The *Integrated Groundwater Monitoring Plan* is periodically revised by DOE and approved by Ohio EPA. An annual groundwater report is submitted to Ohio EPA in accordance with the *Integrated Groundwater Monitoring Plan*.

Groundwater monitoring in 2020 was completed in accordance with the *Integrated Groundwater Monitoring Plan* dated August 2017 (DOE 2017b). The August 2017 *Integrated Groundwater Monitoring Plan* incorporated minor revisions to the monitoring program that were previously approved by Ohio EPA. These revisions included a reduction in sampling parameters and frequency at the X-740 Former Waste Oil Handling Facility and deletion of one well from the monitoring program for the X-735 Landfills because the well required removal due to construction activities for the OSWDF.

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

Two water-bearing zones are present beneath the industrialized portion of 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.

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. PORTS is the largest industrial user of water in the vicinity and obtains water from water supply well fields north and west of PORTS in the Scioto River Valley buried aquifer.

DOE has filed a deed notification at the Pike County Auditor's Office that restricts the use of groundwater beneath the PORTS site.

6.3.3 Monitoring Activities

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.

6.3.4 Emerging Contaminants

Federal and state regulators are interested in emerging contaminants of concern that may be present at DOE sites. These emerging contaminants are chemicals that have been detected in drinking water supplies around the United States, but their risk to human health and the environment may not be fully understood.

PORTS collects samples biennially (every two years) at selected groundwater monitoring wells for some of these contaminants: 1,4-dioxane, 1,2,3-trichloropropane, 2,4-dinitrotoluene, and N-nitrosodimethylamine. In the most recent sampling conducted in 2019, none of these contaminants were detected except 1,4-dioxane. 1,4-Dioxane is routinely detected in the PORTS TCE groundwater plumes. Concentrations of 1,4-dioxane detected in groundwater in 2019 ranged from 2 to 37 µg/L. 1,4-Dioxane is a common component of chlorinated solvents like 1,1,1-trichloroethane and TCE, which were historically used at PORTS.

Perfluoroalkyl substances and polyfluoroalkyl substances (PFAS) are another type of emerging contaminant. PORTS groundwater is not currently monitored for these contaminants. Chapter 2, Section 2.3.4.2, provides more information about these substances and discusses sampling for PFAS in the PORTS water supply.

6.4 GROUNDWATER MONITORING AREAS

The *Integrated Groundwater Monitoring Plan* requires groundwater monitoring of the following areas within the quadrants of the site designated by the RCRA Corrective Action Program (DOE 2017b). These areas (see Figure 6.1) are:

- Quadrant I
  - X-749 Contaminated Materials Disposal Facility /X-120 Former Training Facility,
  - PK Landfill,
  - Quadrant I Groundwater Investigative (5-Unit) Area,
  - X-749A Classified Materials Disposal Facility,
- Quadrant II
  - Quadrant II Groundwater Investigative (7-Unit) Area,
  - X-701B Former Holding Pond,
  - X-633 Former Recirculating Cooling Water Complex,
- Quadrant III
  - X-616 Former Chromium Sludge Surface Impoundments,
  - X-740 Former Waste Oil Handling Facility,

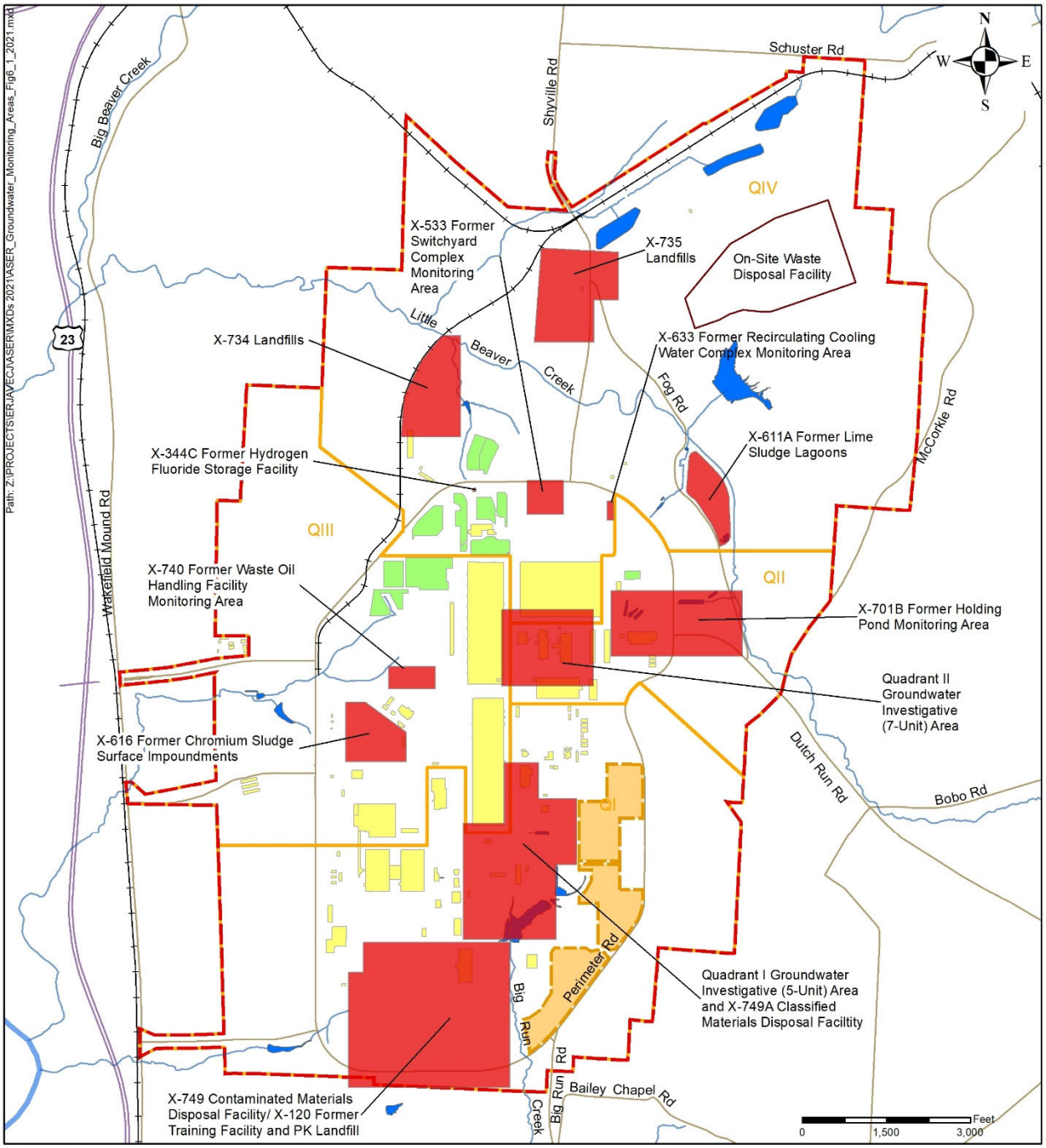

Figure 6.1. Groundwater monitoring areas at PORTS.

- Quadrant IV
  - X-611A Former Lime Sludge Lagoons,
  - X-735 Landfills,
  - X-734 Landfills,
  - X-533 Former Switchyard Complex, and
  - X-344C Former Hydrogen Fluoride Storage Building.

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 (DOE 2017b).

In general, samples are collected from wells (or surface water locations) at each area listed above and are analyzed for metals, VOCs, and/or radionuclides. Table 6.1 lists the analytical requirements for each groundwater monitoring area and other monitoring programs described in this chapter. Constituents detected in the groundwater are then compared to standards called preliminary remediation goals to assess the potential for each constituent to affect human health and the environment. Preliminary remediation goals are initial clean-up goals developed early in the decision-making process that are 1) protective of human health and the environment, and 2) comply with applicable or relevant and appropriate requirements. Preliminary remediation goals are intended to satisfy regulatory cleanup requirements. For groundwater at PORTS, preliminary remediation goals are the Ohio EPA drinking water standards (maximum contaminant levels).

Five areas of groundwater contamination, commonly called groundwater plumes, have been identified at PORTS. Groundwater contamination consists of VOCs (primarily TCE) and radionuclides such as technetium-99. The areas that contain groundwater plumes are X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, Quadrant I Groundwater Investigative (5-Unit) Area, Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Former Holding Pond, and X-740 Former Waste Oil Handling Facility. Other areas are monitored to evaluate 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 2020.

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2020

Monitoring Area or Program	Analytes	
X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility[a,b]	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U total metals: Be, Cd, Cr, Mn, Ni
PK Landfill[b]	VOCs	total metals: Be, Cd, Cr, Mn, Ni
Quadrant I Groundwater Investigative (5-Unit) Area[a,b]	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U total metals: Be, Cd, Cr, Mn, Ni

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2020 (continued)

Monitoring Area or Program	Analytes	
X-749A Classified Materials Disposal Facility	VOCs–2 technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U alkalinity chloride sulfate chemical oxygen demand total dissolved solids	total metals: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn nitrate/nitrite ammonia
Quadrant II Groundwater Investigative (7-Unit) Area[a,b]	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U total metals: Be, Cd, Cr, Mn, Ni
X-701B Former Holding Pond[a,b]	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U	alkalinity chloride sulfate total dissolved solids total metals: Be, Cd, Cr, Mn, Ni
X-633 Former Recirculating Cooling Water Complex	total metals: Cr	
X-616 Former Chromium Sludge Surface Impoundments	VOCs	total metals: Be, Cd, Cr, Mn, Ni
X-740 Former Waste Oil Handling Facility[a]	VOCs	
X-611A Former Lime Sludge Lagoons	total metals: Be, Cr	
X-735 Landfills	VOCs–2 technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U alkalinity chloride sulfate chemical oxygen demand total dissolved solids	total metals: Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Hg, Pb, Mg, Mn, Ni, K, Se, Ag, Na, Tl, V, Zn nitrate/nitrite ammonia
X-734 Landfills	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U alkalinity chloride	total metals: Be, Cd, Cr, Mn, Ni, Na ammonia chemical oxygen demand nitrate/nitrite sulfate total dissolved solids
X-533 Former Switchyard Complex	total metals: Cd, Ni	

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2020 (continued)

Monitoring Area or Program	Analytes	
X-344C Former Hydrogen Fluoride Storage Building	VOCs	
Surface Water	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U
Water Supply	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U alpha activity
Exit Pathway	VOCs transuranics: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U

[a]Selected well(s) in this area are sampled once every two years for a comprehensive list of more than 200 potential contaminants (40 CFR Part 264 Appendix IX – Appendix to Ohio Administrative Code Rule 3745-54-98).
[b]Not all wells in this area are analyzed for all listed analytes.

Notes:
VOCs: 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, TCE, trichlorofluoromethane (CFC-11), vinyl chloride, xylenes (m,p-xylenes).

VOCs–2: VOCs listed above 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.

Appendix C lists the symbols for metals and transuranic radionuclides.

6.4.1 X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility

In the southernmost portion of PORTS in Quadrant I, groundwater concerns focus on three contaminant sources: X-749 Contaminated Materials Disposal Facility (also called the X-749 Landfill), X-120 Former Training Facility, and PK Landfill. A contaminant plume consisting of VOCs, primarily TCE, is associated with the X-749 Contaminated Materials Disposal Facility and X-120 Former Training Facility. The PK Landfill, located immediately northeast of the X-749 Landfill, is not a contaminant source to the X-749/X-120 groundwater plume.

6.4.1.1 X-749 Contaminated Materials Disposal Facility

The X-749 Contaminated Materials Disposal Facility is a landfill located in the south-central section of the facility in Quadrant I. The landfill covers approximately 11.5 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 in 1992 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 extended 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 FBP NPDES Outfall 608, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

The leading edge of the contaminated groundwater plume originating from the X-749 Landfill is near 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, VOCs moved beyond the wall. In 2007, four groundwater extraction wells were installed in the X-749 South Barrier Wall Area, and in 2008, two extraction wells were installed in the groundwater collection system on the southwest side of the landfill. These extraction wells are controlling migration of the plume off plant property and reducing concentrations of TCE in groundwater. Two additional groundwater extraction wells were installed in 2010 to further control migration of the X-749/X-120 groundwater plume and remediate areas of higher TCE concentrations within the plume. A third extraction well was installed in the X-120 area of the plume (see Section 6.4.1.2). Chapter 3, Section 3.3.1.1, provides additional information about the remedial actions implemented to address the X-749/X-120 groundwater plume.

Eighty-four wells and one sump/extraction well were sampled during 2020 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells and sump in this area.

6.4.1.2 X-120 Former Training Facility

The X-120 Former Training Facility (originally called the Goodyear Training Facility and also called the X-120 Old Training Facility), which is west and north of the X-749 Contaminated Materials Disposal Facility, covered an area of approximately 11.5 acres west of the present-day XT-847 building. The X-120 Former Training Facility 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 VOCs, primarily TCE. In 1996, a horizontal well was installed along the approximate axis of the X-120 plume. Contaminated groundwater flowed from this well to the X-625 Groundwater Treatment Facility. In 2003, operation of the X-625 Groundwater Treatment Facility and horizontal well ceased with the approval of Ohio EPA due to the limited amount of groundwater collected by the well. A groundwater extraction well was installed in 2010 in the area west of the X-120 Former Training Facility to remediate the higher concentrations of TCE in groundwater in this area. Chapter 3, Section 3.3.1.1, provides additional information about the remedial actions implemented to address the X-749/X-120 groundwater plume.

Eighty-four wells and one sump/extraction well were sampled during 2020 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells and sump in this area.

6.4.1.3 Monitoring results for the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility in 2020

The most extensive and most concentrated constituents associated with the X-749/X-120 plume are VOCs, particularly TCE (see Figure 6.2). As shown in the adjacent summary, the number of wells with TCE over 5 µg/L has been stable over the last five years. The average and median concentrations of TCE in wells within the X-749/X-120 plume are decreasing, which indicates that the overall extent of the plume is relatively stable, but concentrations of TCE within the plume are decreasing.

X-749/X-120: TCE	2016	2020
Number of wells sampled	85	85
Number of wells over 5 µg/L	43	42
Average TCE (µg/L)	303	209
Median TCE (µg/L)	60	50

In the fourth quarter of 2020, TCE and *cis*-1,2-dichloroethene were detected in the sample collected from off-site well WP-01G at 0.827 and 1.17 µg/L, respectively. VOCs have occasionally been detected in well WP-01G, but not since 2008 (DOE 2009a). Well WP-01G is approximately 60 feet south of well X749-97G, and is slightly upgradient, although the change in groundwater elevation between the wells was less than 0.1 ft in 2019 (DOE 2020a) and 2020 (DOE 2021). Concentrations of VOCs detected in well X749-97G were higher than typical in 2019-2020. It appears that VOCs in the area of well X749-97G may be affecting well WP-01G. DOE will continue to monitor this area in 2021.

VOCs were not detected in off-site well WP-03G in 2020. In 2018 and 2019, TCE and other VOCs were detected in well WP-03G at concentrations less than 0.5 µg/L. Prior to 2018, VOCs had not been detected in well WP-03G since 2012 (DOE 2013a), although these VOCs were routinely detected in the well from its installation in 2004 to 2012 (DOE 2011a, DOE 2012, DOE 2013a). VOCs were not detected in 2020 in any of the other off-site monitoring wells.

Groundwater in the area north of the X-749 Landfill was investigated as part of the Deferred Units RCRA Facility Investigation. The results of this investigation have expanded the X-749/X-120 Gallia groundwater plume in the northern portion of the monitoring area. Four new permanent monitoring wells were installed in 2020 for this investigation. Figure 6.2 includes the results for TCE at these four new wells. The 2020 monitoring results for these new wells have changed the plume in the northern portion of the monitoring area that was previously based on 2015 monitoring data collected from temporary sampling points. Analytical data for this investigation are provided in the *Deferred Units Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Report* (DOE 2020c).

Concentrations of TCE changed in the X-749/X-120 groundwater plume in 2020 as described below:

- On the northern perimeter of the plume, TCE continued to increase in well X749-40G (18 µg/L). The concentration of TCE in well X749-40G has increased from 9 µg/L in 2019 and less than 0.5 µg/L in 2016-2017 (see Figure 6.2). TCE was also detected at 140 µg/L in well X749-30G, which defines the area of the TCE plume that is higher than 100 µg/L.

- The southeastern portion of the plume expanded in 2020 based on the fourth quarter detection of TCE in well X749-13G at 5.08 µg/L. Concentrations of TCE in well X749-13G have fluctuated just above and below 5 µg/L (the definition of the plume perimeter) in 2018-2020 (see Figure 6.2).

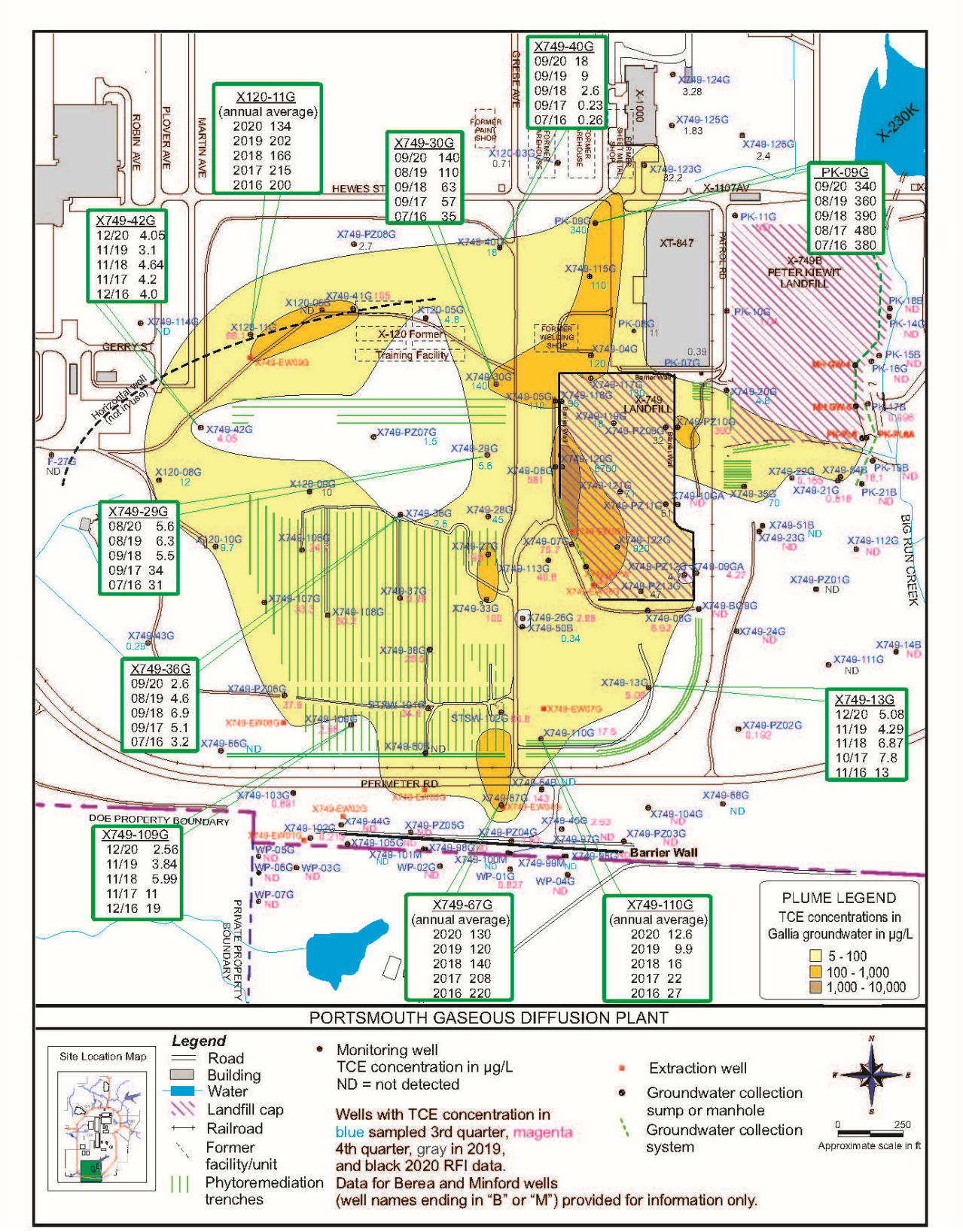

Figure 6.2. TCE-contaminated Gallia groundwater plume at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020.

Extraction well X749-EW09G was installed in 2010 to remediate higher concentrations of TCE associated with the former X-120 facility in the northern portion of the X-749/X-120 groundwater plume. Well X120-11G, which is immediately north of X749-EW09G, monitors the highest concentrations of TCE in this area. The average concentration of TCE detected in 2020 in well X120-11G (134 µg/L) is less than average concentrations in 2016-2019 (166-215 µg/L) (see Figure 6.2).

Extraction well X749-EW08G is intended to control migration of the southwestern portion of the X-749/X-120 groundwater plume. TCE was not detected in the downgradient well X749-66G in 2020.

Groundwater extraction well X749-EW07G was installed in 2010 to remediate areas of higher TCE concentrations south of the X-749 Landfill. Wells X749-67G and X749-110G monitor the performance of extraction well X749-EW07G. The average concentration of TCE detected in 2020 in well X749-67G (130 µg/L) is similar to the average concentration in 2019 (120 µg/L) and has decreased from the average annual concentrations detected in 2016-2018 (see Figure 6.2). The average concentration of TCE detected in 2020 in well X749-110G (12.6 µg/L) is similar to the average concentration in 2019 (9.9 µg/L) but has decreased from the average annual concentrations detected in 2016-2018 (see Figure 6.2). These results indicate that extraction well X749-EW07G is functioning as intended to reduce concentrations of TCE south of the X-749 Landfill.

6.4.2 PK Landfill

The PK Landfill is located west of Big Run Creek just south of the X-230K Holding Pond in Quadrant I and northeast of the X-749 Landfill. PK 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 originating 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 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. Although the PK Landfill is adjacent to the X-749 Landfill and X-749/X-120 groundwater plume, it is not a source of contaminants detected in the X-749/X-120 groundwater plume. A cap was constructed over the landfill in 1998. Chapter 3, Section 3.3.1.2, provides additional information about the remedial actions implemented at PK Landfill.

In 2020, nine wells and two sumps were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells, sumps, and manholes in this area.

6.4.2.1 Monitoring results for the PK Landfill in 2020

The PK Landfill is not part of the X-749/X-120 groundwater plume, although some of the wells associated with the PK Landfill are contaminated with low levels of VOCs, including TCE (see Figure 6.2). Most of the detections of VOCs in the PK Landfill monitoring wells are below preliminary remediation goals. In 2020, vinyl chloride was detected in samples collected from wells PK-17B and PK-21B at concentrations ranging from 10.5 to 24.2 µg/L, which exceed the preliminary remediation goal of 2 µg/L. Vinyl chloride is typically detected in these wells at concentrations above the preliminary remediation goal. No other VOCs were detected in the PK Landfill monitoring wells at concentrations that exceeded the preliminary remediation goals.

6.4.3. Quadrant I Groundwater Investigative (5-Unit) Area

The Quadrant I Groundwater Investigative (5-Unit) Area consists of a groundwater plume resulting from a number of potential sources of groundwater contamination in the northern portion of Quadrant I: the X-231A and X-231B Oil Biodegradation Plots, X-600 Former Steam Plant Complex, X-600A Former Coal Pile Yard, X-621 Coal Pile Runoff Treatment Facility, X-710 Technical Services Building, the X-760 Former Pilot Investigation Building, and the X-770 Former Mechanical Testing Facility. The X-231B Southwest Oil Biodegradation Plot was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*.

Three groundwater extraction wells were installed in 1991 as part of an IRM for the X-231B Southwest Oil Biodegradation Plot. Eleven additional groundwater extraction wells were installed in 2001-2002 as part of the remedial actions required by the Quadrant I Decision Document. These wells began operation in 2002. An additional extraction well south of the X-326 Process Building began operating in 2009. The extracted groundwater is treated at the X-622 Groundwater Treatment Facility and discharged through FBP NPDES Outfall 608, which flows into the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). Multimedia landfill caps were installed over the X-231B area and a similar area, X-231A, in 2000 to minimize water infiltration and control the spread of contamination. Chapter 3, Section 3.3.1.3, provides additional information about the remedial actions implemented in the Quadrant I Groundwater Investigative (5-Unit) Area.

Twenty-two wells were sampled in 2020 as part of the monitoring program for the Quadrant I Groundwater Investigative (5-Unit) Area. Two wells (X326-09G and X326-10G) were not sampled in 2020 because the wells were removed for pre-demolition activities at the X-326 Process Building. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.3.1 Monitoring results for the Quadrant I Groundwater Investigative (5-Unit) Area in 2020

A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant I Groundwater Investigative (5-Unit) Area (see Figure 6.3). Other VOCs are also present in the plume. As shown in the adjacent summary, the number of wells with TCE over 5 µg/L has been relatively stable over the last five years. The average and median concentrations of TCE are stable or have decreased, which indicates that the overall extent of the plume is stable. The overall extent of the plume is relatively stable, and concentrations of TCE are stable or decreasing in most wells that monitor the plume. Note that data for wells X326-09G and X326-10G in 2016 were not included in this evaluation because the wells were removed in 2020.

5-Unit: TCE	2016	2020
Number of wells sampled	24	22
Number of wells over 5 µg/L	14	13
Average TCE (µg/L)	263	274
Median TCE (µg/L)	220	110

Concentrations of TCE are changing in wells that monitor the northern portion of the plume near the former X-760 and X-770 Buildings and the X-710 Technical Services Building (see Figure 6.3). TCE in well X760-03G decreased to 60 µg/L. However, TCE continues to increase in well X231B-36G, which monitors the northern portion of the plume on the south side of the X-710 Technical Services Building. TCE was detected at 1100 µg/L in 2020, which has increased from 850 µg/L in 2019.

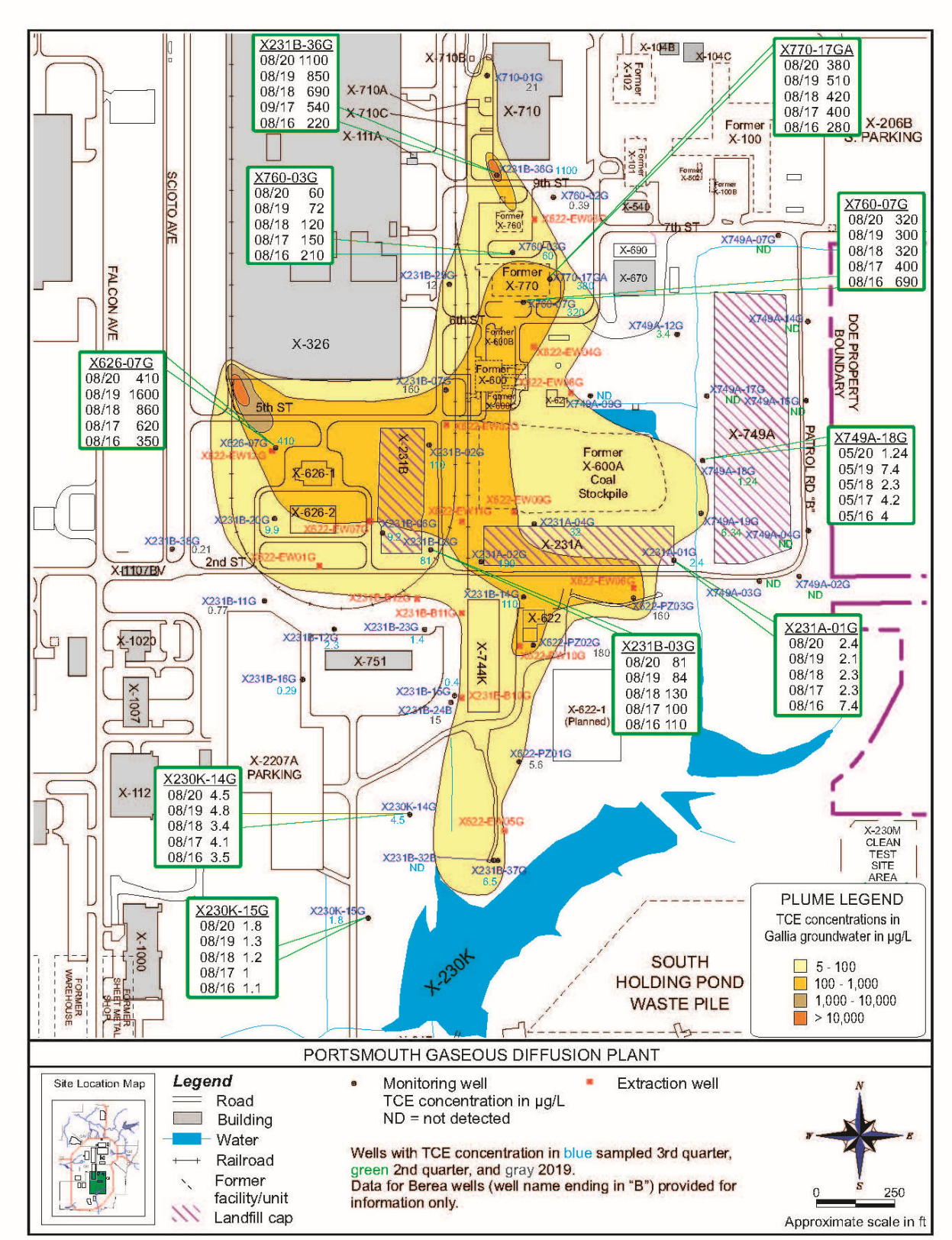

Figure 6.3. TCE-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative (5-Unit) Area – 2020.

6.4.4 X-749A Classified Materials Disposal Facility

The 6-acre X-749A Classified Materials Disposal Facility (also called the X-749A Landfill) is a landfill that operated from 1953 through 1988 for the disposal of wastes classified under the Atomic Energy Act (see Figure 6.3). 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 the X-230K South Holding Pond (FBP NPDES Outfall 002). Although the X-749A Classified Materials Disposal Facility is located at the eastern edge of the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume, the X-749A Landfill is not the source of the VOCs detected in some of the X-749A monitoring wells at the eastern edge of the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume.

Ten wells associated with the landfill were sampled in 2020. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.4.1 Monitoring results for the X-749A Classified Materials Disposal Facility in 2020

Under the detection monitoring program for the X-749A Landfill, concentrations of alkalinity, ammonia, calcium, chloride, iron, nitrate/nitrite, sodium, and sulfate in downgradient Gallia wells were evaluated using two statistical procedures to monitor potential impacts to groundwater and trends in concentrations of these parameters. Ohio EPA is notified when the statistical control limit for any of the indicator parameters using the first statistical procedure is exceeded at any of the downgradient Gallia wells in two consecutive semiannual sampling events. The second statistical procedure monitors long-term trends in concentrations of the indicator parameters and does not require Ohio EPA notification. None of the control limits requiring Ohio EPA notification were exceeded in the X-749A wells in 2020.

6.4.5 Quadrant II Groundwater Investigative (7-Unit) Area

The Quadrant II Groundwater Investigative (7-Unit) 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 TCE and other VOCs from metal-cleaning operations. The X-701C Neutralization Pit was located within a TCE plume centered around the X-700 and X-705 buildings. The pit was removed in 2001. In 2010, Ohio EPA approved an IRM to remediate contaminant source areas within the southeastern portion of the groundwater plume, which was completed in 2013. Chapter 3, Section 3.3.2.1 provides additional information about the Quadrant II Groundwater Investigative (7-Unit) Area.

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 FBP NPDES Outfall 611, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). Twenty-four wells are part of the routine monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.5.1 Monitoring results for the Quadrant II Groundwater Investigative (7-Unit) Area in 2020

A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant II Groundwater Investigative (7-Unit) Area (see Figure 6.4). As shown in the adjacent summary, the number of wells with TCE over 5 µg/L has been stable over the last five years. The average and median concentrations of TCE in wells within the 7-Unit plume are stable or have decreased, which indicates that the overall extent of the plume is stable, and concentrations of TCE within the plume are stable or decreasing slightly.

7-Unit: TCE	2016	2020
Number of wells sampled	14	14
Number of wells over 5 µg/L	12	12
Average TCE (µg/L)	120,000	120,000
Median TCE (µg/L)	1500	570

Groundwater in the western and northwestern portion of the monitoring area, beneath and adjacent to the X-333 and X-330 Process Buildings, was investigated in 2015 as part of the Deferred Units RCRA Facility Investigation. The results from the sampling locations that were part of this investigation have expanded the Gallia groundwater plume in the western and northwestern portion of the monitoring area.

6.4.6 X-701B Former Holding Pond

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

The X-701B Former Holding Pond was used from the beginning of plant operations in 1954 until 1988. The pond was designed for neutralization and settlement of acid waste from several sources. TCE and other VOCs 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 Former Holding Pond. The X-744Y Waste Storage Yard is south of the X-701B Former Holding Pond. The yard was approximately 15 acres and surrounded the X-744G Bulk Storage Building. RCRA hazardous waste was managed in this area.

A contaminated groundwater plume extends from the X-701B Former Holding Pond towards Little Beaver Creek. Three groundwater extraction wells were installed in 1993 southeast of the X-701B Former Holding Pond and a sump was installed in 1995 in the bottom of the pond as part of the RCRA closure of the unit. These wells and sump were designed to intercept contaminated groundwater originating from the holding pond area before it could join the existing groundwater contaminant plume. The extraction wells and sump were removed between 2009 and 2011 because of the X-701B IRM (see Chapter 3, Section 3.3.2.2).

Two groundwater interceptor trenches (French drains) are used to intercept TCE-contaminated groundwater in the eastern portion of the monitoring area. These interceptor trenches, called the X-237 Groundwater Collection System, control TCE 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 FBP NPDES Outfall 015, which flows to Little Beaver Creek.

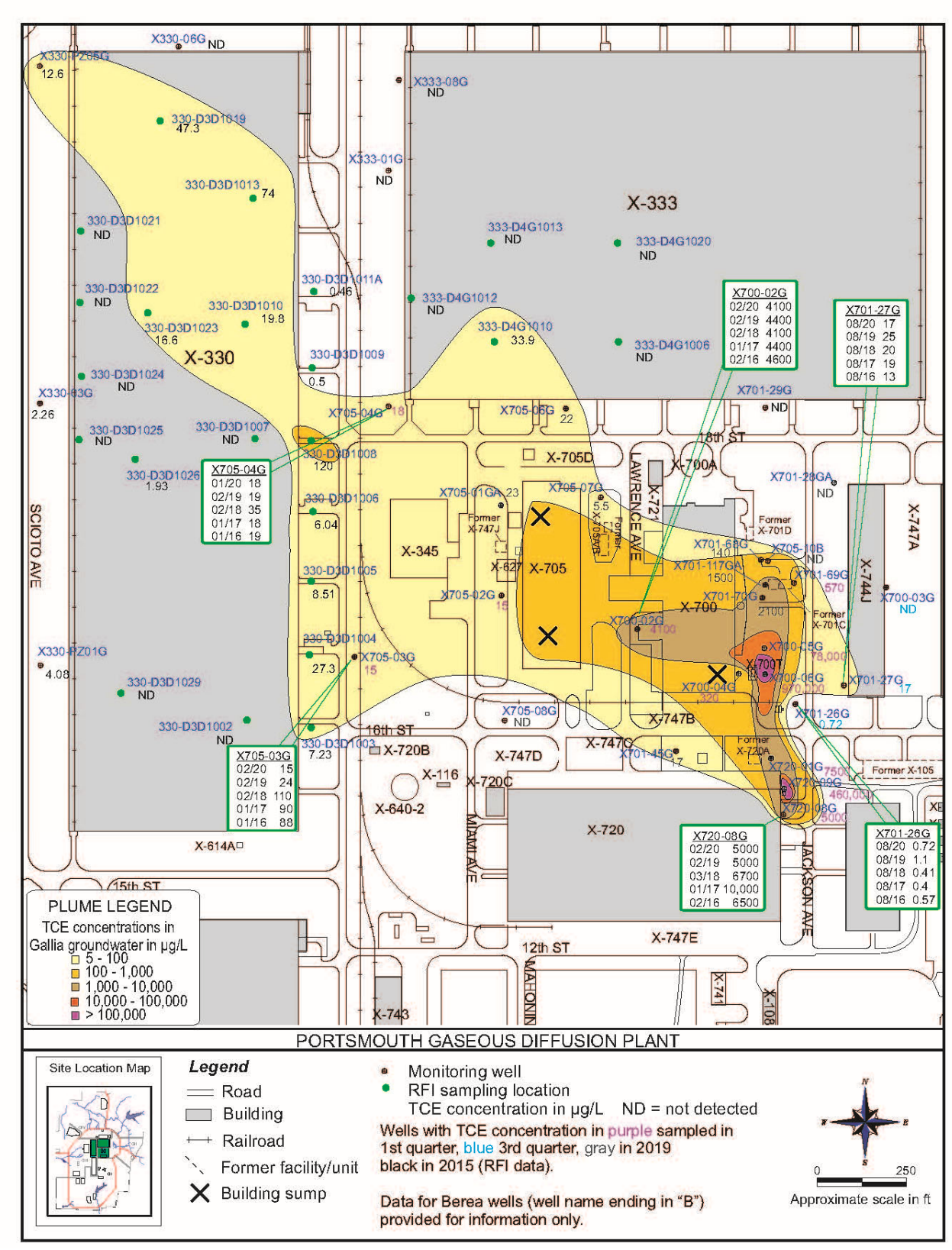

Figure 6.4. TCE-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative (7-Unit) Area – 2020.

Groundwater remediation in the X-701B Former Holding Pond Area was initiated in 2006 (see Chapter 3, Section 3.3.2.2). Oxidant was injected into the subsurface in the western portion of the area from 2006 through 2008 to remediate VOCs in soil and groundwater. The X-701B IRM was initiated in December 2009 and completed in 2011 to further address contaminants remaining in soil and groundwater following the oxidant injections. Contaminated soil in the X-701B IRM area was removed and mixed with oxidant, with additional oxidant mixed into soil remaining at the bottom of the excavation.

Sixty-two wells that monitor the X-701B Former Holding Pond area were sampled in 2020. Table 6.1 lists the analytical parameters for the wells that are part of the *Integrated Groundwater Monitoring Plan* (DOE 2017b).

6.4.6.1 Monitoring results for the X-701B Former Holding Pond in 2020

A contaminated groundwater plume consisting of TCE and other VOCs is located in the X-701B Former Holding Pond area (see Figure 6.5). As shown in the adjacent summary, the average and median concentrations of TCE in wells within the X-701B plume have decreased in the last five years. The number of wells with concentrations over 5 µg/L is the same; however, three wells on the north or south sides of the plume have increased to over 5 µg/L in the last five years and replaced one well removed from the program and two wells that have decreased to less than 5 µg/L.

X-701B: TCE	2016	2020
Number of wells sampled	62	62
Number of wells over 5 µg/L	44	44
Average TCE (µg/L)	31,500	15,800
Median TCE (µg/L)	5450	3700

TCE is increasing in three wells in the southern portion of the plume: X701-19G, X701-23G, and X701-79G (see Figure 6.5). TCE was detected at 5.62 µg/L in the sample collected from well X701-19G, which monitors the southern edge of the plume. This detection is the first above 5 µg/L. TCE was not detected in well X701-19G prior to the third quarter of 2018. TCE has increased in X701-23G from 2.1 µg/L in 2015 to 10.8 µg/L in 2020. TCE has increased in X701-79G from 93 µg/L in 2015 to 430 µg/L in 2020.

The concentration of TCE detected in well X701-42G on the north edge of plume increased to 3600 µg/L in 2019 and remained at 3600 µg/L in 2020. TCE was detected at 250 µg/L in 2018 and less than 10 µg/L in 2016-2017 (see Figure 6.5). TCE also increased in well X230J7-02GA, located immediately south of the X-230J7 Holding Pond. Typical detections in 2016-2019 were approximately 500 µg/L or less. In 2020, TCE was detected in well X230J7-02GA at 810 and 2940 µg/L (first and third quarter samples).

TCE has increased in well X701-21G from less than 50 µg/L in 2016 to concentrations ranging from 2000 to 25,000 µg/L in 2018-2020. In the third quarter of 2020, TCE was detected at 13,600 µg/L in well X701-21G. The increasing concentrations of TCE in some of the X-701B monitoring wells are being considered as part of the evaluation of the detections of VOCs in the East Drainage Ditch and Little Beaver Creek (see Section 6.4.15.1) and the X-237 Groundwater Collection System, which is continuing in 2021.

TCE is decreasing in many of the wells that monitor the western portion of the X-701B plume (the area west of Perimeter Road). Prior to 2019, TCE was detected at concentrations greater than 100,000 µg/L in three wells: X701-130G, X701-TC28G, and X701-TC61G. In 2019 and 2020, TCE decreased to less than 100,000 µg/L in each well, although concentrations have varied above and below 100,000 µg/L in the first and third quarter samples collected from wells X701-TC28G and X701-TC61G.

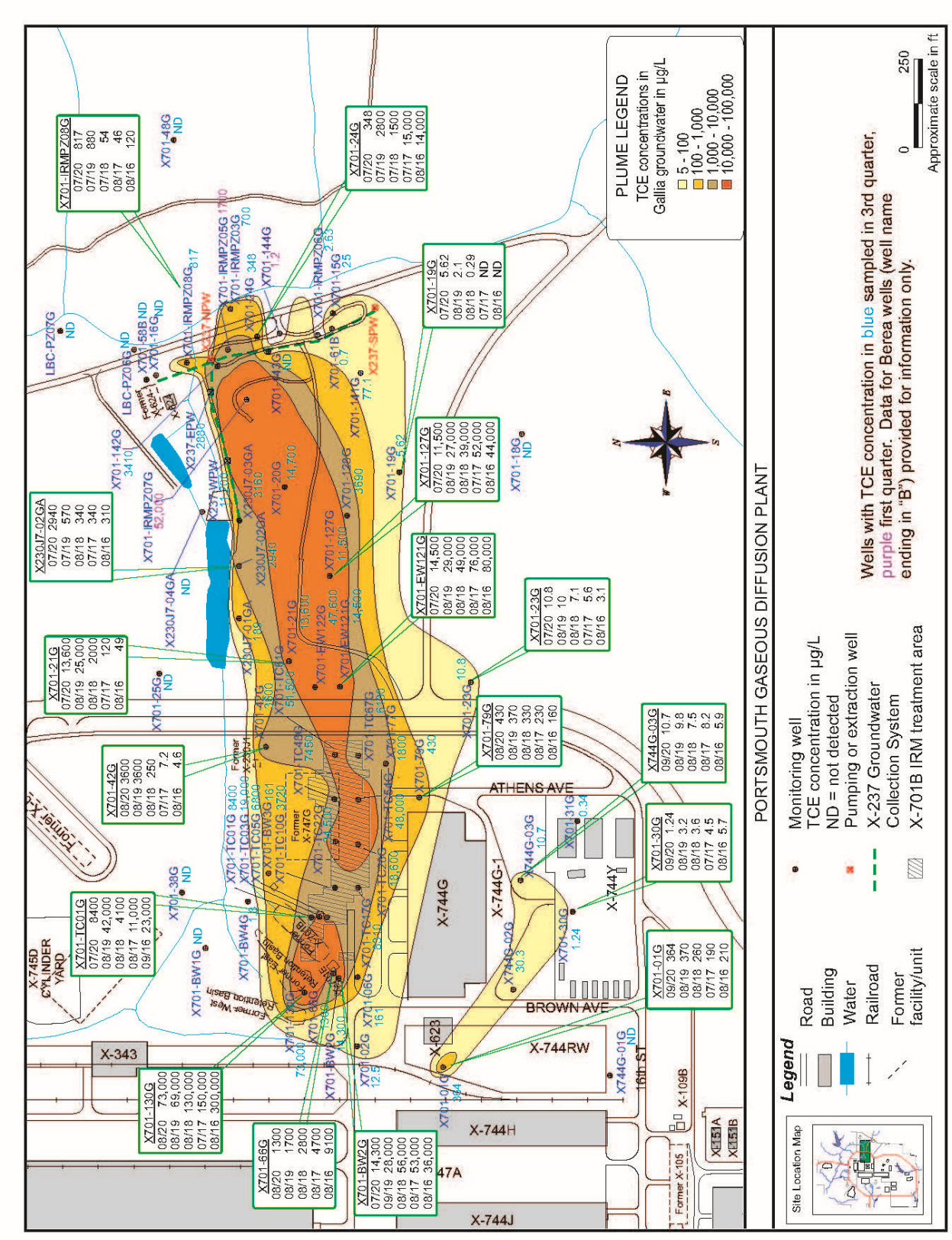

Figure 6.5. TCE-contaminated Gallia groundwater plume at the X-701B Former Holding Pond – 2020.

Samples from 49 wells that monitor the X-701B Holding Pond were analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and/or uranium-238). Plutonium-239/240 was detected at 0.095 pCi/L in the third quarter sample collected from well X701-TC28G. No other transuranics (americium-241, neptunium-237, or plutonium-238) were detected in the X-701B wells. Technetium-99 was not detected in any of the X-701B wells at levels that exceeded the Ohio EPA drinking water standard (900 pCi/L, based on a 4 mrem/year dose from beta emitters).

Uranium was detected above Ohio EPA drinking water standards (30 µg/L) in one well installed within the IRM area: X701-TC48G. Concentrations of radionuclides present in groundwater in the X-701B area can be affected by the oxidant used in the 2010 X-701B IRM and the oxidant injections conducted in 2006 through 2008 that were part of the X-701B groundwater remedy. The oxidant, which affects the oxidation/reduction potential and pH of the soil and/or groundwater, temporarily causes metals in soil to be mobilized into the groundwater. It is expected that the metals will move downgradient with groundwater flow for a short distance and then be re-adsorbed into the soil matrix as the geochemistry of the soil and groundwater returns to ambient conditions.

Samples from five wells that monitor the area near the X-744G Bulk Storage Building and X-744Y Storage Yard were analyzed for cadmium and nickel, which were detected above preliminary remediation goals in three of the five wells (X701-01G, X744G-01G, and X744G-02G). These results are typical for the X-744 area wells. Nickel was also detected at concentrations above the preliminary remediation goal in samples collected from wells X701-20G and X701-127G, which monitor the center of the plume downgradient from the IRM treatment area and the area in which oxidant was injected from 2006 through 2008. This area is likely affected by the oxidant used in the X-701B IRM and the oxidant injections conducted in 2006 through 2008.

6.4.7 X-633 Former Recirculating Cooling Water Complex

The X-633 Former Recirculating Cooling Water Complex in Quadrant II consisted 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. D&D of the facilities was completed in 2010. Chapter 3, Section 3.3.2.3 provides additional information about the RCRA investigation of soils and groundwater in this area.

The X-633 Former Recirculating Cooling Water Complex 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 in 1998 and 1999 to assess the area for metals contamination. Based on detections of chromium above the preliminary remediation goal, this area was added to the PORTS groundwater monitoring program. Two wells are sampled semiannually for chromium as part of the monitoring program for this area.

6.4.7.1 Monitoring results for the X-633 Former Recirculating Cooling Water Complex in 2020

Chromium was detected in both of the X-633 monitoring wells in 2020. The sample collected from well X633-07G contained chromium at a concentration above the preliminary remediation goal of 100 µg/L: 355 µg/L in the fourth quarter. Samples collected from well X633-PZ04G and the second quarter sample from well X633-07G also contained chromium but at concentrations below the preliminary remediation goal. Figure 6.6 shows the chromium concentrations detected in the X-633 Former Recirculating Cooling Water Complex wells.

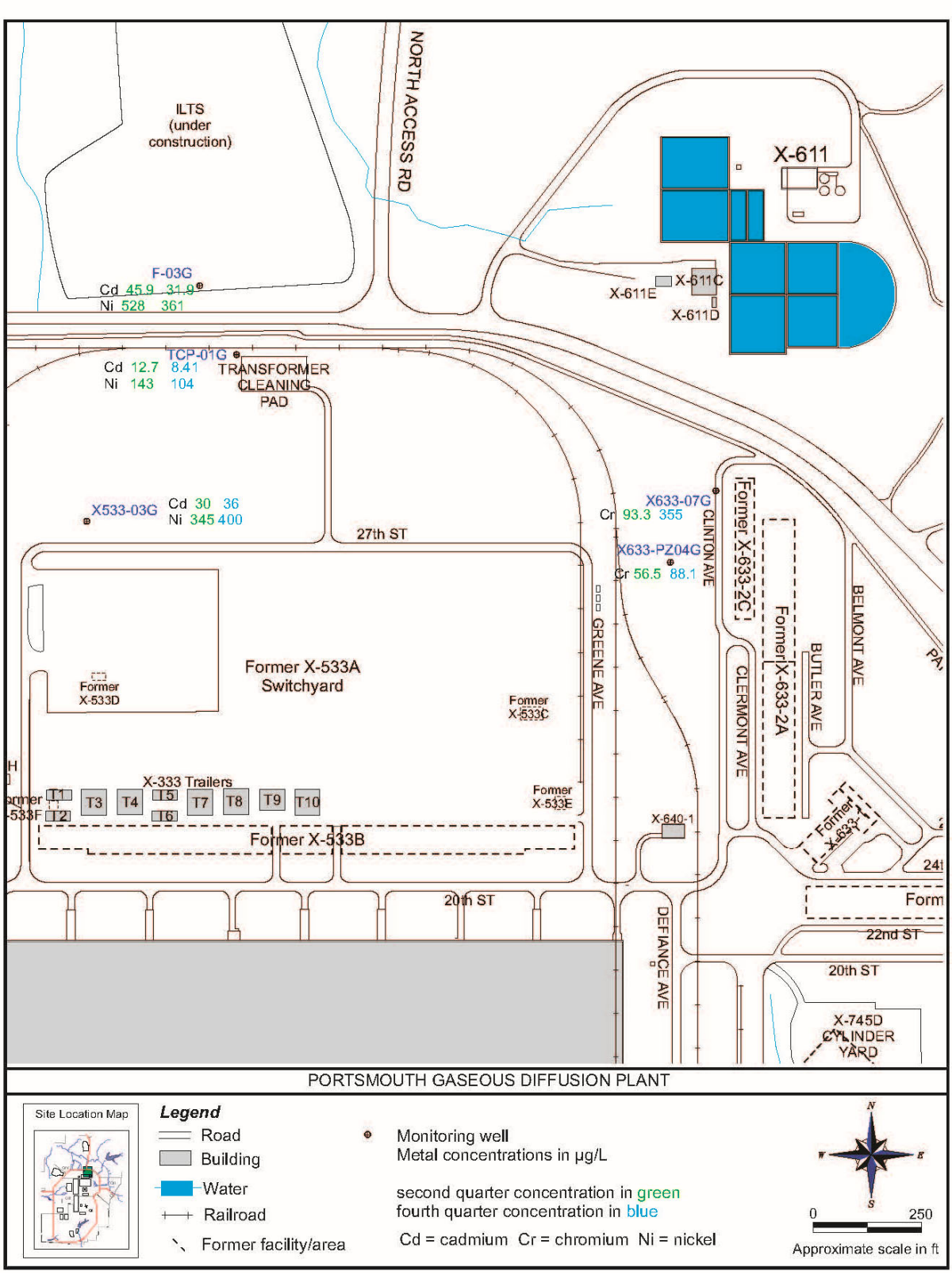

Figure 6.6. Metal concentrations in groundwater at the X-633 Former Recirculating Cooling Water Complex and X-533 Former Switchyard Complex – 2020.

6.4.8 X-616 Former Chromium Sludge Surface Impoundments

The X-616 Former Chromium Sludge Surface Impoundments in Quadrant III 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. Sixteen wells are sampled 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-616 Former Chromium Sludge Surface Impoundments in 2020

Chromium is of special concern at X-616 because of the previous use of the area. In 2020, chromium was detected above the preliminary remediation goal of 100 µg/L in one well that monitors the X-616 area: well X616-05G (on the northeastern boundary of the area). Chromium is typically detected above the preliminary remediation goal in this well. Nickel was detected above the preliminary remediation goal (100 µg/L for Gallia wells) in two wells (X616-05G and X616-25G). Nickel is typically detected above the preliminary remediation goal in these two wells. Figure 6.7 shows the concentrations of chromium and nickel in wells at the X-616 Former Chromium Sludge Surface Impoundments.

TCE was detected above the preliminary remediation goal of 5 µg/L in three wells west of the former surface impoundments: wells X616-09G, X616-13G, and X616-20B. TCE has been detected above 5 µg/L in wells X616-09G and X616-20B since 2004 or earlier. Concentrations of TCE increased to above 5 µg/L in well X616-13G in 2013. Figure 6.7 shows the concentrations of TCE detected in the X-616 wells in 2020.

6.4.9 X-740 Former Waste Oil Handling Facility

The X-740 Former Waste Oil Handling Facility, which was demolished in 2006, was located on the western half of PORTS south of the X-530A Switchyard in Quadrant III. 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. A sump within the building was used between 1986 and 1990 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 Former 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 phytoremediation area above the groundwater plume near the X-740 Former Waste Oil Handling Facility. Because phytoremediation did not work as anticipated to reduce the concentrations of VOCs in groundwater in this area, three rounds of oxidant injections were completed during 2008. Additional alternatives for groundwater remediation in this area were evaluated in 2009, and a pilot study of enhanced anaerobic bioremediation took place from 2010 through 2015. Chapter 3, Section 3.3.3, provides additional information about the remedial activities for the X-740 area.

Nineteen wells that monitor the X-740 Former Waste Oil Handling Facility were sampled during 2020. After the wells were sampled, all but three of the wells that are part of the monitoring program were removed to prepare for excavation of the groundwater plume in accordance with the NRD DFF&O (see Chapter 3, Section 3.3.3).

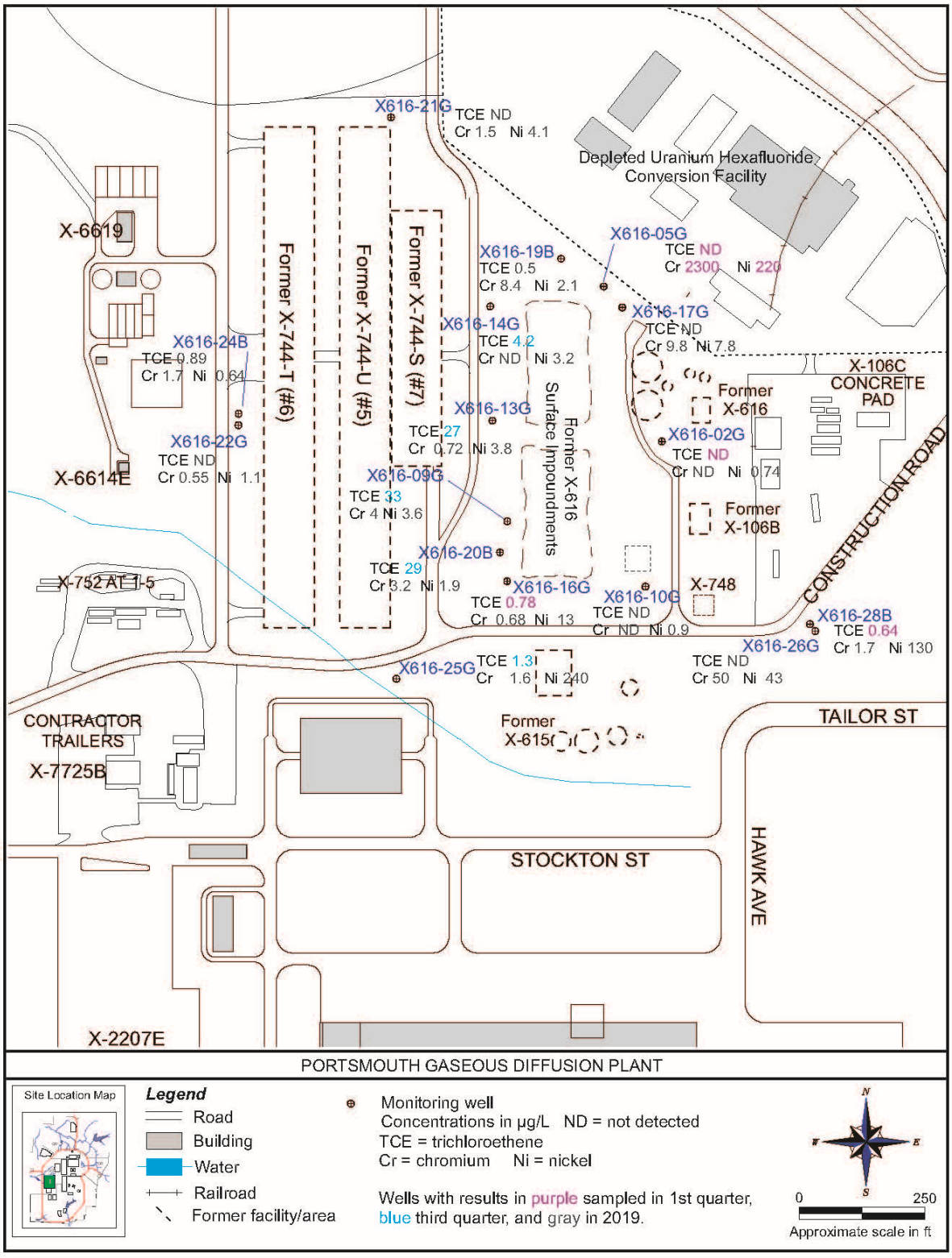

Figure 6.7. TCE and metal concentrations in groundwater at the X-616 Former Chromium Sludge Surface Impoundments – 2020.

6.4.9.1 Monitoring results for the X-740 Former Waste Oil Handling Facility in 2020

In general, concentrations of TCE continue to decrease in the TCE plume near the X-740 facility due to the bioremediation project that took place in this area (see Chapter 3, Section 3.3.3). As shown in the adjacent summary, the number of wells over 5 µg/L, average TCE within the plume, and median TCE have all decreased over the last five years.

X-740: TCE	2016	2020
Number of wells sampled	19	19
Number of wells over 5 µg/L	12	9
Average TCE (µg/L)	70	38.5
Median TCE (µg/L)	27	19.6

In 2020, concentrations of TCE continued to decrease in Gallia wells that monitor the X-740 groundwater plume with one exception. TCE returned to typical levels in well X740-PZ17G (12.5 µg/L) in 2020 after a detection of less than 1 µg/L in 2019. Figure 6.8 shows the Gallia groundwater plume and decreasing TCE concentrations in selected wells for the X-740 Former Waste Handling Facility.

6.4.10 X-611A Former Lime Sludge Lagoons

The X-611A Former Lime Sludge Lagoons in Quadrant IV were comprised of 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 covered a surface area of approximately 18 acres and were constructed in a low-lying area that included Little Beaver Creek. As a result, approximately 1500 feet of Little Beaver Creek were 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. Chapter 3, Section 3.3.4.1, provides more information about this remediation. 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.

6.4.10.1 Monitoring results for the X-611A Former Lime Sludge Lagoons in 2020

The six monitoring wells at X-611A are sampled and analyzed semiannually for beryllium and chromium. In 2020, chromium was detected in the samples collected from five of the six wells in this area at concentrations between 0.55 and 19 µg/L, which are below the preliminary remediation goal (100 µg/L).

In 2020, beryllium was detected in five of the six wells in this area at concentrations between 0.11 and 1.7 µg/L, which are less than the preliminary remediation goals (6.5 µg/L for Gallia wells and 7 µg/L for Berea wells). Figure 6.9 shows the concentrations of beryllium and chromium detected in the X-611A wells in 2020.

6.4.11 X-735 Landfills

Several distinct waste management units are contained within the X-735 Landfills area in Quadrant IV. The main units consist of the hazardous waste landfill, referred to as the X-735 RCRA Landfill, 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 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.

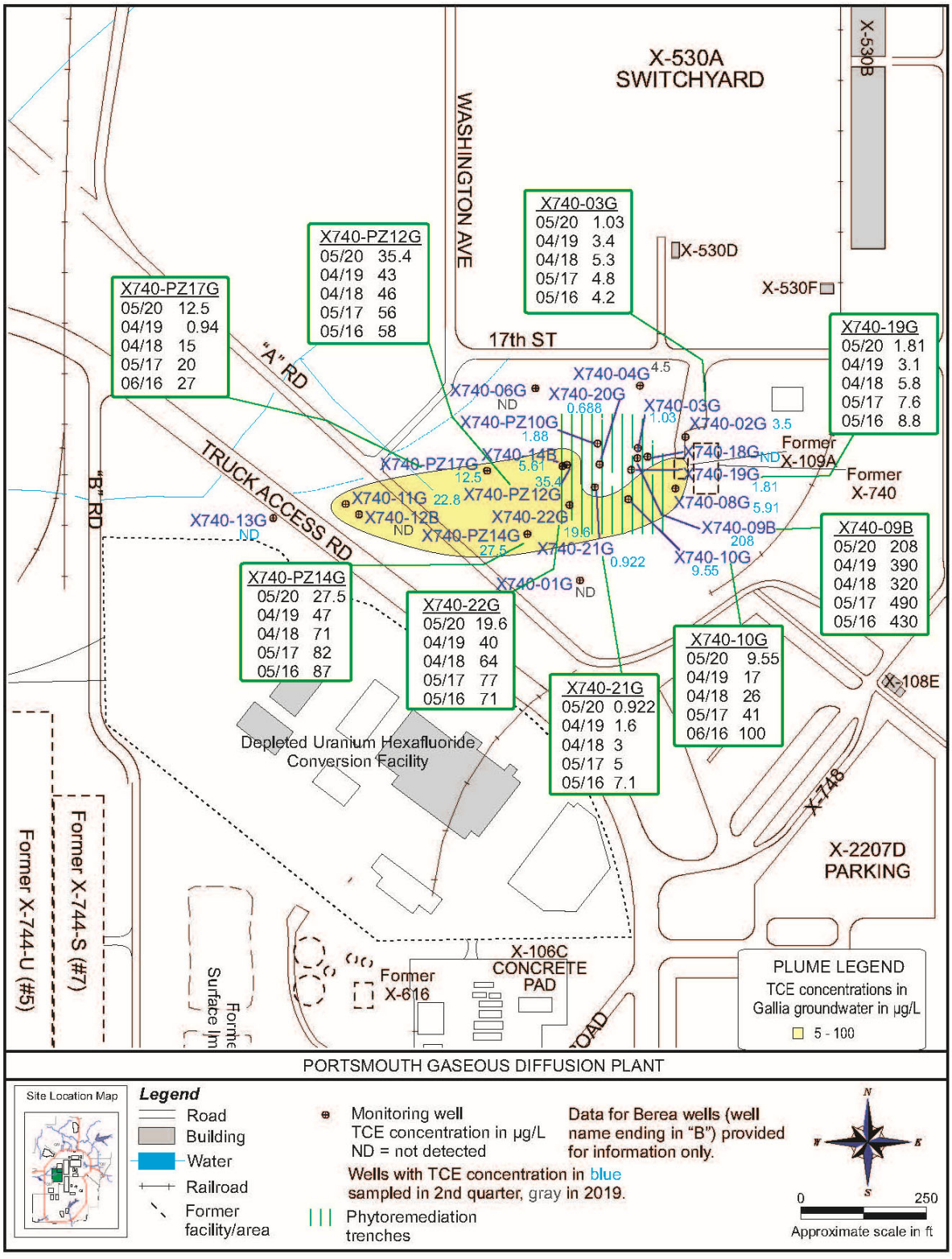

Figure 6.8. TCE-contaminated Gallia groundwater plume near the X-740 Former Waste Oil Handling Facility – 2020.

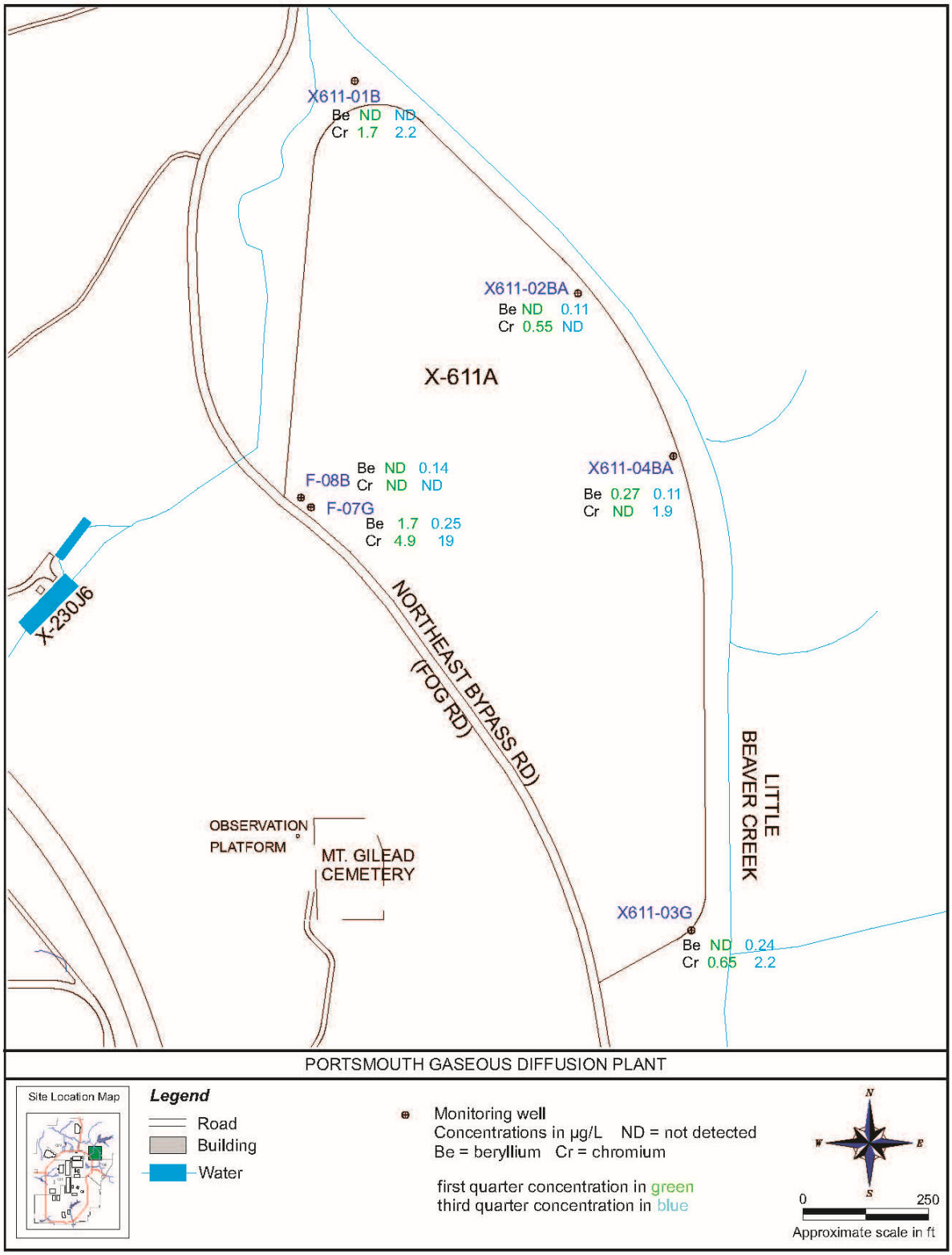

Figure 6.9. Metal concentrations in groundwater at the X-611A Former Lime Sludge Lagoons – 2020.

Initially, a total of 17.9 acres was approved by 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 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 RCRA Landfill.

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.

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 (DOE 2017b). In addition, the *Corrective Measures Plan for the X-735 Landfill* was approved by Ohio EPA in 2008 (DOE 2007a). This plan provides the monitoring requirements for Gallia wells that monitor the X-735 Landfill. Corrective measures monitoring was implemented because Ohio EPA determined that assessment monitoring of the landfill, completed between 2005 and 2007, identified that a small release of leachate constituents is occurring or has occurred from the X-735 Landfills. Twenty-one wells were sampled in 2020 as part of the monitoring programs for this area. Table 6.1 lists the analytical parameters and Figure 6.10 shows the monitoring wells in this area.

6.4.11.1 Monitoring results for the X-735 Landfills in 2020

The monitoring program at the X-735 Landfills includes corrective measures monitoring for Gallia wells and detection monitoring for Berea wells. As required by the corrective measures monitoring program, concentrations of three metals (cobalt, mercury, and nickel) and five indicator parameters (alkalinity, chloride, sodium, sulfate, and total dissolved solids) detected in downgradient Gallia wells are compared to concentration limits based on drinking water standards or site background concentrations. None of these concentration limits were exceeded in 2020.

The detection monitoring program for X-735 Berea wells continued in 2020. Concentrations of alkalinity, ammonia, calcium, chloride, iron, nitrate/nitrite, potassium, sodium, and sulfate in downgradient Berea wells were evaluated to monitor potential impacts to groundwater and trends in concentrations of these parameters. No control limits used to determine a statistically significant change in the indicator parameters requiring Ohio EPA notification were exceeded in the X-735 Berea wells in 2020.

Samples from four of the wells were also analyzed for technetium-99, uranium, and isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238). Technetium-99 was not detected in any of the wells. Uranium and uranium isotopes, if detected, were present at low levels typical for the wells in this area and below the drinking water standard (30 µg/L for uranium).

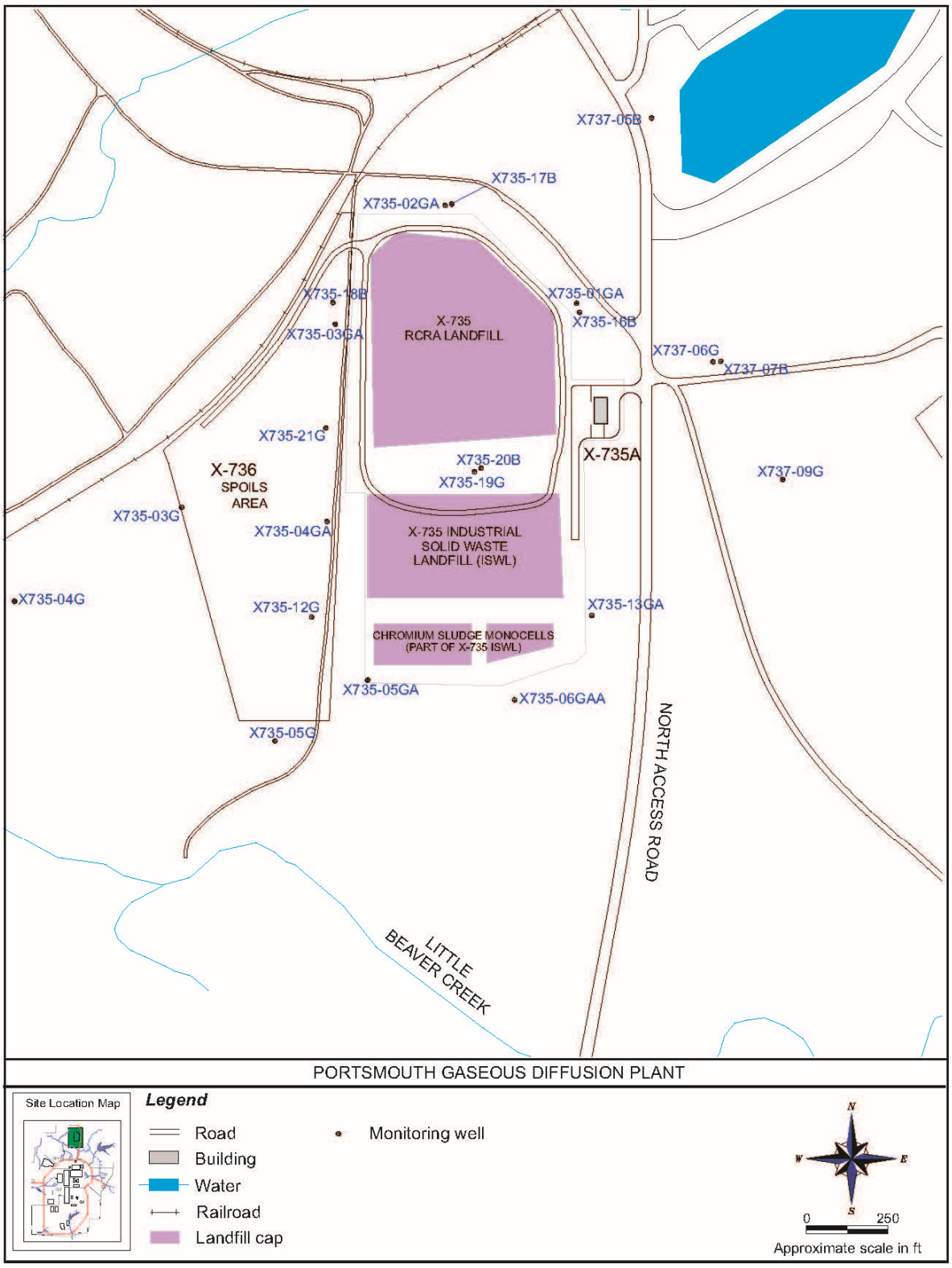

Figure 6.10. Monitoring wells at the X-735 Landfills.

6.4.12 X-734 Landfills

The X-734 Landfills in Quadrant IV 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 included 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 Landfills were closed in accordance with regulations in effect at that time, and no groundwater monitoring of the area was required. However, the RCRA Facility Investigation conducted in the early 1990s identified the presence of VOCs, metals, and radionuclides in soil and/or groundwater in the area. The X-734 Landfills were capped in 1999-2000 as part of the remedial actions required for Quadrant IV. Chapter 3, Section 3.3.4.2, provides more information about the remedial actions for this area.

Fifteen wells (see Figure 6.11) are sampled semiannually as part of the monitoring program for this area. Table 6.1 lists the monitoring parameters for the wells in this area.

6.4.12.1 Monitoring results for the X-734 Landfills in 2020

VOCs are routinely detected in a number of the wells that monitor the X-734 Landfills, but generally at concentrations below preliminary remediation goals. In 2019, no VOCs were detected at concentrations above the preliminary remediation goals in the samples collected from the X-734 monitoring wells.

Samples from nine of the X-734 monitoring wells were also analyzed for five metals (beryllium, cadmium, chromium, manganese, and nickel). None of the samples contained metals at concentrations above the respective preliminary remediation goal.

6.4.13 X-533 Former Switchyard Complex

The X-533 Former Switchyard Complex in Quadrant IV consisted 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. D&D of the facilities began in 2010 and was completed in 2011. Soil contaminated with PCBs or metals was removed from three areas within the complex in 2010; however, none of the soil removal areas were located near the groundwater area of concern (the north side of the area near the transformer cleaning pad).

The X-533 Former Switchyard Complex 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 in 1998 and 1999 to assess the area for metals contamination. The area was added to the PORTS groundwater monitoring program because the sampling identified metals that may have contaminated groundwater in this area. Three wells are sampled semiannually for cadmium and nickel.

6.4.13.1 Monitoring results for the X-533 Former Switchyard Complex in 2020

Three wells that monitor the X-533 Former Switchyard Complex (F-03G, TCP-01G, and X533-03G) were sampled in the second and fourth quarters of 2020 and analyzed for cadmium and nickel. Each of the wells contained these metals at concentrations above the preliminary remediation goals (6.5 µg/L for cadmium and 100 µg/L for nickel). Concentrations of cadmium detected in the wells ranged from 8.41 to 45.9 µg/L, and concentrations of nickel detected in the wells ranged from 104 to 528 µg/L. Figure 6.6 shows the concentrations of metals detected in the X-533 wells in 2020.

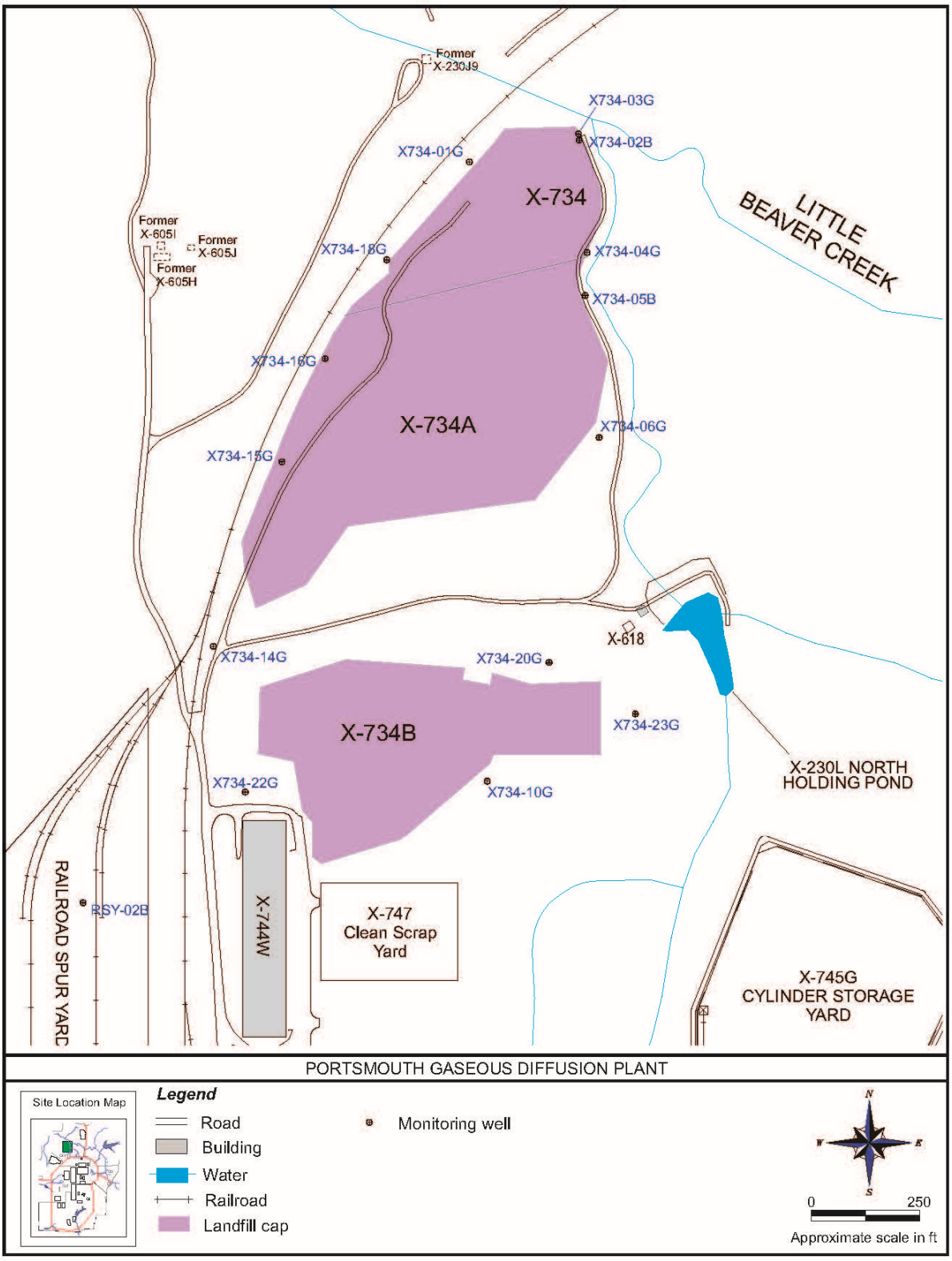

Figure 6.11. Monitoring wells at the X-734 Landfills.

6.4.14 X-344C Former Hydrogen Fluoride Storage Building

The X-344C Former Hydrogen Fluoride Storage Building and associated hydrogen fluoride storage tanks were demolished and removed in 2006. In 2009, an investigation of soils and groundwater near the former building determined that groundwater in one monitoring well south of the former building contained two VOCs (*cis*-1,2-dichloroethene and *trans*-1,2-dichloroethene) at concentrations below the preliminary remediation goals.

This area was added to the PORTS groundwater monitoring program in 2010. One well is sampled annually for VOCs under the monitoring program for this area (see Figure 6.12).

6.4.14.1 Monitoring results for the X-344C Former Hydrogen Fluoride Storage Building in 2020

Two VOCs, *cis*-1,2-dichloroethene and TCE, were detected in the sample collected in the first quarter of 2020 at low concentrations of 1.6 µg/L or less, which are below the preliminary remediation goals. These detections are consistent with the data collected at this well in 2015 through 2019.

6.4.15 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 14 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 groundwater discharges.

- Little Beaver Creek sample locations LBC-SW02 and LBC-SW03 assess potential contamination from the X-611A Former Lime Sludge Lagoons.

- Big Run Creek sample location BRC-SW01 assesses potential groundwater discharges from the Quadrant I Groundwater Investigative (5-Unit) Area.

- Big Run Creek sample location BRC-SW05 monitors potential discharges from the X-749/PK Landfill groundwater collection system on the east side of the landfills, as well as the Quadrant I Groundwater Investigative (5-Unit) Area.

- Big Run Creek sample location BRC-SW02 (downstream from BRC-SW01 and BRC-SW05) monitors potential discharges from the Quadrant I Groundwater Investigative (5-Unit) Area, X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, and PK Landfill.

- Southwestern Drainage Ditch sample locations UND-SW01 and UND-SW02 assess potential groundwater releases to this creek and the X-2230M Southwest 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 West Holding Pond.

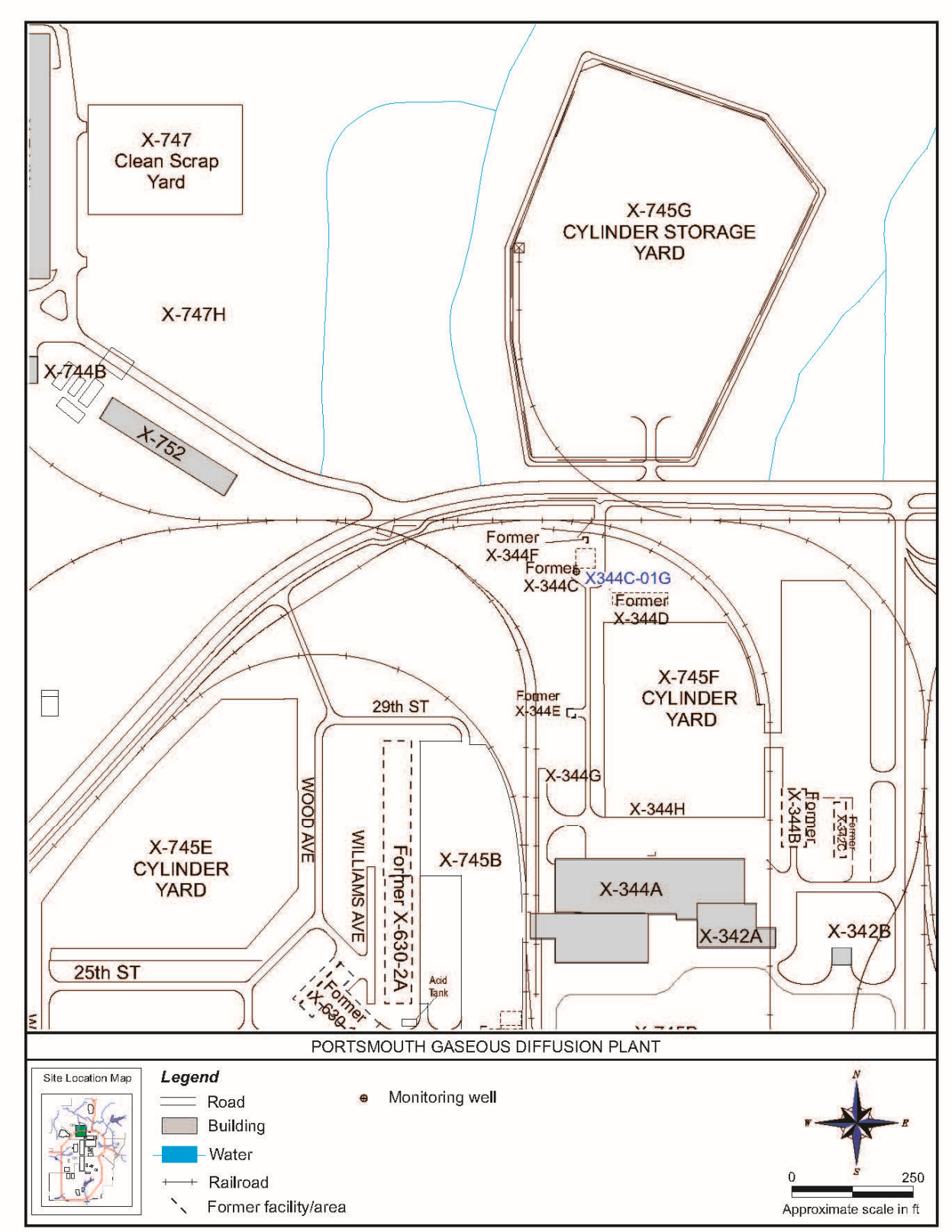

Figure 6.12. Monitoring well at the X-344C Former Hydrogen Fluoride Storage Building.

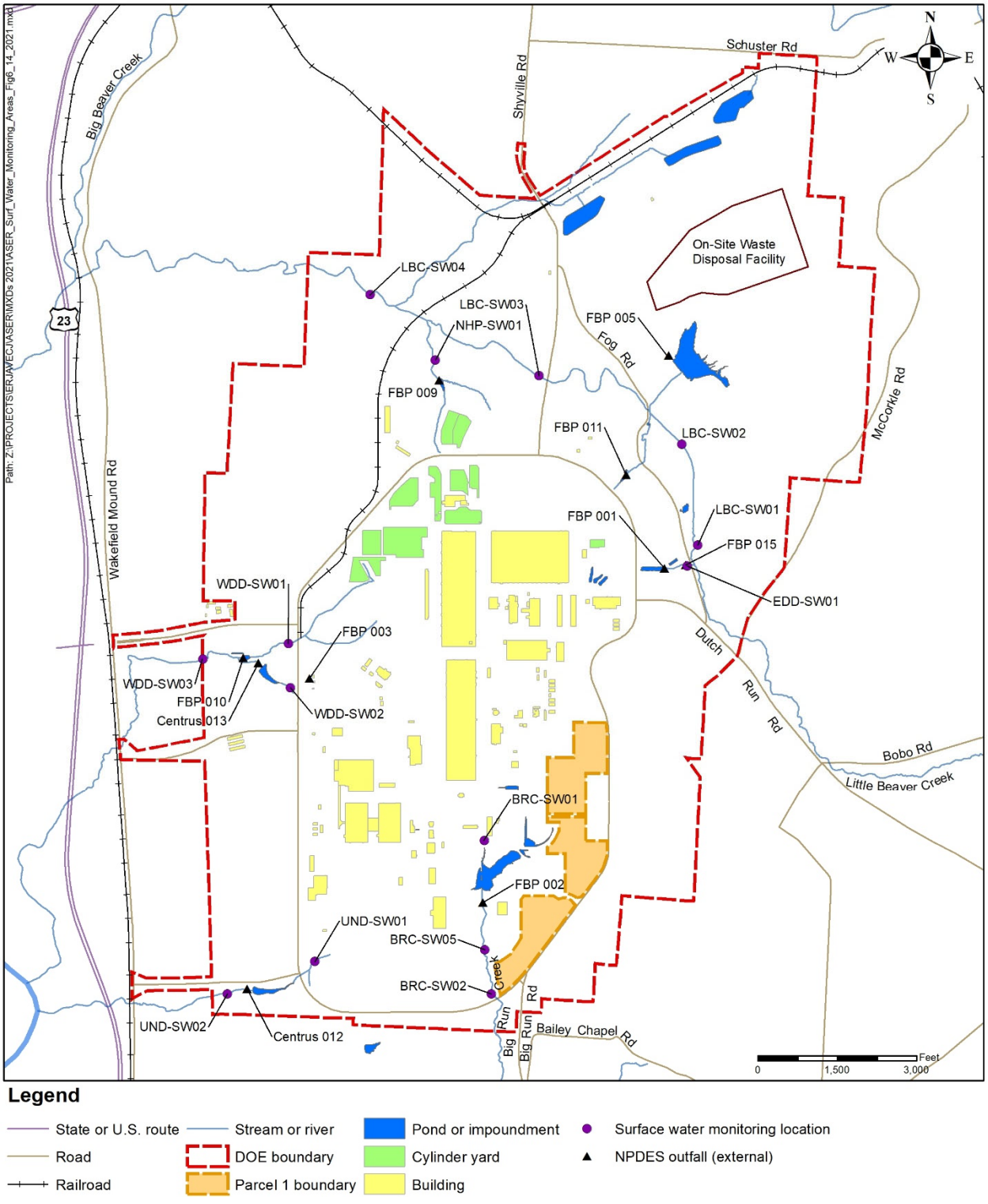

Figure 6.13. Surface water monitoring locations.

6.4.15.1 Monitoring results for surface water in 2020

Trihalomethanes are a category of VOCs 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 below the Ohio EPA non-drinking water quality criteria for the protection of human health in the Ohio River drainage basin (bromodichloromethane – 460 µg/L; bromoform – 3600 µg/L; chloroform – 4700 µg/L; and dibromochloromethane – 340 µg/L).

TCE and other VOCs are routinely detected in East Drainage Ditch and Little Beaver Creek. For the third year in a row (2018-2020), concentrations of TCE detected in East Drainage Ditch and Little Beaver Creek were elevated in the fourth quarter, with concentrations decreasing in first quarter samples (from the previous fourth quarter samples), and continuing to decrease to lower or undetected concentrations in the second and/or third quarters. In the fourth quarter of 2020, TCE was detected in the sample collected from EDD-SW01 at 167 µg/L. Concentrations of TCE detected in the fourth quarter samples from Little Beaver Creek ranged from 10.7 µg/L to below detection limits. The detections of TCE were below the Ohio EPA non-drinking water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin. An evaluation of the detections of VOCs in the East Drainage Ditch and Little Beaver Creek, the X-701B Holding Pond area, and the X-237 Groundwater Collection System is continuing in 2021 in conjunction with Ohio EPA.

Since the 1990s, TCE has been detected regularly at low levels in samples collected from the Southwestern Drainage Ditch (UND-SW01, located inside Perimeter Road). The concentrations of VOCs detected at this monitoring location were typical for this location. VOCs were not detected in the first, second, and third quarter samples collected from the downgradient sampling location on the Southwestern Drainage Ditch (UND-SW02), with the exception of TCE, which was detected in the duplicate sample collected in the first quarter at 0.28 µg/L. TCE, c*is*-1,2-dichloroethene, and 1,1-dichloroethene were detected in the fourth quarter sample collected from UND-SW02 at concentrations ranging from 0.417 to 3.41 µg/L, which were similar to results for UND-SW01. The detections of TCE were below the Ohio EPA non-drinking water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin.

Samples collected in the second and fourth quarters of 2020 were analyzed for selected transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). No transuranics were detected in the surface water samples collected during 2020.

Technetium-99 was detected at levels up to 41.5 pCi/L in samples collected from the East Drainage Ditch (EDD-SW01) and Little Beaver Creek (LBC-SW01, LBC-SW02, and LBC-SW04). These detections are within the historical range of technetium-99 detected in surface water at PORTS, and are less than 0.1% of the DOE derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011b).

The concentrations of uranium detected in the surface water samples were 1.3% or less of the DOE derived concentration standards for uranium isotopes (680 pCi/L for uranium-233/234, 720 pCi/L for uranium-235, and 750 pCi/L for uranium-238) (DOE 2011b). The detections of uranium and uranium isotopes in surface water during 2020 were within the historical range of uranium detected in surface water at PORTS.

6.4.16 Water Supply Monitoring

Routine monitoring of private 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 *Integrated Groundwater Monitoring Plan* (DOE 2017b).

The purpose of the program is to determine whether PORTS has had any impact on the quality of the private residential drinking water sources. 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).

Four residential drinking water sources participated in the program in 2020. The PORTS water supply is also sampled as part of this program. Figure 6.14 shows the drinking water sources that were part of the monitoring program in 2020. 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. Wells are sampled semiannually with samples analyzed for the parameters listed in Table 6.1. The *2020 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides data for the water supply monitoring program (DOE 2021).

In the third quarter of 2020, TCE was detected at an estimated concentrations of 0.29 and 0.3 µg/L in the regular and duplicate samples collected from RES-017, which is south of PORTS on Big Run Road. No other VOCs were detected in the samples at this location. Since this residential water supply was added to the monitoring program in 2009, TCE has routinely been detected in the water supply samples at concentrations up to 1 µg/L. These detections are less than the drinking water standard for TCE (5 µg/L). Big Run Creek is located between RES-017 and the affected water-bearing formation (i.e., Gallia groundwater) located in the southern portion of the plant site west of Big Run Creek. The Gallia groundwater drains into Big Run Creek.

Chlorination byproducts called trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in treated drinking water, were detected in the first and third quarter samples collected from residential sampling location RES-015. Trihalomethanes are not typically detected in groundwater samples. The total concentration of these trihalomethanes was less than the Ohio EPA drinking water standard (80 µg/L for total trihalomethanes) in the first quarter sample. In the third quarter, the total concentration of these trihalomethanes (143 µg/L) was above the Ohio EPA drinking water standard (80 µg/L for total trihalomethanes). Additional samples from RES-015 were collected in January 2021 and analyzed for trihalomethanes. Total trihalomethanes in regular and duplicate samples were 35 and 36 µg/L, respectively, which is below the Ohio EPA drinking water standard (80 µg/L for total trihalomethanes).

Each sample was analyzed for transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). No transuranics or technetium-99 were detected in any of the water supply samples collected in 2020. Low levels of uranium and uranium isotopes detected in some of the wells are consistent with naturally-occurring concentrations found in groundwater in the area.

6.5 DOE ORDER MONITORING PROGRAMS

One of the DOE surveillance monitoring programs at PORTS is exit pathway monitoring. Exit pathway monitoring assesses the effect of the facility on off-site surface water and groundwater quality.

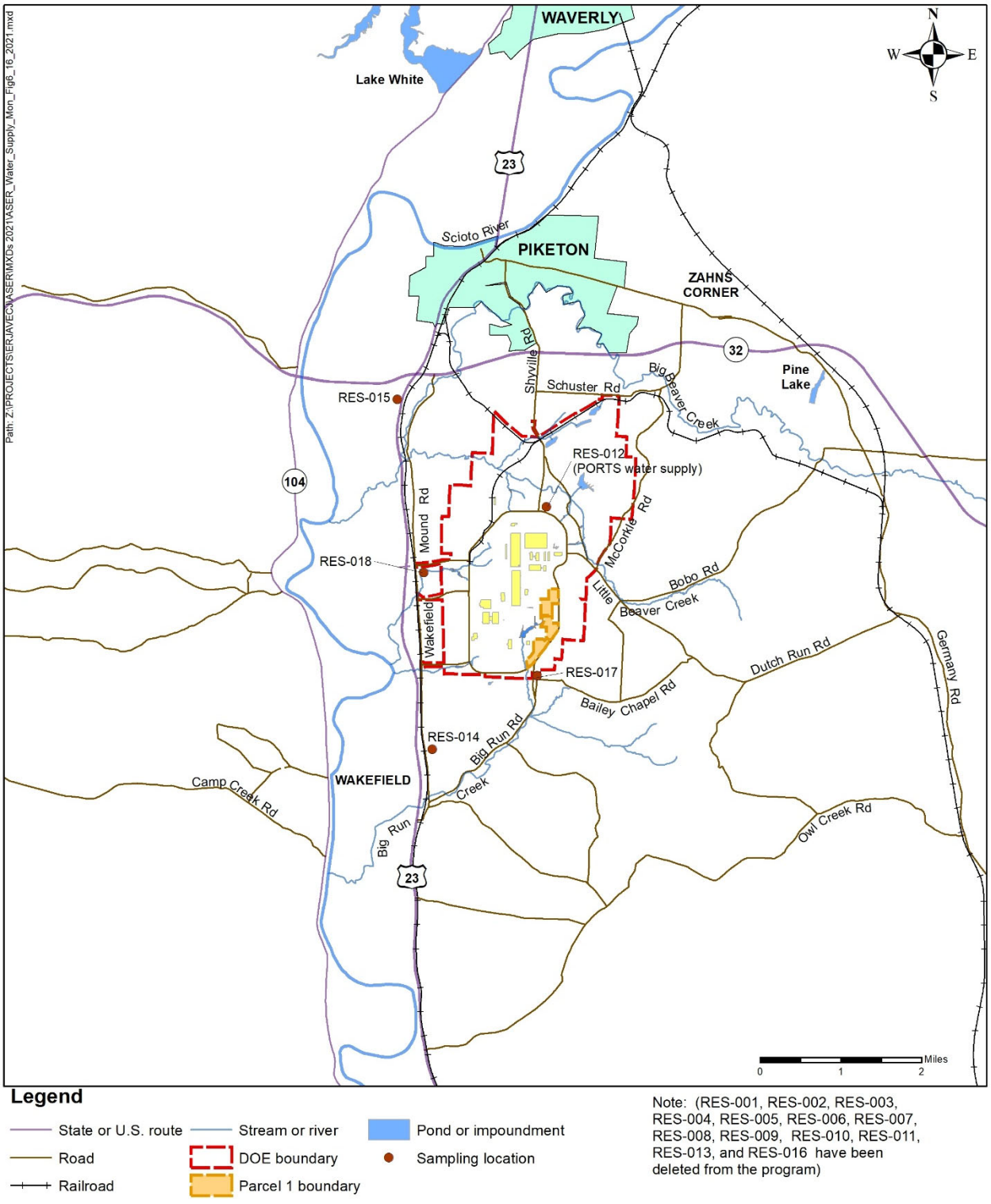

Figure 6.14. Water supply monitoring locations.

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 surface water from PORTS NPDES outfalls and groundwater discharge 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 (see Figure 6.15). Chloroform, which is a common residual in chlorinated drinking water, was detected in a sample collected from West Drainage Ditch at concentrations below Ohio EPA non-drinking water quality criteria for trihalomethanes for the protection of human health in the Ohio River drainage basin (see Section 6.4.15.1). TCE was detected in the samples collected from Little Beaver Creek (LBC-SW04) and Southwestern Drainage Ditch (UND-SW02) at concentrations up to 3.41 µg/L. These detections were also below the Ohio EPA non-drinking water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin.

No transuranics (americium-241, neptunium-237, plutonium-238, plutonium-239/240) were detected in samples collected at the surface water exit pathway monitoring locations. Technetium-99 was detected at 5.62 pCi/L in a sample collected from Little Beaver Creek (LBC-SW04). This detection is within the historical range of technetium-99 detected in surface water at PORTS and is 0.013% of the derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011b). The derived concentration standard is the concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (ingestion of water or inhalation of air) would result in a dose of 100 mrem. A concentration of 100% of the derived concentration standard would equate to a dose at the DOE limit of 100 mrem/year (DOE 2011b).

VOCs were also detected in on-site groundwater monitoring wells that are part of the exit pathway monitoring program. TCE and other VOCs were detected in two wells that monitor the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility (see Section 6.4.1.3). TCE was detected in on-site well X749-45G at concentrations ranging from 2.93 to 14 µg/L, with results above the Ohio EPA drinking water standard (5 µg/L) in the first, second, and third quarter samples collected from the well. All other detections of TCE and other VOCs in the exit pathway monitoring wells were below Ohio EPA drinking water standards.

Well X701-48G was the only exit pathway groundwater monitoring well sampled for radionuclides in 2020 (most exit pathway monitoring wells are sampled for radionuclides every two years in odd-numbered years). Technetium-99 was detected at 12.6 pCi/L. This detection is 0.029% of the derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011b). No other radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and uranium-238) were detected in well X701-48G in 2020.

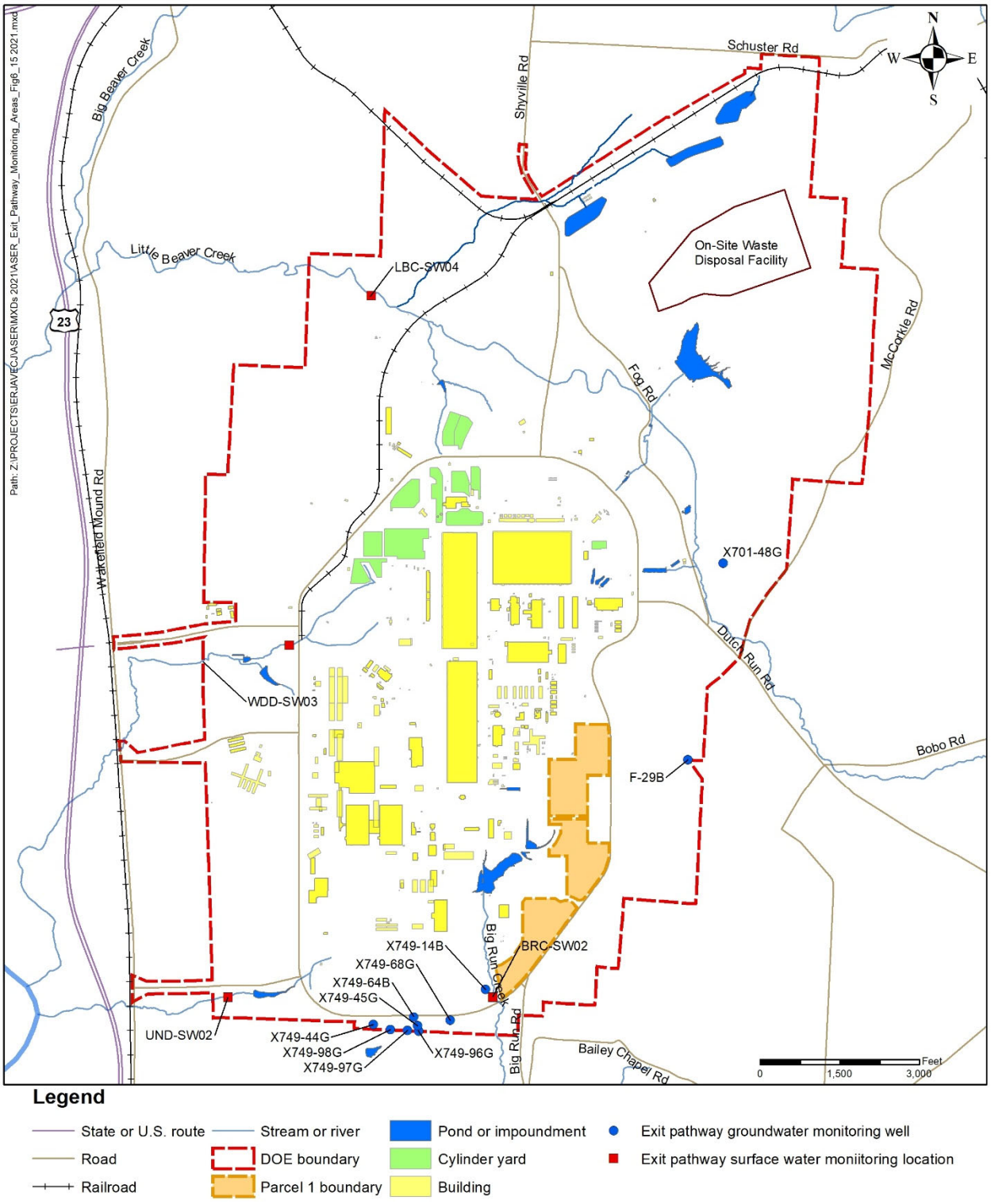

Figure 6.15. Exit pathway monitoring locations.

6.6 GROUNDWATER TREATMENT FACILITIES

In 2020, a combined total of approximately 33.6 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 10 gallons of TCE 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 TCE removed by PORTS groundwater treatment facilities in 2020[a]

Facility	Gallons of water treated	Gallons of TCE removed
X-622	21,811,900	2.45
X-623	5700	< 0.0001
X-624	402,380	0.40
X-627	11,377,050	7.18

[a]Source: *2020 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2021)

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 (see Figures 6.2 and 6.3):

- groundwater collection system with associated sump (X749-WPW) and extraction wells X749-EW05G and X749-EW06G on the southwest boundary of the X-749 Landfill;
- groundwater extraction wells X749-EW01G, X749-EW02G, X749-EW03G, and X749-EW04G installed in 2007 in the X-749 South Barrier Wall area;
- groundwater extraction wells (X749-EW07G, X749-EW08G, and X749-EW09G) installed in 2010 in the X-749/X-120 groundwater plume;
- groundwater collection system and associated sumps (PK-PL6 and PK-PL6A) on the eastern boundary of the PK Landfill; and
- fifteen extraction wells located in the Quadrant I Groundwater Investigative (5-Unit) Area.

The facility processed approximately 21.8 million gallons of groundwater during 2020, thereby removing approximately 2.45 gallons of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 608, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 608 in 2020.

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. Prior to implementation of the X-701B IRM in 2009, the X-623 Groundwater Treatment Facility treated TCE-contaminated groundwater from a sump in the bottom of the X-701B Former Holding Pond and three groundwater extraction wells (X623-EW01G, X623-EW02G, and X623-EW03G) east of the holding pond. The sump and extraction wells were removed in 2009-2011 to facilitate implementation of the IRM.

During 2020, the X-623 Groundwater Treatment Facility operated only during August, September, and November to treat miscellaneous water associated with site activities in accordance with the NPDES permit.

The facility treated 5,700 gallons of water during 2020, thereby removing less than 0.0001 gallon of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 610, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 610 in 2020.

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 TCE-contaminated groundwater from the X-237 Groundwater Collection System on the east side of the X-701B groundwater plume. The X-237 Groundwater Collection System consists of north-south and east-west collection trenches and two sumps/pumping wells (see Figure 6.5).

The X-624 Groundwater Treatment Facility treated approximately 402,380 gallons of water in 2020, thereby removing approximately 0.40 gallon of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 015, which discharges to Little Beaver Creek. No NPDES permit limitations were exceeded at Outfall 015 in 2020.

6.6.4 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 (7-Unit) Area plume, and contaminated water is collected in the sumps located in the basement of each building (see Figure 6.4).

Approximately 11.4 million gallons of groundwater were processed during 2020, thereby removing approximately 7.18 gallons of TCE from the water. Treated water from the facility discharges through FBP NPDES Outfall 611, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). No NPDES permit limitations were exceeded at Outfall 611 in 2020.

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7. QUALITY ASSURANCE

7.1 SUMMARY

Quality assurance and quality control are essential components of DOE environmental monitoring programs at PORTS. Quality is integrated into sample preservation, field data and sample collection, sample transportation, sample analysis, data management, and recordkeeping. Numerous program assessment activities in the field and within the facilities are conducted at regular intervals to demonstrate that quality is built into and maintained in all DOE programs. Analytical laboratories used by DOE contractors during 2020 participated in the DOE Consolidated Audit Program and Mixed-Analyte Performance Evaluation Program.

FBP implements and conducts its QA Program in compliance with the following standards or regulations:

- DOE Order 414.1D, *Quality Assurance*;
- American Society of Mechanical Engineers Nuclear Quality Assurance Standards NQA-1-2008 with the NQA-1a-2009 Addenda, *QA Requirements for Nuclear Facility Applications*;
- Title 10 CFR Part 830, Nuclear Safety Management.

7.2 QUALITY ASSURANCE INTRODUCTION

Quality assurance, an integral part of environmental monitoring, requires systematic control of the processes involved in sampling the environment and in analyzing the samples. To demonstrate accurate results, DOE uses the following planned and systematic controls:

- implementation of standard operating procedures for sample collection and analysis;
- training and qualification of surveyors and analysts;
- implementation of sample tracking and chain-of-custody procedures to demonstrate traceability and integrity of samples and data;
- participation in external quality control programs;
- frequent calibration and routine maintenance of measuring and test equipment;
- maintenance of internal quality control programs;
- implementation of good measurement techniques and good laboratory practices; and
- frequent assessments of field sampling, measurement activities, and laboratory processes.

Environmental sampling is conducted by DOE contractors at PORTS in accordance with state and federal regulations and DOE Orders. Sampling plans and procedures are prepared, and appropriate sampling instruments or devices are selected in accordance with practices recommended by U.S. EPA, the American Society for Testing and Materials, or other authorities. Chain-of-custody forms document sample custody from sample collection through receipt by the analytical laboratory. The samples remain in the custody of the sampling group until the samples are received at the laboratory. Samples shipped to an off-site laboratory are sealed within the shipping container to prevent tampering until they are received by the sample custodian at the off-site laboratory.

The analytical data are reviewed to determine compliance with applicable regulations and permits. The data are used to identify locations and concentrations of contaminants of concern, to evaluate the rate and extent of contamination at the site, and to help determine the need for remedial action. Adequate and complete documentation generated as a result of these efforts supports the quality standards established by DOE. Quality Assurance Project Plans were used by FBP and MCS during 2020 to ensure a consistent system for collecting, assessing, and documenting environmental data of known and documented quality.

7.3 SAMPLE COLLECTION AND HANDLING

The FBP Quality Assurance Project Plan consists of the *Sample Analysis Data Quality Assurance Project Plan* (DOE 2014b), project-specific sampling and analysis plans (SAPs), and their associated data quality objectives (DQOs). While the DQOs and SAPs are specific to discrete projects, the *Sample Analysis Data Quality Assurance Project Plan* (DOE 2014b) provides an overarching framework to ensure that standardized and consistent processes are utilized to obtain samples, perform data collection, and perform laboratory services.

Personnel involved in sampling and monitoring are properly trained through a combination of classroom, on-line, and/or on-the-job training as required by environmental, health, and safety regulations and DOE contract requirements. Procedures are developed from guidelines and regulations created by DOE or other regulatory agencies that have authority over PORTS activities.

Data generated from sampling can be greatly influenced by the methods used to collect and transport the samples. A quality assurance program provides the procedures for proper sample collection so that the samples represent the conditions that exist in the environment at the time of sampling. The DOE quality assurance program at PORTS mandates compliance with written sampling procedures, use of clean sampling devices and containers, use of approved sample preservation techniques, and collection of field quality control samples. Chain-of-custody procedures are strictly followed to maintain sample integrity. In order to maintain sample integrity, samples are delivered to the laboratory as soon as practicable after collection.

Field quality control samples that are collected and analyzed include trip blanks, field blanks, field duplicates, and equipment rinseates. Quality control samples for environmental monitoring are collected at a target rate of one per twenty environmental samples or one per analytical batch for environmental samples, as applicable to the samples being collected and the analyses required. Not all types of sampling require all of the field quality control samples. Table 7.1 summarizes the uses and definitions of the field quality control samples.

Analytical results for field quality control samples are evaluated to determine if the sampling activities have biased the environmental sample results. This evaluation typically occurs as part of data validation and/or assessment (see Section 7.6.2). An example of the successful use of quality control samples to identify bias in sampling is in the ambient air monitoring program (see Chapter 4, Section 4.6.1). Field blank samples collected for the ambient air program contain low levels of uranium and uranium isotopes. Upon further investigation, it was discovered that the filters used to collect air samples contain low levels of uranium due to the materials used to make the filters. Therefore, levels of uranium reported in ambient air may be slightly elevated.

Table 7.1. Definitions and purpose of field quality control samples

Type of sample	Definition and purpose
Trip blank	Used to evaluate contamination from VOCs during the sampling process. The trip blank is an unopened container of laboratory-grade water that accompanies environmental samples analyzed for VOCs from sample collection through laboratory analysis.
Field blank	Used to evaluate contamination during the sampling process. The field blank is a container of laboratory-grade water that is carried into the field and opened to expose the field blank to field conditions when the environmental samples are collected. The field blank is analyzed for the same analytes as the environmental samples.
Field duplicate	Used to document the precision of the sampling process and provide information on analytical variability caused by collection methods, laboratory procedures, and sample heterogeneity (the variability within the sample media). A field duplicate, or duplicate sample, is a second environmental sample collected at the same time and from the same place as the first environmental sample. The duplicate sample is analyzed for the same analytes as the first sample.
Equipment rinseate	Used to assess contamination that could be present from reusable sampling equipment, such as a bailer used at a groundwater well to collect water. The sample is collected by rinsing the cleaned equipment with laboratory-grade water. An equipment rinseate is not required when dedicated or disposable sampling equipment is used for sample collection. The equipment rinseate sample is typically analyzed for the same analytes as the associated environmental samples.

7.4 ANALYTICAL QUALITY ASSURANCE

In 2020, samples collected for DOE environmental monitoring programs at PORTS such as NPDES monitoring, groundwater monitoring required by the *Integrated Groundwater Monitoring Plan* (DOE 2017b), and environmental monitoring required by the *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017a), were sent to analytical laboratories that participated in DOE programs to ensure data quality (see Section 7.5). DOE contractors at PORTS only use analytical laboratories that demonstrate compliance in the following areas through participation in independent audits and surveillance programs:

- compliance with federal waste disposal regulations,
- data quality,
- materials management,
- sample control,
- data management,
- electronic data management,
- implementation of a laboratory quality assurance plan, and
- review of external and internal performance evaluation program.

When available and appropriate for the sample matrix, U.S. EPA-approved methods are used for sample analysis. When U.S. EPA-approved methods are not available, other nationally recognized methods, such as those developed by DOE and American Society for Testing and Materials, are used. Analytical methods are identified in a statement of work for laboratory services. Analytical laboratories follow chain-of-custody procedures and document the steps in sample handling, analysis, and reporting.

7.5 DOE AUDIT PROGRAMS

PORTS is required by DOE, Ohio EPA, and/or U.S. EPA to participate in independent QC programs. The DOE Consolidated Audit Program implements annual performance qualification audits of environmental laboratories. The DOE Mixed-Analyte Performance Evaluation Program provides semiannual performance testing and evaluation of analytical laboratories. The site also participates in voluntary independent programs to improve analytical QC. These programs generate data that readily are recognized as objective measures that provide participating laboratories and government agencies a periodic review of their performance. These programs are conducted by EPA, DOE, and commercial laboratories. Data that do not meet acceptable criteria are investigated and documented according to formal procedures. Although participation in certain programs is mandatory, the degree of participation is voluntary, so that each laboratory can select parameters of particular interest to that facility.

The following analytical laboratories were used by FBP, MCS, and/or Centrus in 2020 for analysis of environmental samples discussed in this report:

- GEL Laboratories, LLC
- Eurofins TestAmerica
- Southwest Research Institute
- ALS
- ETT Environmental, Inc.
- Portsmouth Analytical Laboratory
- Radiation Detection Company
- ARS Aleut Analytical, LLC

The DOE Consolidated Audit Program also audits commercial treatment, storage, and disposal facilities that are used by PORTS for disposal of RCRA hazardous waste and mixed waste (RCRA hazardous waste and low-level radioactive waste). The following facilities were used by PORTS for disposal of RCRA hazardous and mixed waste in 2020:

- Perma-Fix (Diversified Scientific Solutions)
- US Ecology
- Energy*Solutions*
- Nevada National Security Site

7.6 DATA MANAGEMENT

After analytical laboratory data are received by DOE contractors, they are verified for completeness, correctness, consistency, and compliance with written analytical specifications. Selected data are independently evaluated using a systematic process that compares the data to established quality assurance/quality control criteria. An independent data validator checks documentation produced by the analytical laboratory to verify that the laboratory has provided data that meet established criteria.

7.6.1 Data Management Systems

The data generated from sampling events are stored in the Project Environmental Measurements System (PEMS), a consolidated site data system for tracking and managing data. PEMS is used to manage field-generated data, import laboratory-generated data, input data qualifiers identified during data validation, and transfer data to the PORTS Oak Ridge Environmental Information System (OREIS) database. PORTS OREIS is used to consolidate data from PEMS for long term storage.

Environmental data from PORTS OREIS is periodically loaded into the PPPO Environmental Geographic Analytical Spatial Information System (PEGASIS). PEGASIS allows public access to environmental

monitoring data and displays it on a local map that shows the locations the data were collected. Public access to PEGASIS is available at pegasis.ports.pppo.gov

7.6.2 Data Verification, Validation, and Assessment

Data verification is the systematic process of checking data for completeness, correctness, consistency, and compliance with written analytical specifications. The verification process compares the laboratory data package to requirements associated with the project and documents requirements that were and were not met. All data collected for environmental monitoring programs are verified.

Data validation is the process performed by a qualified individual for a data set, independent from sampling, laboratory, project management, or other decision making personnel. Data validation evaluates laboratory adherence to analytical method requirements to determine the technical reliability of the reported results. Data are qualified as acceptable, estimated, or rejected. These validation qualifiers are stored in PEMS and transferred with the data to PORTS OREIS. Typically, at least 10% of analytical data associated with the environmental sampling programs are validated.

Data assessment is conducted by trained technical personnel in conjunction with other project team members. Data are reviewed for compliance with applicable standards or limits, as applicable. Current analytical results are also compared to previous results for the sampling location. Other data analyses may be completed such as trend analyses or summary statistics (calculation of average, median, data range, etc.).

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9. GLOSSARY

air stripper – Equipment that bubbles air through water to remove volatile organic compounds from the water.

alpha activity – The rate of emission of alpha particles from a given material.

alpha particle – A positively charged particle consisting of two protons and two neutrons, identical with the nucleus of a helium atom; emitted by several radioactive substances.

ambient – Of the surrounding area or the environment. Ambient air usually means outdoor air (as opposed to indoor air).

analyte – The specific component that is being measured in a chemical analysis.

aquifer – A permeable layer of sand, gravel, and/or rock below the ground surface that is capable of yielding quantities of groundwater to wells and springs. A subsurface zone that yields economically important amounts of water to wells.

atom – Smallest unit of an element capable of entering into a chemical reaction.

average – A measure of the central tendency, or middle, of a group of numbers.

background radiation – Naturally-occurring radiation that includes cosmic radiation, terrestrial radiation, and internal radiation.

beta activity – The rate of emission of beta particles from a given material.

beta particle – A negatively charged particle emitted from the nucleus of an atom during radioactive decay. It has a mass and charge equal to those of an electron.

biota – Animal and plant life.

categorical exclusion – A class of actions that either individually or cumulatively do not have a significant effect on the human environment and therefore do not require preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act.

chain-of-custody – A process that documents custody and control of a sample through sample collection, transportation and analysis.

closure – Formal shutdown of a hazardous waste management facility under the Resource Conservation and Recovery Act or Comprehensive Environmental Response, Compensation, and Liability Act.

compliance – Fulfillment of applicable regulations or requirements of a plan or schedule ordered or approved by a government authority.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – An act to provide for liability, compensation, cleanup, and emergency response for hazardous substances released to the environment and the cleanup of inactive hazardous waste disposal sites.

concentration – The amount of a substance contained in a unit volume or mass of a sample.

contaminant – Any substance that enters a system (the environment, food, the human body, etc.) where it is not normally found. Contaminants include substances that spoil food, pollute the environment, or cause other adverse effects.

cosmic radiation – Ionizing radiation with very high energies that originates outside the earth's atmosphere. Cosmic radiation is one contributor to natural background radiation.

critical habitat – Specific geographic areas, whether occupied by a species listed under the Endangered Species Act or not, that are essential for conservation of the species and that have been formally designated by a rule published in the Federal Register.

curie (Ci) – A unit of radioactivity, defined as that quantity of any radioactive nuclide which has 3.7×10^{10} (37 billion) disintegrations per second. Several fractions of the curie are commonly used:

millicurie (mCi) – 10^{-3} Ci, one-thousandth of a curie; 3.7×10^{7} disintegrations per second.
microcurie (µCi) – 10^{-6} Ci, one-millionth of a curie, 3.7×10^{4} disintegrations per second.
picocurie (pCi) – 10^{-12} Ci, one-trillionth of a curie; 0.037 disintegration per second.

decontamination and decommissioning (D&D) – Removing equipment, demolishing buildings, disposing of wastes, and investigating potential contamination in areas of PORTS that are no longer part of current operations.

deferred unit – An area at PORTS that was in or adjacent to the gaseous diffusion production and operational areas such that remedial activities would have interrupted operations, or an area that could have become recontaminated from ongoing operations.

derived concentration standard – The concentration of a radionuclide in air or water that under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air, or inhalation) would result in either a dose of 0.1 rem (100 mrem) or a dose of 5 rem to any tissue, including skin and the lens of the eye. The DOE publication *Derived Concentration Technical Standard* (DOE 2011b) provides the derived concentration standards.

dose – In this document, "dose" is used exclusively to refer to a radiological dose; the energy imparted to matter by ionizing radiation.

- **absorbed dose** – The total amount of energy absorbed per unit mass (the amount of energy deposited in body tissue) as a result of exposure to radiation. The unit of absorbed dose is the rad, equal to 0.01 joule per kilogram in any medium. (1 rad = 0.01 gray).

- **effective dose** – A measure of the potential biological risk of health effects due to exposure to radiation measured in units of mrem (1 mrem = 0.01 mSv). In this document, the term "effective dose" is often shortened to "dose."

- **population dose** – The sum of the effective doses to all persons in a specified population measured in units of person-rem (or person-sievert).

Note that "dose" can also be used to refer to a chemical dose; however, chemical doses are not discussed in this document.

downgradient – The direction that groundwater flows; similar to downstream for surface water.

downgradient well – A well installed downgradient of a site that may be capable of detecting migration of contaminants from a site.

duplicate sample – a sample collected from the same location at the same time and using the same sampling device (if possible) as the regular sample.

effluent – A liquid or gaseous discharge to the environment.

effluent monitoring – The collection and analysis of samples or measurement of liquid and gaseous effluents to characterize and quantify the release of contaminants, assess radiation exposures to the public, and demonstrate compliance with applicable standards.

Environmental Restoration – A DOE program that directs the assessment and cleanup of its sites (remediation) and facilities (decontamination and decommissioning) contaminated as a result of nuclear-related activities.

exposure (radiation) – The incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is exposure to ionizing radiation that takes place at a person's workplace. Population exposure is the exposure to the total number of persons who inhabit an area.

external radiation – The exposure to ionizing radiation when the radiation source is located outside the body.

gamma ray – High-energy short-wavelength electromagnetic radiation emitted from the nucleus of an excited atom. Gamma rays are identical to X-rays except for the source of the emission.

glove box – An enclosure with built-in sleeves and gloves used by a person to manipulate hazardous materials such as highly enriched uranium without directly exposing the person to the material.

groundwater – Any water found below the land surface.

half-life, radiological – The time required for half of a given number of atoms of a specific radionuclide to decay. Each nuclide has a unique half-life; half-lives can range in duration from less than a second to many millions of years.

industrial solid waste landfill – A type of landfill that exclusively disposes of solid waste generated by manufacturing or industrial operations.

in situ – In its original place; field measurements taken without removing the sample from its original location; remediation performed while the contaminated media (e.g., groundwater or soil) remains below the surface or in place.

interim remedial measure (IRM) – Cleanup activities initiated after it has been determined that contamination or waste disposal practices pose an immediate threat to human health and/or the environment. These measures are implemented until a more permanent solution can be made.

internal radiation – Occurs when radionuclides enter the body, for example, by ingestion of food or liquids, by inhalation, or through an open wound.

irradiation – Exposure to external radiation.

isotopes – Forms of an element having the same number of protons but differing numbers of neutrons in their nuclei.

maximally exposed individual – A hypothetical individual who – because of realistically assumed proximity, activities and habits – would receive the highest radiation dose, taking into account all pathways, from a given event, process, or facility (DOE Order 458.1).

maximum contaminant level (MCL) – The maximum permissible level of a contaminant in drinking water provided by a public water system.

median – The middle value in a group of numbers. The median can be a more useful measurement of the central tendency of a group of numbers if some of the numbers in the group are significantly higher or lower than the rest of the numbers in the group.

migration – The transfer or movement of a material through air, soil, or groundwater.

millirem (mrem) – The dose that is one-thousandth of a rem.

monitoring – Process whereby the quantity and quality of factors that can affect the environment or human health are measured periodically to regulate and control potential impacts.

natural radiation – Radiation from cosmic and other naturally occurring radionuclide sources (such as radon) in the environment.

nuclide – An atom specified by atomic weight, atomic number, and energy state.

outfall – The point of conveyance (e.g., drain or pipe) of wastewater or other effluents into a ditch, pond, or river.

part per billion – A unit measure of concentration equivalent to the weight to volume ratio expressed as microgram per liter (µg/L) or the weight to weight ratio of microgram per kilogram (µg/kg).

part per million – A unit measure of concentration equivalent to the weight to volume ratio expressed as milligram per liter (mg/L), the weight to weight ratio expressed as milligram per kilogram (mg/kg), or the weight to weight ratio of microgram per gram (µg/g).

perfluoroalkyl and polyfluoroalkyl substances (PFAS) – A group of manmade chemicals used in non-stick products such as Teflon, in water and stain repellant fabrics, and firefighting foam, among many uses. PFAS are also used in industries including aerospace, automotive, construction, electronics, and military. Certain types of PFAS may have negative health effects for humans and the environment.

person-rem – A unit of measure for the collective dose to a population group. For example, a dose of 1 rem to 10 individuals results in a collective dose of 10 person-rem.

pH – A measure of the hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH from 0 to 7, neutral solutions have a pH equal to 7, and basic solutions have a pH from 7 to 14.

polychlorinated biphenyls (PCBs) – Man-made chemicals that range from oily liquids to waxy solids. PCBs were used in hundreds of industrial and commercial applications due to their chemical properties until production in the United States ceased in 1977. PCBs have been demonstrated to cause a variety of adverse health effects in animals and possibly cause cancer and other adverse health effects in humans.

preliminary remediation goal – An initial clean-up goal developed early in the decision-making process that is 1) protective of human health and the environment, and 2) complies with applicable or relevant and appropriate requirements. Preliminary remediation goals are intended to satisfy regulatory cleanup requirements. For groundwater at PORTS, preliminary remediation goals are the National Pollutant Discharge Elimination System (NPDES) drinking water standards (maximum contaminant levels).

quality assurance – Any action in environmental monitoring to demonstrate the reliability of monitoring and measurement data.

quality control – The routine application of procedures within environmental monitoring to obtain the required standards of performance in monitoring and measurement processes.

rad – The unit of absorbed dose deposited in a volume of material.

radioactivity – The spontaneous emission of radiation, generally alpha or beta particles or gamma rays, from the nucleus of an unstable isotope.

radionuclide – A radioactive nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accomplished by the emission of photons or particles.

release – Any discharge to the environment. "Environment" is broadly defined as any water, land, or ambient air.

rem – The unit of dose (absorbed dose in rads multiplied by the radiation quality factor). Dose is frequently reported in units of millirem (mrem), which is one-thousandth of a rem.

remediation – The correction or cleanup of a site contaminated with waste. See "Environmental Restoration."

reportable quantity – A release to the environment that exceeds reportable quantities as defined by the Comprehensive Environmental Response, Compensation, and Liability Act.

Resource Conservation and Recovery Act (RCRA) – Federal legislation that regulates the transport, treatment, and disposal of solid and hazardous wastes.

riparian – Related to the banks of a river or wetlands adjacent to rivers and streams.

settleable solids – Material settling out of suspension in a liquid within a defined period of time.

source – A point or object from which radiation or contamination emanates.

Superfund – The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act and Superfund Amendments and Reauthorization Act that funds and conducts U.S. EPA emergency and long-term removal and remedial actions.

surface water – All water on the surface of the earth, as distinguished from groundwater.

suspended solids – Particles suspended in water, such as silt or clay, that can be trapped by a filter.

terrestrial radiation – Ionizing radiation emitted from radioactive materials in the earth's soils such as potassium-40, radon, thorium, and uranium. Terrestrial radiation contributes to natural background radiation.

transuranics – Elements such as americium, plutonium, and neptunium that have atomic numbers (the number of protons in the nucleus) greater than 92 (uranium). All transuranics are radioactive.

trichloroethene (TCE) – A colorless liquid used in many industrial applications as a cleaner and/or solvent. One of many chemicals that is classified as a volatile organic compound. High levels of TCE may cause health effects such as liver and lung damage and abnormal heartbeat; moderate levels may cause dizziness or headache. The U.S. Environmental Protection Agency Integrated Risk Information System characterizes TCE as carcinogenic to humans by all routes of exposure. This conclusion is based on convincing evidence of a causal association between TCE exposure in humans and kidney cancer.

trip blank – A quality control sample of water that accompanies sample containers from the analytical laboratory, to the field sampling location where environmental samples are collected, back to the analytical laboratory to determine whether environmental samples have been contaminated during transport, shipment, and/or site conditions.

turbidity – A measure of the concentration of sediment or suspended particles in a liquid.

upgradient – In the opposite direction of groundwater flow; similar to upstream for surface water.

upgradient well – A well installed hydraulically upgradient of a site to provide data to compare to a downgradient well to determine whether the site is affecting groundwater quality.

volatile organic compounds (VOCs) – Organic (carbon-containing) compounds that evaporate readily at room temperature. These compounds are present in solvents, degreasers, paints, thinners, and fuels. Due to a number of factors including widespread industrial use, they are commonly found as contaminants in soil and groundwater. VOCs found at PORTS include TCE, vinyl chloride, benzene, and dichloroethenes.

weighting factor (radiation) – The factor by which an absorbed dose (rad) is multiplied to obtain a quantity that expresses, on a common scale for all ionizing radiation, the biological damage to an exposed person. The weighting factor is used because some types of radiation, such as alpha particles, are more biologically damaging than others.

weighting factor (tissue) – A tissue specific number that represents the fraction of the total potential health risk resulting from uniform, whole body irradiation to the specific organ or tissue (bone marrow, lungs, thyroid, etc.).

wetland – An area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, floodplains, fens, and similar areas. A jurisdictional wetland is one that falls under state or federal regulatory authority; a non-jurisdictional wetland does not.

APPENDIX A

ENVIRONMENTAL PERMITS

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Table A.1. DOE environmental permits and registrations at PORTS

Permit/registered source	Source no.	Issue date	Expiration date	Status
FBP– Clean Air Act Permits				
Title V Permit	P0109662	4/28/2014	5/19/2019	Active Renewal submitted 11/13/2018
Permit to Install X-627 Groundwater Treatment Facility (06-07283)	P474, T104, T105	3/15/2005	None	Active
Permit to Install and Operate X-735 Landfill Cap and Venting System (northern portion) (P0104170)	P023	11/12/2008	None	Active
Permit to Install X-670A Cooling Tower (P0106292)	P539	07/29/2010	None	Active
Permit to Install X-333 Low Assay Withdrawal Seal Exhaust System (06-07984)	P117	01/10/2006	None	Inactive
Permit to Install Biodenitrification Vent #1 (06-07928)	P040	11/03/2005	None	Active
Permit to Install Biodenitrification Vent #2 (06-07928)	P041	11/03/2005	None	Active
Permit to Install Biodenitrification Vent #3 (06-07928)	P042	11/03/2005	None	Active
Permit to Install X-700 Radiation Calibration Lab Fume Hood (06-07928)	P045	11/03/2005	None	Active
Permit to Install X-705 Calciners (B Area) (06-07928)	P053	11/03/2005	None	Active
Permit to Install X-344 Pigtail Gulper (06-07760)	P430	05/17/2005	None	Active
Permit to Install X-705 8 inch, 12 inch, and 2.5 Ton Uranium Cylinders, Cleaned for Reuse or Disposal (06-06703)	P470	04/11/2002	None	Active
Permit to Install X-344 Toll Transfer Facility (06-06303)	P469	12/12/2000	None	Active
Permit to Install X-343 Feed Vaporization and Sampling (06-06302)	P468	12/12/2000	None	Inactive
Permit to Install 85 Horsepower Trash Pump (06-06170)	P467	05/24/2000	None	Active
Permit to Install X-847 Glove Box (06-5682)	P466	07/21/1999	None	Active
X-624 Groundwater Treatment Facility (now considered a *de minimis* source)	P019	10/28/1992	None	Active
Permit to Install X-623 Groundwater Treatment Facility (06-4613)	P018	01/08/1992	None	Active
Permit to Install X-749 Contaminated Materials Disposal Facility (06-2999)	P027	04/17/1991	None	Active
Permit to Install Gasoline Dispensing Facility (06-02906)	G001	10/31/1990	None	Active

Table A.1. DOE environmental permits and registrations at PORTS (continued)

Permit/registered source	Source no.	Issue date	Expiration date	Status
MCS – Clean Air Act Permits				
Permit No. P0109511 to Install and Operate Process Line 1 (DUF_6 Conversion Facility)	P001	3/23/2012	3/23/2022	Active
Permit No. P0109511 to Install and Operate Process Line 2 (DUF_6 Conversion Facility)	P002	3/23/2012	3/23/2022	Active
Permit No. P0109511 to Install and Operate Process Line 3 (DUF_6 Conversion Facility)	P003	3/23/2012	3/23/2022	Active
Permit No. P0109511 to Install and Operate HVAC System (DUF_6 Conversion Facility)	P004	3/23/2012	3/23/2022	Active
FBP – Clean Water Act/Safe Drinking Water Act Permits				
NPDES Permit	0IO00000*OD	7/1/2020 (effective date)	6/30/2025	Active
Safe Drinking Water Act – License to Operate a Public Water System	OH6632414		Renewed annually	Active
Permit to Install X-622 Groundwater Treatment Facility	06-2951	11/20/1990	None	Active
Permit to Install X-623 Groundwater Treatment Facility	06-3528	1/9/1996	None	Active
Permit to Install X-624 Groundwater Treatment Facility	06-3556	10/28/1992	None	Active
Permit to Install X-627 Groundwater Treatment Facility	06-07283	1/13/2004	None	Active
MCS – Clean Water Act Permit				
NPDES Permit	0IS00034*CD	10/1/2019 (effective date)	9/30/2024	Active
FBP – Hazardous Waste Permit				
RCRA Part B Permit (DOE/FBP)	Ohio Permit No. 04-66-0680	3/25/2011	3/25/2021	Active Renewal submitted 9/23/2020
FBP – Registrations				
Underground Storage Tank Registration	66005107		Renewed annually	Active

APPENDIX B

INTRODUCTION TO RADIATION

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This section presents basic facts concerning radiation. The information is intended as a basis for understanding the dose associated with releases from the Portsmouth Gaseous Diffusion Plant (PORTS), not as a comprehensive discussion of radiation and its effects on the environment and biological systems. *The McGraw-Hill Dictionary of Scientific and Technical Terms* (McGraw-Hill 1989) defines radiation and radioactivity as follows:

> *radiation*—1) The emission and propagation of waves transmitting energy through space or through some medium; for example, the emission and propagation of electromagnetic, sound, or elastic waves. 2) The energy transmitted through space or some medium; when unqualified, usually refers to electromagnetic radiation. Also known as radiant energy. 3) A stream of particles, such as electrons, neutrons, protons, alpha particles, or high-energy photons, or a mixture of these (McGraw-Hill 1989).
>
> *radioactivity*—A particular type of radiation emitted by a radioactive substance, such as alpha radioactivity (McGraw-Hill 1989).

Radiation occurs naturally; it was not invented but discovered. People are constantly exposed to radiation. For example, radon in air, potassium in food and water, and uranium, thorium, and radium in the earth's crust are all sources of radiation. The following discussion describes important aspects of radiation, including atoms and isotopes; types of radiation; radiation measurement; sources of radiation; and dose information.

ATOMS AND ISOTOPES

All matter is made up of atoms. An atom is "a unit of measure consisting of a single nucleus surrounded by a number of electrons equal to the number of protons in the nucleus" (American Nuclear Society 1986). The number of protons in the nucleus determines an element's atomic number, or chemical identity. With the exception of hydrogen, the nucleus of each type of atom also contains at least one neutron. Unlike protons, the number of neutrons may vary among atoms of the same element. The number of neutrons and protons determines the atomic weight. Atoms of the same element with a different number of neutrons are called isotopes. In other words, isotopes have the same chemical properties but different atomic weights. Figure B.1 depicts isotopes of the element hydrogen.

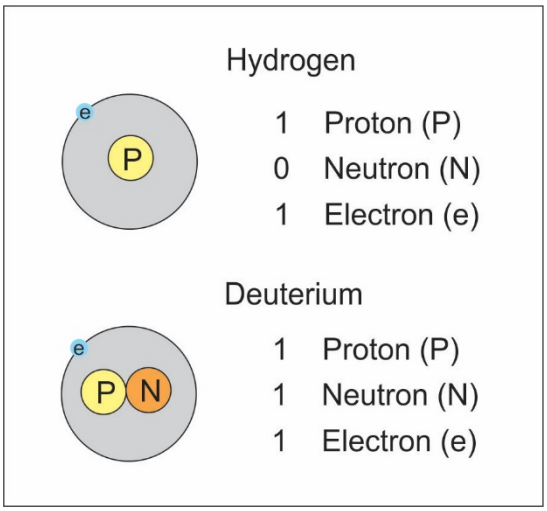

Figure B.1. Isotopes of the element hydrogen.

Another example is the element uranium, which has 92 protons; all isotopes of uranium, therefore, have 92 protons. However, each uranium isotope has a different number of neutrons. Uranium-238 (also denoted ^{238}U) has 92 protons and 146 neutrons; uranium-235 has 92 protons and 143 neutrons; uranium-234 has 92 protons and 142 neutrons.

Some isotopes are stable, or nonradioactive; some are radioactive. A radioactive isotope, or radionuclide, gives off radioactivity because the nucleus has too many particles, too much energy, or too much mass to be stable. The nucleus of the atom disintegrates in an attempt to reach a stable or nonradioactive state. As the nucleus disintegrates, energy is released in the form of radiation. Each radionuclide has a "radioactive half-life," which is the average time that it takes for half of a specified number of atoms to decay. Half-lives can be very short (less than a second) or very long (millions of years), depending on the radionuclide. Appendix C presents the half-lives of radionuclides of interest at PORTS.

RADIATION

Although there are different types of radiation, radiation given off by radionuclides such as uranium-235 is called ionizing radiation. In this report, the term radiation is used to describe ionizing radiation.

Ionizing radiation is capable of changing the chemical state of matter and subsequently causing biological damage, and thus is potentially harmful to human health. Ionizing radiation can include alpha particles, beta particles, and gamma rays. Figure B.2 shows the penetrating potential of different types of ionizing radiation.

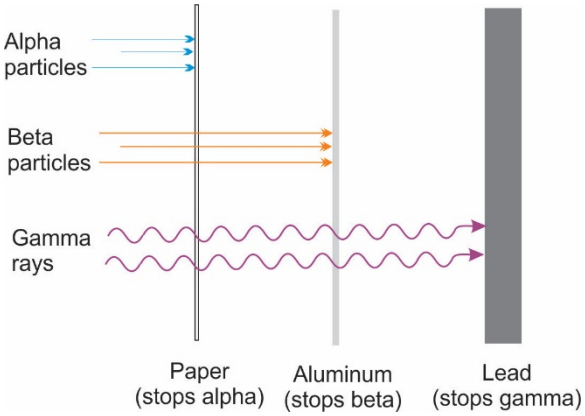

Figure B.2. Penetrating power of radiation.

MEASURING RADIATION

To determine the possible effects of radiation on the environment and the health of people, the radiation must be measured. More precisely, its potential to cause damage must be determined.

Activity

When measuring the amount of radiation in the environment, what is actually being measured is the rate of radioactive decay, or activity. The rate of decay varies widely among the various radionuclides. For that reason, 1 gram of a radioactive substance may contain the same amount of activity as several tons of another material. This activity is expressed in a unit of measure known as a curie (Ci). More specifically, 1 curie = 3.7E+10 (37,000,000,000) atom disintegrations per second (dps). A curie is a relatively large measure of radiation; therefore, radioactivity is often measured in this report in picocuries (pCi). A picocurie is one trillionth of a curie or 2.2 disintegrations per minute.

Absorbed Dose

The absorbed dose is the total amount of energy absorbed per unit mass (the amount of energy deposited in body tissue) as a result of exposure to radiation. Absorbed dose is expressed in a unit of measure known as a rad. In terms of human health, however, it is the effect of the absorbed energy that is important, not the actual amount. Therefore, this type of dose measurement is not used in this report.

Effective Dose

The effective dose is a measure of the potential biological damage that could be caused by exposure to and subsequent absorption of radiation to the body. Effective dose is expressed in a unit of measure known as a rem. One rem of any type of radiation has the same total damaging effect. Because a rem represents a fairly large dose, dose is often expressed as a millirem (mrem) or 1/1000 of a rem.

Although there are several specific types of dose measurements, for simplicity, this report discusses dose in terms of the effective dose. The effective dose is the sum of the doses received by all organs or tissues

of the body after each one has been multiplied by the appropriate radiation and tissue weighting factors. It includes the dose from radiation sources internal and/or external to the body. In this report, the term "effective dose" is often shortened to "dose".

Population Dose

The sum of the effective doses to all the people in a specified community is called the population dose, or sometimes, the collective dose. If 100 people in the community each received a dose of 1 mrem, the population dose would be 100 person-mrem, or 0.1 person-rem (changing the units from mrem to rem).

Table B.1 summarizes radiation and dose terminology, definitions, and units of measure used in this report.

Table B.1. Summary of radiation and dose terminology

Term	Definition	Unit of measure (Standard system)
Activity	The amount of radiation emitted by a radioactive material.	Ci or pCi
Absorbed dose	The total amount of energy deposited in body tissue as a result of exposure to radiation.	rad
Effective dose (shortened to dose in this report)	A measure of the potential biological damage that could be caused by exposure to and subsequent absorption of radiation to the body.	rem or mrem
Population dose	The sum of the effective doses to all persons in a specified community.	Person-rem

Table B.2 provides unit of radiation measure and applicable conversions to the international measurement system.

Table B.2. Units of radiation measure

Standard System	International System	Conversion
Ci (curie)	becquerel (Bq)	1 Ci = 3.7 x 10^{10} Bq
rad (radiation absorbed dose)	gray (Gy)	1 rad = 0.01 Gy
rem (roentgen equivalent man)	sievert (Sv)	1 rem = 0.01 Sv

SOURCES OF RADIATION

Radiation is everywhere. Most occurs naturally, but a small percentage is human-made. Naturally occurring radiation is known as background radiation.

Background Radiation

Many materials are naturally radioactive. In fact, this naturally occurring radiation is the major source of radiation in the environment. Although people have little control over the amount of background radiation to which they are exposed, this exposure must be put into perspective. Background radiation remains relatively constant over time; background radiation present in the environment today is much the same as it was hundreds of years ago.

Sources of background radiation include uranium in the earth, radon in the air, and potassium in food. Background radiation is categorized as cosmic, terrestrial, or internal, depending on its origin. In the United States, the average person receives an annual dose from natural background radiation of 311 mrem/year. Table B.3 summarizes various doses from both naturally-occurring and human-made radiation sources.

Exposure to radiation from atmospheric testing of atomic weapons is considered part of background radiation. However, testing of atomic weapons has been suspended in the United States and most parts of the world. China conducted the last atmospheric atomic weapons test in 1980. Fallout from atmospheric weapons testing is not currently a significant contributor to background radiation (Health Physics Society 2010).

Cosmic/space radiation. Energetically charged particles from outer space continuously hit the earth's atmosphere. These particles and the secondary particles and photons they create are called cosmic or space radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level — the higher a person is in elevation, the less shielding is provided by the atmosphere.

The average annual dose received by residents of the United States from cosmic radiation is about 33 mrem/year (National Council on Radiation Protection [NCRP] 2009). The average annual dose to a person living in Honolulu, Hawaii (at sea level and near the equator) is about 20 mrem/year, while the average annual dose to a person living in Colorado Springs, Colorado (high altitude and latitude) is about 70 mrem/year (Health Physics Society 2010).

Terrestrial radiation. Terrestrial radiation refers to radiation emitted from radioactive materials in the earth's rocks, soils, and minerals. Radon, radon progeny, the relatively short-lived decay products of radium-226, potassium-40, thorium isotopes, and uranium isotopes are the elements responsible for most terrestrial radiation.

The average annual dose received from terrestrial gamma radiation is about 21 mrem/year in the United States (NCRP 2009). Similar to cosmic radiation, this dose varies geographically across the country with the lowest doses on the Atlantic and Gulf coastal plains and highest doses in the mountains in the western United States.

Internal radiation. Radioactive material in the environment can enter the body through different routes of exposure, for example, the air people breathe and the food they eat, or through an open wound. Natural radionuclides that can enter the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, and lead in the uranium-238 and thorium-232 decay series. In addition, the body contains isotopes of potassium (potassium-40), rubidium (rubidium-87), and carbon (carbon-14).

Inhalation of the short-lived decay products of radon are the major contributors to the annual dose equivalent for internal radionuclides, mostly radon-222). They contribute an average annual dose of about 228 mrem/year (NCRP 2009). The average annual dose from ingestion of radionuclides is about 29 mrem/year, which can be attributed to the naturally occurring potassium-40, thorium isotopes, uranium isotopes, and the uranium and thorium decay series (NCRP 2009).

Table B.3. Comparison and description of various dose levels[a]

Dose level	Description
0.85 mrem	Approximate daily dose for a person in the United States from natural background radiation, including radon
1.92 mrem	Cosmic dose to a person on a one-way airplane flight from Washington D.C. to Seattle
10 mrem	Annual exposure limit, set by the U.S. Environmental Protection Agency (U.S. EPA), for exposures from airborne emissions from operations of nuclear fuel cycle facilities, including power plants and uranium mines and mills
36 mrem	Average annual dose to a person who smokes one pack of cigarettes per day
36 mrem	Mammogram (two views)
46 mrem	Estimate of the largest dose any off-site person could have received from the March 28, 1979, Three Mile Island nuclear power plant accident
60 mrem	X-ray (single exposure) of abdomen or hip
100 mrem	Annual dose limit to a member of the public from radiological activities, including remediation, at a DOE facility
244 mrem	Average dose from an upper gastrointestinal diagnostic X-ray series
300 mrem	Average annual dose to a person in the United States from all sources of medical radiation
311 mrem	Average annual dose to a person in the United States from all sources of natural background radiation, including radon
620 mrem	Average annual dose to a person in the United States from all sources of natural and human-made radiation (based on rounded values for individual categories)
700 mrem	Computed tomography (CT scan) – chest
1000-5000 mrem	U.S. EPA protective action guideline calling for public officials to take emergency action when the dose to a member of the public from a nuclear accident will likely reach this range
5000 mrem	Annual dose limit for occupational exposure of radiation workers set by the Nuclear Regulatory Commission and DOE
10,000 mrem	The Biological Effects of Ionizing Radiation V report estimated that an acute dose at this level would result in a lifetime excess risk of death from cancer of 0.8%, which means that of 1000 persons exposed at 10,000 mrem, eight persons would die from cancer caused by the radiation exposure (Biological Effects of Ionizing Radiation 1990)
25,000 mrem	U.S. EPA guideline maximum dose to emergency workers volunteering for non-lifesaving work

Table B.3. Comparison and description of various dose levels[a] (continued)

Dose level	Description
75,000 mrem	U.S. EPA guideline for maximum dose to emergency workers volunteering for lifesaving work
50,000-600,000 mrem	Doses in this range received over a short period of time will produce radiation sickness in varying degrees. At the lower end of this range, people are expected to recover completely, given proper medical attention. At the top of this range, most people would die within 60 days.

[a]Adapted from Savannah River Site Environmental Report for 1993, Summary Pamphlet, WSRC-TR-94-076, (Westinghouse Savannah River Company 1994) and NCRP Report No. 160, *Ionizing Radiation Exposure of the Population of the United States* (NCRP 2009).

Human-made Radiation

Most people are exposed to human-made sources of radiation. Examples include consumer products, medical sources, and industrial or occupational sources. About one-half of 1% of the U.S. population performs work in which radiation in some form is present. In the United States, the average person receives an annual dose from human-made radiation of approximately 313 mrem/year, primarily from medical procedures.

Consumer products and activities. Some consumer products are sources of radiation. In some consumer products, such as smoke detectors, watches, or clocks, radiation is essential to the performance of the device. In other products or activities, such as smoking tobacco products or building materials, the radiation occurs incidentally to the product function. Commercial air travel is another consumer activity that results in exposure to radiation (from cosmic radiation).

The U.S. average annual dose received by an individual from consumer products is about 13 mrem/year (NCRP 2009). Almost 90 percent of this annual dose results from smoking cigarettes, commercial air travel, and building materials (radionuclides present in brick, masonry, cement, concrete, and other materials).

Medical sources. Radiation is an important tool of diagnostic medicine and treatment, and, in this use, is the main source of exposure to human-made radiation. Exposure is deliberate and directly beneficial to the patients exposed. Generally, medical exposures result from beams directed to specific areas of the body. Thus, all body organs generally are not irradiated uniformly. Radiation and radioactive materials are also used in a wide variety of pharmaceuticals and in the preparation of medical instruments, including the sterilization of heat-sensitive products such as plastic heart valves. Nuclear medicine examinations and treatment involve the internal administration of radioactive compounds, or radiopharmaceuticals, by injection, inhalation, consumption, or insertion. Even then, radionuclides are not distributed uniformly throughout the body.

Medical exams and procedures account for the largest portion of the average annual dose received from human-made sources. These procedures include x-rays, computed tomography (CT) scans—a more sophisticated type of x-ray), fluoroscopy, and nuclear medicine. The increase in the use of medical imaging procedures, especially computed tomography, over the last 25 years has resulted in a marked increase in the average annual dose from medical sources received by a person in the United States: 53 mrem/year in the early 1980s to 300 mrem/year in 2006 (NCRP 2009). The actual annual doses received by individuals who complete such medical exams can be much higher than the average value because not everyone receives such exams each year.

Industrial and occupational sources. Other sources of radiation include emissions of radioactive materials from nuclear facilities such as uranium enrichment plants, uranium mines, and nuclear power plants; emissions from mineral extraction facilities; and the transportation of radioactive materials. Workers in certain occupations may also be exposed to radiation due to their jobs, in addition to the average background radiation exposure. These occupations include positions in medicine, aviation, research, education, and government. Pilots and other air crew members have the highest annual average exposure to radiation as part of their jobs: 307 mrem/year (NCRP 2009). This exposure is from cosmic radiation.

Small doses received by individuals occur as a result of emissions of radioactive materials from nuclear facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials. The combination of these sources contributes less than 1 mrem/year to the average annual dose to an individual (NCRP 2009).

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APPENDIX C

RADIONUCLIDE AND CHEMICAL NOMENCLATURE

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Table C.1. Nomenclature for elements and chemical constituents

Constituent	Symbol
Aluminum	Al
Ammonia	NH_3
Antimony	Sb
Arsenic	As
Barium	Ba
Beryllium	Be
Cadmium	Cd
Calcium	Ca
Chromium	Cr
Cobalt	Co
Copper	Cu
Iron	Fe
Lead	Pb
Lithium	Li
Magnesium	Mg
Manganese	Mn
Mercury	Hg
Nickel	Ni
Nitrogen	N
Nitrate ion	NO_3-
Nitrite ion	NO_2-
Phosphorus	P
Phosphate ion	PO_4^{2-}
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Sulfate ion	SO_4-
Sulfur dioxide	SO_2
Thallium	Tl
Uranium	U
Vanadium	V
Zinc	Zn

Table C.2. Nomenclature and half-life for radionuclides

Radionuclide	Symbol	Half-life (years)
Americium-241	^{241}Am	432.2
Neptunium-237	^{237}Np	2,140,000
Plutonium-238	^{238}Pu	87.7
Plutonium-239	^{239}Pu	24,100
Plutonium-240	^{240}Pu	6,564
Technetium-99	^{99}Tc	211,000
Thorium-228	^{228}Th	1.9116
Thorium-230	^{230}Th	75,400
Thorium-232	^{232}Th	14,100,000,000
Uranium-233	^{233}U	159,000
Uranium-234	^{234}U	246,000
Uranium-235	^{235}U	704,000,000
Uranium-236	^{236}U	23,400,000
Uranium-238	^{238}U	4,470,000,000

Source: *Derived Concentration Technical Standard* (DOE 2011b), Table A.3.

DOE/PPPO/03-1034&D1

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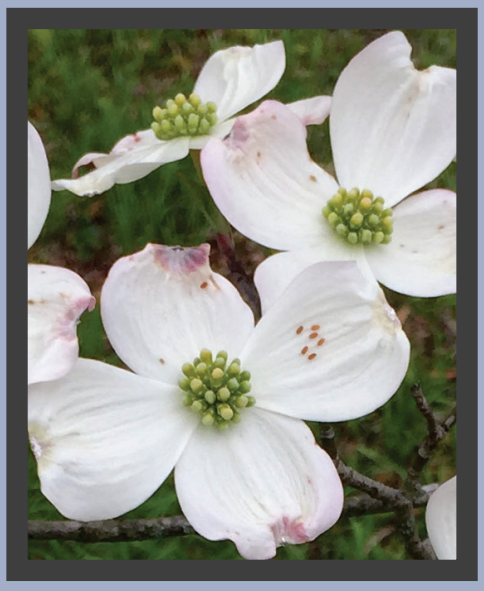
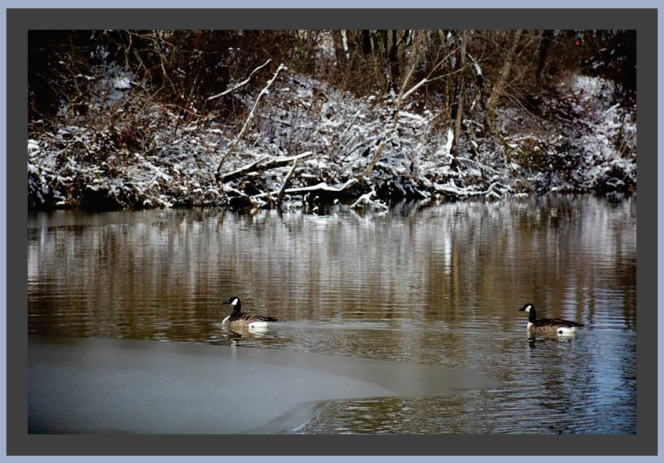
Portsmouth Gaseous Diffusion Plant

Annual Site Environmental Data 2020





September 2021

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Data – 2020
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-1035&D1

September 2021

By
Fluor-BWXT Portsmouth LLC, under Contract DE-AC30-10CC40017

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This document has been approved for public release:

Richard Henderson (signature on file) 9/8/2021
Classification Office Date

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CONTENTS

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TABLES

ACRONYMS AND ABBREVIATIONS

#/100 mL	number per 100 mL
ACP	American Centrifuge Plant
°C	degrees Celsius
Ci	curie
cm	centimeter
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
FBP	Fluor-BWXT Portsmouth LLC
°F	degrees Fahrenheit
g	gram
GPD	gallons per day
in.	inch
kg	kilogram
L	liter
m	meter
m^3	cubic meter
µg	microgram
mg	milligram
MCS	Mid-America Conversion Services, LLC
MGD	million gallons per day
mrem	millirem
ng	nanogram
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
OVEC	Ohio Valley Electric Corporation
PCB	polychlorinated biphenyl
pCi	picocurie
PK	Peter Kiewit
PORTS	Portsmouth Gaseous Diffusion Plant
SU	standard unit
TUa	acute toxicity unit
VOC	volatile organic compound

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1. INTRODUCTION

Environmental monitoring at the Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant (PORTS) is conducted throughout the year. Monitoring demonstrates the site is a safe place to work, plant operations do not adversely affect neighboring communities, and activities comply with federal and state regulations.

This document is a compilation of the environmental monitoring data for calendar year 2020 and is intended as a tool for analysts in environmental monitoring, environmental restoration, and other related disciplines. The data in this document form the basis for the summary information in the *Portsmouth Gaseous Diffusion Plant Annual Site Environmental Report – 2020* (DOE 2021b).

The DOE has established a total public annual dose limit of 100 millirem (mrem)/year above background in DOE Order 458.1, *Radiation Protection of the Public and the Environment*. This annual dose limit is also subject to the concept of "as low as reasonably achievable[1]. Radiological monitoring data presented in this Data Report and discussed in the *Annual Site Environmental Report for 2020* indicate that the maximum annual dose a member of the public could receive from radionuclides released by PORTS in 2020 or detected by environmental monitoring programs in 2020 is 1.0 mrem/year and is considered as low as reasonably achievable.

Other non-radiological chemicals such as polychlorinated biphenyls (PCBs), metals, and volatile organic compounds (VOCs) are also monitored. Discharges of metals and other chemicals to surface water are controlled by National Pollutant Discharge Elimination System (NPDES) permits. Emissions of some non-radiological air pollutants are controlled by air emission permits issued by Ohio Environmental Protection Agency (Ohio EPA). The *Portsmouth Gaseous Diffusion Plant Annual Site Environmental Report – 2020* (DOE 2021b) provides more information about non-radiological chemicals released from PORTS or detected by PORTS monitoring programs during 2020.

[1] "As low as reasonably achievable" is an approach to radiation protection to manage and control releases of radioactive material to the environment, the workforce, and members of the public so that levels are as low as reasonable, taking into account societal, environmental, technical, economic, and public policy considerations. As low as reasonably achievable is not a specific release or dose limit, but a process that has the goal of optimizing control and managing release of radioactive material to the environment and doses so they are as far below the applicable limits as reasonably achievable. This approach optimizes radiation protection.

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2. ENVIRONMENTAL MONITORING

This section provides environmental monitoring data collected in 2020 by DOE contractors Fluor-BWXT Portsmouth LLC (FBP) and Mid-America Conversion Services, LLC (MCS). Data collected by Centrus for NPDES outfalls associated with the American Centrifuge Plant (ACP) are also reported in this section.

The following tables are provided in this section:

- Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2020
- Table 2.2. FBP NPDES permit summary January 2020 – June 2020
- Table 2.3. FBP NPDES permit summary July 2020 – December 2020
- Table 2.4. MCS NPDES permit summary – 2020
- Table 2.5. FBP NPDES discharge summary and compliance rates – 2020
- Table 2.6. MCS NPDES discharge summary and compliance rates – 2020
- Table 2.7. Centrus NPDES discharge monitoring results – 2020
- Table 2.8 Radionuclides in surface water runoff samples from FBP and MCS cylinder storage yards – 2020
- Table 2.9. Drainage basin monitoring of surface water and sediment for MCS cylinder storage yards – 2020
- Table 2.10. Ambient air monitoring program summary for radionuclides and fluoride – 2020
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- Table 2.17. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2020
- Table 2.18. Biota (fish) monitoring program results – 2020
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- Table 2.20. Biota (deer) monitoring program results – 2020
- Table 2.21. Biota (milk and eggs) monitoring program results – 2020.

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2020

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
001	Americium-241	4(4)	< 0.0027	< 0.024	
	Neptunium-237	4(4)	0	< 0.00248	
	Plutonium-238	4(4)	0	< 0.00844	
	Plutonium-239/240	4(4)	< 0.00624	< 0.0169	
	Technetium-99	13(2)	< 1.77	50.3	18.6
	Uranium	13(0)	< 0.348	5.24	2.53
	Uranium-233/234	13(0)	0.594	9.54	4.77
	Uranium-235/236	13(4)	< 0.0325	0.509	
	Uranium-238	13(0)	0.112	1.68	0.812
002	Americium-241	4(4)	0	< 0.0185	
	Neptunium-237	4(4)	0	< 0.00773	
	Plutonium-238	4(4)	0	< 0.00392	
	Plutonium-239/240	4(4)	0	< 0.0232	
	Technetium-99	12(12)	0	< 3.76	
	Uranium	12(1)	< 0.218	1.05	0.721
	Uranium-233/234	12(0)	0.29	1.02	0.601
	Uranium-235/236	12(12)	< 0.00613	< 0.0682	
	Uranium-238	12(1)	< 0.0626	0.344	0.237
003	Americium-241	4(4)	< 0.00372	< 0.0205	
	Neptunium-237	4(4)	0	< 0.00958	
	Plutonium-238	4(4)	0	< 0.00292	
	Plutonium-239/240	4(4)	0	< 0.00785	
	Technetium-99	12(0)	39	97.3	66.8
	Uranium	12(0)	1.11	3.41	2.34
	Uranium-233/234	12(0)	0.754	2.73	1.76
	Uranium-235/236	12(10)	< 0.0126	0.137	
	Uranium-238	12(0)	0.37	1.13	0.774
004	Americium-241	4(4)	0	< 0.0259	
	Neptunium-237	4(4)	0	0	
	Plutonium-238	4(4)	0	< 0.0109	
	Plutonium-239/240	4(4)	< 0.00336	< 0.0145	
	Technetium-99	12(12)	0	< 2.69	
	Uranium	12(12)	< 0.0698	< 0.264	
	Uranium-233/234	12(12)	< 0.0358	< 0.0979	
	Uranium-235/236	12(12)	0	< 0.0227	
	Uranium-238	12(12)	< 0.0235	< 0.0857	

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2020 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
005	Americium-241	4(4)	0	< 0.0166	
	Neptunium-237	4(4)	0	< 0.00264	
	Plutonium-238	4(4)	0	< 0.00673	
	Plutonium-239/240	4(4)	< 0.00558	< 0.0127	
	Technetium-99	12(11)	0	75	
	Uranium	12(10)	< 0.0775	0.267	
	Uranium-233/234	12(6)	< 0.0225	0.151	
	Uranium-235/236	12(12)	0	< 0.0277	
	Uranium-238	12(9)	< 0.0261	0.0902	
009	Americium-241	4(4)	0	< 0.015	
	Neptunium-237	4(4)	0	< 0.0141	
	Plutonium-238	4(4)	0	< 0.00392	
	Plutonium-239/240	4(4)	0	< 0.00905	
	Technetium-99	12(12)	0	< 3.14	
	Uranium	12(0)	1.35	6.27	3.24
	Uranium-233/234	12(0)	0.547	2.53	1.41
	Uranium-235/236	12(10)	< 0.0393	0.121	
	Uranium-238	12(0)	0.447	2.09	1.08
010	Americium-241	4(4)	< 0.0146	< 0.028	
	Neptunium-237	4(4)	0	< 0.00703	
	Plutonium-238	4(4)	0	< 0.0186	
	Plutonium-239/240	4(4)	< 0.00677	< 0.0217	
	Technetium-99	12(10)	0	26.1	
	Uranium	12(1)	1.04	2.26	1.69
	Uranium-233/234	12(0)	0.451	2.06	1.17
	Uranium-235/236	12(11)	< 0.0201	< 0.101	
	Uranium-238	12(0)	0.345	0.746	0.558
011	Americium-241	4(4)	< 0.00316	< 0.0337	
	Neptunium-237	4(4)	< 0.00276	< 0.0102	
	Plutonium-238	4(4)	0	0	
	Plutonium-239/240	4(4)	0	< 0.0209	
	Technetium-99	12(12)	0	< 4.55	
	Uranium	12(0)	0.889	2.47	1.89
	Uranium-233/234	12(0)	0.339	1.23	0.900
	Uranium-235/236	12(11)	< 0.0142	< 0.0952	
	Uranium-238	12(0)	0.297	0.821	0.627
015	Americium-241	4(4)	0	< 0.0139	
	Neptunium-237	4(4)	0	< 0.00602	
	Plutonium-238	4(4)	0	< 0.00608	
	Plutonium-239/240	4(4)	0	< 0.0183	
	Technetium-99	12(12)	0	< 4.71	
	Uranium	12(1)	< 0.277	1.14	0.751
	Uranium-233/234	12(0)	0.107	0.823	0.438
	Uranium-235/236	12(12)	0	< 0.0966	
	Uranium-238	12(1)	< 0.0907	0.367	0.248

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2020 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
608	Americium-241	4(4)	0	< 0.0106	
	Neptunium-237	4(4)	0	< 0.00213	
	Plutonium-238	4(4)	0	< 0.0148	
	Plutonium-239/240	4(4)	< 0.00621	< 0.0148	
	Technetium-99	12(0)	123	451	194
	Uranium	12(0)	0.553	1.26	0.911
	Uranium-233/234	12(0)	0.212	0.747	0.392
	Uranium-235/236	12(12)	0	< 0.0364	
	Uranium-238	12(0)	0.184	0.422	0.303
610	Americium-241	2(2)	0	< 0.0138	
	Neptunium-237	2(2)	0	< 0.0157	
	Plutonium-238	2(2)	0	< 0.00446	
	Plutonium-239/240	2(2)	0	< 0.0163	
	Technetium-99	3(2)	< 2.22	11.6	
	Uranium	3(0)	0.834	1.68	1.27
	Uranium-233/234	3(0)	1.08	2.09	1.62
	Uranium-235/236	3(2)	< 0.0089	0.125	
	Uranium-238	3(0)	0.279	0.545	0.415
611	Americium-241	4(4)	< 0.00801	< 0.0367	
	Neptunium-237	4(4)	< 0.00223	< 0.0208	
	Plutonium-238	4(4)	0	< 0.0166	
	Plutonium-239/240	4(4)	0	< 0.0167	
	Technetium-99	12(0)	9.57	654	339
	Uranium	12(0)	2.9	5.2	4.15
	Uranium-233/234	12(0)	2.3	4.42	3.51
	Uranium-235/236	12(0)	0.136	0.269	0.198
	Uranium-238	12(0)	0.945	1.71	1.36
		Centrus outfalls			
012	Americium-241	4(4)	< 0.042	< 0.089	
	Neptunium-237	4(4)	< 0.053	< 0.294	
	Plutonium-238	4(4)	< 0.067	< 0.111	
	Plutonium-239/240	4(4)	< 0.05	< 0.111	
	Technetium-99	51(51)	< 8.16	< 12	
	Uranium	51(0)	0.52	2.15	1.17
013	Americium-241	4(4)	< 0.053	< 0.075	
	Neptunium-237	4(4)	< 0.057	< 0.194	
	Plutonium-238	4(4)	< 0.049	< 0.077	
	Plutonium-239/240	4(4)	< 0.065	< 0.087	
	Technetium-99	51(51)	< 7.94	< 11.7	
	Uranium	51(0)	0.21	1.70	0.96

[a]FBP internal NPDES Outfalls 608, 610, and 611 discharge to NPDES Outfall 003 (X-6619 Sewage Treatment Plant).
[b]Uranium is reported in µg/L; all other radionuclides are reported in pCi/L.
[c]Number in parentheses is the number of samples that were below the detection limit.
[d]Minimum or maximum values reported as "0" may actually be negative results. A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results. These negative value results are reported as "0" in the table for simplicity.
[e]Averages were not calculated for outfalls that had greater than 15% of the results below the detection limit. For outfalls with less than 15% of the results below the detection limit, any result below the detection limit was assigned a value at the detection limit to calculate the average for the parameter. These criteria were adapted from *Data Quality Assessment: A Reviewer's Guide* (EPA 2006).

Table 2.2. FBP NPDES permit summary January 2020 – June 2020

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 001 (X-230J7 East Holding Pond)					
Cadmium, total recoverable	µg/L	1/quarter	24-hr composite		
Chlorine, total residual	mg/L	1/week	Grab	0.05	0.05
Copper, total recoverable	µg/L	1/quarter	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/quarter	24-hr composite		
Mercury, total (low level)	ng/L	1/month	Grab	25	1700
Oil & grease	mg/L	1/week	Grab	10	15
pH	SU	1/week	Grab		6.5–9.0
Precipitation, total	in.	Daily	24-hr total		
Dissolved solids, total (Residue, total filterable)	mg/L	1/week	24-hr composite		
Silver, total recoverable	µg/L	1/month	24-hr composite		
Total suspended solids[b]	mg/L	1/week	24-hr composite	20	45
Zinc, total recoverable	µg/L	1/quarter	24-hr composite		
FBP Outfall 002 (X-230K South Holding Pond)					
Cadmium, total recoverable	µg/L	1/quarter	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/quarter	24-hr composite		
Mercury, total (low level)	ng/L	1/quarter	Grab		
pH	SU	1/week	Grab		6.5–9.0
Nitrogen, ammonia (NH_3)	mg/L	1/month	24-hr composite		
Oil & grease	mg/L	1/week	Grab		10
Selenium, total recoverable	µg/L	1/month	24-hr composite		5.0
Silver, total recoverable	µg/L	1/quarter	24-hr composite		
Thallium, total recoverable	µg/L	1/quarter	24-hr composite		
Total suspended solids[b]	mg/L	1/week	24-hr composite	20	45
FBP Outfall 003 (X-6619 Sewage Treatment Plant)					
Acute toxicity, *Ceriodaphnia dubia*	TUa	1/quarter	24-hr composite		
Acute toxicity, *Pimephales promelas*	TUa	1/quarter	24-hr composite		
Carbonaceous biochemical oxygen demand, 5-day	mg/L	1/week	24-hr composite	10 (15.1)	15 (22.7)
Copper, total recoverable	µg/L	1/quarter	24-hr composite		
E. coli[c]	#/100 mL	1/week	Grab	126	284
Flow rate	MGD	Daily	24-hr total		
Mercury, total	ng/L	1/month	Grab	66 (0.000099)	1700 (0.0025)

Table 2.2. FBP NPDES permit summary January 2020 – June 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 003 (X-6619 Sewage Treatment Plant)					
Nitrogen, ammonia (NH_3)	mg/L	1/2 weeks	24-hr composite		
Nitrite plus nitrate	mg/L	1/quarter	24-hr composite		
Oil & grease	mg/L	1/quarter	Grab		
pH	SU	3/week	Grab		6.5–9.0
Silver, total recoverable	µg/L	1/quarter	24-hr composite		
Thallium, total recoverable	µg/L	1/quarter	24-hr composite		
Total suspended solids	mg/L	1/week	24-hr composite	12 (18.2)	18 (27.3)
Zinc, total recoverable	µg/L	1/quarter	24-hr composite		
FBP Outfall 004 (Cooling Tower Blowdown)					
Acute toxicity, *Ceriodaphnia dubia*	TUa	1/quarter	24-hr composite		
Acute toxicity, *Pimephales promelas*	TUa	1/quarter	24-hr composite		
Chlorine, total residual	mg/L	1/week	Grab		0.05
Copper, total recoverable	µg/L	1/month	24-hr composite		66 (0.160)
Dissolved solids, total (Residue, total filterable)	mg/L	1/month	24-hr composite	3500 (8480)	4000 (9690)
Flow rate	MGD	Daily	24-hr total		
Mercury, total	ng/L	1/quarter	Grab		
Oil & grease	mg/L	1/month	Grab	15	20
pH	SU	1/month	Grab		6.5–9.0
Total suspended solids	mg/L	1/month	24-hr composite	18 (43)	27 (65)
Zinc, total recoverable	µg/L	1/quarter	24-hr composite		
FBP Outfall 005 (X-611B Lime Sludge Lagoons)					
Flow rate	MGD	3/week	24-hr total (estimate)		
Lead, total recoverable	µg/L	1/month	Grab		
Mercury, total	ng/L	1/month	Grab		
pH	SU	1/week	Grab		6.5–10.0
Selenium, total recoverable	µg/L	1/month	Grab		5
Total suspended solids[b]	mg/L	1/week	Grab	10	15
FBP Outfall 009 (X-230L North Holding Pond)					
Bis(2-ethylhexyl)phthalate	µg/L	1/month	Composite	8.4	1105
Copper, total recoverable	µg/L	1/month	Grab		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/quarter	Grab		
Mercury, total	ng/L	1/quarter	Grab		
Oil & grease	mg/L	1/month	Grab	10	15
pH	SU	1/week	Grab		6.5–9.0

Table 2.2. FBP NPDES permit summary January 2020 – June 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 009 (X-230L North Holding Pond)					
Silver, total recoverable	µg/L	1/month	Grab	1.3	2.7
Total suspended solids[b]	mg/L	1/week	Grab	30	45
Zinc, total recoverable	µg/L	1/quarter	Grab		
FBP Outfall 010 (X-230J5 Northwest Holding Pond)					
Flow rate	MGD	Daily	24-hr total		
Lead, total recoverable	µg/L	1/month	24-hr composite		
Mercury, total	ng/L	1/quarter	Grab		
Oil & grease	mg/L	1/month	Grab	10	15
pH	SU	1/2 weeks	Grab		6.5–9.0
Precipitation, total	in.	Daily	24-hr total		
Selenium, total recoverable	µg/L	1/month	24-hr composite		
Total suspended solids[b]	mg/L	1/2 weeks	24-hr composite	30	45
Zinc, total recoverable	µg/L	1/month	24-hr composite		
FBP Outfall 011 (X-230J6 Northeast Holding Pond)					
Cadmium, total recoverable	µg/L	1/quarter	Grab		
Chlorine, total residual	mg/L	1/2 weeks	Grab	0.05	0.05
Copper, total recoverable	µg/L	1/month	Grab		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/quarter	Grab		
Oil & grease	mg/L	1/2 weeks	Grab	10	15
pH	SU	1/2 weeks	Grab		6.5–9.0
Precipitation, total	in.	Daily	24-hr total		
Selenium, total recoverable	µg/L	1/month	Grab		5.6
Thallium, total recoverable	µg/L	1/quarter	Grab		
Total suspended solids[b]	mg/L	1/2 weeks	Grab	30	45
Zinc, total recoverable	µg/L	1/month	Grab		
FBP Outfall 015 (X-624 Groundwater Treatment Facility)					
Arsenic, total recoverable	µg/L	1/quarter	Grab		
Barium, total recoverable	µg/L	1/quarter	Grab		
Flow rate	MGD	Daily	24-hr total		
PCBs	µg/L	1/quarter	Grab		*d*
pH	SU	1/2 weeks	Grab		6.5–9.0
Silver, total recoverable	µg/L	1/month	Grab	1.3	6.8
Trichloroethene	µg/L	1/2 weeks	Grab	10	10

Table 2.2. FBP NPDES permit summary January 2020 – June 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 602 (X-621 Coal Pile Runoff Treatment Facility)					
Flow rate	MGD	Daily	24-hr total (estimate)		
Iron, total[b]	µg/L	1/2 weeks	Grab	3500	7000
Manganese, total[b]	µg/L	1/2 weeks	Grab	2000	4000
pH	SU	1/2 weeks	Grab		6.0–10.0
Precipitation, total	in.	Daily	24-hr total		
Total suspended solids[b]	mg/L	1/2 weeks	Grab	35	50
FBP Outfall 604 (X-700 Biodenitrification Facility)					
Copper, total	µg/L	1/month	24-hr composite		
Iron, total	µg/L	1/month	24-hr composite		
Flow rate	MGD	Daily	24-hr total estimate		
Nickel, total	µg/L	1/month	24-hr composite		
Nitrogen, nitrate	mg/L	1/month	24-hr composite		
pH	SU	1/month	Grab		6.5–9.0
Zinc, total	µg/L	1/month	24-hr composite		
FBP Outfall 605 (X-705 Microfiltration Treatment System)					
Chromium, hexavalent	µg/L	1/month	Grab		
Chromium, total	µg/L	1/month	24-hr composite		
Copper, total	µg/L	1/month	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Nickel, total	µg/L	1/month	24-hr composite		
Nitrogen, ammonia (NH_3)	mg/L	1/month	24-hr composite		
Nitrogen, nitrate	mg/L	1/month	24-hr composite		
Nitrogen, nitrite	mg/L	1/month	24-hr composite		
Nitrogen, Kjeldahl	mg/L	1/month	24-hr composite		
Oil & grease	mg/L	1/month	Grab		
pH	SU	1/month	Grab		6.5–10.0
Sulfate (SO_4)	mg/L	1/month	24-hr composite		
Total suspended solids	mg/L	1/month	24-hr composite	20	30
Trichloroethene	µg/L	1/month	Grab		
Zinc, total	µg/L	1/month	24-hr composite		
FBP Outfall 608 (X-622 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2 weeks	Grab		
trans-1,2-dichloroethene	µg/L	1/2 weeks	Grab	25	66
Trichloroethene	µg/L	1/2 weeks	Grab	10	10

Table 2.2. FBP NPDES permit summary January 2020 – June 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 610 (X-623 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2 weeks	Grab		
trans-1,2-dichloroethene	µg/L	1/2 weeks	Grab	25	66
Trichloroethene	µg/L	1/2 weeks	Grab	10	10
FBP Outfall 611 (X-627 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2 weeks	Grab		
Trichloroethene	µg/L	1/2 weeks	Grab	10	10
FBP Monitoring Station 801 (Upstream Monitoring)					
48-hr acute toxicity, *Ceriodaphnia dubia*	% affected	1/quarter	Grab		
96-hr acute toxicity, *Pimephales promelas*	% affected	1/quarter	Grab		
FBP Monitoring Station 902 (Downstream Farfield Monitoring)					
Water temperature	°C	2/week	24-hr maximum	27.8[c]	29.4[c]
FBP Monitoring Station 903 (Downstream Farfield Monitoring)					
Water temperature	°C	2/week	24-hr maximum	27.8[c]	29.4[c]

[a]If provided in the permit, the loading limit, in kg/day or kg/month, is provided in parentheses.
[b]Limitations do not apply if flow increases as a result of a precipitation or snow melt event and conditions specified in the permit are met.
[c]Summer only (May through October).
[d]No detectable PCBs.

Table 2.3. FBP NPDES permit summary July 2020 – December 2020

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 001 (X-230J7 East Holding Pond)					
Chlorine, total residual	mg/L	1/week	Grab	0.05	0.05
Copper, total recoverable	µg/L	1/quarter	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/quarter	24-hr composite		
Mercury, total (low level)	ng/L	1/month	Grab	20	1700
Oil & grease	mg/L	1/week	Grab		10
pH	SU	1/week	Grab		6.5–9.0
Precipitation, total	in.	Daily	24-hr total		
Silver, total recoverable	µg/L	1/quarter	24-hr composite		
Total suspended solids[b]	mg/L	1/week	24-hr composite	20	45
Zinc, total recoverable	µg/L	1/quarter	24-hr composite		
FBP Outfall 002 (X-230K South Holding Pond)					
Bis(2-ethylhexyl)phthalate	µg/L	1/month	Multiple grab	8.4	1100
Chlorine, total residual	mg/L	1/week	Grab		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/quarter	24-hr composite		
Mercury, total (low level)	ng/L	1/quarter	Grab		
pH	SU	1/week	Grab		6.5–9.0
Oil & grease	mg/L	1/week	Grab		10
Selenium, total recoverable	µg/L	1/quarter	24-hr composite		
Total suspended solids[b]	mg/L	1/week	24-hr composite	20	45
FBP Outfall 003 (X-6619 Sewage Treatment Plant)					
Acute toxicity, *Ceriodaphnia dubia*	TUa	1/year	24-hr composite		
Acute toxicity, *Pimephales promelas*	TUa	1/year	24-hr composite		
Carbonaceous biochemical oxygen demand, 5-day	mg/L	1/week	24-hr composite	10 (14.8)	15 (22.2)
E. coli[c]	#/100 mL	1/week	Grab	126	284
Flow rate	MGD	Daily	24-hr total		
Mercury, total	ng/L	1/month	Grab	27 (0.000040)	1700 (0.0025)
Nitrogen, ammonia (NH_3)	mg/L	1/2 weeks	24-hr composite		
Nitrite plus nitrate	mg/L	1/quarter	24-hr composite		
Oil & grease	mg/L	1/quarter	Grab		
pH	SU	3/week	Grab		6.5–9.0
Total suspended solids	mg/L	1/week	24-hr composite	12 (17.8)	18 (26.6)

Table 2.3. FBP NPDES permit summary July 2020 – December 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 004 (Cooling Tower Blowdown)					
Acute toxicity, *Ceriodaphnia dubia*	TUa	1/quarter	24-hr composite		
Acute toxicity, *Pimephales promelas*	TUa	1/quarter	24-hr composite		
Beryllium, total recoverable	µg/L	1/month	24-hr composite		
Cadmium, total recoverable	µg/L	1/month	24-hr composite		
Chlorine, total residual	mg/L	1/week	Grab		0.05
Chromium, total recoverable	µg/L	1/month	24-hr composite		
Cobalt, total recoverable	µg/L	1/month	24-hr composite		
Copper, total recoverable	µg/L	1/month	24-hr composite		66 (0.575)
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/month	24-hr composite		
Mercury, total (low level)	ng/L	1/month	Grab	12 (0.000105)	1700 (0.0148)
Nickel, total recoverable	µg/L	1/month	24-hr composite		
Oil & grease	mg/L	1/week	Grab		10
PCBs	µg/L	1/month	24-hr composite		*d*
pH	SU	1/week	Grab		6.5–9.0
Residue, total filterable	mg/L	1/month	24-hr composite		
Selenium, total recoverable	µg/L	1/month	24-hr composite		
Silver, total recoverable	µg/L	1/month	24-hr composite		
Total suspended solids	mg/L	1/week	24-hr composite	11.2 (97.6)	12.5 (109)
Vanadium, total recoverable	µg/L	1/month	24-hr composite		
Zinc, total recoverable	µg/L	1/month	24-hr composite		
FBP Outfall 005 (X-611B Lime Sludge Lagoons)					
Flow rate	MGD	1/day	24-hr total (estimate)		
Mercury, total	ng/L	1/quarter	Grab		
pH	SU	1/week	Grab		6.5–9.0
Selenium, total recoverable	µg/L	1/quarter	Grab		
Total suspended solids[b]	mg/L	1/week	Grab	10	15
FBP Outfall 009 (X-230L North Holding Pond)					
Barium, total recoverable	µg/L	1/quarter	Grab		
Chlorine, total residual	mg/L	1/week	Grab		
Chromium, total recoverable	µg/L	1/month	Grab		
Copper, total recoverable	µg/L	1/quarter	Grab		
Flow rate	MGD	Daily	24-hr total		
Iron, total recoverable	µg/L	1/quarter	Grab		

Table 2.3. FBP NPDES permit summary July 2020 – December 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 009 (X-230L North Holding Pond)					
Mercury, total	ng/L	1/quarter	Grab		
Oil & grease	mg/L	1/month	Grab		10
PCBs	µg/L	1/month	24-hr composite		*d*
pH	SU	1/week	Grab		6.5–9.0
Thallium, total recoverable	µg/L	1/month	Grab		
Trichloroethene	µg/L	1/month	Grab		
Total suspended solids[b]	mg/L	1/week	Grab	30	45
Zinc, total recoverable	µg/L	1/quarter	Grab		
FBP Outfall 010 (X-230J5 Northwest Holding Pond)					
Chromium, total recoverable	µg/L	1/month	24-hr composite		
Copper, total recoverable	µg/L	1/quarter	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Iron, total recoverable	µg/L	1/quarter	24-hr composite		
Lead, total recoverable	µg/L	1/quarter	24-hr composite		
Mercury, total	ng/L	1/quarter	Grab		
Oil & grease	mg/L	1/month	Grab		10
PCBs	µg/L	1/month	24-hr composite		*d*
pH	SU	1/2 weeks	Grab		6.5–9.0
Precipitation, total	in.	Daily	24-hr total		
Selenium, total recoverable	µg/L	1/quarter	24-hr composite		
Thallium, total recoverable	µg/L	1/month	24-hr composite		
Total suspended solids[b]	mg/L	1/2 weeks	24-hr composite	30	45
Trichloroethene	µg/L	1/month	Grab		
Zinc, total recoverable	µg/L	1/quarter	24-hr composite		
FBP Outfall 011 (X-230J6 Northeast Holding Pond)					
Chlorine, total residual	mg/L	1/2 weeks	Grab	0.05	0.05
Chromium, total recoverable	µg/L	1/month	Grab		
Copper, total recoverable	µg/L	1/quarter	Grab		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/quarter	Grab		
Oil & grease	mg/L	1/2 weeks	Grab		10
PCBs	µg/L	1/month	Grab		*d*
pH	SU	1/2 weeks	Grab		6.5–9.0
Precipitation, total	in.	Daily	24-hr total		
Selenium, total recoverable	µg/L	1/quarter	Grab		5.6
Thallium, total recoverable	µg/L	1/month	Grab		
Total suspended solids[b]	mg/L	1/2 weeks	Grab	30	45
Trichloroethene	µg/L	1/month	Grab		
Zinc, total recoverable	µg/L	1/month	Grab		

Table 2.3. FBP NPDES permit summary July 2020 – December 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 015 (X-624 Groundwater Treatment Facility)					
Arsenic, total recoverable	µg/L	1/quarter	Grab		
Barium, total recoverable	µg/L	1/quarter	Grab		
Flow rate	MGD	Daily	24-hr total		
PCBs	µg/L	1/quarter	Grab		*d*
pH	SU	1/2 weeks	Grab		6.5–9.0
Trichloroethene	µg/L	1/2 weeks	Grab	10	10
FBP Outfall 602 (X-621 Coal Pile Runoff Treatment Facility)					
Flow rate	MGD	Daily	24-hr total estimate		
Iron, total[b]	µg/L	1/2 weeks	Grab	3500	7000
Manganese, total[b]	µg/L	1/2 weeks	Grab	2000	4000
pH	SU	1/2 weeks	Grab		
Precipitation, total	in.	Daily	24-hr total		
Residue, settleable	mL/L	When disch	Grab		
Total suspended solids[b]	mg/L	1/2 weeks	Grab	35	50
FBP Outfall 604 (X-700 Biodenitrification Facility)					
Copper, total	µg/L	1/month	Grab		
Iron, total	µg/L	1/month	Grab		
Flow rate	MGD	Daily	24-hr total estimate		
Nickel, total	µg/L	1/month	Grab		
Nitrogen, nitrate	mg/L	1/month	Grab		
pH	SU	1/month	Grab		6.5–9.0
Zinc, total	µg/L	1/month	Grab		
FBP Outfall 605 (X-705 Microfiltration Treatment System)					
Chromium, hexavalent	µg/L	1/month	Grab		
Chromium, total	µg/L	1/month	Grab		
Copper, total	µg/L	1/month	Grab		
Flow rate	MGD	Daily	24-hr total		
Nickel, total	µg/L	1/month	Grab		
Nitrogen, ammonia (NH_3)	mg/L	1/month	Grab		
Nitrogen, nitrate	mg/L	1/month	Grab		
Nitrogen, nitrite	mg/L	1/month	Grab		
Nitrogen, Kjeldahl	mg/L	1/month	Grab		
Oil & grease	mg/L	1/month	Grab		
pH	SU	1/month	Grab		6.5–10.0
Sulfate (SO_4)	mg/L	1/month	Grab		
Total suspended solids	mg/L	1/month	Grab	20	30
Trichloroethene	µg/L	1/month	Grab		
Zinc, total	µg/L	1/month	Grab		

Table 2.3. FBP NPDES permit summary July 2020 – December 2020 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 608 (X-622 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2 weeks	Grab		
trans-1,2-dichloroethene	µg/L	1/2 weeks	Grab	25	66
Trichloroethene	µg/L	1/2 weeks	Grab	10	10
FBP Outfall 610 (X-623 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2 weeks	Grab		
trans-1,2-dichloroethene	µg/L	1/2 weeks	Grab	25	66
Trichloroethene	µg/L	1/2 weeks	Grab	10	10
FBP Outfall 611 (X-627 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2 weeks	Grab		
Trichloroethene	µg/L	1/2 weeks	Grab	10	10
FBP Monitoring Station 801 (Upstream Monitoring)					
48-hr acute toxicity, *Ceriodaphnia dubia*	% affected	1/quarter	Grab		
96-hr acute toxicity, *Pimephales promelas*	% affected	1/quarter	Grab		
FBP Monitoring Station 902 (Downstream Farfield Monitoring)					
Water temperature	°C	2/week	24-hr maximum	27.8[c]	29.4[c]
FBP Monitoring Station 903 (Downstream Farfield Monitoring)					
Water temperature	°C	2/week	24-hr maximum	27.8[c]	29.4[c]

[a]If provided in the permit, the loading limit, in kg/day or kg/month, is provided in parentheses.
[b]Limitations do not apply if flow increases as a result of a precipitation or snow melt event and conditions specified in the permit are met.
[c]Summer only (May through October).
[d]No detectable PCBs.

Table 2.4. MCS NPDES permit summary – 2020

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Unit	Measurement frequency	Sampling type	Concentration	
				Monthly	Daily
MCS Outfall 001[a]					
Biochemical oxygen demand, 5-day	mg/L	1/week	24-hr composite		
Chlorine, total residual	mg/L	Daily	Grab		0.05
Residue, total filterable	mg/L	1/week	24-hr composite		1500
Flow rate	GPD	Daily	24-hr total estimate		
Nitrogen, ammonia	mg/L	1/week	24-hr composite		
Oil and grease, total	mg/L	1/month	Grab		
pH	SU	Daily	Grab		6.5–9.0
Phosphorus, total	mg/L	1/week	24-hr composite		
Total suspended solids[b]	mg/L	1/week	24-hr composite	30	45
Water temperature	°F	Daily	Maximum	*c*	*c*
MCS Outfall 602					
Flow rate	GPD	Daily	24-hr total estimate		
pH	SU	Daily	Grab		

[a]These monitoring requirements and limits apply only when process water is being discharged through the outfall.
[b]Limitations do not apply if flow increases as a result of a precipitation or snow melt event and conditions specified in the permit are met.
[c]Maximum daily and monthly average limits vary according to month.

Table 2.5. FBP NPDES discharge summary and compliance rates – 2020

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Unit
Outfall 001 (X-230J7 East Holding Pond)						
Cadmium, total recoverable	-	2(2)	< 0.088	< 0.088		µg/L
Chlorine, total residual	98	49(34)	< 0.02	0.052		mg/L
monthly average	100	12	0	0.03		mg/L
Copper, total recoverable	-	4(1)	< 0.71	3.3		µg/L
Flow rate	-	366	0.080	2.29	0.620	MGD
Fluoride, total	-	4(3)	< 0.17	0.20		mg/L
Mercury, total (low level)	100	12(0)	4.28	11.1	6.69	ng/L
monthly average[d]	100	12	4.28	11.1	6.69	ng/L
Oil & grease	100	48(46)	< 1.6	5.1		mg/L
monthly average[d]	100	6	0	1.1		mg/L
pH	100	48	7.22	8.89	8.03	SU
Precipitation, total	-	366	0	2.36	0.13	in.
Residue, total filterable	-	24(0)	110	380	211	mg/L
Silver, total recoverable	-	8(6)	< 0.045	0.088		µg/L
Total suspended solids	100	48(3)	0.8	9.6		mg/L
monthly average[d]	100	12	2.6	6.8		mg/L
Zinc, total recoverable	-	4(1)	< 2	54		µg/L
Outfall 002 (X-230K South Holding Pond)						
Bis(2-ethylhexyl)phthalate	100	6(6)	< 0.58	< 0.74		µg/L
monthly average[d]	100	6	0	0		µg/L
Cadmium, total recoverable	-	2(2)	< 0.088	< 0.088		µg/L
Chlorine, total residual	-	24(2)	< 0.02	0.097	0.045	mg/L
Flow rate	-	366	0.005	2.59	0.472	MGD
Fluoride, total	-	4(4)	< 0.17	< 0.17		mg/L
Mercury, total (low level)	-	4(0)	1.70	8.66	4.58	ng/L
Nitrogen, ammonia (NH_3)	-	6(0)	0.034	0.11	0.071	mg/L
Oil & grease	100	48(47)	< 1.6	2.3		mg/L
pH	100	48	7.49	8.70	8.02	SU
Selenium, total recoverable	-	8(7)	< 1	1.3		µg/L
Silver, total recoverable	-	2(1)	< 0.045	0.065		µg/L
Thallium, total recoverable	-	2(2)	< 0.066	< 0.066		µg/L
Total suspended solids	100	48(2)	< 1.1	32	7.0	mg/L
monthly average[d]	100	12	1.2	15	7.0	mg/L
Outfall 003 (X-6619 Sewage Treatment Plant)						
Acute toxicity, *Ceriodaphnia dubia*	-	3(3)	< 1	< 1		TUa
Acute toxicity, *Pimephales promelas*	-	3(3)	< 1	< 1		TUa
Carbonaceous biochemical oxygen demand, 5-day	100	48(39)	< 5.0	11.8		mg/L
monthly average[d]	100	12	0	5.1		mg/L
Carbonaceous biochemical oxygen demand, 5-day (loading)	100	48	0	15		kg/day
monthly average[d]	100	12	0	4.2		kg/day
Copper, total recoverable	-	2(0)	2.8	3.8	3.3	µg/L

Table 2.5. FBP NPDES discharge summary and compliance rates – 2020 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Unit
Outfall 003 (X-6619 Sewage Treatment Plant)						
E. coli[b]	100	24(12)	< 1	6.3		#/100 mL
monthly average[d]	100	12	0	3.4		#/100 mL
Flow rate	-	366	0.156	0.657	0.299	MGD
Mercury, total (low level)	100	24(0)	7.52	101	35.9	ng/L
monthly average[d]	67	12	7.52	53.1	29.2	ng/L
Mercury, total (low level) (loading)	100	24	0.00000925	0.000141	0.0000454	kg/day
monthly average[d]	83	12	0.00000925	0.0000687	0.0000353	kg/day
Nitrite plus nitrate (NH_3)	-	3(0)	6.12	8.8	7.5	mg/L
Nitrogen, ammonia	-	24(13)	< 0.022	2.1		mg/L
Oil & grease	-	4(4)	< 1.7	< 2		mg/L
pH	100	200	7.15	8.63	7.85	SU
Silver, total recoverable	-	2(1)	< 0.045	0.058		µg/L
Thallium, total recoverable	-	2(1)	< 0.066	0.11		µg/L
Total suspended solids	98	48(10)	0.8	19		mg/L
monthly average[d]	100	12	0.6	7.5		mg/L
Total suspended solids (loading)	100	48	0	25		kg/day
monthly average[d]	100	12	0.63	8.3		kg/day
Zinc, total recoverable	-	2(0)	27	39	33	µg/L
Outfall 004 (Cooling Tower Blowdown)						
Acute toxicity, *Ceriodaphnia dubia*	-	4(4)	< 1	< 1		TUa
Acute toxicity, *Pimephales promelas*	-	4(4)	< 1	< 1		TUa
Beryllium, total recoverable	-	6(6)	< 0.15	< 0.15		µg/L
Cadmium, total recoverable	-	6(5)	< 0.088	0.088		µg/L
Chlorine, total residual	100	45(45)	< 0.02	< 0.02		mg/L
Chromium, total recoverable	-	6(0)	8.3	15	10.3	µg/L
Cobalt, total recoverable	-	6(0)	0.22	0.31	0.26	µg/L
Copper, total recoverable	100	12(0)	24	44	33	µg/L
Copper, total recoverable (loading)	100	12	0.0020	0.0070	0.0047	kg/day
Flow rate	-	324	0	0.136	0.038	MGD
Fluoride, total	-	6(0)	0.19	0.38	0.27	µg/L
Mercury, total (low level)	100	8(0)	1.53	3.11	2.21	ng/L
monthly average[d]	100	6	1.64	3.11	2.33	ng/L
Mercury, total (low level) (loading)	100	6	0.000000251	0.000000530	0.000000347	kg/day
monthly average[d]	100	6	0.000000251	0.000000530	0.000000347	kg/day
Nickel, total recoverable	-	6(0)	0.53	2.2	1.5	µg/L
Oil & grease	100	27(25)	< 1.6	< 2.0		mg/L
monthly average[d]	100	6	0	0		mg/L
PCBs		6(6)	< 0.094	< 0.11		µg/L

Table 2.5. FBP NPDES discharge summary and compliance rates – 2020 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Unit
Outfall 004 (Cooling Tower Blowdown)						
pH	100	26	6.50	8.12	7.01	SU
Residue, total filterable	100	12(0)	460	790	581	mg/L
monthly average[d]	100	6	500	790	597	mg/L
Residue, total filterable (loading)	100	6	45	111	76	kg/day
monthly average[d]	100	6	45	111	76	kg/day
Selenium, total recoverable	-	6(6)	< 1	< 1		µg/L
Silver, total recoverable	-	6(6)	< 0.045	< 0.045		µg/L
Total suspended solids	100	26(1)	< 1.1	9.2	3.7	mg/L
monthly average[d]	100	12	1.2	7.4	3.4	mg/L
Total suspended solids (loading)	100	26	0	1.4	0.52	kg/day
monthly average[d]	100	12	0.09	1.1	0.48	kg/day
Vanadium, total recoverable	-	6(2)	< 1.1	2.2		µg/L
Zinc, total recoverable	-	8(0)	30	36	33	µg/L
Outfall 005 (X-611B Lime Sludge Lagoons)						
Flow rate	-	250	0	4.131	1.121	MGD
Lead, total recoverable	-	6(4)	< 0.23	0.60		µg/L
Mercury, total (low level)	-	8(0)	0.541	4.07	2.24	ng/L
pH	98	42	7.29	9.61	8.57	SU
Selenium, total recoverable	-	6(6)	< 1	< 1		µg/L
Total suspended solids	86	49(13)	< 1.1	20.2		mg/L
monthly average[d]	92	12	0	13.6		mg/L
Outfall 009 (X-230L North Holding Pond)						
Barium, total recoverable	-	2(0)	24	26	25	µg/L
Bis(2-ethylhexyl)phthalate	100	6(6)	< 0.58	< 0.62		µg/L
monthly average[d]	100	6	0	0		µg/L
Chlorine, total residual	100	24(6)	< 0.02	0.045		mg/L
Chromium, total recoverable	-	6(4)	< 0.88	1.5		µg/L
Copper, total recoverable	-	8(1)	< 0.71	2.1	1.3	µg/L
Flow rate	-	366	0.160	2.15	0.846	MGD
Fluoride, total	-	2(1)	< 0.17	0.17		mg/L
Iron, total recoverable	-	2(0)	430	510	470	µg/L
Mercury, total	-	4(0)	1.64	3.61	2.54	ng/L
Oil & grease	100	13(12)	< 1.6	2.3		mg/L
monthly average[d]	100	12	0	2.3		mg/L
PCBs		6(6)	< 0.095	< 0.11		µg/L
pH	100	48	7.41	8.36	7.86	SU
Silver, total recoverable	100	6(6)	< 0.045	< 0.045		µg/L
monthly average[d]	100	6	0	0		µg/L
Thallium, total recoverable	100	6(6)	< 0.066	0.079		µg/L
Total suspended solids	100	48(1)	< 1.1	43	12	mg/L
monthly average[d]	100	12	3.3	29	12	mg/L
Trichloroethene		6(6)	< 0.18	< 0.18		µg/L
Zinc, total recoverable	-	4(0)	13	20	17	µg/L

Table 2.5. FBP NPDES discharge summary and compliance rates – 2020 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Unit
Outfall 010 (X-230J5 Northwest Holding Pond)						
Chromium, total recoverable	-	6(3)	< 0.88	4.4		µg/L
Copper, total recoverable	-	2(0)	2.3	4.8	3.6	µg/L
Flow rate	-	366	0.050	1.10	0.448	MGD
Iron, total recoverable	-	2(0)	1600	4600	3100	µg/L
Lead, total recoverable	-	8(1)	< 0.23	3.1	0.89	µg/L
Mercury, total	-	4(0)	2.79	5.54	4.11	ng/L
Oil & grease	100	13(12)	< 1.6	4.3		mg/L
monthly average[d]	100	12	0	2.15		mg/L
PCBs	100	6(6)	< 0.093	< 0.10		µg/L
pH	100	24	7.21	8.22	7.80	SU
Precipitation, total	-	366	0	2.36	0.13	in.
Selenium, total recoverable	-	8(8)	< 1.0	< 1.0		µg/L
Thallium, total recoverable	-	6(5)	< 0.066	0.18		µg/L
Total suspended solids	100	24(1)	< 1.1	33	10	mg/L
monthly average[d]	100	12	1	24	9.8	mg/L
Trichloroethene		6(6)	< 0.18	< 0.18		µg/L
Zinc, total recoverable	-	8(0)	12	39	28	µg/L
Outfall 011 (X-230J6 Northeast Holding Pond)						
Cadmium, total recoverable	-	2(1)	< 0.088	0.11		µg/L
Chlorine, total residual	100	24(18)	< 0.02	0.05		mg/L
monthly average[d]	100	12	0	0.04		mg/L
Chromium, total recoverable	-	6(0)	1.2	7.0	2.9	µg/L
Copper, total recoverable	-	8(0)	0.97	2.5	1.8	µg/L
Flow rate	-	366	0.007	0.590	0.056	MGD
Fluoride, total	-	4(2)	< 0.17	0.27		mg/L
Oil & grease	100	24(23)	< 1.6	2.6		mg/L
monthly average[d]	100	12	0	1.3		mg/L
PCBs	100	6(6)	< 0.097	< 0.11		µg/L
pH	100	24	7.53	8.53	7.99	SU
Precipitation, total	-	366	0	2.36	0.13	in.
Selenium, total recoverable	-	8(8)	< 1	< 1		µg/L
Thallium, total recoverable	100	8(2)	< 0.066	0.13		µg/L
Total suspended solids	100	24(6)	< 1.1	12		mg/L
monthly average[d]	100	12	0.8	6.6		mg/L
Trichloroethene		6(6)	< 0.18	< 0.18		µg/L
Zinc, total recoverable	-	12(0)	2.9	62	28	µg/L
Outfall 015 (X-624 Groundwater Treatment Facility)						
Arsenic, total recoverable	-	4(3)	< 0.5	0.52		µg/L
Barium, total recoverable	-	4(0)	24	29	27	µg/L
Flow rate	-	188	0.0001	0.0049	0.0021	MGD
PCBs	100	4(4)	< 0.097	< 0.10		µg/L
pH	100	24	7.15	8.33	7.65	SU
Silver, total recoverable	-	6(6)	< 0.045	< 0.045		µg/L
Trichloroethene	100	24(22)	< 0.18	1.1		µg/L
monthly average[d]	100	12	0	0.55		µg/L

Table 2.5. FBP NPDES discharge summary and compliance rates – 2020 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Unit
Outfall 602 (X-621 Coal Pile Runoff Treatment Facility)						
Flow rate	-	28	0.001	0.247	0.118	MGD
Iron, total	100	10(0)	97	910	344	µg/L
monthly average[d]	100	8	129	910	360	µg/L
Manganese, total	100	10(0)	96	340	269	µg/L
monthly average[d]	100	8	96	340	261	µg/L
pH	100	11	7.00	9.56	8.28	SU
Precipitation, total	-	245	0	2.16	0.14	in.
Residue, settleable (volume)		3(3)	< 0.10	< 0.12		mL/L
Total suspended solids	100	10(0)	10	25	17	mg/L
monthly average[d]	100	8	10	25	17	mg/L
Outfall 604 (X-700 Biodenitrification Facility)						
Copper, total	-	4(1)	< 0.71	3.7		µg/L
Flow rate	-	35	0.004	0.011	0.010	MGD
Iron, total	-	4(0)	130	1100	420	µg/L
Nickel, total	-	4(0)	1.1	1.5	1.2	µg/L
Nitrogen, nitrate	-	4(0)	3.9	7.5	6.1	mg/L
pH	100	4	7.72	8.47	8.26	SU
Zinc, total	-	4(0)	6.4	29	13	µg/L
Outfall 605 (X-705 Microfiltration Treatment System)[e]						
Outfall 608 (X-622 Groundwater Treatment Facility)						
Flow rate	-	356	0.0014	0.0860	0.0613	MGD
pH	-	24	7.29	8.35	7.93	SU
Trichloroethene	100	24(0)	1.3	3.45	2.1	µg/L
monthly average[d]	100	12	1.4	2.9	2.1	µg/L
1,2-*trans*-dichloroethene	100	24(24)	< 0.21	< 0.21		µg/L
monthly average[d]	100	12	0	0		µg/L
Outfall 610 (X-623 Groundwater Treatment Facility)						
Flow rate	-	3	0.0015	0.0027	0.0019	MGD
pH	-	3	7.55	7.84	7.71	SU
Trichloroethene	100	3(3)	< 0.18	< 0.18		µg/L
monthly average[d]	100	3	0	0		µg/L
1,2-*trans*-dichloroethene	100	3(3)	< 0.21	< 0.21		µg/L
monthly average[d]	100	3	0	0		µg/L
Outfall 611 (X-627 Groundwater Treatment Facility)						
Flow rate	-	366	0.0178	0.0457	0.0311	MGD
pH	-	24	6.95	8.89	8.16	SU
Trichloroethene	100	24(13)	< 0.18	6.0		µg/L
monthly average[d]	100	12	0	5.8		µg/L
Monitoring Station 801 (Upstream Monitoring)						
48-hr acute toxicity, *Ceriodaphnia dubia*	-	4(4)	0	0		% affected
96-hr acute toxicity, *Pimephales promelas*	-	4(4)	0	0		% affected

Table 2.5. FBP NPDES discharge summary and compliance rates – 2020 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Unit
Monitoring Station 902 (Downstream Farfield Monitoring)						
Water temperature	100	96	3.48	28.13	16.07	°C
monthly average	100	12	6.04	27.46	16.07	°C
Monitoring Station 903 (Downstream Farfield Monitoring)						
Water temperature	100	96	4.86	26.90	16.48	°C
monthly average	100	12	6.61	25.81	16.48	°C

[a]Compliance rates are provided only for those parameters with a limit specified in the NPDES permit (many parameters require monitoring only). At all outfalls except Outfalls 003, 004, and 605, permit limitations do not apply to total suspended solids if flow increases as a result of precipitation or snow melt and conditions set in the permit are met. Sample results for total suspended solids that are elevated due to precipitation (and not subject to permit limitations) are not reported in this table, although they are included in the total number of samples reported for each outfall.
[b]Number in parentheses is the number of samples that were below the detection limit.
[c]Averages were not calculated for outfalls that had greater than 15% of the results below the detection limit. This criterion was adapted from *Data Quality Assessment: A Reviewer's Guide* (EPA 2006). For outfalls with less than 15% of the results below the detection limit, any result below the detection limit was assumed to be zero for calculating the average for the parameter in accordance with averaging for NPDES data completed by Ohio EPA.
[d]To compute the monthly average, parameters that were undetected were assumed to be zero. Exceedances due to flow increases from precipitation or snow melt (see footnote a) were not included in the monthly average calculation. The monthly average limitation for some parameters was added to some outfalls or deleted from some outfalls in the NPDES permit effective July 1, 2020.
[e]The X-705 Microfiltration Treatment System (Outfall 605) did not operate in 2020.

Table 2.6. MCS NPDES discharge summary and compliance rates – 2020

Parameter	NPDES compliance rate (%)	Number of measurements	Result			Unit
			Minimum	Maximum	Average	
		Outfall 001[a]				
		Outfall 602				
Flow rate	-	366	350	11,512	6213	GPD
pH	100	255	6.51	8.76	7.72	SU

[a]This outfall was not used for process water discharges in 2020; therefore, monitoring was not required.

Table 2.7. Centrus NPDES discharge monitoring results – 2020

Parameter	Number of samples[a]	Concentration			Unit
		Minimum	Maximum	Average[b]	
Outfall 012 (X-230M Southwest Holding Pond)					
Chlorine	24(0)	0	0.05	0.02	mg/L
Flow rate	366	0.0273	1.631	0.261	MGD
Mercury	12(0)	0.714	4.97	2.29	ng/L
Oil and grease	24(21)	< 1.6	1.9		mg/L
PCBs, total	1(1)	< 0.096			µg/L
pH	24	7.60	8.64	8.14	SU
Total suspended solids	24(4)	< 1.1	10		mg/L
Outfall 013 (X-230N West Holding Pond)					
Barium	12(0)	19	35	26	µg/L
Cadmium	12(5)	< 0.018	0.43		µg/L
Chlorine	24(0)	0	0.050	0.017	mg/L
Copper	12(2)	< 0.71	5.1		µg/L
Flow rate	366	0.0154	1.502	0.206	MGD
Mercury	12(1)	0.374	< 10	2.79	ng/L
Oil and grease	24(23)	< 1.6	< 2.3		mg/L
PCBs, total	1(1)	< 0.1			µg/L
pH	24	7.02	8.53	8.17	SU
Total suspended solids	24(3)	< 1.1	9.2	3.8	mg/L
Zinc	12(0)	2.1	37	18	µg/L
Outfall 613 (X-6002 Particulate Separator)					
Chlorine	11(0)	0	0.05	0.03	mg/L
Flow rate	48	0	0.022	0.0010	MGD
Total suspended solids	11(5)	< 1.1	8.8		mg/L

[a]Number in parentheses is the number of samples that were below the detection limit.
[b]Averages were not calculated for outfalls that had greater than 15% of the results below the detection limit. This criterion was adapted from *Data Quality Assessment: A Reviewer's Guide* (EPA 2006). For outfalls with less than 15% of the results below the detection limit, any result below the detection limit was assigned a value at the detection limit for calculating an average for the parameter in accordance with averaging for NPDES data completed by Ohio EPA.

Table 2.8. Radionuclides in surface water runoff samples from FBP and MCS cylinder storage yards – 2020

Sample location	Parameter	Unit	Number of samples[a]	Minimum[b]	Maximum	Average[c]
			FBP cylinder storage yards			
X745-B1	Alpha activity	pCi/L	10(3)	< 1.07	14.5	
	Beta activity	pCi/L	10(0)	3.43	59.5	19.3
	Uranium	µg/L	10(0)	0.22	1.35	0.720
X745-B2	Alpha activity	pCi/L	11(0)	1.96	182	42.9
	Beta activity	pCi/L	11(1)	< 5.67	88.4	38.7
	Uranium	µg/L	11(1)	< 0.009	115	36.4
X745-B3	Alpha activity	pCi/L	11(4)	< 2.21	30.9	
	Beta activity	pCi/L	11(0)	4.58	138	27.5
	Uranium	µg/L	11(0)	0.12	39	5.90
X745-D1	Alpha activity	pCi/L	12(4)	< 1.01	33.7	
	Beta activity	pCi/L	12(0)	3.69	100	23.6
	Uranium	µg/L	12(0)	0.0801	43.8	9.69
X745-F1	Alpha activity	pCi/L	11(5)	< 1.32	18.5	
	Beta activity	pCi/L	11(4)	< 0.20	23.3	
	Uranium	µg/L	11(0)	0.16	7.76	3.67
X745-F2	Alpha activity	pCi/L	12(9)	0	8.1	
	Beta activity	pCi/L	12(4)	< 0.344	31.9	
	Uranium	µg/L	12(0)	0.226	7.13	3.79
X745-F3	Alpha activity	pCi/L	12(5)	< 1.15	4.47	
	Beta activity	pCi/L	12(4)	< 0.394	6.98	
	Uranium	µg/L	12(0)	0.737	4.38	2.59
			MCS cylinder storage yards			
X745-C1	Alpha activity	pCi/L	12(10)	0	9.08	
	Beta activity	pCi/L	12(8)	< 0.12	8.67	
	Uranium	µg/L	12(0)	1.14	6.45	2.80
X745-C2	Alpha activity	pCi/L	12(10)	0	5.09	
	Beta activity	pCi/L	12(9)	< 0.247	5.28	
	Uranium	µg/L	12(0)	0.779	7.11	4.57
X745-C3	Alpha activity	pCi/L	12(11)	0	7.27	
	Beta activity	pCi/L	12(9)	0	6.09	
	Uranium	µg/L	12(0)	0.843	3.83	2.27
X745-C4	Alpha activity	pCi/L	12(11)	< 0.233	4.77	
	Beta activity	pCi/L	12(9)	< 2.15	5.03	
	Uranium	µg/L	12(0)	1.47	4.58	3.39
X745-E1	Alpha activity	pCi/L	12(10)	< 0.158	5.84	
	Beta activity	pCi/L	12(5)	< 1.77	9.71	
	Uranium	µg/L	12(0)	0.246	4.00	1.16

Table 2.8. Radionuclides in surface water runoff samples from FBP and MCS cylinder storage yards – 2020 (continued)

Sample location	Parameter	Unit	Number of samples[a]	Minimum[b]	Maximum	Average[c]
MCS cylinder storage yards (continued)						
X745-G1A	Alpha activity	pCi/L	12(10)	< 0.793	5.67	
	Beta activity	pCi/L	12(12)	< 0.178	< 4.37	
	Uranium	µg/L	12(0)	1.52	4.87	2.24
X745-G2	Alpha activity	pCi/L	12(12)	< 1.31	< 3.59	
	Beta activity	pCi/L	12(7)	0	6.20	
	Uranium	µg/L	12(0)	0.427	3.48	1.83

[a]Number in parentheses is the number of samples that were below the detection limit.
[b]Minimum values reported as "0" may actually be negative results. A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results. These negative value results are reported as "0" in the table for simplicity.
[c]Averages were not calculated for locations that had greater than 15% of the results below the detection limit. For locations with less than 15% of the results below the detection limit, any result below the detection limit was assigned a value at the detection limit to calculate the average for the parameter. These criteria were adapted from *Data Quality Assessment: A Reviewer's Guide* (EPA 2006).

Table 2.9. Drainage basin monitoring of surface water and sediment for MCS cylinder storage yards – 2020

Location	Parameter[a]	First quarter[b]			Second quarter[b]		
		SW-F	SW-UF	Sed	SW-F	SW-UF	Sed
UDS X01	Total PCB	0.0311U	0.0311U	92.5	0.0319U	0.0329U	28.4
RM-8	Total PCB	0.0311U	0.0320U	61.6	0.0323U	0.0322U	45
UDS X02	Total PCB	0.0323U	0.0351U	59	0.0336U	0.0328U	21.26
RM-10	Total PCB	0.0311U	0.0333U	20.7	0.0337U	0.0336U	2.18J

Location	Parameter[a]	Third quarter[b]			Fourth quarter[b]		
		SW-F	SW-UF	Sed	SW-F	SW-UF	Sed
UDS X01	Total PCB	0.0314U	0.0316U	51.2	0.0319U	0.0317U	7.33U
RM-8	Total PCB	0.0313U	0.0314U	14	0.0319U	0.328U	48.3
UDS X02	Total PCB	0.0314U	0.0317U	12.4	0.0316U	0.0321U	49
RM-10	Total PCB	0.0312U	0.0317U	6.48	0.0317U	0.0321U	17.46

[a]Results for surface water (SW) are reported in µg/L; results for sediment (Sed) are reported in µg/kg.
[b]Abbreviations and data qualifiers are as follows: SW-F – filtered surface water. SW-UF – unfiltered surface water. Sed – sediment. J – the reported value is an estimated concentration greater than or equal to the method detection limit but less than the reporting limit. U – undetected.

Table 2.10. Ambient air monitoring program summary for radionuclides and fluoride – 2020

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
		On-site air samplers			
A8	Americium-241	4(4)	< 2.2E-07	< 1.1E-06	
	Fluoride	50(39)	< 0.0052	0.018	
	Neptunium-237	4(4)	0	< 7.4E-07	
	Plutonium-238	4(4)	0	< 1.3E-06	
	Plutonium-239/240	4(4)	< 6.5E-07	< 1.6E-06	
	Technetium-99	12(9)	< 4.6E-06	3.1E-04	
	Thorium-228	4(4)	0	< 3.4E-06	
	Thorium-230	4(4)	< 2.3E-06	< 5.8E-06	
	Thorium-232	4(4)	< 2.5E-07	< 3.1E-06	
	Uranium	12(9)	< 6.6E-06	< 3.6E-05	
	Uranium-233/234	12(11)	< 1.7E-06	1.7E-05	
	Uranium-235/236	12(12)	< 2.8E-07	< 1.9E-06	
	Uranium-238	12(9)	< 2.1E-06	< 1.2E-05	
A10	Americium-241	4(4)	0	< 9.0E-07	
	Fluoride	52(47)	< 0.0040	< 0.015	
	Neptunium-237	4(4)	< 1.2E-07	< 6.5E-07	
	Plutonium-238	4(4)	0	< 1.4E-07	
	Plutonium-239/240	4(4)	< 3.9E-07	< 8.9E-07	
	Technetium-99	12(10)	< 8.2E-06	2.2E-04	
	Thorium-228	4(3)	< 3.1E-07	< 4.8E-06	
	Thorium-230	4(4)	0	< 5.4E-06	
	Thorium-232	4(4)	< 1.6E-06	< 3.3E-06	
	Uranium	12(11)	< 6.9E-06	< 2.3E-05	
	Uranium-233/234	12(10)	< 3.4E-06	1.0E-05	
	Uranium-235/236	12(12)	0	< 7.2E-07	
	Uranium-238	12(11)	< 2.3E-06	< 7.8E-06	
A29	Americium-241	4(4)	0	< 1.4E-06	
	Fluoride	52(41)	< 0.0074	0.035	
	Neptunium-237	4(4)	0	< 1.2E-07	
	Plutonium-238	4(4)	0	< 5.4E-07	
	Plutonium-239/240	4(4)	< 1.4E-07	< 1.2E-06	
	Technetium-99	12(7)	0	< 2.1E-04	
	Thorium-228	4(2)	< 2.9E-06	4.3E-05	
	Thorium-230	4(4)	< 5.8E-08	< 9.8E-06	
	Thorium-232	4(4)	< 1.4E-06	< 7.0E-06	
	Uranium	12(9)	< 9.9E-06	3.0E-05	
	Uranium-233/234	12(12)	< 3.5E-06	< 9.3E-06	
	Uranium-235/236	12(12)	0	< 2.0E-06	
	Uranium-238	12(10)	< 3.3E-06	< 9.8E-06	
A36	Americium-241	4(4)	< 5.0E-07	< 2.5E-06	
	Fluoride	53(41)	< 0.0036	0.031	
	Neptunium-237	4(4)	0	< 1.9E-06	
	Plutonium-238	4(4)	0	< 1.4E-07	
	Plutonium-239/240	4(4)	< 4.0E-07	< 1.2E-06	
	Technetium-99	12(8)	< 1.7E-05	2.2E-04	

Table 2.10. Ambient air monitoring program summary for radionuclides and fluoride – 2020 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
		On-site air samplers			
A36	Thorium-228	4(3)	0	< 4.4E-06	
	Thorium-230	4(4)	0	< 7.7E-06	
	Thorium-232	4(4)	0	< 2.1E-06	
	Uranium	12(5)	< 7.3E-06	6.1E-05	
	Uranium-233/234	12(6)	< 1.5E-06	2.9E-05	
	Uranium-235/236	12(12)	0	< 1.2E-06	
	Uranium-238	12(6)	< 2.4E-06	2.0E-05	
A36 (duplicate (station rad only)	Americium-241	4(4)	< 6.6E-07	< 1.1E-06	
	Neptunium-237	4(4)	0	< 9.0E-07	
	Plutonium-238	4(4)	< 2.8E-07	< 1.2E-06	
	Plutonium-239/240	4(4)	< 1.4E-07	< 9.3E-07	
	Technetium-99	12(7)	< 1.7E-05	7.7E-04	
	Thorium-228	4(3)	< 2.3E-06	6.3E-06	
	Thorium-230	4(4)	0	< 5.8E-06	
	Thorium-232	4(4)	< 1.1E-06	< 3.8E-06	
	Uranium	12(3)	< 1.2E-05	5.6E-05	
	Uranium-233/234	12(5)	< 3.3E-06	2.9E-05	
	Uranium-235/236	12(12)	< 1.6E-07	< 2.2E-06	
	Uranium-238	12(5)	< 3.9E-06	1.9E-05	
A40A	Fluoride	53(41)	< 0.0045	0.028	
A50	Americium-241	1(1)	< 8.3E-07		
	Neptunium-237	1(1)	0		
	Plutonium-238	1(1)	< 4.8E-07		
	Plutonium-239/240	1(1)	< 4.8E-07		
	Technetium-99	3(3)	< 1.1E-05	< 4.0E-05	
	Thorium-228	1(1)	< 5.2E-06		
	Thorium-230	1(1)	< 2.6E-06		
	Thorium-232	1(0)	4.3E-06		
	Uranium	3(1)	< 2.3E-05	3.7E-05	
	Uranium-233/234	3(1)	1.0E-05	1.9E-05	
	Uranium-235/236	3(3)	< 7.4E-07	< 1.1E-06	
	Uranium-238	3(1)	< 7.5E-06	1.2E-05	
A52	Americium-241	1(1)	< 1.3E-06		
	Neptunium-237	1(1)	< 2.0E-07		
	Plutonium-238	1(1)	< 9.2E-07		
	Plutonium-239/240	1(1)	< 1.1E-06		
	Technetium-99	3(2)	< 4.2E-05	5.6E-04	
	Thorium-228	1(1)	< 9.3E-07		
	Thorium-230	1(1)	0		
	Thorium-232	1(1)	< 3.3E-06		
	Uranium	3(1)	< 2.1E-05	6.5E-05	
	Uranium-233/234	3(1)	< 9.7E-06	4.0E-05	
	Uranium-235/236	3(3)	< 2.6E-07	< 2.5E-06	
	Uranium-238	3(1)	< 6.9E-06	2.1E-05	

Table 2.10. Ambient air monitoring program summary for radionuclides and fluoride – 2020 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
		On-site air samplers			
A54	Americium-241	1(1)	< 8.8E-07		
	Neptunium-237	1(1)	0		
	Plutonium-238	1(1)	0		
	Plutonium-239/240	1(1)	0		
	Technetium-99	3(3)	0	< 3.2E-05	
	Thorium-228	1(1)	< 5.0E-06		
	Thorium-230	1(1)	< 2.0E-06		
	Thorium-232	1(1)	< 4.3E-06		
	Uranium	3(2)	< 1.5E-05	2.5E-05	
	Uranium-233/234	3(2)	< 6.6E-06	1.4E-05	
	Uranium-235/236	3(3)	< 1.7E-07	< 1.0E-06	
	Uranium-238	3(3)	< 4.8E-06	< 8.2E-06	
T7	Americium-241	4(4)	< 2.5E-07	< 1.8E-06	
	Neptunium-237	4(4)	0	< 3.4E-07	
	Plutonium-238	4(4)	0	< 1.2E-06	
	Plutonium-239/240	4(4)	0	< 9.7E-07	
	Technetium-99	12(7)	< 9.7E-06	2.1E-04	
	Thorium-228	4(4)	< 1.3E-06	< 3.1E-06	
	Thorium-230	4(4)	0	< 4.8E-06	
	Thorium-232	4(4)	< 2.5E-07	< 2.1E-06	
	Uranium	12(11)	< 3.8E-06	2.3E-05	
	Uranium-233/234	12(11)	< 2.0E-06	1.5E-05	
	Uranium-235/236	12(12)	< 1.5E-07	< 7.7E-07	
	Uranium-238	12(11)	< 1.2E-06	< 7.8E-06	
		Off-site air samplers			
A3	Americium-241	4(4)	< 1.4E-07	< 8.8E-07	
	Fluoride	51(29)	0.0037	0.039	
	Neptunium-237	4(4)	0	< 3.6E-07	
	Plutonium-238	4(4)	0	0	
	Plutonium-239/240	4(4)	< 4.8E-07	< 1.4E-06	
	Technetium-99	12(9)	0	2.4E-04	
	Thorium-228	4(4)	< 5.6E-07	< 5.0E-06	
	Thorium-230	4(4)	< 5.5E-07	< 9.2E-06	
	Thorium-232	4(4)	< 2.0E-06	< 2.6E-06	
	Uranium	12(11)	< 5.8E-06	< 2.8E-05	
	Uranium-233/234	12(11)	< 4.2E-06	1.5E-05	
	Uranium-235/236	12(12)	< 1.3E-07	< 1.9E-06	
	Uranium-238	12(11)	< 1.8E-06	< 9.2E-06	
A6	Americium-241	4(4)	< 2.0E-07	< 1.5E-06	
	Fluoride	48(40)	< 0.0046	< 0.024	
	Neptunium-237	4(4)	0	< 5.3E-07	
	Plutonium-238	4(4)	0	< 9.7E-07	
	Plutonium-239/240	4(4)	< 5.3E-07	< 1.6E-06	
	Technetium-99	12(9)	0	2.2E-04	
	Thorium-228	4(3)	0	< 4.4E-06	
	Thorium-230	4(4)	0	< 5.6E-06	
	Thorium-232	4(4)	< 1.2E-06	< 2.9E-06	

Table 2.10. Ambient air monitoring program summary for radionuclides and fluoride – 2020 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
A6	Uranium	12(9)	< 6.9E-06	< 3.4E-05	
	Uranium-233/234	12(12)	< 2.5E-06	< 1.1E-05	
	Uranium-235/236	12(12)	0	< 1.1E-06	
	Uranium-238	12(10)	< 2.2E-06	< 1.1E-05	
A9	Americium-241	4(4)	< 1.2E-07	< 1.5E-06	
	Fluoride	52(44)	< 0.0048	0.023	
	Neptunium-237	4(4)	0	< 3.6E-07	
	Plutonium-238	4(4)	0	< 7.5E-07	
	Plutonium-239/240	4(4)	< 4.3E-07	< 1.2E-06	
	Technetium-99	12(8)	0	1.4E-04	
	Thorium-228	4(2)	1.8E-06	6.7E-06	
	Thorium-230	4(4)	< 2.1E-06	< 7.7E-06	
	Thorium-232	4(4)	< 2.1E-06	< 3.7E-06	
	Uranium	12(10)	< 6.5E-06	2.1E-05	
	Uranium-233/234	12(12)	< 3.9E-06	< 7.0E-06	
	Uranium-235/236	12(12)	< 3.2E-07	< 1.2E-06	
	Uranium-238	12(11)	< 2.1E-06	< 6.9E-06	
A12	Americium-241	4(4)	< 3.7E-07	< 1.6E-06	
	Fluoride	52(29)	< 0.0046	0.097	
	Neptunium-237	4(4)	0	< 1.2E-07	
	Plutonium-238	4(4)	0	< 2.6E-07	
	Plutonium-239/240	4(4)	< 2.5E-07	< 5.7E-07	
	Technetium-99	12(7)	< 7.3E-06	6.0E-04	
	Thorium-228	4(3)	< 1.4E-06	5.3E-06	
	Thorium-230	4(4)	0	< 5.0E-06	
	Thorium-232	4(3)	< 1.1E-06	4.2E-06	
	Uranium	12(9)	< 3.9E-06	7.7E-05	
	Uranium-233/234	12(10)	< 3.5E-06	2.8E-05	
	Uranium-235/236	12(12)	< 2.0E-07	< 1.9E-06	
	Uranium-238	12(9)	<1.3E-06	2.6E-05	
A15	Americium-241	4(4)	0	< 1.2E-06	
	Fluoride	52(39)	< 0.0041	0.016	
	Neptunium-237	4(4)	< 1.3E-07	< 8.3E-07	
	Plutonium-238	4(4)	< 1.4E-07	< 4.5E-07	
	Plutonium-239/240	4(4)	< 2.6E-07	< 9.1E-07	
	Technetium-99	12(8)	0	3.6E-04	
	Thorium-228	4(2)	< 1.3E-06	2.6E-05	
	Thorium-230	4(4)	< 5.6E-07	< 5.7E-06	
	Thorium-232	4(4)	< 6.1E-07	< 3.4E-06	
	Uranium	12(11)	< 7.8E-06	< 2.3E-05	
	Uranium-233/234	12(11)	< 3.4E-06	3.2E-05	
	Uranium-235/236	12(12)	< 2.0E-07	< 1.5E-06	
	Uranium-238	12(11)	< 2.5E-06	< 7.4E-06	
A23	Americium-241	4(4)	0	< 9.2E-07	
	Fluoride	53(42)	< 0.0039	0.024	
	Neptunium-237	4(4)	0	< 1.5E-06	
	Plutonium-238	4(4)	< 1.9E-07	< 7.3E-07	
	Plutonium-239/240	4(4)	0	< 2.1E-06	

Table 2.10. Ambient air monitoring program summary for radionuclides and fluoride – 2020 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
A23	Technetium-99	12(9)	< 1.5E-06	3.0E-04	
	Thorium-228	4(2)	< 4.0E-06	6.7E-06	
	Thorium-230	4(4)	< 1.1E-06	< 7.8E-06	
	Thorium-232	4(2)	< 2.3E-06	5.2E-06	
	Uranium	12(9)	8.7E-06	2.5E-05	
	Uranium-233/234	12(11)	< 3.5E-06	1.3E-05	
	Uranium-235/236	12(12)	< 1.6E-07	< 1.4E-06	
	Uranium-238	12(10)	2.9E-06	8.2E-06	
A24	Americium-241	4(4)	< 2.5E-07	< 9.3E-07	
	Fluoride	51(36)	< 0.0028	0.020	
	Neptunium-237	4(4)	0	< 4.4E-07	
	Plutonium-238	4(4)	0	< 6.6E-07	
	Plutonium-239/240	4(4)	< 4.0E-07	< 1.2E-06	
	Technetium-99	12(8)	< 4.0E-06	2.2E-04	
	Thorium-228	4(2)	4.3E-06	7.6E-06	
	Thorium-230	4(4)	< 3.7E-06	< 1.0E-05	
	Thorium-232	4(4)	< 2.1E-06	< 3.0E-06	
	Uranium	12(8)	< 9.8E-06	2.7E-04	
	Uranium-233/234	12(10)	< 4.5E-06	8.5E-05	
	Uranium-235/236	12(11)	0	4.2E-06	
	Uranium-238	12(9)	< 3.2E-06	8.9E-05	
A28	Americium-241	4(4)	0	< 1.2E-06	
	Fluoride	51(35)	< 0.0061	0.026	
	Neptunium-237	4(4)	0	< 6.3E-07	
	Plutonium-238	4(4)	0	< 1.6E-06	
	Plutonium-239/240	4(4)	0	< 1.6E-06	
	Technetium-99	12(8)	< 1.3E-05	1.9E-04	
	Thorium-228	4(2)	< 3.3E-06	5.7E-06	
	Thorium-230	4(4)	0	< 5.0E-06	
	Thorium-232	4(4)	< 1.3E-06	< 2.9E-06	
	Uranium	12(10)	9.3E-06	< 1.9E-05	
	Uranium-233/234	12(12)	< 2.8E-06	< 6.3E-06	
	Uranium-235/236	12(12)	0	< 7.3E-07	
	Uranium-238	12(11)	3.0E-06	< 6.2E-06	
A37 (background)	Americium-241	4(4)	0	< 2.2E-06	
	Fluoride	52(38)	< 0.0045	< 0.015	
	Neptunium-237	4(4)	< 1.3E-07	< 7.4E-07	
	Plutonium-238	4(4)	0	< 1.4E-07	
	Plutonium-239/240	4(4)	< 8.4E-07	< 1.9E-06	
	Technetium-99	12(8)	< 2.9E-06	1.8E-04	
	Thorium-228	4(3)	< 2.7E-06	9.3E-06	
	Thorium-230	4(4)	0	< 5.3E-06	
	Thorium-232	4(4)	< 1.2E-06	< 3.0E-06	
	Uranium	12(10)	< 7.1E-06	< 3.3E-05	
	Uranium-233/234	12(12)	< 2.3E-06	< 9.6E-06	
	Uranium-235/236	12(12)	0	< 1.0E-06	
	Uranium-238	12(11)	< 2.3E-06	< 1.1E-05	

Table 2.10. Ambient air monitoring program summary for radionuclides and fluoride – 2020 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
A41A	Americium-241	4(4)	< 2.5E-07	< 1.4E-06	
	Fluoride	52(33)	< 0.0045	0.019	
	Neptunium-237	4(4)	0	< 8.3E-07	
	Plutonium-238	4(4)	0	< 5.1E-07	
	Plutonium-239/240	4(4)	< 2.6E-07	< 1.8E-06	
	Technetium-99	12(8)	< 3.4E-06	2.3E-04	
	Thorium-228	4(3)	< 2.0E-06	7.1E-06	
	Thorium-230	4(4)	< 1.2E-06	< 8.6E-06	
	Thorium-232	4(4)	< 8.8E-07	3.8E-06	
	Uranium	12(11)	< 6.9E-06	< 2.1E-05	
	Uranium-233/234	12(11)	< 3.4E-06	1.8E-05	
	Uranium-235/236	12(12)	< 1.9E-07	< 1.0E-06	
	Uranium-238	12(12)	< 2.3E-06	< 6.9E-06	

[a]All parameters are measured in pCi/m^3 with the exception of uranium and fluoride which are measured in $\mu g/m^3$.
[b]Radiological samples for technetium-99, uranium, and uranium isotopes are analyzed monthly, samples for americium-241, neptunium-237, plutonium-238, and plutonium-239/240 are analyzed one month per quarter, and samples for fluoride are analyzed weekly. Number in parentheses is the number of samples that were below the detection limit. If the analytical result for a sample was below the detection limit, the ambient air concentration was calculated based on the value for the undetected result.
[c]Results for radionuclides are provided in scientific notation. The number and sign (+ or -) to the right of the "E" indicate the number of places to the right or left of the decimal point. For example, 3.4E-04 is 0.00034 (the decimal point moves four places to the left); 2.1E+02 is 210 (the decimal point moves two places to the right).
Ambient concentrations of uranium and uranium isotopes reported in 2020 may be slightly elevated and should be considered estimated. Uranium and uranium isotopes were detected in quality control samples associated with the ambient air samples and subsequently in unused filters obtained from the manufacturer that are placed at the ambient air stations to collect samples. The presence of uranium and uranium isotopes in the unused filters may have caused slightly elevated analytical results for uranium and uranium isotopes. Levels of these constituents in ambient air are calculated based on the analytical results and therefore may be slightly elevated as well. Reported minimum and maximum values include these estimated results.
[d]Values reported as less than (<) are based on an undetected result. In some cases, a detected result is between minimum and maximum results that are based on undetected results. This can happen because detection limits can vary for samples and because results can be qualified as undetected during data validation.
Values reported as "0" may actually be negative results. A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results. These negative value results are reported as "0" in the table for simplicity.
[e]Averages are not calculated for locations that had greater than 15% of the results below the detection limit. For locations with less than 15% of the results below the detection limit, any result below the detection limit was assigned the value of the undetected result to calculate the average for the parameter. These criteria were adapted from *Data Quality Assessment: A Reviewer's Guide* (EPA 2006).

Table 2.11. Ambient air monitoring program summary for non-radionuclides – 2020

Sampling Location	Parameter	No. of measurements[a]	Minimum[b, c]	Maximum[b, c]	Average[d]
	Particulate matter (PM)[e] (µg/kg)				
A50	PM 2.5 (hourly average)	564	1.2	27.6	10.2
	PM 2.5 (daily average)	23	5.0	17.2	10.1
	PM 10 (hourly average)	564	1.8	156.1	17.7
	PM 10 (daily average)	23	9.1	30.8	17.7
	Metals (µg/kg)				
	Antimony	4(4)	< 5.26E-04	< 2.31E-03	
	Arsenic	4(4)	< 4.05E-03	< 5.94E-03	
	Beryllium	4(4)	< 1.16E-04	< 1.53E-04	
	Cadmium	4(4)	< 6.37E-04	< 9.81E-04	
	Chromium	4(4)	< 6.05E-03	< 9.68E-03	
	Cobalt	4(2)	< 1.34E-04	< 5.41E-04	
	Lead	4(4)	< 3.50E-03	< 7.47E-03	
	Manganese	4(4)	< 1.92E-02	< 3.46E-02	
	Mercury	4(4)	< 1.58E-05	< 2.47E-05	
	Nickel	4(2)	< 2.57E-03	8.51E-03	
	Selenium	4(3)	< 9.29E-05	3.55E-04	
	VOCs (parts per billion by volume)				
	1,1,1-Trichloroethane	3(3)	< 0.049	< 0.049	
	1,1,2-Trichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethene	3(3)	< 0.020	< 0.020	
	1,2-Dichloroethane	3(2)	< 0.025	0.026	
	1,4-Dioxane	3(3)	< 0.075	< 0.075	
	2-Butanone	3(1)	< 0.183	0.604	
	4-Methyl-2-pentanone	3(3)	< 0.135	< 0.135	
	Benzene	3(0)	0.143	0.251	0.152
	Carbon disulfide	3(3)	< 0.028	< 0.028	
	Carbon tetrachloride	3(0)	0.064	0.075	0.058
	Chloroethane	3(3)	< 0.072	< 0.072	
	Chloroform	3(0)	0.018	0.020	0.018
	cis-1,2-Dichloroethene	3(3)	< 0.025	< 0.025	
	Methylene chloride	3(3)	< 0.97	< 0.97	
	Tetrachloroethene	3(2)	< 0.017	< 0.0792	
	Toluene	3(2)	< 0.196	0.427	
	trans-1,2-Dichloroethene	3(3)	< 0.016	< 0.016	
	Trichloroethene	3(2)	< 0.015	< 0.075	
	Vinyl chloride	3(2)	< 0.066	0.068	
	Fibers/Asbestos (fibers per cubic cm)				
	Fibers	4(4)	< 0.0002	< 0.0003	

Table 2.11. Ambient air monitoring program summary for non-radionuclides – 2020 (continued)

Sampling Location	Parameter	No. of measurements[a]	Minimum[b, c]	Maximum[b, c]	Average[d]
	Particulate matter (PM)[e] (µg/kg)				
A51	PM 2.5 (hourly average)	743	1.2	46.7	10.3
	PM 2.5 (daily average)	31	4.8	18.3	10.3
	PM 10 (hourly average)	743	2.0	54.8	14.1
	PM 10 (daily average)	31	6.7	27.4	14.1
	Metals (µg/kg)				
	Antimony	4(3)	< 6.63E-04	< 3.09E-03	
	Arsenic	4(4)	< 5.09E-03	< 7.62E-03	
	Beryllium	4(4)	< 1.21E-04	< 1.73E-04	
	Cadmium	4(4)	< 6.08E-04	< 1.13E-03	
	Chromium	4(4)	< 8.56E-03	< 1.17E-02	
	Cobalt	4(3)	< 1.76E-04	1.71E-03	
	Lead	4(4)	< 4.46E-03	< 8.33E-03	
	Manganese	4(4)	< 2.26E-02	< 5.61E-02	
	Mercury	4(4)	< 1.42E-05	< 3.10E-05	
	Nickel	4(3)	< 1.94E-03	4.48E-02	
	Selenium	4(3)	< 1.14E-04	4.32E-04	
	VOCs (parts per billion by volume)				
	1,1,1-Trichloroethane	3(3)	< 0.049	< 0.049	
	1,1,2-Trichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethene	3(3)	< 0.02	< 0.02	
	1,2-Dichloroethane	3(3)	< 0.025	< 0.025	
	1,4-Dioxane	3(3)	< 0.075	< 0.075	
	2-Butanone	3(1)	< 0.183	0.767	
	4-Methyl-2-pentanone	3(3)	< 0.135	< 0.135	
	Benzene	3(0)	0.123	0.235	0.181
	Carbon disulfide	3(3)	< 0.028	< 0.0321	
	Carbon tetrachloride	3(0)	0.070	0.075	0.072
	Chloroethane	3(3)	< 0.072	< 0.072	
	Chloroform	3(0)	0.019	0.021	0.020
	cis-1,2-Dichloroethene	3(3)	< 0.025	< 0.025	
	Methylene chloride	3(3)	< 0.97	< 0.97	
	Tetrachloroethene	3(3)	< 0.017	< 0.017	
	Toluene	3(2)	< 0.196	0.28	
	trans-1,2-Dichloroethene	3(3)	< 0.016	< 0.016	
	Trichloroethene	3(3)	< 0.015	< 0.022	
	Vinyl chloride	3(3)	< 0.066	< 0.066	
	Fibers/Asbestos (fibers per cubic cm)				
	Fibers	4(4)	< 0.0002	< 0.0002	

Table 2.11. Ambient air monitoring program summary for non-radionuclides – 2020 (continued)

Sampling Location	Parameter	No. of measurements[a]	Minimum[b, c]	Maximum[b, c]	Average[d]
		Particulate matter (PM)[e] (µg/kg)			
A52	PM 2.5 (hourly average)	743	1.1	24.6	9.6
	PM 2.5 (daily average)	31	4.8	16.7	9.6
	PM 10 (hourly average)	743	2.0	37.1	13.8
	PM 10 (daily average)	31	6.9	26.1	13.8
		Metals (µg/kg)			
	Antimony	4(2)	< 5.29E-04	3.02E-03	
	Arsenic	4(4)	< 4.14E-03	< 8.00E-03	
	Beryllium	4(4)	< 1.06E-04	< 1.71E-04	
	Cadmium	4(4)	< 6.55E-04	< 1.24E-03	
	Chromium	4(4)	< 6.44E-03	< 1.34E-02	
	Cobalt	4(4)	< 1.41E-04	< 3.71E-04	
	Lead	4(4)	< 3.89E-03	< 8.75E-03	
	Manganese	4(4)	< 1.68E-02	< 5.26E-02	
	Mercury	4(4)	< 1.47E-05	< 2.83E-05	
	Nickel	4(3)	< 2.10E-03	7.43E-03	
	Selenium	4(3)	< 9.19E-05	3.53E-04	
		VOCs (parts per billion by volume)			
	1,1,1-Trichloroethane	3(3)	< 0.049	< 0.049	
	1,1,2-Trichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethene	3(3)	< 0.020	< 0.020	
	1,2-Dichloroethane	3(3)	< 0.025	< 0.025	
	1,4-Dioxane	3(3)	< 0.075	< 0.075	
	2-Butanone	3(1)	< 0.183	0.567	
	4-Methyl-2-pentanone	3(3)	< 0.135	< 0.135	
	Benzene	3(0)	0.124	0.245	0.186
	Carbon disulfide	3(1)	0.032	0.051	
	Carbon tetrachloride	3(0)	0.067	0.0763	0.072
	Chloroethane	3(3)	< 0.072	< 0.072	
	Chloroform	3(0)	0.019	0.021	0.020
	cis-1,2-Dichloroethene	3(3)	< 0.025	< 0.025	
	Methylene chloride	3(3)	< 0.97	< 0.97	
	Tetrachloroethene	3(2)	< 0.017	0.070	
	Toluene	3(3)	< 0.196	0.220	
	trans-1,2-Dichloroethene	3(3)	< 0.016	< 0.016	
	Trichloroethene	3(2)	< 0.015	< 0.051	
	Vinyl chloride	3(3)	< 0.066	< 0.066	
		Fibers/Asbestos (fibers per cubic cm)			
	Fibers	4(4)	< 0.0002	< 0.0002	

Table 2.11. Ambient air monitoring program summary for non-radionuclides – 2020 (continued)

Sampling Location	Parameter	No. of measurements[a]	Minimum[b, c]	Maximum[b, c]	Average[d]
		Particulate matter (PM)[e] (µg/kg)			
A53	PM 2.5 (hourly average)	718	1.1	25.7	10.0
	PM 2.5 (daily average)	30	4.7	19	10.0
	PM 10 (hourly average)	718	1.9	38.3	14.7
	PM 10 (daily average)	30	6.7	30.2	14.7
		Metals (µg/kg)			
	Antimony	4(3)	< 5.84E-04	< 2.43E-03	
	Arsenic	4(4)	< 4.04E-03	< 6.31E-03	
	Beryllium	4(4)	< 9.45E-05	< 1.36E-04	
	Cadmium	4(4)	< 6.87E-04	< 2.35E-03	
	Chromium	4(4)	< 6.65E-03	< 1.09E-02	
	Cobalt	4(3)	< 1.67E-04	1.30E-03	
	Lead	4(4)	< 4.54E-03	< 7.17E-03	
	Manganese	4(3)	< 2.08E-02	7.21E-02	
	Mercury	4(4)	< 1.50E-05	< 2.56E-05	
	Nickel	4(2)	< 2.30E-03	3.90E-02	
	Selenium	4(3)	< 8.87E-05	6.79E-04	
		VOCs (parts per billion by volume)			
	1,1,1-Trichloroethane	3(3)	< 0.049	< 0.049	
	1,1,2-Trichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethene	3(3)	< 0.020	< 0.020	
	1,2-Dichloroethane	3(3)	< 0.025	< 0.025	
	1,4-Dioxane	3(3)	< 0.075	< 0.075	
	2-Butanone	3(1)	< 0.183	0.388	
	4-Methyl-2-pentanone	3(2)	< 0.135	0.400	
	Benzene	3(0)	0.132	0.279	0.202
	Carbon disulfide	3(2)	< 0.028	0.049	
	Carbon tetrachloride	3(0)	0.072	0.082	0.077
	Chloroethane	3(3)	< 0.072	< 0.072	
	Chloroform	3(1)	< 0.016	0.020	
	cis-1,2-Dichloroethene	3(3)	< 0.025	< 0.025	
	Methylene chloride	3(1)	< 0.97	3.59	
	Tetrachloroethene	3(3)	< 0.017	< 0.017	
	Toluene	3(1)	< 0.196	0.354	
	trans-1,2-Dichloroethene	3(3)	< 0.016	< 0.016	
	Trichloroethene	3(3)	< 0.015	< 0.015	
	Vinyl chloride	3(3)	< 0.066	< 0.066	
		Fibers/Asbestos (fibers per cubic cm)			
	Fibers	4(4)	< 0.0002	< 0.0002	

Table 2.11. Ambient air monitoring program summary for non-radionuclides – 2020 (continued)

Sampling Location	Parameter	No. of measurements[a]	Minimum[b, c]	Maximum[b, c]	Average[d]
		Particulate matter (PM)[e] (µg/kg)			
A54	PM 2.5 (hourly average)	566	1.2	26.9	10.1
	PM 2.5 (daily average)	23	5.0	18.2	10.1
	PM 10 (hourly average)	566	1.8	37.9	14.6
	PM 10 (daily average)	23	9.0	27.8	14.6
		Metals (µg/kg)			
	Antimony	4(3)	< 4.70E-04	< 2.19E-03	
	Arsenic	4(4)	< 3.69E-03	< 5.72E-03	
	Beryllium	4(4)	< 9.12E-05	< 1.53E-04	
	Cadmium	4(4)	< 5.92E-04	< 7.77E-04	
	Chromium	4(4)	< 5.94E-03	< 9.19E-03	
	Cobalt	4(3)	< 1.24E-04	3.68E-04	
	Lead	4(4)	< 3.60E-03	< 6.60E-03	
	Manganese	4(4)	< 1.84E-02	< 2.11E-02	
	Mercury	4(4)	< 1.38E-05	< 2.36E-05	
	Nickel	4(3)	< 1.27E-03	9.51E-03	
	Selenium	4(2)	< 9.05E-05	4.69E-04	
		VOCs (parts per billion by volume)			
	1,1,1-Trichloroethane	3(3)	< 0.049	< 0.049	
	1,1,2-Trichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethane	3(3)	< 0.018	< 0.018	
	1,1-Dichloroethene	3(3)	< 0.020	< 0.020	
	1,2-Dichloroethane	3(2)	< 0.025	0.061	
	1,4-Dioxane	3(3)	< 0.075	< 0.075	
	2-Butanone	3(0)	0.242	0.848	0.563
	4-Methyl-2-pentanone	3(3)	< 0.135	< 0.135	
	Benzene	3(0)	0.153	0.287	0.213
	Carbon disulfide	3(1)	0.031	< 0.126	
	Carbon tetrachloride	3(0)	0.072	0.085	0.078
	Chloroethane	3(2)	< 0.072	0.079	
	Chloroform	3(0)	0.020	0.032	0.024
	cis-1,2-Dichloroethene	3(3)	< 0.025	< 0.025	
	Methylene chloride	3(2)	< 0.97	1.68	
	Tetrachloroethene	3(2)	< 0.017	< 0.026	
	Toluene	3(1)	< 0.196	0.0441	
	trans-1,2-Dichloroethene	3(3)	< 0.016	< 0.016	
	Trichloroethene	3(3)	< 0.015	< 0.015	
	Vinyl chloride	3(2)	< 0.066	0.196	
		Fibers/Asbestos (fibers per cubic cm)			
	Fibers	4(4)	< 0.0002	< 0.0002	

[a]Number in parentheses is the number of samples that were below the detection limit.
[b]If the analytical result for a sample was below the detection limit, the ambient air concentration was calculated based on the value for the undetected result. Values reported as less than (<) are based on an undetected result. In some cases, a detected result is between minimum and maximum results that are based on undetected results. This can happen because detection limits can vary for samples and because results can be qualified as undetected during data validation.
[c]Some results are provided in scientific notation. The number and sign (+ or -) to the right of the "E" indicate the number of places to the right or left of the decimal point. For example, 3.4E-04 is 0.00034 (the decimal point moves four places to the left); 2.1E+02 is 210 (the decimal point moves two places to the right).
[d]Averages are not calculated for locations that had greater than 15% of the results below the detection limit. For locations with less than 15% of the results below the detection limit, any result below the detection limit was assigned the value of the undetected result to calculate the average for the parameter. These criteria were adapted from *Data Quality Assessment: A Reviewer's Guide* (EPA 2006).
[e]Based on standard temperature and pressure.

Table 2.12. External radiation monitoring program (mrem) – 2020

Location	First quarter	Second quarter	Third quarter	Fourth quarter	Cumulative annual whole body dose[a]
Off-site locations					
A12	21	21	22	24	88
A15	21	23	23	25	92
A23	23	20	23	25	91
A24	22	21	23	28	94
A28	20	19	22	25	86
A3	21	19	21	25	86
A6	22	21	22	24	89
A9	21	20	22	24	87
On-site locations					
A29	22	20	22	27	91
A36	20	20	21	27	88
A40A	21	21	22	25	89
A8	24	24	25	27	100
UPOLE-1404A	20	21	22	24	87
UPOLE-518	19	20	21	24	84
UPOLE-862	27	31	30	32	120
UPOLE-874	131	176	137	185	629
UPOLE-906	19	18	18	22	77
UPOLE-933	20	18	19	24	81
X-230J2	22	22	22	26	92

[a]Although external radiation is reported as a "dose", it is simply a measure of the exposure to radiation that a person would receive if they were continuously present at the monitored location. No actual person is present at the monitoring locations for 24 hours per day, 365 days per year.
This external radiation includes background radiation. Background radiation at the off-site monitoring locations ranged from 86 to 94 mrem/year in 2020.

Table 2.13. External radiation monitoring (mrem) at locations near on-site cylinder storage yards – 2020

Location	First quarter	Second quarter	Third quarter	Fourth quarter	Cumulative annual whole body dose[a]
UPOLE-41	135	156	131	159	581
UPOLE-868	257	329	275	325	1186
UPOLE-874	138	161	141	169	609
UPOLE-882	230	301	241	306	1078
UPOLE-890	59	71	62	72	264

[a]Although external radiation is reported as a "dose", it is simply a measure of the exposure to radiation that a person would receive if they were continuously present at the monitored location. No actual person is present at the monitoring locations for 24 hours per day, 365 days per year.
This external radiation includes background radiation. Background radiation at the off-site monitoring locations ranged from 86 to 94 mrem/year in 2020.

Table 2.14. Settleable solids monitoring results – 2020

Sampling location	Parameter[a]	Unit	Results[b] August	Results[b] August	Results[b] December
Little Beaver Creek					
EDD-SW01 (FBP Outfalls 001 & 015)	Settleable solids	mg/L	7.2J	8.4J[c]	4U
	Suspended solids	mg/L	7.2J	8.4J[c]	4U
FBP Outfall 005	Settleable solids	mg/L	4.8J		4U
	Suspended solids	mg/L	4.8J		4U
FBP Outfall 009	Settleable solids	mg/L	4U		4U
	Suspended solids	mg/L	4U		4U
FBP Outfall 011	Settleable solids	mg/L	4U		4U
	Suspended solids	mg/L	4U		4U
Big Run Creek					
FBP Outfall 002	Settleable solids	mg/L	4U		4U
	Suspended solids	mg/L	4U		4U
Scioto River					
ACP NPDES Outfall 012	Settleable solids	mg/L	4U		4U
	Suspended solids	mg/L	4U		4U
WDD-SW03 (FBP Outfall 010 & ACP Outfall 013)	Settleable solids	mg/L	12.4		4U
	Suspended solids	mg/L	12.4		4U
FBP Outfall 003	Settleable solids	mg/L	8.8J	6J	4.4J[c]
	Suspended solids	mg/L	15.2	6J	4.4J[c]
FBP Outfall 004	Settleable solids	mg/L	4U		4U
	Suspended solids	mg/L	4U		4U
Background locations					
RW-6 (Scioto River)	Settleable solids	mg/L	24		4U
	Suspended solids	mg/L	49.2		4U
	Alpha activity	pCi/g	117J		
	Beta/gamma activity	pCi/g	1470U		
RW-5 (Big Beaver Creek)	Settleable solids	mg/L	52.8		4U
	Suspended solids	mg/L	62.8		4U
	Alpha activity	pCi/g	56.9J		
	Beta/gamma activity	pCi/g	1320U		
LBC-SW12 (Little Beaver Creek)	Settleable solids	mg/L	4U		4U
	Suspended solids	mg/L	4U		4U

[a]Suspended solids are the solids in a water sample (such as silt or clay particles) that can be trapped by a filter. Settleable solids are a component of suspended solids defined as the particles that settle out of suspension in water within a defined time period.
[b]Abbreviations and data qualifiers are as follows: J – estimated. U – undetected.
[c]This result is for the duplicate sample collected from this location. A duplicate sample is a sample collected from the same location at the same time and using the same sampling device (if possible) as the regular sample.

Table 2.15. Local surface water monitoring program results – 2020

Location	Parameter[a]	Second quarter[b,c]		Fourth quarter[b,c]
Scioto River	Americium-241	0.012U		0.022U
RW-1A	Neptunium-237	-0.065U		-0.0234U
(downstream)	Plutonium-238	-0.009U		0.22UJ
	Plutonium-239/240	0.04U		-0.049UJ
	Technetium-99	2.296UJ		0.116U
	Uranium	0.773*J		2.036J
	Uranium-233/234	0.917J		0.636J
	Uranium-235/236	0.034UJ		0.026UJ
	Uranium-238	0.254*J		0.68
Scioto River	Americium-241	0.025U	0.006U	0.029U
RW-6	Neptunium-237	-0.0052U	-0.028U	0U
(upstream)	Plutonium-238	0.004U	0.012U	0.018U
	Plutonium-239/240	-0.007U	0.022U	0.015U
	Technetium-99	9.708UJ	2.471*QU	-0.796U
	Uranium	0.659*J	0.896*J	1.778J
	Uranium-233/234	0.885J	0.902J	0.619J
	Uranium-235/236	0.026UJ	0.041UJ	0.023UJ
	Uranium-238	0.217*J	0.295*J	0.594
Little Beaver	Americium-241	0.035U		-0.004U
Creek	Neptunium-237	-0.0049U		0.00807U
RW-7	Plutonium-238	0.002U		0.004U
(downstream)	Plutonium-239/240	0U		0.015U
	Technetium-99	5.332*QUJ		0.983U
	Uranium	0.729J		0.503J
	Uranium-233/234	0.987J		0.626J
	Uranium-235/236	0.01UJ		0.022UJ
	Uranium-238	0.243		0.165
RW-8	Americium-241	-0.006U		0.023U
(downstream)	Neptunium-237	0.052U		0.0151U
	Plutonium-238	-0.009U		0.029U
	Plutonium-239/240	0.003U		-0.007U
	Technetium-99	2.066*QU		3U
	Uranium	0.823J		2.274J
	Uranium-233/234	0.939J		2.97J
	Uranium-235/236	0.007UJ		0.12J
	Uranium-238	0.275		0.745
RW-12	Americium-241	0.014U		0U
(upstream)	Neptunium-237	0.0099U		0.0236U
	Plutonium-238	0.013U		0.017U
	Plutonium-239/240	-0.003U		-0.02U
	Technetium-99	49.72QJ		-1.859U
	Uranium	-0.08*UJ		0.118UJ
	Uranium-233/234	0.006UJ		0.011UJ
	Uranium-235/236	0UJ		0.004UJ
	Uranium-238	-0.027*U		0.039U

Table 2.15. Local surface water monitoring program results – 2020 (continued)

Location	Parameter[a]	Second quarter[b,c]		Fourth quarter[b,c]	
Big Beaver Creek RW-13 (downstream)	Americium-241	0.01U		0.008U	
	Neptunium-237	-0.0094U		-0.0427UJ	
	Plutonium-238	-0.006U		0.01U	
	Plutonium-239/240	-0.006U		0.015U	
	Technetium-99	105.74QJ		1.973U	
	Uranium	0.804*J		0.664J	
	Uranium-233/234	0.965J		0.742J	
	Uranium-235/236	0.039UJ		0UJ	
	Uranium-238	0.264*J		0.223	
RW-5 (upstream)	Americium-241	0.012U		0.002U	
	Neptunium-237	0U		-0.00423U	
	Plutonium-238	-0.005UJ		-0.003U	
	Plutonium-239/240	0.024UJ		0.012U	
	Technetium-99	20.339UJ		1.079U	
	Uranium	0.296*UJ		0.082UJ	
	Uranium-233/234	0.517J		0.027UJ	
	Uranium-235/236	0.011UJ		0.002UJ	
	Uranium-238	0.098*UJ		0.027U	
Big Run Creek RW-2 (downstream)	Americium-241	0U	0.032U[d]	0.002U	0.013U[d]
	Neptunium-237	-0.013U	-0.019U[d]	-0.0385U	-0.0233U[d]
	Plutonium-238	-0.007U	-0.013U[d]	0.004U	-0.01U[d]
	Plutonium-239/240	0.014U	0.013U[d]	0.008U	-0.008U[d]
	Technetium-99	10.154QUJ	9.209[d]	-2.542UJ	7.626J[d]
	Uranium	0.129*UJ	0.163*UJ[d]	0.316UJ	0.288UJ[d]
	Uranium-233/234	0.048UJ	0.012UJ[d]	0.149UJ	0.14J[d]
	Uranium-235/236	0.004UJ	0.009UJ[d]	0.008UJ	0.005UJ[d]
	Uranium-238	0.043*UJ	0.053*U[d]	0.105UJ	0.096UJ[d]
RW-3 (downstream)	Americium-241	0.036U		0.012U	
	Neptunium-237	-0.0089U		0.0142U	
	Plutonium-238	0.01U		-0.016U	
	Plutonium-239/240	-0.003U		-0.002U	
	Technetium-99	4.944U		0.093U	
	Uranium	0.656*J		1.089J	
	Uranium-233/234	0.432J		0.969J	
	Uranium-235/236	0.01UJ		0.037UJ	
	Uranium-238	0.219*J		0.36	

Table 2.15. Local surface water monitoring program results – 2020 (continued)

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]
Big Run Creek (continued)	Americium-241	-0.002U	0.049U
	Neptunium-237	0.01U	0.0133UJ
RW-33 (upstream)	Plutonium-238	-0.009U	0U
	Plutonium-239/240	-0.002U	0.012U
	Technetium-99	3.29U	-0.127U
	Uranium	0.248*UJ	0.169UJ
	Uranium-233/234	0.183J	0.032UJ
	Uranium-235/236	0.007UJ	0.023UJ
	Uranium-238	0.082*UJ	0.053U
Background creeks	Americium-241	0.029U	0.02U
RW-10N	Neptunium-237	0.0052U	-0.004U
	Plutonium-238	0U	0.027U
	Plutonium-239/240	0.016U	0.007U
	Technetium-99	6.805QUJ	2.007U
	Uranium	0.051*UJ	0.174UJ
	Uranium-233/234	0.035UJ	0.046UJ
	Uranium-235/236	0.009UJ	0UJ
	Uranium-238	0.016*U	0.059UJ
RW-10S	Americium-241	0.026U	0U
	Neptunium-237	0.046U	-0.0155U
	Plutonium-238	-0.013U	0.013U
	Plutonium-239/240	-0.008U	-0.008U
	Technetium-99	3.443QU	-3.526U
	Uranium	-0.007*UJ	0.225UJ
	Uranium-233/234	0.004UJ	0.162UJ
	Uranium-235/236	0UJ	0UJ
	Uranium-238	-0.002*U	0.076U
RW-10E	Americium-241	-0.002U	0.023U
	Neptunium-237	0.027U	0.012U
	Plutonium-238	0.001U	0.005U
	Plutonium-239/240	0.036U	-0.007U
	Technetium-99	0.88U	-2.159U
	Uranium	0.122*UJ	0.077UJ
	Uranium-233/234	0.068UJ	0.007UJ
	Uranium-235/236	0UJ	-0.003UJ
	Uranium-238	0.041*U	0.026U

Table 2.15. Local surface water monitoring program results – 2020 (continued)

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]
Background creeks	Americium-241	0.031U	0.007U
RW-10W	Neptunium-237	0.024U	0U
	Plutonium-238	-0.031U	-0.007U
	Plutonium-239/240	0.021U	0.006U
	Technetium-99	3.555QU	-1.788U
	Uranium	0.132*UJ	-0.247UJ
	Uranium-233/234	0.023UJ	0UJ
	Uranium-235/236	0UJ	-0.018UJ
	Uranium-238	0.045*UJ	-0.08UJ

[a]Results are reported in µg/L (uranium) and pCi/L (all other parameters).
[b]Abbreviations and data qualifiers are as follows: * – laboratory control samples failed one or more duplicate criteria. J – the reported result is estimated. Q – one or more quality control criteria failed. U – undetected.
[c]A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results.
[d]This result is for the duplicate sample collected from this location. A duplicate sample is a sample collected from the same location at the same time and using the same sampling device (if possible) as the regular sample.

Table 2.16. Sediment monitoring program results – 2020

Parameter	Unit	Location/results[a,b]			
		Scioto River and outfalls that discharge to the Scioto River			
		RM-6 Upstream @ Piketon	*RM-1A Downstream @ Lucasville*	*RM-9 Outfall 012*	*RM-10 Outfall 010/Outfall 013*
Aluminum	mg/kg	5150DQ	7410DQ	8130DQ	8000DQ
Americium-241	pCi/g	-0.0015U	0.0069U	0.0046U	0.0016UJ
Antimony	mg/kg	0.616DJ	0.613DU	0.613DU	1.54DJ
Arsenic	mg/kg	6.7*DQ	7.1*DQ	7.04*DQ	27.5*DQ
Barium	mg/kg	27.7*BD	49.3*BD	106*BD	57.9*BD
Beryllium	mg/kg	0.331*DJ	0.447*DJ	0.653*DJ	0.844*DJ
Cadmium	mg/kg	0.337DJQ	0.261DJQ	0.341DJQ	0.273DJQ
Calcium	mg/kg	10600D	5240D	6960D	2730DJ
Chromium	mg/kg	7.9*BD	11.2*BD	13.8*BD	28.9*BD
Copper	mg/kg	8.87*BD	8.95*BD	14.8*BD	11.8*BD
Iron	mg/kg	18000*DQ	16200*DQ	15900*DQ	33100*DQ
Lead	mg/kg	7.04*DQ	10.7*DQ	12.2*DQ	15.7*DQ
Magnesium	mg/kg	3970DQ	3520DQ	3550DQ	1680DJQ
Manganese	mg/kg	245*BD	482*BD	383*BD	1100*BD
Mercury	mg/kg	0.0147*J	0.0243*	0.061*	0.0199*J
Neptunium-237	pCi/g	0.005U	0.00084U	0.0059U	0.0024U
Nickel	mg/kg	14.4D	16D	18D	23D
Plutonium-238	pCi/g	0.005U	0.0051U	0.0068U	0.0059U
Plutonium-239/240	pCi/g	0.0034U	0.0059U	0.0068U	0.0071U
PCB, total	µg/kg	6.73	9.99	0.016U	10.3
Selenium	mg/kg	0.305DJQU	0.488DJQU	0.63DJQU	0.81DJQU
Silicon	mg/kg	1120DJQ	1450DJQ	1500DJQ	1450DJQ
Silver	mg/kg	0.271DU	0.27DU	0.27DU	0.272DU
Technetium-99	pCi/g	0.958*QUJ	0.644QUJ	1.361*QUJ	0.219QUJ
Thallium	mg/kg	0.13*DJ	0.144*DJ	0.242*DJ	0.319*DJ
Uranium	µg/g	1.64J	2.05J	2.51J	4.41J
Uranium-233/234	pCi/g	0.91J	0.97J	1.3J	2.2J
Uranium-235/236	pCi/g	0.036UJ	0.059UJ	0.081UJ	0.11UJ
Uranium-238	pCi/g	0.54	0.68	0.83	1.5
Zinc	mg/kg	67*DQJ	68.2*DQJ	81.5*DQJ	139*DJQ

Table 2.16. Sediment monitoring program results – 2020 (continued)

Parameter	Unit	Location/results[a,b]		
			Little Beaver Creek	
		RM-12 Upstream	*RM-12 Upstream (duplicate sample)*	*RM-11 X-230J7 Discharge*
Aluminum	mg/kg	1600DQ	1550DQ	1660DQ
Americium-241	pCi/g	0.0078UJ	0.0015U	0.0042U
Antimony	mg/kg	0.819DJ	1.52DJ	0.904DJ
Arsenic	mg/kg	35.2*DQ	39.4*DQ	31*DQ
Barium	mg/kg	46.2*BD	41.2*BD	44.5*BD
Beryllium	mg/kg	1.09*D	0.931*DJ	0.921*DJ
Cadmium	mg/kg	0.102DJQ	0.125DJQ	0.086DJQ
Calcium	mg/kg	1910D	1680D	997DJ
Chromium	mg/kg	39*BD	33.7*BD	27.3*BD
Copper	mg/kg	14.8*BD	11.4*BD	12.5*BD
Iron	mg/kg	17400*DQJ	11000*DQJ	10500*DQ
Lead	mg/kg	28.3*DQ	25.6*DQ	21.5*DQ
Magnesium	mg/kg	602DJQ	1670DQJ	588DJQ
Manganese	mg/kg	908*BD	837*BD	778*BD
Mercury	mg/kg	0.0147*J	0.019*J	0.0199*
Neptunium-237	pCi/g	0U	0.00091U	0.0041U
Nickel	mg/kg	20.9D	17.7D	15D
Plutonium-238	pCi/g	0.017UJ	0.0054U	0.0081U
Plutonium-239/240	pCi/g	0.0051U	0.0063U	0.01U
PCB, total	µg/kg	0.016U	0.016U	0.016U
Selenium	mg/kg	0.186DJQU	0.136DJQU	0.182DJQU
Silicon	mg/kg	282DJQ	248DJQ	276DJQ
Silver	mg/kg	0.272DU	0.27DU	0.27DU
Technetium-99	pCi/g	0.352*QUJ	0.106*QUJ	1QUJ
Thallium	mg/kg	0.0859*DJ	0.081*DJ	0.0935*DJ
Uranium	µg/g	1.96J	0.987J	2.03J
Uranium-233/234	pCi/g	0.71J	0.37J	0.68J
Uranium-235/236	pCi/g	0.033UJ	0.014UJ	0.025UJ
Uranium-238	pCi/g	0.65J	0.33J	0.68
Zinc	mg/kg	102*DJQ	102*DJQ	94*DJQ

Table 2.16. Sediment monitoring program results – 2020 (continued)

Parameter	Unit	Location/results[a,b]	
		Little Beaver Creek	
		RM-8 Downstream @ Outfall 009 Discharge	*RM-7 Downstream @ Confluence*
Aluminum	mg/kg	8990DQ	7320DQ
Americium-241	pCi/g	0U	0.0047U
Antimony	mg/kg	1.28DJ	0.615DU
Arsenic	mg/kg	46.1*DQ	6.2*DQ
Barium	mg/kg	54.5*BD	54.9*BD
Beryllium	mg/kg	1.36*D	0.428*DJ
Cadmium	mg/kg	0.363DJQ	0.253DJQ
Calcium	mg/kg	6740D	4250D
Chromium	mg/kg	38.2*BD	9.79*BD
Copper	mg/kg	16.5*BD	8.39*BD
Iron	mg/kg	93100*DQ	14900*DQ
Lead	mg/kg	19.4*DQ	8.45*DQ
Magnesium	mg/kg	2560DQ	2960DQ
Manganese	mg/kg	1520*BD	394*BD
Mercury	mg/kg	0.0168*J	0.0211*
Neptunium-237	pCi/g	-0.0023U	-0.0021U
Nickel	mg/kg	29.1D	14.2D
Plutonium-238	pCi/g	0.0079U	0.0062UJ
Plutonium-239/240	pCi/g	-0.0023U	0.0021U
PCB, total	µg/kg	9.73	7.19
Selenium	mg/kg	0.772DJQU	0.403DJQU
Silicon	mg/kg	1410DJQ	1320DJQ
Silver	mg/kg	0.27DU	0.271DU
Technetium-99	pCi/g	0.328*QUJ	0.353*QUJ
Thallium	mg/kg	0.312*DJ	0.151*DJ
Uranium	µg/g	2.99J	1.97J
Uranium-233/234	pCi/g	1.5J	0.82J
Uranium-235/236	pCi/g	0.097UJ	0.033UJ
Uranium-238	pCi/g	0.99	0.66
Zinc	mg/kg	667*DQJ	65.5*DQJ

Table 2.16. Sediment monitoring program results – 2020 (continued)

Parameter	Unit	Location/results[a,b]			
		Big Beaver Creek			
		RM-15 Upstream	*RM-5 Confluence with Little Beaver Creek*	*RM-5 Confluence with Little Beaver Creek (duplicate sample)*	*RM-13 Downstream*
Aluminum	mg/kg	4710DQJ	6340DQ	6240DQ	1320DQ
Americium-241	pCi/g	0.0061U	0.00084U	0.0049U	0.007U
Antimony	mg/kg	0.615DU	0.616DU	0.614DU	0.613DU
Arsenic	mg/kg	18.7*DQ	5.7*DQ	6.21*DQ	6.62*DQ
Barium	mg/kg	54.3*BD	47.2*BD	45.9*BD	47.3*BD
Beryllium	mg/kg	0.911*DJ	0.413*DJ	0.403*DJ	0.466*DJ
Cadmium	mg/kg	0.431DJQ	0.261DJQ	0.226DJQ	0.238DJQ
Calcium	mg/kg	31200DJ	4120DJ	7850DJ	1260D
Chromium	mg/kg	15.8*BD	9.28*BD	10.1*BD	10.5*BD
Copper	mg/kg	14.4*BDJ	7.67*BD	8.13*BD	10.3*BD
Iron	mg/kg	26700*DQJ	13700*DQJ	19000*DQJ	2810*DQ
Lead	mg/kg	840*DQJ	7.86*DQ	9.14*DQ	11.7*DQ
Magnesium	mg/kg	11000DQ	2870DQJ	4150DQJ	658DJQ
Manganese	mg/kg	914*BDJ	369*BD	472*BD	398*BD
Mercury	mg/kg	0.0119*J	0.0177*J	0.0259*	0.0219*
Neptunium-237	pCi/g	0.038	0.0035U	-0.00088U	0.0062U
Nickel	mg/kg	35.5D	14.9D	15.4D	15.7D
Plutonium-238	pCi/g	0.011UJ	0.007U	0.00087U	0.0099U
Plutonium-239/240	pCi/g	0.013UJ	0.0053U	0.00088U	0U
PCB, total	µg/kg	5.13	8.79J	14.6J	0.016U
Selenium	mg/kg	0.452DJQU	0.337DJQU	0.368DJQU	0.318DJQU
Silicon	mg/kg	1520DJQ	1180DJQ	1230DJQ	246DJQ
Silver	mg/kg	0.27DU	0.271DU	0.27DU	0.27DU
Technetium-99	pCi/g	1.174*QUJ	0.655*QUJ	0.609*QUJ	0.298*QUJ
Thallium	mg/kg	0.197*DJ	0.134*DJ	0.135*DJ	0.159*DJ
Uranium	µg/g	2.24J	2.64J	3.45J	1.95J
Uranium-233/234	pCi/g	1.1J	1.1J	1.3J	0.76J
Uranium-235/236	pCi/g	0.075UJ	0.066UJ	0.033UJ	0.064UJ
Uranium-238	pCi/g	0.74	0.88J	1.2J	0.64
Zinc	mg/kg	181*DJQ	63.7*DQJ	77.7*DJQ	74.9*DQJ

Table 2.16. Sediment monitoring program results – 2020 (continued)

Parameter	Unit	Location/results[a,b]		
			Big Run Creek	
		RM-33 Upstream	*RM-3 Downstream*	*RM-2 Downstream @ Wakefield*
Aluminum	mg/kg	7770DQ	9360DQ	11100DQ
Americium-241	pCi/g	0.0041U	0.0064U	0.0081U
Antimony	mg/kg	0.618DU	0.647DJ	3.25DJ
Arsenic	mg/kg	8.74*DQ	25.6*DQ	44.2*DQ
Barium	mg/kg	53.5*BD	58.3*BD	28.9*BD
Beryllium	mg/kg	0.551*DJ	0.764*DJ	1.43*D
Cadmium	mg/kg	0.422DJQ	0.246DJQ	0.449DJQ
Calcium	mg/kg	21800D	2790D	607DJU
Chromium	mg/kg	10.9*BD	19.3*BD	44.1*BD
Copper	mg/kg	10.1*BD	12.1*BD	12.6*BD
Iron	mg/kg	17400*DQ	30100*DQ	173000*DQ
Lead	mg/kg	20.2*DQ	15.6*DQ	20*DQ
Magnesium	mg/kg	10700DQ	1930DJQ	1060DQ
Manganese	mg/kg	631*BD	760*BD	697*BD
Mercury	mg/kg	0.0262*	0.0252*	0.0126*J
Neptunium-237	pCi/g	-0.0027U	0.00089U	0.00085U
Nickel	mg/kg	20.4D	19.1D	36.5D
Plutonium-238	pCi/g	0.0045U	0.0097U	0.0059U
Plutonium-239/240	pCi/g	0.0072U	0.0027U	0.0068UJ
PCB, total	µg/kg	0.016U	24.2	0.016U
Selenium	mg/kg	0.648DJQU	0.594DJQU	0.431DJQU
Silicon	mg/kg	1200DJQ	1480DJQ	1030DJQ
Silver	mg/kg	0.272DU	0.272DU	0.27DU
Technetium-99	pCi/g	0.162*QUJ	0.263*QUJ	-0.009*QUJ
Thallium	mg/kg	0.207*DJ	0.324*DJ	0.137*DJ
Uranium	µg/g	2.81J	4.51J	2.32J
Uranium-233/234	pCi/g	0.9J	2.4J	0.85J
Uranium-235/236	pCi/g	0.072UJ	0.12UJ	0.043UJ
Uranium-238	pCi/g	0.93	1.5	0.77
Zinc	mg/kg	117*DJQ	111*DJQ	156*DJQ

Table 2.16. Sediment monitoring program results – 2020 (continued)

Parameter	Unit	Location/results[a,b]			
		Background creeks			
		RM-10N North background	*RM-10S South background*	*RM-10E East background*	*RM-10W West background*
Aluminum	mg/kg	7830DQ	1240DQ	7330DQ	1720DQ
Americium-241	pCi/g	0.0065UJ	-0.00098U	0.003UJ	0.0018U
Antimony	mg/kg	0.62DU	3.19DJ	1.44DJ	1.55DJ
Arsenic	mg/kg	46.5*DQ	55*DQ	190*DQJ	52.9*DQ
Barium	mg/kg	49*BD	33.1*BD	42*BD	38.4*BD
Beryllium	mg/kg	1.53*D	0.973*DJ	1.41*D	1.27*D
Cadmium	mg/kg	0.39DJQ	0.333DJQ	0.433DJQ	0.366DJQ
Calcium	mg/kg	604DJU	1720D	595	564DJU
Chromium	mg/kg	38.2*BD	44.6*BD	61.2*BD	44.2*BD
Copper	mg/kg	21.3*BD	10.3*BDJ	14.5*BD	14.4*BD
Iron	mg/kg	117000*DQ	14000*DQ	95900*DQJ	25600*DQ
Lead	mg/kg	66*DQ	27.9*DQ	98.1*DQJ	27.2*DQ
Magnesium	mg/kg	972DJQ	2280DQ	935QJ	954DJQ
Manganese	mg/kg	912*BD	738*BD	801*BD	934*BD
Mercury	mg/kg	0.0184*J	0.0117*J	0.00832*J	0.00868*J
Neptunium-237	pCi/g	0.0009U	-0.0027U	0.0017U	0U
Nickel	mg/kg	40.2D	27.4D	61.7D	34.5D
Plutonium-238	pCi/g	0.0072UJ	0.0063U	0.0051U	0.0046U
Plutonium-239/240	pCi/g	0.0018U	0.0054U	0.0025U	0.0062U
PCB, total	µg/kg	0.016U	0.016U	0.016U	0.016U
Selenium	mg/kg	0.219DJQU	0.0863DJQU	0.605DJQU	0.162DJQU
Silicon	mg/kg	1010DQ	200DJQ	854DJQ	249DJQ
Silver	mg/kg	0.273DU	0.27DU	0.269DU	0.27DU
Technetium-99	pCi/g	0.075QUJ	0.209QUJ	-0.007QUJ	0.012QUJ
Thallium	mg/kg	0.177*DJ	0.137*DJ	0.146*DJ	0.193*DJ
Uranium	µg/g	3.43J	4.2J	3.17J	2.55J
Uranium-233/234	pCi/g	1.3J	1.4J	1.1J	1J
Uranium-235/236	pCi/g	0.052UJ	0.036UJ	0.052UJ	0.063UJ
Uranium-238	pCi/g	1.1	1.4	1.1	0.85
Zinc	mg/kg	209*DQJ	114*DJQ	292*DQJ	164*DJQ

[a]Abbreviations and data qualifiers are as follows: * – laboratory control samples failed one or more duplicate criteria. B – the analyte was detected in an associated blank. D – the result is reported from a dilution. J – the reported result is estimated. Q – one or more quality control criteria failed. U – undetected.
[b]A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results.

Table 2.17. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2020

Parameter[a]	Location/results[b,c]			
	A8 – On site at northwest boundary		*T7 – On site near X-230L North Holding Pond*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	-0.0009U	-0.0013U	-0.0016U	-0.0005U
Neptunium-237	0.0016UJ	0.006U	0.001U	0.002U
Plutonium-238	0.00019U	0.0039UJ	0.0017UJ	0.003U
Plutonium-239/240	0.00037U	0.0039UJ	0.0012UJ	0.0101UJ
Technetium-99	0.02U	-0.012U	-0.03UJ	0.004U
Uranium	0.119J	2.58J	0.041J	1.29J
Uranium-233/234	0.0409UJ	0.99J	0.0149UJ	0.465J
Uranium-235/236	0.0027UJ	0.034J	0.0012UJ	0.0264J
Uranium-238	0.0397	0.86	0.0135	0.428
	A10 – On site on northwest segment of Perimeter Road		*A29 – On site at OVEC*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	-0.0008U	-0.0009U	-0.0005U	0.0002U
Neptunium-237	0.0005U	-0.004U	0.0001U	0.013UJ
Plutonium-238	0.0011UJ	0.0075UJ	0.0007U	0.0027UJ
Plutonium-239/240	0.0017UJ	0.0021U	0.0008U	0.0091UJ
Technetium-99	-0.048U	-0.044U	-0.087UJ	0.096UJ
Uranium	0.118J	0.81J	0.009UJ	0.95J
Uranium-233/234	0.042UJ	0.33J	0.0072UJ	0.317J
Uranium-235/236	0.0013UJ	0.0136UJ	0.0024UJ	0.0198J
Uranium-238	0.039	0.27	0.0027UJ	0.315
	A36 – On site at X-611 Water Treatment Plant		*A6 – North of PORTS in Piketon*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	-0.0007U	0.0033U	-0.0001U	-0.0007U
Neptunium-237	0.0006U	0.011UJ	0.0008U	0.021UJ
Plutonium-238	0.0011UJ	0.0051UJ	0.0031UJ	0.0021U
Plutonium-239/240	0.0023UJ	0.026UJ	0.002UJ	0.0114UJ
Technetium-99	-0.041U	0.1UJ	0.021U	-0.018U
Uranium	0.054J	0.75J	0.054J	1.26J
Uranium-233/234	0.0242UJ	0.373J	0.0179UJ	0.326J
Uranium-235/236	0.0023UJ	0.0119UJ	0.0021UJ	0.0227J
Uranium-238	0.0176	0.249	0.0177	0.421

Table 2.17. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2020 (continued)

Parameter[a]	Location/results[b,c]			
	A24 – North of PORTS at Schuster Road		*A41A - North of PORTS at Zahns Corner*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	-0.0005U	0.0018U	-0.001U	0.0008U
Neptunium-237	0.0014UJ	0.011UJ	0.0007U	0.011U
Plutonium-238	0.0042UJ	-0.0024U	0.0007U	0.0016U
Plutonium-239/240	0.0021UJ	0.0048U	0.0027UJ	0.0054UJ
Technetium-99	-0.026U	0.07UJ	-0.03U	0.043U
Uranium	0.0021UJ	0.92J	0.0088UJ	1.1J
Uranium-233/234	0.0041UJ	0.288J	0.0065UJ	0.387J
Uranium-235/236	0.0013UJ	0.0169UJ	0.0021UJ	0.0133UJ
Uranium-238	0.0005UJ	0.306	0.0026UJ	0.369
	A23 – Northeastern PORTS boundary		*A12 – Eastern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	-0.0005U	0.0031U	-0.0001U	0.0028U
Neptunium-237	0.0008U	0.015UJ	0.0003U	0.015UJ
Plutonium-238	-0.0003U	0.0028UJ	0.001U	0.001U
Plutonium-239/240	0.0021UJ	0.0113UJ	0.0009UJ	0.0176UJ
Technetium-99	-0.032U	0.13UJ	-0.078U	-0.022U
Uranium	0.0046UJ	0.92J	0.004UJ	0.9J
Uranium-233/234	0.0084UJ	0.307J	0.0035UJ	0.362J
Uranium-235/236	-0.0001UJ	0.0099UJ	0.0017UJ	0.0206J
Uranium-238	0.0016UJ	0.308	0.0011UJ	0.3
	A15 – Southeast of PORTS on Loop Road		*A3 – Southern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	-0.0001U	0.0067UJ	-0.0004U	0.0053UJ
Neptunium-237	0.0007U	0.009UJ	-0.0001U	0.009UJ
Plutonium-238	0.0007UJ	0.0009U	0.0016UJ	0.0041U
Plutonium-239/240	-0.0004UJ	0.0071UJ	0.0012U	0.0173UJ
Technetium-99	-0.041U	-0.009U	0.001UJ	-0.009U
Uranium	0.0086UJ	1J	0.0091UJ	0.92J
Uranium-233/234	0.0044UJ	0.352J	0.0075UJ	0.395J
Uranium-235/236	0.0008UJ	0.015UJ	0.0017UJ	0.0184UJ
Uranium-238	0.0027UJ	0.333	0.0028UJ	0.305

Table 2.17. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2020 (continued)

Parameter[a]	Location/results[b,c]			
	A9 – South of PORTS		*A28 – Southwest of PORTS on Camp Creek Road*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	-0.0012U	0.0061UJ	-0.0004U	-0.0016U
Neptunium-237	0.0003U	0.033UJ	0.0001U	0.0091UJ
Plutonium-238	0.0023UJ	0.0068UJ	-0.0005U	0.0023UJ
Plutonium-239/240	0.0023UJ	0.023UJ	0.0014UJ	0.0039UJ
Technetium-99	0.013U	0.15UJ	-0.055U	-0.09U
Uranium	0.035J	1.11J	0.023UJ	0.8J
Uranium-233/234	0.013UJ	0.309J	0.0159UJ	0.432J
Uranium-235/236	0.0009UJ	0.021J	0.0012UJ	0.0202J
Uranium-238	0.0117J	0.371	0.0077UJ	0.267
	A37 – Background station near Otway			
	Vegetation	Soil		
Americium-241	0.001U	0U		
Neptunium-237	0.0004U	0U		
Plutonium-238	0.0007U	0.0054UJ		
Plutonium-239/240	0.0013U	0.0063UJ		
Technetium-99	-0.036U	0.014U		
Uranium	0.0297J	0.96J		
Uranium-233/234	0.014UJ	0.369J		
Uranium-235/236	0.0013UJ	0.0112UJ		
Uranium-238	0.0098J	0.321		
	Duplicate vegetation samples		*Duplicate soil samples*	
	A29	A41A	A12	A6
Americium-241	0.0001U	-0.0013U	0.0024U	-0.0021U
Neptunium-237	0.0009U	0.0006U	0.014UJ	0.013UJ
Plutonium-238	0.0002U	0.0014UJ	0.0038UJ	0.0016U
Plutonium-239/240	0.0008U	0.0003U	0.0086UJ	0.0183J
Technetium-99	0.26UJ	0U	0.087UJ	0.007U
Uranium	0.048J	0.0064UJ	0.96J	1.25J
Uranium-233/234	0.0183J	0.0041UJ	0.377J	0.306J
Uranium-235/236	0.0016UJ	0.00056UJ	0.0166J	0.0118UJ
Uranium-238	0.016J	0.0021UJ	0.318	0.42

[a]All parameters are measured in pCi/g with the exception of uranium which is measured in µg/g.
[b]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[c]A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results.

Table 2.18. Biota (fish) monitoring program results – 2020

Parameter	Unit	Location/fish/results[a,b]		
		Scioto River (RW-1A) drum	*Scioto River (RW-6) catfish*	*Big Beaver Creek (RW-15) large mouth bass*
Americium-241	pCi/g	-0.00014U	-0.000599U	0.000215U
Neptunium-237	pCi/g	0.000629U	0.00104U	0.000732U
Plutonium-238	pCi/g	-0.000696U	0U	0.000394U
Plutonium-239/240	pCi/g	0.0000578U	0.00129UJ	0.000786U
PCB, total	µg/kg	63.1	63.3	124
Technetium-99	pCi/g	-0.0173U	-0.0942U	-0.1U
Uranium	µg/g	0.000231U	-0.000896UJ	0.00164UJ
Uranium-233/234	pCi/g	0.00349UJ	0.00426UJ	0.00234UJ
Uranium-235/236	pCi/g	0.0014UJ	0.000224UJ	0.000151UJ
Uranium-238	pCi/g	-0.00014U	-0.000336U	0.000528U
		Big Beaver Creek (RW-13) large mouth bass	*Little Beaver Creek (RW-8) large mouth bass*	*Little Beaver Creek (RW-8) large mouth bass (duplicate sample)*
Americium-241	pCi/g	-0.000496U	-0.000171UJ	-0.000144U
Neptunium-237	pCi/g	-0.000404U	0.000578UJ	0.000501U
Plutonium-238	pCi/g	0.000986UJ	0.000217U	-0.000527UJ
Plutonium-239/240	pCi/g	0.000983UJ	0.000795U	0UJ
PCB, total	µg/kg	862	3170	149
Technetium-99	pCi/g	-0.051U	-0.076U	-0.0878U
Uranium	µg/g	0.00556UJ	0.00227UJ	0.00439UJ
Uranium-233/234	pCi/g	0.00478UJ	0.00219UJ	0.00385UJ
Uranium-235/236	pCi/g	0.000465UJ	0.00151UJ	0.00122UJ
Uranium-238	pCi/g	0.00179UJ	0.000529U	0.00128UJ

[a]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[b]A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results.

Table 2.19. Biota (crops) monitoring program results – 2020

Parameter	Unit	Location/crop/results[a,b]		
		Off-site #2 corn	*Off-site #2 tomatoes*	*Off-site #5 corn*
Americium-241	pCi/g	-0.0007U	-0.001U	-0.001U
Neptunium-237	pCi/g	0.0003U	-0.0001U	0.001U
Plutonium-238	pCi/g	0.0016UJ	0.0013UJ	0.0025UJ
Plutonium-239/240	pCi/g	0.002UJ	0.0007U	0.0001U
Technetium-99	pCi/g	-0.013U	-0.006U	-0.09U
Uranium	µg/g	0.00461UJ	0.00394UJ	0.00902UJ
Uranium-233/234	pCi/g	0.0068UJ	0.0004UJ	0.0037UJ
Uranium-235/236	pCi/g	0.0008UJ	-0.0002UJ	0.0024UJ
Uranium-238	pCi/g	0.0014UJ	0.0014UJ	0.0027UJ
		Off-site #5 tomatoes	*Off-site #6 corn*	*Off-site #6 peppers*
Americium-241	pCi/g	-0.0029U	-0.0003U	-0.0006U
Neptunium-237	pCi/g	0.0027U	0.001U	0.0008U
Plutonium-238	pCi/g	0.0038UJ	0.002UJ	0.0016UJ
Plutonium-239/240	pCi/g	0.0038UJ	0.0018UJ	0.0018UJ
Technetium-99	pCi/g	-0.095U	-0.063U	-0.079U
Uranium	µg/g	0.00762UJ	0.0039UJ	0.0133UJ
Uranium-233/234	pCi/g	0.014UJ	0.0074UJ	0.0106UJ
Uranium-235/236	pCi/g	0.0031UJ	0.0021UJ	0.0036UJ
Uranium-238	pCi/g	0.0021UJ	0.001U	0.0039UJ
		Off-site #6 tomatoes	*Off-site #6 tomatoes (duplicate sample)*	
Americium-241	pCi/g	-0.0007U	-0.0016U	
Neptunium-237	pCi/g	0.0006U	0.0002U	
Plutonium-238	pCi/g	0.0019UJ	0.0014UJ	
Plutonium-239/240	pCi/g	0.0013UJ	0.0024UJ	
Technetium-99	pCi/g	0.086UJ	0.007U	
Uranium	µg/g	0.00743UJ	0.011UJ	
Uranium-233/234	pCi/g	0.0157UJ	0.0185UJ	
Uranium-235/236	pCi/g	0.0012UJ	0.0035UJ	
Uranium-238	pCi/g	0.0023UJ	0.0032UJ	

Table 2.19. Biota (crops) monitoring program results – 2020 (continued)

Parameter	Unit	Location/crop/results[a,b]		
		Off-site #8 corn	*Off-site #8 tomatoes*	
Americium-241	pCi/g	-0.0009U	-0.0009U	
Neptunium-237	pCi/g	0.0011UJ	0.0006U	
Plutonium-238	pCi/g	0.0012UJ	0.0023UJ	
Plutonium-239/240	pCi/g	0.0011U	0.0019UJ	
Technetium-99	pCi/g	-0.09U	-0.036U	
Uranium	µg/g	0.00158UJ	0.00838UJ	
Uranium-233/234	pCi/g	0.0025UJ	0.0108UJ	
Uranium-235/236	pCi/g	0.0005UJ	0.0001UJ	
Uranium-238	pCi/g	0.0005U	0.0028UJ	
		Off-site #9 beans	*Off-site #9 cucumbers*	*Off-site #9 tomatoes*
Americium-241	pCi/g	-0.0035U	-0.0015U	-0.001U
Neptunium-237	pCi/g	0.0012U	0.0012UJ	0.0004U
Plutonium-238	pCi/g	0.0063UJ	0.0001U	0.0013UJ
Plutonium-239/240	pCi/g	0.0047UJ	-0.0004U	0.0003U
Technetium-99	pCi/g	0.08U	-0.043U	-0.038U
Uranium	µg/g	0.046UJ	0.0093UJ	0.0091UJ
Uranium-233/234	pCi/g	0.032J	0.0117UJ	0.0093UJ
Uranium-235/236	pCi/g	0.0086UJ	0.0034UJ	0.0011UJ
Uranium-238	pCi/g	0.0141UJ	0.0026UJ	0.0029UJ

[a]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[b]A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results.

Table 2.20. Biota (deer) monitoring program results – 2020

Parameter	Unit	February (2/20/2020)[a,b]	February (2/27/2020)[a,b]	November[a,b]
		kidney		
Americium-241	pCi/g	0.00143U	-0.00122U	-0.000874U
Neptunium-237	pCi/g	-0.000481U	-0.000507U	0.0013U
Plutonium-238	pCi/g	-0.000309U	0.000973U	-0.00109U
Plutonium-239/240	pCi/g	0.00309U	0.0026U	0.00327UJ
Technetium-99	pCi/g	0.0522U	-0.0721U	0.169UJ
Uranium	µg/g	0.000322UJ	0.00201UJ	0.0053UJ
Uranium-233/234	pCi/g	-0.00028UJ	0.00227UJ	0.0056UJ
Uranium-235/236	pCi/g	0.000696UJ	0.000705UJ	0.0023UJ
Uranium-238	pCi/g	0U	0.000567U	0.0014U
		liver		
Americium-241	pCi/g	0.00151U	-0.000297U	-0.000498U
Neptunium-237	pCi/g	-0.000272U	0U	0.000482U
Plutonium-238	pCi/g	-0.00153U	0.00155U	0.00199U
Plutonium-239/240	pCi/g	0.00184U	0.000622U	0.00199U
Technetium-99	pCi/g	-0.0825U	-0.0466U	0.495
Uranium	µg/g	0.000305UJ	-0.000156UJ	0.0021UJ
Uranium-233/234	pCi/g	0.00132UJ	0.00272UJ	0.0083UJ
Uranium-235/236	pCi/g	0.000659UJ	-0.000338UJ	0.0018UJ
Uranium-238	pCi/g	0U	0U	0.0004U
		muscle		
Americium-241	pCi/g	-0.000339U	-0.000331U	-0.00181U
Neptunium-237	pCi/g	-0.000522U	0U	0U
Plutonium-238	pCi/g	-0.000706U	0.000302U	0.000978U
Plutonium-239/240	pCi/g	0.000706U	0.00181U	0.00147U
Technetium-99	pCi/g	0.00161U	-0.0811U	0.062UJ
Uranium	µg/g	0.000000147UJ	0.00422UJ	0.0012UJ
Uranium-233/234	pCi/g	0.000917UJ	0.00124UJ	0.01UJ
Uranium-235/236	pCi/g	0UJ	0.00115UJ	0UJ
Uranium-238	pCi/g	0U	0.00124U	0.0004U

[a]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[b]A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results.

Table 2.21. Biota (milk and eggs) monitoring program results – 2020

Parameter	Unit	Milk[a,b]	Milk[a,b] *(duplicate sample)*	Eggs[a,b]
Americium-241	pCi/g	-0.0005U	0.0003U	0.0003U
Neptunium-237	pCi/g	-0.00014U	-0.0005U	0.0011UJ
Plutonium-238	pCi/g	0.00126UJ	0.00064U	0.00049U
Plutonium-239/240	pCi/g	0U	0.00079UJ	0.00033U
Technetium-99	pCi/g	-0.042U	-0.017U	-0.03U
Uranium	µg/g	0.001U	-0.0009UJ	0UJ
Uranium-233/234	pCi/g	0.0027UJ	0.0016UJ	0.0029UJ
Uranium-235/236	pCi/g	0.00015UJ	0.00036UJ	0UJ
Uranium-238	pCi/g	0.0003U	-0.00036U	0U

[a]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[b]A negative concentration of radioactivity is reported by the laboratory when the sample count rate minus the laboratory background count rate is negative (i.e., the background count rate was greater than the sample count rate). When the background activity is subtracted from the sample activity to obtain a net value, a negative value results.

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3. AIR DOSE

This section provides summary tables of air emissions and dose assessments completed by DOE for compliance with the National Emission Standards for Hazardous Air Pollutants for airborne radionuclide emissions. The following tables are provided in this section:

- Table 3.1. Emissions (Ci/year) from DOE air emission sources – 2020
- Table 3.2. Predicted radiation doses from airborne releases at PORTS – 2020
- Table 3.3. Dose calculations for ambient air monitoring stations – 2020.

Table 3.1. Emissions (Ci/year) from DOE air emission sources – 2020

Radionuclide	Group 1[a]	Group 2[b]	Group 3[c]	DUF_6 facility[d]
Americium-241	2.813E-06	-	2.821E-06	-
Neptunium-237	9.003E-08	-	2.991E-05	-
Plutonium-238	5.320E-11	-	4.839E-07	-
Plutonium-239/240	4.329E-07	-	1.538E-05	-
Technetium-99	5.243E-05	9.731E-04	2.756E-02	-
Uranium-233/234	3.989E-06	2.370E-05	5.226E-03	4.79E-07
Uranium-235	3.991E-06	7.905E-06	2.213E-04	2.19E-08
Uranium-238	2.408E-05	2.129E-05	7.388E-04	1.18E-06
Thorium-228	2.924E-11	0	4.217E-06	-
Thorium-230	1.558E-09	1.926E-07	1.091E-05	-
Thorium-231	6.215E-10	7.905E-06	1.719E-04	1.59E-07
Thorium-232	5.922E-12	2.755E-08	3.615E-06	-
Thorium-234	3.969E-09	2.129E-05	6.763E-04	1.45E-05
Total	8.78E-05	1.06E-03	3.47E-02	1.63E-05

[a]Group 1 consists of the X-710 Vents and X-622 Groundwater Treatment Facility.
[b]Group 2 consists of the X-344A Gulper Vent and X-344A Cold Trap Vent.
[c]Group 3 consists of the X-330 Vents, X-333 Vents, X-705 Vents, X-623 Groundwater Treatment Facility, X-624 Groundwater Treatment Facility, and X-627 Groundwater Treatment Facility.
[d]DUF_6 – depleted uranium hexafluoride.

Note: Measurements are provided in scientific notation. The number and sign (+ or -) to the right of the "E" indicate the number of places to the right or left of the decimal point. For example, 3.4E-04 is 0.00034 (the decimal point moves four places to the left); 2.1E+02 is 210 (the decimal point moves two places to the right).

Table 3.2. Predicted radiation doses from airborne releases at PORTS – 2020

Effective dose to:	
Maximally exposed individual (mrem/year)	0.068
Population[a] (person-rem/year)	0.35

[a]Population within 50 miles (80 kilometers) of plant site.

Table 3.3. Dose calculations for ambient air monitoring stations – 2020

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]
A3	Americium-241	4.9E-04	
	Neptunium-237	1.1E-04	
	Plutonium-238	0	
	Plutonium-239/240	9.2E-04	
	Technetium-99	3.3E-03	
	Thorium-228	2.3E-03	
	Thorium-230	1.7E-03	
	Thorium-232	9.1E-04	
	Uranium-233/234	1.2E-03	
	Uranium-235/236	9.8E-05	
	Uranium-238	6.1E-04	0.012
A6	Americium-241	8.5E-04	
	Neptunium-237	1.6E-04	
	Plutonium-238	5.9E-04	
	Plutonium-239/240	1.1E-03	
	Technetium-99	3.0E-03	
	Thorium-228	4.0E-03	
	Thorium-230	1.1E-03	
	Thorium-232	1.0E-03	
	Uranium-233/234	4.4E-04	
	Uranium-235/236	5.5E-05	
	Uranium-238	7.4E-04	0.013
A8	Americium-241	6.0E-04	
	Neptunium-237	2.3E-04	
	Plutonium-238	7.9E-04	
	Plutonium-239/240	1.0E-03	
	Technetium-99	4.3E-03	
	Thorium-228	1.6E-03	
	Thorium-230	1.1E-03	
	Thorium-232	1.1E-03	
	Uranium-233/234	1.3E-03	
	Uranium-235/236	9.9E-05	
	Uranium-238	7.8E-04	0.013

Table 3.3. Dose calculations for ambient air monitoring stations – 2020 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station
A9	Americium-241	8.5E-04	
	Neptunium-237	1.1E-04	
	Plutonium-238	4.6E-04	
	Plutonium-239/240	8.3E-04	
	Technetium-99	1.9E-03	
	Thorium-228	6.1E-03	
	Thorium-230	1.5E-03	
	Thorium-232	1.3E-03	
	Uranium-233/234	2.8E-04	
	Uranium-235/236	6.2E-05	
	Uranium-238	4.5E-04	0.014
A10	Americium-241	5.0E-04	
	Neptunium-237	2.0E-04	
	Plutonium-238	8.5E-05	
	Plutonium-239/240	6.0E-04	
	Technetium-99	3.0E-03	
	Thorium-228	4.3E-03	
	Thorium-230	1.0E-03	
	Thorium-232	1.1E-03	
	Uranium-233/234	8.0E-04	
	Uranium-235/236	3.7E-05	
	Uranium-238	5.2E-04	0.012
A12	Americium-241	8.9E-04	
	Neptunium-237	3.6E-05	
	Plutonium-238	1.6E-04	
	Plutonium-239/240	3.8E-04	
	Technetium-99	8.3E-03	
	Thorium-228	4.8E-03	
	Thorium-230	9.6E-04	
	Thorium-232	2.9E-03	
	Uranium-233/234	2.2E-03	
	Uranium-235/236	9.9E-05	
	Uranium-238	1.7E-03	0.022
A15	**Americium-241**	6.4E-04	
	Neptunium-237	2.5E-04	
	Plutonium-238	2.8E-04	
	Plutonium-239/240	6.0E-04	
	Technetium-99	5.0E-03	
	Thorium-228	2.3E-02	
	Thorium-230	1.1E-03	
	Thorium-232	1.2E-03	
	Uranium-233/234	2.6E-03	
	Uranium-235/236	7.8E-05	
	Uranium-238	4.9E-04	0.036

Table 3.3. Dose calculations for ambient air monitoring stations – 2020 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station
A23	Americium-241	5.1E-04	
	Neptunium-237	4.6E-04	
	Plutonium-238	4.5E-04	
	Plutonium-239/240	1.4E-03	
	Technetium-99	4.2E-03	
	Thorium-228	6.1E-03	
	Thorium-230	1.5E-03	
	Thorium-232	3.6E-03	
	Uranium-233/234	1.0E-03	
	Uranium-235/236	7.0E-05	
	Uranium-238	5.5E-04	0.020
A24	Americium-241	5.1E-04	
	Neptunium-237	1.3E-04	
	Plutonium-238	4.1E-04	
	Plutonium-239/240	7.7E-04	
	Technetium-99	3.1E-03	
	Thorium-228	6.9E-03	
	Thorium-230	1.9E-03	
	Thorium-232	1.0E-03	
	Uranium-233/234	6.8E-03	
	Uranium-235/236	4.3E-04	
	Uranium-238	5.9E-03	0.028
A28	Americium-241	6.5E-04	
	Neptunium-237	1.9E-04	
	Plutonium-238	1.0E-03	
	Plutonium-239/240	1.1E-03	
	Technetium-99	2.6E-03	
	Thorium-228	5.1E-03	
	Thorium-230	9.5E-04	
	Thorium-232	9.8E-04	
	Uranium-233/234	2.5E-04	
	Uranium-235/236	3.7E-05	
	Uranium-238	4.1E-04	0.013
A29	Americium-241	7.6E-04	
	Neptunium-237	3.7E-05	
	Plutonium-238	3.3E-04	
	Plutonium-239/240	8.1E-04	
	Technetium-99	2.9E-03	
	Thorium-228	3.9E-02	
	Thorium-230	1.9E-03	
	Thorium-232	2.4E-03	
	Uranium-233/234	3.7E-04	
	Uranium-235/236	1.0E-04	
	Uranium-238	6.5E-04	0.049

Table 3.3. Dose calculations for ambient air monitoring stations – 2020 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station
A36	Americium-241	1.4E-03	
	Neptunium-237	5.8E-04	
	Plutonium-238	8.6E-05	
	Plutonium-239/240	7.7E-04	
	Technetium-99	3.1E-03	
	Thorium-228	4.0E-03	
	Thorium-230	1.5E-03	
	Thorium-232	7.2E-04	
	Uranium-233/234	2.4E-03	
	Uranium-235/236	6.4E-05	
	Uranium-238	1.3E-03	0.016
A37	Americium-241	1.2E-03	
	Neptunium-237	2.3E-04	
	Plutonium-238	8.8E-05	
	Plutonium-239/240	1.3E-03	
	Technetium-99	2.4E-03	
	Thorium-228	8.5E-03	
	Thorium-230	1.0E-03	
	Thorium-232	1.0E-03	
	Uranium-233/234	3.8E-04	
	Uranium-235/236	5.3E-05	
	Uranium-238	7.2E-04	0.017
A41A	Americium-241	7.8E-04	
	Neptunium-237	2.5E-04	
	Plutonium-238	3.1E-04	
	Plutonium-239/240	1.2E-03	
	Technetium-99	3.1E-03	
	Thorium-228	6.5E-03	
	Thorium-230	1.6E-03	
	Thorium-232	1.3E-03	
	Uranium-233/234	1.4E-03	
	Uranium-235/236	5.4E-05	
	Uranium-238	2.3E-04	0.017
A50	Americium-241	4.6E-04	
	Neptunium-237	0	
	Plutonium-238	2.9E-04	
	Plutonium-239/240	3.2E-04	
	Technetium-99	2.8E-04	
	Thorium-228	2.4E-03	
	Thorium-230	5.0E-04	
	Thorium-232	3.0E-03	
	Uranium-233/234	1.5E-03	
	Uranium-235/236	5.6E-05	
	Uranium-238	8.3E-04	0.0095

Table 3.3. Dose calculations for ambient air monitoring stations – 2020 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station
A52	Americium-241	7.4E-04	
	Neptunium-237	6.1E-05	
	Plutonium-238	5.6E-04	
	Plutonium-239/240	7.7E-04	
	Technetium-99	7.8E-03	
	Thorium-228	4.2E-04	
	Thorium-230	0	
	Thorium-232	1.1E-03	
	Uranium-233/234	3.2E-03	
	Uranium-235/236	1.3E-04	
	Uranium-238	1.4E-03	0.016
A54	Americium-241	4.9E-04	
	Neptunium-237	0	
	Plutonium-238	0	
	Plutonium-239/240	0	
	Technetium-99	2.2E-04	
	Thorium-228	2.2E-03	
	Thorium-230	3.8E-04	
	Thorium-232	1.5E-03	
	Uranium-233/234	1.1E-03	
	Uranium-235/236	5.1E-05	
	Uranium-238	2.7E-04	0.0063
T7	Americium-241	1.0E-03	
	Neptunium-237	1.0E-04	
	Plutonium-238	7.4E-04	
	Plutonium-239/240	6.5E-04	
	Technetium-99	2.9E-03	
	Thorium-228	1.4E-03	
	Thorium-230	9.1E-04	
	Thorium-232	7.1E-04	
	Uranium-233/234	1.2E-03	
	Uranium-235/236	4.0E-05	
	Uranium-238	5.2E-04	0.010

[a]Parameters listed in **bold** type were detected at least once in the samples collected in 2020 (see Table 2.10).
[b]The dose calculation is based on the maximum detection of each parameter at each station. For parameters that were not detected, half of the highest undetected result for the parameter was used to calculate the activity of each parameter in ambient air that is the basis for the dose. Measurements are provided in scientific notation. The number and sign (+ or -) to the right of the "E" indicate the number of places to the right or left of the decimal point. For example, 3.4E-04 is 0.00034 (the decimal point moves four places to the left); 2.1E+02 is 210 (the decimal point moves two places to the right).

4. GROUNDWATER

This section summarizes analytical results for routine groundwater monitoring at PORTS in 2020 at the following locations:

- X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility
- Peter Kiewit (PK) Landfill
- Quadrant I Groundwater Investigative (5-Unit) Area
- X-749A Classified Materials Disposal Facility
- Quadrant II Groundwater Investigative (7-Unit) Area
- X-701B Former Holding Pond
- X-633 Former Recirculating Cooling Water Complex
- X-616 Former Chromium Sludge Surface Impoundments
- X-740 Former Waste Oil Handling Facility
- X-611A Former Lime Sludge Lagoons
- X-735 Landfills
- X-734 Landfills
- X-533 Former Switchyard Complex
- X-344C Former Hydrogen Fluoride Storage Building
- Surface water monitoring locations
- Exit pathway monitoring locations.

Results for radiological parameters and VOCs are reported in this section. Only those VOCs that were detected in at least one sampling event are listed in this section.

All results are included for radiological parameters, even if a specific constituent was not detected at a specific well or location during any sampling event in 2020. Sampling for radionuclides is not part of the monitoring programs for PK Landfill, X-633 Former Recirculating Cooling Water Complex, X-616 Former Chromium Sludge Surface Impoundments, X-740 Former Waste Oil Handling Facility, X-611A Former Lime Sludge Lagoons, X-533 Former Switchyard Complex, and X-344C Former Hydrogen Fluoride Storage Building.

Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments are included in this section because chromium is a primary contaminant in this area. Results are provided for metals at the X-633 Former Recirculating Cooling Water Complex, X-611A Former Lime Sludge Lagoons, and X-533 Former Switchyard Complex because metals are the only analytical parameters for these areas.

Acetone was frequently detected in both environmental and blank samples (field and trip blanks) collected in 2020. Acetone is a common laboratory contaminant that is not typically detected in the PORTS groundwater plumes. Detections of acetone can be qualified by the laboratory with a “B”, which indicates that the analyte was also detected in the laboratory blank associated with the environmental sample and may be present due to laboratory contamination. TCE, 2-butanone, and m,p-xylenes were also detected in laboratory blanks in 2020.

Other VOCs were detected in more than two trip and/or field blanks during 2020. These VOCs are 1,1,1-trichloroethane, 1,2-dichlorobenzene, 2-butanone, bromomethane, carbon disulfide, *cis*-1,2-dichloroethene, styrene, and TCE. These detections indicate that samples (both environmental samples and blank samples) may become contaminated with low concentrations of VOCs during other portions of the sampling process, although contamination can still occur in the laboratory. Other sources of contamination may include storage areas for sampling equipment (such as bottles and blank water),

areas in which samples are collected or prepared, sample containers (such as vials for VOC samples), and storage areas after samples are collected (such as refrigerators or sample shipping containers).

The primary purpose of the groundwater data is to determine the nature and extent of contamination in groundwater and associated surface water at PORTS. Data collected in 2020 meet this purpose.

Complete groundwater monitoring results for sampling completed as required by the *Integrated Groundwater Monitoring Plan* (DOE 2017) are provided in the *2020 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2021a). The *2020 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* also provides the following information not included in this Data Report:

- Results for special studies conducted during 2020 at the X-701B Holding Pond/Little Beaver Creek, X-633 Former Recirculating Cooling Water Complex, and X-630 Former Recirculating Cooling Water Complex.

- Results for duplicate samples (samples collected from the same location, at the same time, and from the same sampling device as the regular sample), which are collected at a frequency of one per 20 sampling locations per groundwater monitoring area. Duplicate samples are analyzed for the same parameters as the regular sample associated with the sampling location.

The following tables are included in this section:

- Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020

- Table 4.2. VOCs detected at the PK Landfill – 2020

- Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2020

- Table 4.4. VOCs detected at the X-749A Classified Materials Disposal Facility – 2020

- Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2020

- Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020

- Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020

- Table 4.8. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2020

- Table 4.9. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2020

- Table 4.10. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2020

- Table 4.11. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2020

- Table 4.12. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2020

- Table 4.13. VOCs detected at the X-735 Landfills – 2020

- Table 4.14. Results for radionuclides at the X-735 Landfills – 2020
- Table 4.15. VOCs detected at the X-734 Landfills – 2020
- Table 4.16. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2020
- Table 4.17. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2020
- Table 4.18. VOCs detected at surface water monitoring locations – 2020
- Table 4.19. Results for radionuclides at surface water monitoring locations – 2020.

Results for exit pathway monitoring locations sampled during 2020 (that are part of the monitoring programs for other areas) are provided in the tables for their respective monitoring areas as follows:

- Table 4.1: VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility (wells X749-14B, X749-44G, X749-45G, X749-64B, X749-68G, X749-96G, X749-97G and X749-98G).
- Tables 4.6 and 4.7: Results for radionuclides and VOCs detected at X-701B Former Holding Pond area well X701-48G.
- Tables 4.18 and 4.19: VOCs and radionuclides detected at surface water monitoring locations BRC-SW02, LBC-SW04, UND-SW02, and WDD-SW03.

The following laboratory data qualifiers are used in the tables in this section:

Data qualifier	Meaning
*	Quality control samples failed one or more duplicate criteria.
B	The analyte was detected in the laboratory blank sample.
D	The reported result is from a dilution.
J	The reported value is estimated.
Q	One or more quality control criteria failed.
U	Undetected

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
PK-09G	cis-1,2-Dichloroethene	µg/L			9 D	
	Trichloroethene	µg/L			340 D	
STSW-101G	1,1,1-Trichloroethane	µg/L		2.06 UJ		2.48
	1,1,2-Trichloroethane	µg/L		0.602 U		0.291 J
	1,1-Dichloroethane	µg/L		8.86		12.3
	1,1-Dichloroethene	µg/L		20.6		26.7
	1,2-Dichloroethane	µg/L		1.8 J		2.08
	Chloroform	µg/L		0.61 U		0.734 J
	cis-1,2-Dichloroethene	µg/L		4.49		5.12
	Tetrachloroethene	µg/L		0.763 U		0.813 J
	Trichloroethene	µg/L		23.4 QJ		34.9
STSW-102G	1,1,1-Trichloroethane	µg/L		2.64 UJ		3.76
	1,1-Dichloroethane	µg/L		30.1		34.8
	1,1-Dichloroethene	µg/L		18.2		22.8
	1,2-Dichloroethane	µg/L		10.6		10.8
	Chloroform	µg/L		1.2 J		1.46
	cis-1,2-Dichloroethene	µg/L		9.78		10.1
	trans-1,2-Dichloroethene	µg/L		0.586 U		0.385 J
	Trichloroethene	µg/L		64.5 QJ		80.8
WP-01G	cis-1,2-Dichloroethene	µg/L		0.37 U		1.17
	Trichloroethene	µg/L		0.638 U		0.827 J
X120-05G	1,1-Dichloroethene	µg/L			0.44 J	
	Trichloroethene	µg/L			4.8	
X120-08G	1,1,1-Trichloroethane	µg/L			2.5	
	1,1,2-Trichloroethane	µg/L			0.36 J	
	1,1-Dichloroethane	µg/L			6.1	
	1,1-Dichloroethene	µg/L			25	
	Chloroform	µg/L			0.67 J	
	cis-1,2-Dichloroethene	µg/L			0.66 J	
	Trichloroethene	µg/L			12	
X120-10G	1,1,1-Trichloroethane	µg/L			2.5	
	1,1,2-Trichloroethane	µg/L			0.69 J	
	1,1-Dichloroethane	µg/L			12	
	1,1-Dichloroethene	µg/L			37	
	Chloroform	µg/L			0.88 J	
	cis-1,2-Dichloroethene	µg/L			0.96 J	
	Trichloroethene	µg/L			9.7	
X120-11G	1,1-Dichloroethene	µg/L		0.86 U		0.663 J
	cis-1,2-Dichloroethene	µg/L		4.88		5.18
	Trichloroethene	µg/L		179		88.1
X749-04G	Chloroform	µg/L			0.18 J	
	cis-1,2-Dichloroethene	µg/L			0.29 J	
	Tetrachloroethene	µg/L			2.4	
	Trichloroethene	µg/L			120	
X749-05G	1,1-Dichloroethane	µg/L			0.85 J	
	Carbon tetrachloride	µg/L			0.25 J	
	Chloroform	µg/L			0.87 J	
	cis-1,2-Dichloroethene	µg/L			0.97 J	
	Tetrachloroethene	µg/L			1.4	
	Trichloroethene	µg/L			110	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-06G	1,1,1-Trichloroethane	µg/L		9.66		18 D
	1,1,2-Trichloroethane	µg/L		1.41 J		2.59 DJ
	1,1-Dichloroethane	µg/L		89.3		148 D
	1,1-Dichloroethene	µg/L		69.8		112 D
	1,2-Dichloroethane	µg/L		1.86 J		3.23 DJ
	2-Butanone	µg/L		1.26 *U		15.7 BDJ
	Chloroform	µg/L		8.61		14.2 D
	cis-1,2-Dichloroethene	µg/L		24.7		39.3 D
	Tetrachloroethene	µg/L		5.19 Q		15 D
	Trichloroethene	µg/L		299 DQ		561 D
X749-07G	1,1,1-Trichloroethane	µg/L		5.13		9.71
	1,1-Dichloroethane	µg/L		18.4		17.8
	1,1-Dichloroethene	µg/L		15		17.9
	1,2-Dichloroethane	µg/L		9.26		8.84
	2-Butanone	µg/L		1.26 U		4.25 BJ
	Chloroform	µg/L		0.858 J		1.26
	cis-1,2-Dichloroethene	µg/L		5.1		7.46
	Tetrachloroethene	µg/L		0.763 U		0.707 J
	Trichloroethene	µg/L		46.9		75.7
X749-08G	1,1,1-Trichloroethane	µg/L		3.21 UJ		4.02
	1,1-Dichloroethane	µg/L		0.801 J		0.842 J
	1,1-Dichloroethene	µg/L		3.92		4.22 J
	2-Butanone	µg/L		1.26 U		4.02 BJ
	cis-1,2-Dichloroethene	µg/L		0.919 J		0.89 J
	Trichloroethene	µg/L		6.47		6.92
X749-09GA	1,1,1-Trichloroethane	µg/L		3.01 UJ		2.87
	1,1-Dichloroethane	µg/L		0.734 J		0.59 J
	1,1-Dichloroethene	µg/L		2.28 J		2.08
	2-Butanone	µg/L		1.26 U		4.2 BJ
	cis-1,2-Dichloroethene	µg/L		0.724 J		0.465 J
	Trichloroethene	µg/L		6.61		4.27
X749-10GA	1,1-Dichloroethane	µg/L		0.641 U		0.547 J
	1,1-Dichloroethene	µg/L		0.86 U		1.87
	2-Butanone	µg/L		1.26 U		3.99 BJ
	cis-1,2-Dichloroethene	µg/L		0.37 U		0.56 J
X749-13G	1,1,1-Trichloroethane	µg/L		1.62 UJ		1.86
	1,1-Dichloroethane	µg/L		0.641 U		0.425 J
	1,1-Dichloroethene	µg/L		1.97 J		2.45
	cis-1,2-Dichloroethene	µg/L		0.442 J		0.412 J
	Trichloroethene	µg/L		3.77 UJ		5.08
X749-14B	2-Butanone	µg/L		1.26 U		4.15 BJ
X749-20G	1,1-Dichloroethane	µg/L			0.53 J	
	1,1-Dichloroethene	µg/L			0.41 J	
	1,2-Dichloroethane	µg/L			0.27 J	
	cis-1,2-Dichloroethene	µg/L			0.65 J	
	Trichloroethene	µg/L			4.8	
X749-21G	2-Butanone	µg/L		1.26 U		3.94 BJ
	Trichloroethene	µg/L		0.638 QU		0.618 J
X749-22G	1,1-Dichloroethane	µg/L		2.46		2.4
	1,1-Dichloroethene	µg/L		3.64		3.97

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-22G	2-Butanone	µg/L		1.26 U		4.28 BJ
	cis-1,2-Dichloroethene	µg/L		1.23 J		1.07
	Trichloroethene	µg/L		0.638 U		0.165 J
X749-23G	2-Butanone	µg/L		1.26 U		3.96 BJ
X749-24G	2-Butanone	µg/L		1.26 U		3.9 BJ
X749-26G	1,1-Dichloroethane	µg/L		3.22		0.699 J
	1,1-Dichloroethene	µg/L		3.77		0.926 J
	1,2-Dichloroethane	µg/L		1.44 J		0.301 J
	cis-1,2-Dichloroethene	µg/L		0.83 J		0.15 U
	Trichloroethene	µg/L		6.25		2.86
X749-27G	1,1,1-Trichloroethane	µg/L		20.1		14.5
	1,1,2-Trichloroethane	µg/L		1.13 J		0.933 J
	1,1-Dichloroethane	µg/L		174		108
	1,1-Dichloroethene	µg/L		241 D		147
	1,2-Dichloroethane	µg/L		100		55.2
	Bromomethane	µg/L		1.45 U		0.296 J
	Chloroform	µg/L		15.9		11.9
	cis-1,2-Dichloroethene	µg/L		27		19.9
	Tetrachloroethene	µg/L		1.25 J		1.64
	Trichloroethene	µg/L		243 D		198
X749-28G	1,1,1-Trichloroethane	µg/L			5	
	1,1,2-Trichloroethane	µg/L			0.36 J	
	1,1-Dichloroethane	µg/L			8.3	
	1,1-Dichloroethene	µg/L			30	
	1,2-Dichloroethane	µg/L			1.7	
	Chloroform	µg/L			1.3	
	cis-1,2-Dichloroethene	µg/L			1.1	
	Tetrachloroethene	µg/L			0.65 J	
	Trichloroethene	µg/L			45	
X749-29G	Trichloroethene	µg/L			5.6	
X749-30G	1,1-Dichloroethene	µg/L			0.66 J	
	Chloroform	µg/L			0.22 J	
	cis-1,2-Dichloroethene	µg/L			2.5	
	Trichloroethene	µg/L			140 J	
X749-33G	1,1,1-Trichloroethane	µg/L		2.95 UJ		9.4
	1,1,2-Trichloroethane	µg/L		0.602 U		0.69 J
	1,1-Dichloroethane	µg/L		12.1		40.1
	1,1-Dichloroethene	µg/L		17.6		61.8
	1,2-Dichloroethane	µg/L		5.99		17.2
	Chloroethane	µg/L		0.84 U		0.619 J
	Chloroform	µg/L		1.18 J		4.33
	cis-1,2-Dichloroethene	µg/L		2 J		7.22
	Tetrachloroethene	µg/L		0.763 U		1.41
	Trichloroethene	µg/L		33 QJ		100
X749-35G	1,1,1-Trichloroethane	µg/L			33	
	1,1-Dichloroethane	µg/L			7.8	
	1,1-Dichloroethene	µg/L			25	
	Chloroform	µg/L			0.18 J	
	cis-1,2-Dichloroethene	µg/L			7	
	trans-1,2-Dichloroethene	µg/L			0.18 J	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-35G	Trichloroethene	µg/L			70	
	Vinyl chloride	µg/L			0.9 J	
X749-36G	1,1-Dichloroethane	µg/L			0.86 J	
	1,1-Dichloroethene	µg/L			2.2	
	cis-1,2-Dichloroethene	µg/L			0.16 J	
	Trichloroethene	µg/L			2.6	
X749-37G	1,1-Dichloroethane	µg/L		2.41		3.57
	1,1-Dichloroethene	µg/L		5.05		9.04
	1,2-Dichloroethane	µg/L		0.406 U		0.417 J
	Chloroform	µg/L		0.61 U		0.194 J
	cis-1,2-Dichloroethene	µg/L		1.21 J		1.39
	Tetrachloroethene	µg/L		0.763 U		0.481 J
	Trichloroethene	µg/L		5.13		9.26
X749-38G	1,1,1-Trichloroethane	µg/L		1.93 UJ		2.74
	1,1,2-Trichloroethane	µg/L		0.602 U		0.331 J
	1,1-Dichloroethane	µg/L		6.53		9.92
	1,1-Dichloroethene	µg/L		15.3		23.5
	1,2-Dichloroethane	µg/L		0.739 J		1.11
	Bromodichloromethane	µg/L		1.28 J		0.17 U
	Chloroform	µg/L		0.61 U		0.557 J
	cis-1,2-Dichloroethene	µg/L		3.13		4.1
	Tetrachloroethene	µg/L		0.763 U		0.803 J
	Trichloroethene	µg/L		17		28.5
X749-40G	1,1-Dichloroethene	µg/L			2.3	
	Chloroform	µg/L			0.34 J	
	cis-1,2-Dichloroethene	µg/L			0.68 J	
	Trichloroethene	µg/L			18	
X749-41G	cis-1,2-Dichloroethene	µg/L		0.914 J		0.263 J
	Trichloroethene	µg/L		381 D		105
X749-42G	1,1-Dichloroethane	µg/L		0.641 U		0.453 J
	1,1-Dichloroethene	µg/L		1.41 J		1.77
	Trichloroethene	µg/L		2.9		4.05
X749-43G	1,1-Dichloroethene	µg/L			0.51 J	
	Trichloroethene	µg/L			0.29 J	
X749-45G	1,1,1-Trichloroethane	µg/L	0.16 U	0.73 J	0.16 U	0.16 U
	1,1-Dichloroethane	µg/L	5	4.1	2.8	0.906 J
	1,1-Dichloroethene	µg/L	4.6	3.56	2.2	0.67 J
	1,2-Dichloroethane	µg/L	1.2	1.15 J	0.88 J	0.13 U
	cis-1,2-Dichloroethene	µg/L	4.7	4.22	2.2	0.575 J
	Trichloroethene	µg/L	14	11.4	8.8	2.93
X749-50B	1,1-Dichloroethane	µg/L			1	
	cis-1,2-Dichloroethene	µg/L			0.35 J	
	Trichloroethene	µg/L			0.34 J	
X749-54B	1,1-Dichloroethane	µg/L		3.33		2.93
	2-Butanone	µg/L		1.26 U		4.44 BJ
	Trichloroethene	µg/L		2.11 QUJ		18.1
X749-67G	1,1,1-Trichloroethane	µg/L	3.9	2.85 UJ	3.5	3.65
	1,1-Dichloroethane	µg/L	47	41.9	46	48.6
	1,1-Dichloroethene	µg/L	35	28.1	37	37.3
	1,2-Dichloroethane	µg/L	14	12.6	13	14.4

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-67G	Chloroform	µg/L	2.5	1.86 J	2.4	2.43
	cis-1,2-Dichloroethene	µg/L	22	22.2	22	24
	trans-1,2-Dichloroethene	µg/L	0.19 J	0.586 U	0.15 U	0.261 J
	Trichloroethene	µg/L	130	104 QJ	130	143
X749-97G	1,1-Dichloroethane	µg/L	1.6	1.41 J	0.22 U	0.22 U
	1,1-Dichloroethene	µg/L	0.76 J	0.86 U	0.23 U	0.23 U
	cis-1,2-Dichloroethene	µg/L	0.71 J	0.676 J	0.15 U	0.15 U
	Trichloroethene	µg/L	2.9	2.33	0.32 J	0.16 U
X749-102G	1,1-Dichloroethene	µg/L	0.47 J	0.86 U	0.23 U	0.23 U
	Trichloroethene	µg/L	0.45 J	0.638 U	0.16 U	0.215 J
X749-103G	1,1-Dichloroethane	µg/L	0.22 U	0.641 U	0.22 U	0.587 J
	1,1-Dichloroethene	µg/L	0.23 U	0.86 U	0.54 J	0.907 J
	cis-1,2-Dichloroethene	µg/L	0.15 U	0.37 U	0.15 U	0.186 J
	Trichloroethene	µg/L	0.21 J	0.638 QU	0.23 J	0.891 J
X749-106G	1,1,1-Trichloroethane	µg/L		4.43		4.94
	1,1,2-Trichloroethane	µg/L		0.602 U		0.585 J
	1,1-Dichloroethane	µg/L		10.4		11.5
	1,1-Dichloroethene	µg/L		30.3		32.5
	1,2-Dichloroethane	µg/L		1.01 J		1.03
	Chloroform	µg/L		0.822 J		0.906 J
	cis-1,2-Dichloroethene	µg/L		2.04		2.24
	Tetrachloroethene	µg/L		0.763 U		0.847 J
	Trichloroethene	µg/L		20.3		24.7
X749-107G	1,1,1-Trichloroethane	µg/L		4.78		5.6
	1,1,2-Trichloroethane	µg/L		0.605 J		0.72 J
	1,1-Dichloroethane	µg/L		14.1		14.7
	1,1-Dichloroethene	µg/L		42		42.1
	1,2-Dichloroethane	µg/L		1.41 J		1.24
	Chloroform	µg/L		1.1 J		1.23
	cis-1,2-Dichloroethene	µg/L		3.1		2.98
	Tetrachloroethene	µg/L		0.763 U		0.904 J
	Trichloroethene	µg/L		28.6		33.3
X749-108G	1,1,1-Trichloroethane	µg/L		15.6		17.8
	1,1,2-Trichloroethane	µg/L		1.09 J		1.09
	1,1-Dichloroethane	µg/L		22.2		22.5
	1,1-Dichloroethene	µg/L		61.5		62.8
	1,2-Dichloroethane	µg/L		1.87 J		1.81
	Chloroform	µg/L		2.02 J		2.02
	cis-1,2-Dichloroethene	µg/L		3.92		3.67
	Tetrachloroethene	µg/L		1.06 J		1.31
	Trichloroethene	µg/L		53		60.2
X749-109G	1,1,1-Trichloroethane	µg/L		0.796 UJ		0.497 J
	1,1-Dichloroethane	µg/L		0.813 J		0.962 J
	1,1-Dichloroethene	µg/L		1.08 J		1.71 J
	cis-1,2-Dichloroethene	µg/L		0.572 J		0.516 J
	Trichloroethene	µg/L		1.74 JQU		2.56
X749-110G	1,1,1-Trichloroethane	µg/L		1.52 UJ		2.69 J
	1,1-Dichloroethane	µg/L		1.61 J		2.85
	1,1-Dichloroethene	µg/L		4.05		8.39 J
	1,2-Dichloroethane	µg/L		0.469 J		0.898 J

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-110G	2-Butanone	µg/L		1.26 *U		3.98 BJ
	Chloroform	µg/L		0.61 U		0.256 J
	cis-1,2-Dichloroethene	µg/L		1.89 J		3.43
	trans-1,2-Dichloroethene	µg/L		0.586 U		0.422 J
	Trichloroethene	µg/L		7.64		17.5 J
X749-112G	2-Butanone	µg/L		1.26 U		4.13 BJ
X749-113G	1,1,1-Trichloroethane	µg/L		7.33		12.4
	1,1-Dichloroethane	µg/L		16.7		19.9
	1,1-Dichloroethene	µg/L		24.1		29.1
	1,2-Dichloroethane	µg/L		10.6		12.1
	2-Butanone	µg/L		1.26 U		4.05 BJ
	Chloroform	µg/L		1.34 J		1.84
	cis-1,2-Dichloroethene	µg/L		2.6		3.08
	Tetrachloroethene	µg/L		0.763 U		0.619 J
	Trichloroethene	µg/L		29		40.8
X749-114G	1,1,1-Trichloroethane	µg/L			0.184 J	
	1,1-Dichloroethane	µg/L			0.395 J	
	Benzene	µg/L			0.201 J	
	cis-1,2-Dichloroethene	µg/L			1.27	
X749-115G	cis-1,2-Dichloroethene	µg/L			3.9	
	Trichloroethene	µg/L			110 J	
X749-117G	Chloroform	µg/L			0.68 J	
	cis-1,2-Dichloroethene	µg/L			0.43 J	
	Tetrachloroethene	µg/L			1.2	
	Trichloroethene	µg/L			130	
X749-118G	1,1-Dichloroethane	µg/L			1.1	
	1,1-Dichloroethene	µg/L			0.35 J	
	1,2-Dichloroethane	µg/L			0.17 J	
	4-Methyl-2-pentanone	µg/L			1.6 J	
	Carbon disulfide	µg/L			0.31 J	
	Carbon tetrachloride	µg/L			0.83 J	
	cis-1,2-Dichloroethene	µg/L			2.5	
	Tetrachloroethene	µg/L			1.6	
	Trichloroethene	µg/L			95	
X749-119G	Chloroform	µg/L			0.97 J	
	cis-1,2-Dichloroethene	µg/L			0.17 J	
	Trichloroethene	µg/L			18 J	
X749-120G	1,1,1-Trichloroethane	µg/L			510 D	
	1,1,2-Trichloroethane	µg/L			73 D	
	1,1-Dichloroethane	µg/L			4800 D	
	1,1-Dichloroethene	µg/L			3500 D	
	1,2-Dichloroethane	µg/L			81 D	
	Chloroform	µg/L			250 D	
	cis-1,2-Dichloroethene	µg/L			1200 D	
	Methylene chloride	µg/L			80 DJ	
	Tetrachloroethene	µg/L			290 D	
	Trichloroethene	µg/L			6700 D	
	Vinyl chloride	µg/L			69 D	
X749-121G	1,1,1-Trichloroethane	µg/L			34 D	
	1,1,2-Trichloroethane	µg/L			0.95 DJ	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-121G	1,1-Dichloroethane	µg/L			16 D	
	1,1-Dichloroethene	µg/L			320 D	
	1,2-Dichloroethane	µg/L			1.9 DJ	
	Chloroethane	µg/L			4.2 D	
	Chloroform	µg/L			1.1 DJ	
	cis-1,2-Dichloroethene	µg/L			9.8 D	
	Trichloroethene	µg/L			71 D	
	Vinyl chloride	µg/L			2 D	
X749-122G	1,1,1-Trichloroethane	µg/L			250 D	
	1,1,2-Trichloroethane	µg/L			1.4 DJ	
	1,1-Dichloroethane	µg/L			74 D	
	1,1-Dichloroethene	µg/L			300 D	
	1,2-Dichloroethane	µg/L			3.6 DJ	
	Benzene	µg/L			5.2 D	
	Chloroform	µg/L			1.5 DJ	
	cis-1,2-Dichloroethene	µg/L			51 D	
	trans-1,2-Dichloroethene	µg/L			0.84 DJ	
	Trichloroethene	µg/L			920 D	
	Vinyl chloride	µg/L			4 D	
X749-BG9G	2-Butanone	µg/L		1.26 U		4.02 BJ
X749-PZ02G	2-Butanone	µg/L		1.26 U		3.91 BJ
	Trichloroethene	µg/L		0.638 QU		0.192 J
X749-PZ04G	1,1-Dichloroethane	µg/L	1.7	1.39 J	1	0.558 J
	1,1-Dichloroethene	µg/L	0.97 J	0.86 U	0.39 J	0.23 U
	cis-1,2-Dichloroethene	µg/L	0.59 J	0.398 J	0.24 J	0.15 U
	Trichloroethene	µg/L	4.3	3.39 QUJ	2.7	1.63
X749-PZ06G	1,1,1-Trichloroethane	µg/L		4.66		5.88
	1,1,2-Trichloroethane	µg/L		0.7 J		0.686 J
	1,1-Dichloroethane	µg/L		17.3		17.4
	1,1-Dichloroethene	µg/L		51.5		56.8
	1,2-Dichloroethane	µg/L		1.49 J		0.13 U
	Chloroform	µg/L		1.16 J		1.36
	cis-1,2-Dichloroethene	µg/L		3.05		3.02
	Tetrachloroethene	µg/L		0.763 U		0.479 J
	Trichloroethene	µg/L		32.3		37.9
X749-PZ07G	1,1-Dichloroethene	µg/L			0.54 J	
	Trichloroethene	µg/L			1.5	
X749-PZ10G	1,1,1-Trichloroethane	µg/L		4.71		6.53 D
	1,1-Dichloroethene	µg/L		101		0.92 U
	1,2-Dichloroethane	µg/L		0.426 J		0.52 U
	2-Butanone	µg/L		1.26 U		15.7 BDJ
	Chloroform	µg/L		22.7		24.4 D
	cis-1,2-Dichloroethene	µg/L		0.621 J		0.6 U
	Trichloroethene	µg/L		353 D		390 D
X749-WPW	1,1,1-Trichloroethane	µg/L		33.5		53.9 D
	1,1,2-Trichloroethane	µg/L		0.717 J		0.888 DJ
	1,1-Dichloroethane	µg/L		55.7		64.7 D
	1,1-Dichloroethene	µg/L		82		123 D
	1,2-Dichloroethane	µg/L		8.19		10.4 D
	Benzene	µg/L		1.34 J		0.407 DJ

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-WPW	Chloroform	µg/L		8.33		14.5 D
	cis-1,2-Dichloroethene	µg/L		72.3		36.4 D
	Tetrachloroethene	µg/L		2.01 J		4.06 D
	Trichloroethene	µg/L		233 D		331 D
	Vinyl chloride	µg/L		3.71		5.33 DQ

Table 4.2 VOCs detected at PK Landfill – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
PK-10G	Trichloroethene	µg/L		0.87 J		1.04
PK-16G	cis-1,2-Dichloroethene	µg/L		0.37 U		0.43 J
PK-17B	1,1-Dichloroethane	µg/L		2.01		3.93
	1,1-Dichloroethene	µg/L		0.86 U		0.85 J
	Benzene	µg/L		0.378 U		0.477 J
	Chlorobenzene	µg/L		0.647 UJ		2.6
	cis-1,2-Dichloroethene	µg/L		34.4		62.3
	trans-1,2-Dichloroethene	µg/L		0.979 UJ		2.12
	Trichloroethene	µg/L		0.923 JQU		0.996 J
	Vinyl chloride	µg/L		11		24.2
PK-21B	1,1-Dichloroethane	µg/L		125		131 J
	1,1-Dichloroethene	µg/L		0.998 J		1.19
	1,2-Dichloroethane	µg/L		0.519 J		0.13 U
	Benzene	µg/L		0.642 J		0.768 J
	cis-1,2-Dichloroethene	µg/L		9.6		10.9
	Vinyl chloride	µg/L		10.5		14 Q
PK-PL6	1,1,1-Trichloroethane	µg/L	1.1	0.722 U	0.722 U	0.643 J
	1,1-Dichloroethane	µg/L	2.1	2.5	5.01	1.85
	1,1-Dichloroethene	µg/L	0.75 J	0.86 U	0.86 U	0.553 J
	Acetone	µg/L	2.3 J	6.69 U	6.69 U	1.9 U
	cis-1,2-Dichloroethene	µg/L	0.87 J	1.38 J	1.7 JQU	0.969 J
	Trichloroethene	µg/L	1	1.19 J	1.14 JQU	0.259 J
PK-PL6A	1,1,1-Trichloroethane	µg/L	1.5	0.722 U	0.722 U	1.45
	1,1-Dichloroethane	µg/L	2.6	2.46	9.36 J	5.82
	1,1-Dichloroethene	µg/L	1	0.86 U	1.5 J	0.939 J
	Benzene	µg/L	0.16 U	0.378 U	0.837 J	0.16 U
	cis-1,2-Dichloroethene	µg/L	1.2	0.37 U	2.74 Q	2.25
	Trichloroethene	µg/L	1.7	1.53 J	1.29 JQU	1.04
	Vinyl chloride	µg/L	0.1 U	0.741 U	0.841 J	0.1 QU

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X230K-14G	Acetone	µg/L			2.2 J	
	cis-1,2-Dichloroethene	µg/L			0.35 J	
	Trichloroethene	µg/L			4.5	
X230K-15G	Bromomethane	µg/L			0.54 J	
	cis-1,2-Dichloroethene	µg/L			0.25 J	
	Trichloroethene	µg/L			1.8	
X231A-01G	Acetone	µg/L			2 J	
	cis-1,2-Dichloroethene	µg/L			0.37 J	
	Trichloroethene	µg/L			2.4	
X231A-02G	1,1,2-Trichloroethane	µg/L			0.6 J	
	1,1-Dichloroethane	µg/L			6.8	
	1,1-Dichloroethene	µg/L			97	
	Benzene	µg/L			0.28 J	
	Chloroform	µg/L			0.92 J	
	cis-1,2-Dichloroethene	µg/L			9	
	Tetrachloroethene	µg/L			0.47 J	
	trans-1,2-Dichloroethene	µg/L			0.38 J	
	Trichloroethene	µg/L			190	
X231A-04G	1,1-Dichloroethene	µg/L			0.52 J	
	Acetone	µg/L			2.1 J	
	Chloroform	µg/L			0.19 J	
	cis-1,2-Dichloroethene	µg/L			5.8	
	Trichloroethene	µg/L			32	
	Trichlorofluoromethane	µg/L			1 J	
X231B-02G	1,1,1-Trichloroethane	µg/L	0.68 J		0.16 U	
	1,1,2-Trichloroethane	µg/L	0.33 J		0.27 U	
	1,1-Dichloroethane	µg/L	0.62 J		0.22 U	
	1,1-Dichloroethene	µg/L	73		39	
	Chloroform	µg/L	1.6		2.8	
	cis-1,2-Dichloroethene	µg/L	7.4		6.6	
	trans-1,2-Dichloroethene	µg/L	1.3		0.64 J	
	Trichloroethene	µg/L	120		110	
X231B-03G	1,1,1-Trichloroethane	µg/L	1		0.87 J	
	1,1,2-Trichloroethane	µg/L	0.47 J		0.44 J	
	1,1-Dichloroethane	µg/L	1.1		1.9	
	1,1-Dichloroethene	µg/L	92		89	
	Benzene	µg/L	0.2 J		0.17 J	
	Chloroform	µg/L	0.16 U		0.32 J	
	cis-1,2-Dichloroethene	µg/L	3.1		4.5	
	trans-1,2-Dichloroethene	µg/L	0.47 J		0.44 J	
	Trichloroethene	µg/L	62		81	
X231B-06G	1,1,1-Trichloroethane	µg/L	3		1.5	
	1,1-Dichloroethane	µg/L	4.4		2.4	
	1,1-Dichloroethene	µg/L	7		13	
	Chloroform	µg/L	0.16 U		1.4	
	Trichloroethene	µg/L	3.3 J		9.2	
	Trichlorofluoromethane	µg/L	0.29 U		1.2 J	
X231B-12G	1,1,1-Trichloroethane	µg/L			1.1	
	1,1-Dichloroethene	µg/L			11	
	Trichloroethene	µg/L			2.3	

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231B-12G	Trichlorofluoromethane	µg/L			0.69 J	
X231B-14G	1,1,1-Trichloroethane	µg/L			0.74 J	
	1,1-Dichloroethane	µg/L			1.3	
	1,1-Dichloroethene	µg/L			23	
	Chloroform	µg/L			0.76 J	
	cis-1,2-Dichloroethene	µg/L			7.3	
	Trichloroethene	µg/L			110	
X231B-15G	1,1-Dichloroethene	µg/L			1.2	
	1,2-Dichlorobenzene	µg/L			0.18 J	
	1,4-Dichlorobenzene	µg/L			0.24 J	
	Carbon disulfide	µg/L			0.43 J	
	Chloroform	µg/L			1.1	
	cis-1,2-Dichloroethene	µg/L			0.25 J	
	Trichloroethene	µg/L			0.4 J	
X231B-16G	1,1,1-Trichloroethane	µg/L			0.28 J	
	1,1-Dichloroethene	µg/L			1.6	
	Chloroform	µg/L			0.38 J	
	Trichloroethene	µg/L			0.29 J	
X231B-20G	1,1-Dichloroethene	µg/L			1.3	
	Chloroform	µg/L			0.36 J	
	Trichloroethene	µg/L			9.9	
X231B-23G	1,1-Dichloroethene	µg/L			3	
	Trichloroethene	µg/L			1.4	
X231B-36G	Trichloroethene	µg/L			1100 D	
X231B-37G	1,1-Dichloroethane	µg/L			0.84 J	
	1,1-Dichloroethene	µg/L			1	
	Benzene	µg/L			0.21 J	
	cis-1,2-Dichloroethene	µg/L			8.8	
	trans-1,2-Dichloroethene	µg/L			0.72 J	
	Trichloroethene	µg/L			6.5	
	Vinyl chloride	µg/L			0.83 J	
X626-07G	1,1,1-Trichloroethane	µg/L	1.6 U		3.8 DJ	
	1,1-Dichloroethene	µg/L	330 D		590 DJ	
	cis-1,2-Dichloroethene	µg/L	3.6 DJ		1.5 U	
	Trichloroethene	µg/L	1200 D		410 DJ	
X749A-09G	Acetone	µg/L			2.1 J	
X760-03G	Acetone	µg/L			2.3 J	
	cis-1,2-Dichloroethene	µg/L			0.85 J	
	Trichloroethene	µg/L			60	
X760-07G	Chloroform	µg/L			0.33 DJ	
	cis-1,2-Dichloroethene	µg/L			3.9 D	
	Trichloroethene	µg/L			320 D	
X770-17GA	Acetone	µg/L	3.8 U		5.2 DJ	
	cis-1,2-Dichloroethene	µg/L	1.4 DJ		1.2 DJ	
	Trichloroethene	µg/L	460 D		380 D	

Table 4.4 VOCs detected at the X-749A Classified Materials Disposal Facility – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749A-12G	1,2-Dichlorobenzene	µg/L		0.612 J		
	cis-1,2-Dichloroethene	µg/L		3.25		
	Trichloroethene	µg/L		3.4		
X749A-18G	1,1,1-Trichloroethane	µg/L		0.739 J		
	Trichloroethene	µg/L		1.24 J		
X749A-19G	Trichloroethene	µg/L		6.34		

Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X700-02G	1,1-Dichloroethane	µg/L	13 DJ			
	cis-1,2-Dichloroethene	µg/L	2000 D			
	Trichloroethene	µg/L	4100 DJ			
	Vinyl chloride	µg/L	81 D			
X700-04G	1,1-Dichloroethene	µg/L	32 DJ			
	cis-1,2-Dichloroethene	µg/L	5900 D			
	trans-1,2-Dichloroethene	µg/L	11 DJ			
	Trichloroethene	µg/L	320 D			
	Vinyl chloride	µg/L	2500 D			
X700-05G	Acetone	µg/L	4300 BDJ			
	cis-1,2-Dichloroethene	µg/L	41000 D			
	Trichloroethene	µg/L	78000 D			
	Vinyl chloride	µg/L	2200 D			
X700-06G	cis-1,2-Dichloroethene	µg/L	1800 DJ			
	Trichloroethene	µg/L	970000 D			
X701-26G	Acetone	µg/L	1.9 U		2 J	
	Tetrachloroethene	µg/L	0.98 J		1.1	
	Trichloroethene	µg/L	0.43 J		0.72 J	
X701-27G	1,1-Dichloroethane	µg/L	0.22 U		0.49 J	
	1,1-Dichloroethene	µg/L	1.1		0.94 J	
	cis-1,2-Dichloroethene	µg/L	3.9		3.4	
	Trichloroethene	µg/L	17		17	
X701-69G	1,1-Dichloroethene	µg/L	0.99 DJ			
	cis-1,2-Dichloroethene	µg/L	160 D			
	trans-1,2-Dichloroethene	µg/L	3.9 DJ			
	Trichloroethene	µg/L	570 D			
	Vinyl chloride	µg/L	1.6 DJ			
X705-02G	1,1-Dichloroethene	µg/L	0.29 J			
	cis-1,2-Dichloroethene	µg/L	0.44 J			
	Trichloroethene	µg/L	15			
X705-03G	1,1-Dichloroethane	µg/L	0.83 J			
	1,1-Dichloroethene	µg/L	4.6			
	cis-1,2-Dichloroethene	µg/L	4.3			
	Tetrachloroethene	µg/L	0.82 J			
	trans-1,2-Dichloroethene	µg/L	0.33 J			
	Trichloroethene	µg/L	15			
X705-04G	1,1-Dichloroethene	µg/L	0.56 J			
	Carbon tetrachloride	µg/L	8.4			
	Chloroform	µg/L	150			
	Tetrachloroethene	µg/L	1.8			
	Trichloroethene	µg/L	18			
X720-01G	1,1-Dichloroethene	µg/L	69 DJ			
	cis-1,2-Dichloroethene	µg/L	1200 D			
	Trichloroethene	µg/L	7500 DJ			
X720-08G	1,1-Dichloroethene	µg/L	56 D			
	cis-1,2-Dichloroethene	µg/L	18 DJ			
	Tetrachloroethene	µg/L	24 DJ			
	Trichloroethene	µg/L	5000 D			
X720-09G	1,1-Dichloroethene	µg/L	12000 D			
	cis-1,2-Dichloroethene	µg/L	19000 DJ			

Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X720-09G	Trichloroethene	µg/L	460000 D			

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ06G	cis-1,2-Dichloroethene	µg/L	0.19 J		0.37 U	
	Trichloroethene	µg/L	1.4		0.638 U	
X230J7-01GA	1,1,2,2-Tetrachloroethane	µg/L	0.84 U		0.968 J	
	1,2-Dimethylbenzene	µg/L	0.76 U		0.718 J	
	cis-1,2-Dichloroethene	µg/L	3.6 DJ		4.99	
	m,p-Xylenes	µg/L	0.61 U		0.897 J	
	Trichloroethene	µg/L	370 D		189 DQ	
X230J7-02GA	1,1,1-Trichloroethane	µg/L	1.6 U		3.96	
	1,1,2,2-Tetrachloroethane	µg/L	2.1 U		25	
	1,1,2-Trichloroethane	µg/L	2.7 U		4.15	
	1,1-Dichloroethane	µg/L	2.2 U		0.794 J	
	1,1-Dichloroethene	µg/L	2.3 U		0.905 J	
	1,2-Dimethylbenzene	µg/L	1.9 U		0.718 J	
	Carbon tetrachloride	µg/L	1.9 U		1.32 J	
	Chloroform	µg/L	1.6 U		0.853 J	
	Chloromethane	µg/L	3 U		0.986 J	
	cis-1,2-Dichloroethene	µg/L	57 D		153	
	m,p-Xylenes	µg/L	1.5 U		0.864 J	
	Tetrachloroethene	µg/L	2 U		8.82 QJ	
	trans-1,2-Dichloroethene	µg/L	4.6 DJ		18.1	
	Trichloroethene	µg/L	810 D		2940 DQJ	
	Vinyl chloride	µg/L	1 U		2.61 J	
X230J7-03GA	1,1,1-Trichloroethane	µg/L	3.2 U		1.76 J	
	1,1,2,2-Tetrachloroethane	µg/L	4.2 U		9.25	
	1,1,2-Trichloroethane	µg/L	5.4 U		3.29	
	1,1-Dichloroethene	µg/L	4.6 U		1.26 J	
	1,2-Dimethylbenzene	µg/L	3.8 U		0.698 J	
	cis-1,2-Dichloroethene	µg/L	160 D		164 D	
	Tetrachloroethene	µg/L	7 DJ		2.79 Q	
	trans-1,2-Dichloroethene	µg/L	7.3 DJ		10.7	
	Trichloroethene	µg/L	2500 DJ		3160 DQ	
	Vinyl chloride	µg/L	2 JU		5.36	
X237-EPW	1,1,2,2-Tetrachloroethane	µg/L			39.2	
	1,1,2-Trichloroethane	µg/L			18	
	1,1-Dichloroethane	µg/L			1.57 J	
	1,1-Dichloroethene	µg/L			17.7	
	1,2-Dichloroethane	µg/L			0.925 J	
	Chloroform	µg/L			1.73 J	
	cis-1,2-Dichloroethene	µg/L			1140 DQ	
	Tetrachloroethene	µg/L			10.9	
	trans-1,2-Dichloroethene	µg/L			41.7	
	Trichloroethene	µg/L			2880 DQ	
	Vinyl chloride	µg/L			28.1	
X237-WPW	1,1,1-Trichloroethane	µg/L			8.08	
	1,1,2,2-Tetrachloroethane	µg/L			117	
	1,1,2-Trichloroethane	µg/L			41.8	
	1,1-Dichloroethane	µg/L			1.76 J	
	1,1-Dichloroethene	µg/L			16.4	
	1,2-Dichloroethane	µg/L			1.34 J	
	Benzene	µg/L			0.426 J	

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X237-WPW	Bromodichloromethane	µg/L			1.35 J	
	Carbon tetrachloride	µg/L			1.2 J	
	Chloroform	µg/L			5.55	
	cis-1,2-Dichloroethene	µg/L			369 DQ	
	Tetrachloroethene	µg/L			47.3	
	Toluene	µg/L			0.437 J	
	trans-1,2-Dichloroethene	µg/L			45.6	
	Trichloroethene	µg/L			11200 DQJ	
	Vinyl chloride	µg/L			113 D	
X701-01G	1,1-Dichloroethene	µg/L	1.3		3.26 DJ	
	cis-1,2-Dichloroethene	µg/L	29		73.3 D	
	trans-1,2-Dichloroethene	µg/L	1.2		3.45 DJ	
	Trichloroethene	µg/L	150		364 D	
	Vinyl chloride	µg/L	0.36 J		0.4 U	
X701-02G	1,1-Dichloroethene	µg/L	0.36 J		0.86 U	
	cis-1,2-Dichloroethene	µg/L	3.4		3.72	
	trans-1,2-Dichloroethene	µg/L	0.2 J		0.586 U	
	Trichloroethene	µg/L	17		12.5 Q	
X701-06G	1,1-Dichloroethene	µg/L	6.6 D		5.95	
	cis-1,2-Dichloroethene	µg/L	26 D		43	
	trans-1,2-Dichloroethene	µg/L	1.4 DJ		1.41 J	
	Trichloroethene	µg/L	230 DJ		161 DQ	
	Vinyl chloride	µg/L	0.4 U		1.25 J	
X701-15G	1,1,1-Trichloroethane	µg/L	0.16 U		0.926 J	
	1,1,2,2-Tetrachloroethane	µg/L	0.21 U		1.38 J	
	1,1,2-Trichloroethane	µg/L	0.27 U		2.13	
	1,1-Dichloroethene	µg/L	0.3 J		0.86 U	
	cis-1,2-Dichloroethene	µg/L	250 D		521 DQ	
	trans-1,2-Dichloroethene	µg/L	3.4		21	
	Trichloroethene	µg/L	4.3		25 Q	
	Vinyl chloride	µg/L	0.26 J		17.9	
X701-19G	Acetone	µg/L	1.9 U		21.8 J	
	cis-1,2-Dichloroethene	µg/L	0.33 J		0.476 J	
	Trichloroethene	µg/L	2.7		5.62 Q	
X701-20G	1,1,2,2-Tetrachloroethane	µg/L	100 DJ		102 DJQ	
	Acetone	µg/L	1200 BDJ		669 DQU	
	Carbon disulfide	µg/L	98 DJ		58.2 DU	
	cis-1,2-Dichloroethene	µg/L	730 D		289 DQJ	
	Tetrachloroethene	µg/L	140 DJ		76.3 DQU	
	trans-1,2-Dichloroethene	µg/L	73 DJ		58.6 DU	
	Trichloroethene	µg/L	60000 DJ		14700 DQJ	
X701-21G	1,1,1-Trichloroethane	µg/L	16 U		19.5	
	1,1,2,2-Tetrachloroethane	µg/L	21 U		120	
	1,1,2-Trichloroethane	µg/L	27 U		18.7	
	1,1-Dichloroethane	µg/L	22 U		2.96	
	1,1-Dichloroethene	µg/L	23 U		1.02 J	
	1,2-Dichloroethane	µg/L	13 U		0.521 J	
	2-Butanone	µg/L	200 U		2.95 J	
	Acetone	µg/L	190 U		47.7	
	Benzene	µg/L	16 U		0.394 J	

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-21G	Carbon tetrachloride	µg/L	19 U		1.98 J	
	Chloroform	µg/L	16 U		3.16	
	Chloromethane	µg/L	30 U		5.27	
	cis-1,2-Dichloroethene	µg/L	420 D		222 D	
	Tetrachloroethene	µg/L	26 DJ		69.7	
	trans-1,2-Dichloroethene	µg/L	72 DJ		98.7	
	Trichloroethene	µg/L	5700 D		13600 DQ	
	Vinyl chloride	µg/L	10 U		3.57	
X701-23G	cis-1,2-Dichloroethene	µg/L			0.991 J	
	Trichloroethene	µg/L			10.8 Q	
X701-24G	1,1,1-Trichloroethane	µg/L	3.2 U		1.01 J	
	1,1,2,2-Tetrachloroethane	µg/L	4.2 U		1.32 J	
	1,1,2-Trichloroethane	µg/L	5.4 U		2.42	
	1,1-Dichloroethene	µg/L	8.9 DJ		7.98	
	1,2-Dichloroethane	µg/L	2.6 U		0.417 J	
	1,2-Dimethylbenzene	µg/L	3.8 U		0.705 J	
	cis-1,2-Dichloroethene	µg/L	2400 D		2260 D	
	trans-1,2-Dichloroethene	µg/L	14 DJ		19.3	
	Trichloroethene	µg/L	780 D		348 DQ	
	Vinyl chloride	µg/L	79 D		49.5	
X701-25G	Trichloroethene	µg/L	0.53 J		0.16 U	
X701-30G	Trichloroethene	µg/L	1.8		1.24	
	Trichlorofluoromethane	µg/L	0.29 U		0.409 J	
X701-38G	1,2-Dichlorobenzene	µg/L			0.17 J	
	Acetone	µg/L			2.1 J	
	Chloroform	µg/L			0.21 J	
X701-42G	1,1,1-Trichloroethane	µg/L			7.1 DJ	
	1,1,2,2-Tetrachloroethane	µg/L			11 DJ	
	Carbon disulfide	µg/L			6.7 DJ	
	Chloroform	µg/L			6.4 DJ	
	cis-1,2-Dichloroethene	µg/L			460 D	
	Tetrachloroethene	µg/L			11 DJ	
	trans-1,2-Dichloroethene	µg/L			56 D	
	Trichloroethene	µg/L			3600 D	
	Vinyl chloride	µg/L			16 DJ	
X701-48G	Acetone	µg/L			24.4 J	
X701-58B	1,2-Dimethylbenzene	µg/L			0.734 J	
	Ethylbenzene	µg/L			0.485 J	
	m,p-Xylenes	µg/L			0.94 J	
X701-61B	Trichloroethene	µg/L			0.7 JQ	
X701-66G	1,1-Dichloroethene	µg/L	2.3 U		2.9 DJ	
	1,2-Dichloroethane	µg/L	1.3 U		2.2 DJ	
	Carbon disulfide	µg/L	1.7 U		1.7 DJ	
	Chloroform	µg/L	1.6 U		1.8 DJ	
	cis-1,2-Dichloroethene	µg/L	150 D		190 D	
	Tetrachloroethene	µg/L	2 DJ		3.2 DJ	
	trans-1,2-Dichloroethene	µg/L	3.3 DJ		3.4 DJ	
	Trichloroethene	µg/L	990 D		1300 DJ	
	Vinyl chloride	µg/L	5.5 DJ		15 D	
X701-77G	Acetone	µg/L			52 DJ	

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-77G	cis-1,2-Dichloroethene	µg/L			28 DJ	
	Tetrachloroethene	µg/L			3.4 DJ	
	Trichloroethene	µg/L			1800 DJ	
X701-79G	Acetone	µg/L			5.4 DJ	
	cis-1,2-Dichloroethene	µg/L			5.1 D	
	Tetrachloroethene	µg/L			0.43 DJ	
	Trichloroethene	µg/L			430 D	
X701-127G	1,1,1-Trichloroethane	µg/L	64 U		4.45	
	1,1,2,2-Tetrachloroethane	µg/L	84 U		54.6	
	1,1,2-Trichloroethane	µg/L	110 U		37.3	
	1,1-Dichloroethane	µg/L	88 U		0.987 J	
	1,1-Dichloroethene	µg/L	92 U		5.68	
	1,2-Dichloroethane	µg/L	52 U		0.961 J	
	Carbon tetrachloride	µg/L	76 U		1.46 J	
	Chloroform	µg/L	64 U		4.21	
	cis-1,2-Dichloroethene	µg/L	370 DJ		97.2 DJ	
	Tetrachloroethene	µg/L	80 U		23.9	
	trans-1,2-Dichloroethene	µg/L	60 U		10.5	
	Trichloroethene	µg/L	24000 D		11500 DQ	
	Vinyl chloride	µg/L	40 U		0.954 J	
X701-128G	1,1,1-Trichloroethane	µg/L	16 U		1.58 J	
	1,1,2,2-Tetrachloroethane	µg/L	21 U		2.74	
	1,1,2-Trichloroethane	µg/L	27 U		5.28	
	1,1-Dichloroethene	µg/L	23 U		2.92 J	
	Chloroform	µg/L	16 U		0.652 J	
	cis-1,2-Dichloroethene	µg/L	140 D		102	
	Tetrachloroethene	µg/L	20 U		6.68	
	trans-1,2-Dichloroethene	µg/L	15 U		2.36	
	Trichloroethene	µg/L	11000 D		3690 DQJ	
	Vinyl chloride	µg/L	10 U		1.17 J	
X701-130G	Chloroform	µg/L			140 DJ	
	cis-1,2-Dichloroethene	µg/L			400 D	
	Tetrachloroethene	µg/L			200 DJ	
	Trichloroethene	µg/L			73000 D	
X701-141G	cis-1,2-Dichloroethene	µg/L			1.74 J	
	Trichloroethene	µg/L			77.1 Q	
X701-142G	1,1,2,2-Tetrachloroethane	µg/L	8.4 U		1.3 J	
	1,1,2-Trichloroethane	µg/L	11 U		10.6	
	1,1-Dichloroethane	µg/L	8.8 U		0.749 J	
	1,1-Dichloroethene	µg/L	9.2 U		8.69	
	1,2-Dichloroethane	µg/L	5.2 U		0.778 J	
	cis-1,2-Dichloroethene	µg/L	2500 D		561 DQ	
	Tetrachloroethene	µg/L	8 U		1.52 J	
	trans-1,2-Dichloroethene	µg/L	28 DJ		46.1	
	Trichloroethene	µg/L	3500 D		3410 DQ	
	Vinyl chloride	µg/L	32 DJ		93	
X701-143G	1,1-Dichloroethene	µg/L	2.3 U		1.22 J	
	Carbon disulfide	µg/L	1.7 U		0.585 J	
	Chloroethane	µg/L	4.1 U		6.13	
	cis-1,2-Dichloroethene	µg/L	1100 D		710 DQ	

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-143G	trans-1,2-Dichloroethene	µg/L	2.9 DJ		2.23	
	Trichloroethene	µg/L	4.5 DJ		1.23 JQU	
	Vinyl chloride	µg/L	930 D		269 D	
X701-144G	1,1-Dichloroethene	µg/L	0.46 J			
	Carbon disulfide	µg/L	0.19 J			
	cis-1,2-Dichloroethene	µg/L	170			
	trans-1,2-Dichloroethene	µg/L	2.4			
	Trichloroethene	µg/L	1.2			
	Vinyl chloride	µg/L	61			
X701-BW2G	1,1,1-Trichloroethane	µg/L			4.21	
	1,1,2-Trichloroethane	µg/L			3.78	
	1,1-Dichloroethane	µg/L			3.81	
	1,1-Dichloroethene	µg/L			32.6	
	1,2-Dichloroethane	µg/L			0.653 J	
	Benzene	µg/L			0.969 J	
	Chloroform	µg/L			65.2	
	cis-1,2-Dichloroethene	µg/L			233 D	
	Tetrachloroethene	µg/L			17.5 Q	
	trans-1,2-Dichloroethene	µg/L			21.7	
	Trichloroethene	µg/L			14300 DQ	
	Vinyl chloride	µg/L			6.17	
X701-BW3G	1,1-Dichloroethene	µg/L			1.18 J	
	Chloroethane	µg/L			0.908 J	
	cis-1,2-Dichloroethene	µg/L			118	
	Trichloroethene	µg/L			161 DQ	
	Vinyl chloride	µg/L			8.38	
X701-BW4G	Carbon disulfide	µg/L	0.17 U		0.18 J	
	cis-1,2-Dichloroethene	µg/L	6.4		11	
	trans-1,2-Dichloroethene	µg/L	0.35 J		0.82 J	
	Trichloroethene	µg/L	1.4		1.8	
	Vinyl chloride	µg/L	0.1 U		0.6 J	
X701-EW121G	cis-1,2-Dichloroethene	µg/L	340 D		128 DJQ	
	Tetrachloroethene	µg/L	92 DJ		76.3 DQU	
	trans-1,2-Dichloroethene	µg/L	30 DJ		58.6 DU	
	Trichloroethene	µg/L	35000 D		14500 DQ	
X701-EW122G	1,1,1-Trichloroethane	µg/L	160 U		34.1	
	1,1,2,2-Tetrachloroethane	µg/L	300 DJ		657 DJ	
	1,1,2-Trichloroethane	µg/L	270 U		65.6	
	1,1-Dichloroethane	µg/L	220 U		3.46	
	1,1-Dichloroethene	µg/L	230 U		4.77	
	1,2-Dichloroethane	µg/L	130 U		1.83 J	
	2-Butanone	µg/L	2000 U		18.1	
	Benzene	µg/L	160 U		0.889 J	
	Bromomethane	µg/L	210 U		1.88 J	
	Carbon tetrachloride	µg/L	190 U		2.72	
	Chloroform	µg/L	160 U		11.4	
	Chloromethane	µg/L	300 U		14.7	
	cis-1,2-Dichloroethene	µg/L	790 DJ		626 DJ	
	Tetrachloroethene	µg/L	260 DJ		133	
	Toluene	µg/L	170 U		0.428 J	

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-EW122G	trans-1,2-Dichloroethene	µg/L	150 U		113	
	Trichloroethene	µg/L	58000 D		47600 DQ	
	Vinyl chloride	µg/L	100 U		2.42 J	
X701-IRMPZ03G	1,1,2-Trichloroethane	µg/L	2 DJ		0.602 U	
	1,1-Dichloroethene	µg/L	1.3 DJ		1.77 J	
	cis-1,2-Dichloroethene	µg/L	560 D		586 D	
	trans-1,2-Dichloroethene	µg/L	5.8 D		5.7	
	Trichloroethene	µg/L	430 D		700 D	
	Vinyl chloride	µg/L	0.5 U		1.3 J	
X701-IRMPZ05G	1,1-Dichloroethene	µg/L	10 DJ			
	cis-1,2-Dichloroethene	µg/L	1900 D			
	trans-1,2-Dichloroethene	µg/L	12 DJ			
	Trichloroethene	µg/L	1700 D			
X701-IRMPZ06G	cis-1,2-Dichloroethene	µg/L	150		258 DQ	
	trans-1,2-Dichloroethene	µg/L	10		17.3	
	Trichloroethene	µg/L	4.9		2.63 Q	
	Vinyl chloride	µg/L	2.5		12.4	
X701-IRMPZ07G	cis-1,2-Dichloroethene	µg/L	8000 D			
	trans-1,2-Dichloroethene	µg/L	93 DJ			
	Trichloroethene	µg/L	52000 D			
	Vinyl chloride	µg/L	790 D			
X701-IRMPZ08G	1,1,2,2-Tetrachloroethane	µg/L	4.2 U		3.07	
	1,1,2-Trichloroethane	µg/L	5.4 U		2.47	
	cis-1,2-Dichloroethene	µg/L	1300 D		939 DQJ	
	Tetrachloroethene	µg/L	4 U		1.14 J	
	trans-1,2-Dichloroethene	µg/L	9.5 DJ		7.97	
	Trichloroethene	µg/L	2100 D		817 DQJ	
	Vinyl chloride	µg/L	2 U		1.8 J	
X701-TC01G	1,1,1-Trichloroethane	µg/L	32 DJ		72.2 DQU	
	cis-1,2-Dichloroethene	µg/L	4900 DJ		3290 DQ	
	trans-1,2-Dichloroethene	µg/L	94 DJ		95.5 DJ	
	Trichloroethene	µg/L	8500 DJ		8400 DQ	
	Vinyl chloride	µg/L	130 DJ		74.1 DQU	
X701-TC03G	1,1,2,2-Tetrachloroethane	µg/L	84 U		22 DJ	
	1,2-Dichloroethane	µg/L	52 U		23 DJ	
	Carbon disulfide	µg/L	67 U		29 DJ	
	Chloroform	µg/L	64 U		29 DJ	
	Chloromethane	µg/L	120 U		38 DJ	
	cis-1,2-Dichloroethene	µg/L	5700 D		6000 D	
	Tetrachloroethene	µg/L	80 U		45 DJ	
	trans-1,2-Dichloroethene	µg/L	750 D		400 D	
	Trichloroethene	µg/L	22000 D		19000 D	
	Vinyl chloride	µg/L	40 U		60 DJ	
X701-TC05G	1,1,1-Trichloroethane	µg/L	16 U		47 DJ	
	1,1,2,2-Tetrachloroethane	µg/L	57 DJ		40 DJ	
	Carbon disulfide	µg/L	17 U		13 DJ	
	Chloroform	µg/L	16 U		18 DJ	
	Chloromethane	µg/L	30 U		56 DJ	
	cis-1,2-Dichloroethene	µg/L	1600 D		1400 D	
	Tetrachloroethene	µg/L	27 DJ		22 DJ	

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC05G	trans-1,2-Dichloroethene	µg/L	250 D		240 D	
	Trichloroethene	µg/L	9700 D		6800 D	
X701-TC10G	cis-1,2-Dichloroethene	µg/L	1100 D		340 D	
	Trichloroethene	µg/L	8000 DJ		3720 BDQJ	
X701-TC17G	1,1,1-Trichloroethane	µg/L	27 DJ		72.2 DQU	
	Chloroform	µg/L	28 DJ		61 DQU	
	cis-1,2-Dichloroethene	µg/L	230 D		113 DJ	
	Tetrachloroethene	µg/L	65 DJ		76.3 DQU	
	Trichloroethene	µg/L	15000 D		8310 BDQ	
X701-TC22G	1,1,2,2-Tetrachloroethane	µg/L	84 U		87.5 DJQ	
	cis-1,2-Dichloroethene	µg/L	420 D		221 DQ	
	Tetrachloroethene	µg/L	380 DJ		164 DJQ	
	Trichloroethene	µg/L	62000 D		34500 DQ	
X701-TC28G	1,1,2,2-Tetrachloroethane	µg/L	210 U		95.9 DJQ	
	cis-1,2-Dichloroethene	µg/L	510 DJ		165 DJ	
	Tetrachloroethene	µg/L	900 DJ		395 DQ	
	Trichloroethene	µg/L	150000 D		18600 BDQ	
X701-TC48G	1,1,2,2-Tetrachloroethane	µg/L	21 U		85.6 DJQ	
	Acetone	µg/L	540 DJ		669 DQU	
	cis-1,2-Dichloroethene	µg/L	78 DJ		74.9 DJ	
	Tetrachloroethene	µg/L	37 DJ		76.3 DQU	
	Trichloroethene	µg/L	6200 D		7450 BDQ	
X701-TC54G	1,1,2,2-Tetrachloroethane	µg/L	110 U		280 DJ	
	Carbon disulfide	µg/L	84 U		110 DJ	
	Chloroform	µg/L	80 U		120 DJ	
	cis-1,2-Dichloroethene	µg/L	250 DJ		190 DJ	
	Tetrachloroethene	µg/L	100 U		200 DJ	
	Trichloroethene	µg/L	60000 DJ		48000 D	
X701-TC61G	1,1,2,2-Tetrachloroethane	µg/L	450 DJ		400 DQ	
	Benzene	µg/L	200 DJ		37.8 DQU	
	cis-1,2-Dichloroethene	µg/L	1100 D		628 DQ	
	Tetrachloroethene	µg/L	730 DJ		316 DQ	
	trans-1,2-Dichloroethene	µg/L	380 DJ		85.6 DJ	
	Trichloroethene	µg/L	120000 D		51500 DQ	
X701-TC67G	cis-1,2-Dichloroethene	µg/L	120 D		42.5 DJQ	
	Trichloroethene	µg/L	7300 D		6130 DQ	
X744G-02G	cis-1,2-Dichloroethene	µg/L	1.8		1.97	
	Trichloroethene	µg/L	27		30.3	
	Trichlorofluoromethane	µg/L	2.6		3.09	
X744G-03G	cis-1,2-Dichloroethene	µg/L	0.97 J		0.959 J	
	Trichloroethene	µg/L	11		10.7	
	Trichlorofluoromethane	µg/L	0.4 J		0.657 J	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ06G	Technetium-99	pCi/L	-1.21 U			
	Uranium	µg/L	0.205 UJ			
	Uranium-233/234	pCi/L	0.128 UJ			
	Uranium-235/236	pCi/L	0.00923 UJ			
	Uranium-238	pCi/L	0.0675 U			
X230J7-01GA	Technetium-99	pCi/L	30.8			
	Uranium	µg/L	6.05 J			
	Uranium-233/234	pCi/L	1.91 J			
	Uranium-235/236	pCi/L	0.103 UJ			
	Uranium-238	pCi/L	2.02			
X230J7-02GA	Technetium-99	pCi/L	212			
	Uranium	µg/L	0.29 UJ			
	Uranium-233/234	pCi/L	0.259 UJ			
	Uranium-235/236	pCi/L	-0.00458 UJ			
	Uranium-238	pCi/L	0.0982 UJ			
X230J7-03GA	Americium-241	pCi/L	-0.00983 U			
	Neptunium-237	pCi/L	-0.0164 U			
	Plutonium-238	pCi/L	0.0205 U			
	Plutonium-239/240	pCi/L	0.00843 U			
	Technetium-99	pCi/L	118			
	Uranium	µg/L	0.397 UJ			
	Uranium-233/234	pCi/L	0.275 J			
	Uranium-235/236	pCi/L	0.0134 UJ			
	Uranium-238	pCi/L	0.131 UJ			
X230J7-04GA	Technetium-99	pCi/L			5.85 UJ	
	Uranium	µg/L			0.121 UJ	
	Uranium-233/234	pCi/L			0.029 UJ	
	Uranium-235/236	pCi/L			-0.002 UJ	
	Uranium-238	pCi/L			0.041 U	
X701-01G	Technetium-99	pCi/L	-0.793 U			
	Uranium	µg/L	4.38 J			
	Uranium-233/234	pCi/L	2.07 J			
	Uranium-235/236	pCi/L	0.116 UJ			
	Uranium-238	pCi/L	1.45			
X701-02G	Technetium-99	pCi/L	1.73 U			
	Uranium	µg/L	0.53 J			
	Uranium-233/234	pCi/L	0.438 J			
	Uranium-235/236	pCi/L	0.0899 UJ			
	Uranium-238	pCi/L	0.164 UJ			
X701-06G	Technetium-99	pCi/L	12			
	Uranium	µg/L	2.11 J			
	Uranium-233/234	pCi/L	1.56 J			
	Uranium-235/236	pCi/L	0.0848 UJ			
	Uranium-238	pCi/L	0.695			
X701-15G	Technetium-99	pCi/L	0.507 U			
	Uranium	µg/L	0.115 UJ			
	Uranium-233/234	pCi/L	0.193 UJ			
	Uranium-235/236	pCi/L	0.0283 UJ			
	Uranium-238	pCi/L	0.0342 U			
X701-16G	Technetium-99	pCi/L	0.0394 U			

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-16G	Uranium	µg/L	0.0458 UJ			
	Uranium-233/234	pCi/L	0.196 UJ			
	Uranium-235/236	pCi/L	0.0145 UJ			
	Uranium-238	pCi/L	0.0131 U			
X701-18G	Technetium-99	pCi/L			1.116 QUJ	
	Uranium	µg/L			0.017 UJ	
	Uranium-233/234	pCi/L			0.008 UJ	
	Uranium-235/236	pCi/L			-0.002 UJ	
	Uranium-238	pCi/L			0.006 U	
X701-19G	Technetium-99	pCi/L	3.41 UJ			
	Uranium	µg/L	0.146 UJ			
	Uranium-233/234	pCi/L	0.131 UJ			
	Uranium-235/236	pCi/L	0.0368 UJ			
	Uranium-238	pCi/L	0.0433 U			
X701-20G	Americium-241	pCi/L	-0.00365 U		0.024 U	
	Neptunium-237	pCi/L	0.0853 UJ		-0.00477 U	
	Plutonium-238	pCi/L	0.0344 U		0.019 U	
	Plutonium-239/240	pCi/L	0.016 U		0.012 *QUJ	
	Technetium-99	pCi/L	141		129.57	
	Uranium	µg/L	0.221 UJ		0.261 J	
	Uranium-233/234	pCi/L	0.179 UJ		0.073 J	
	Uranium-235/236	pCi/L	0.0342 UJ		0.017 UJ	
	Uranium-238	pCi/L	0.0691 U		0.085 J	
X701-21G	Technetium-99	pCi/L	412			
	Uranium	µg/L	0.26 UJ			
	Uranium-233/234	pCi/L	0.188 UJ			
	Uranium-235/236	pCi/L	0.0161 UJ			
	Uranium-238	pCi/L	0.0849 UJ			
X701-23G	Technetium-99	pCi/L			28.256 QJ	
	Uranium	µg/L			-0.049 UJ	
	Uranium-233/234	pCi/L			-0.005 UJ	
	Uranium-235/236	pCi/L			0.002 UJ	
	Uranium-238	pCi/L			-0.017 U	
X701-24G	Americium-241	pCi/L	-0.00265 U			
	Neptunium-237	pCi/L	0.0668 U			
	Plutonium-238	pCi/L	0.0179 UJ			
	Plutonium-239/240	pCi/L	0.0226 U			
	Technetium-99	pCi/L	-1.81 U			
	Uranium	µg/L	0.169 UJ			
	Uranium-233/234	pCi/L	0.233 J			
	Uranium-235/236	pCi/L	0.0175 UJ			
	Uranium-238	pCi/L	0.054 U			
X701-25G	Technetium-99	pCi/L	0.107 U			
	Uranium	µg/L	0.085 UJ			
	Uranium-233/234	pCi/L	0.0722 UJ			
	Uranium-235/236	pCi/L	0.00298 UJ			
	Uranium-238	pCi/L	0.0281 U			
X701-30G	Technetium-99	pCi/L	-0.242 U			
	Uranium	µg/L	0.538 J			
	Uranium-233/234	pCi/L	0.265 J			

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-30G	Uranium-235/236	pCi/L	0.0259 UJ			
	Uranium-238	pCi/L	0.177 J			
X701-31G	Technetium-99	pCi/L			1.437 QU	
	Uranium	µg/L			0.448 J	
	Uranium-233/234	pCi/L			0.276 J	
	Uranium-235/236	pCi/L			0.011 UJ	
	Uranium-238	pCi/L			0.149 J	
X701-38G	Technetium-99	pCi/L			1.212 U	
	Uranium	µg/L			0.067 UJ	
	Uranium-233/234	pCi/L			0.083 J	
	Uranium-235/236	pCi/L			-0.001 UJ	
	Uranium-238	pCi/L			0.023 U	
X701-42G	Technetium-99	pCi/L			407.069 QJ	
	Uranium	µg/L			0.16 UJ	
	Uranium-233/234	pCi/L			0.037 UJ	
	Uranium-235/236	pCi/L			0.012 UJ	
	Uranium-238	pCi/L			0.052 UJ	
X701-48G	Americium-241	pCi/L			0.003 U	
	Neptunium-237	pCi/L			0.0159 UJ	
	Plutonium-238	pCi/L			0.006 U	
	Plutonium-239/240	pCi/L			-0.006 U	
	Technetium-99	pCi/L			12.609 J	
	Uranium	µg/L			0.17 UJ	
	Uranium-233/234	pCi/L			-0.003 UJ	
	Uranium-235/236	pCi/L			0 UJ	
	Uranium-238	pCi/L			0.057 U	
X701-58B	Technetium-99	pCi/L			0.816 U	
	Uranium	µg/L			0.126 UJ	
	Uranium-233/234	pCi/L			0.109 J	
	Uranium-235/236	pCi/L			0 UJ	
	Uranium-238	pCi/L			0.042 U	
X701-61B	Technetium-99	pCi/L			1.126 U	
	Uranium	µg/L			0.323 UJ	
	Uranium-233/234	pCi/L			0.111 UJ	
	Uranium-235/236	pCi/L			0.032 UJ	
	Uranium-238	pCi/L			0.104 UJ	
X701-66G	Americium-241	pCi/L	-0.00136 U		0.023 U	
	Neptunium-237	pCi/L	0.106 UJ		0.00569 U	
	Plutonium-238	pCi/L	0.0239 U		0.01 UJ	
	Plutonium-239/240	pCi/L	0.00796 U		0.002 *QUJ	
	Technetium-99	pCi/L	53.8		78.235	
	Uranium	µg/L	0.433 UJ		0.766 J	
	Uranium-233/234	pCi/L	0.499 J		0.342 J	
	Uranium-235/236	pCi/L	-0.00375 UJ		0.06 J	
	Uranium-238	pCi/L	0.146 UJ		0.248	
X701-77G	Technetium-99	pCi/L			22.105	
	Uranium	µg/L			0.112 U	
	Uranium-233/234	pCi/L			0.056 U	
	Uranium-235/236	pCi/L			-0.005 U	
	Uranium-238	pCi/L			0.038 U	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-79G	Technetium-99	pCi/L			26.991	
	Uranium	µg/L			-0.008 U	
	Uranium-233/234	pCi/L			-0.003 U	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			-0.003 U	
X701-127G	Americium-241	pCi/L	-0.0124 U		0.066 U	
	Neptunium-237	pCi/L	0.144 UJ		0.00207 U	
	Plutonium-238	pCi/L	0.0147 U		0.011 U	
	Plutonium-239/240	pCi/L	0.0332 U		0.002 *QUJ	
	Technetium-99	pCi/L	70.1		86.859	
	Uranium	µg/L	0.174 UJ		0.125 UJ	
	Uranium-233/234	pCi/L	0.145 UJ		0.081 J	
	Uranium-235/236	pCi/L	0.00964 UJ		0.017 UJ	
	Uranium-238	pCi/L	0.0569 U		0.039 UJ	
X701-128G	Americium-241	pCi/L	0.0012 U			
	Neptunium-237	pCi/L	0.0496 UJ			
	Plutonium-238	pCi/L	0.0276 UJ			
	Plutonium-239/240	pCi/L	0.00681 U			
	Technetium-99	pCi/L	20.5			
	Uranium	µg/L	0.278 UJ			
	Uranium-233/234	pCi/L	0.216 J			
	Uranium-235/236	pCi/L	0.00713 UJ			
	Uranium-238	pCi/L	0.0922 UJ			
X701-130G	Technetium-99	pCi/L			944.069 QJ	
	Uranium	µg/L			2.947 J	
	Uranium-233/234	pCi/L			4.063 J	
	Uranium-235/236	pCi/L			0.212 J	
	Uranium-238	pCi/L			0.957	
X701-BW1G	Technetium-99	pCi/L			1.263 U	
	Uranium	µg/L			0.062 UJ	
	Uranium-233/234	pCi/L			0.024 UJ	
	Uranium-235/236	pCi/L			0.003 UJ	
	Uranium-238	pCi/L			0.02 U	
X701-BW2G	Technetium-99	pCi/L			1348.654 QJ	
	Uranium	µg/L			0.11 UJ	
	Uranium-233/234	pCi/L			0.053 UJ	
	Uranium-235/236	pCi/L			-0.004 UJ	
	Uranium-238	pCi/L			0.038 U	
X701-BW3G	Technetium-99	pCi/L			163.454 QJ	
	Uranium	µg/L			-0.046 UJ	
	Uranium-233/234	pCi/L			0.028 UJ	
	Uranium-235/236	pCi/L			-0.014 UJ	
	Uranium-238	pCi/L			-0.013 U	
X701-BW4G	Technetium-99	pCi/L	170			
	Uranium	µg/L	-0.0198 UJ			
	Uranium-233/234	pCi/L	0.0647 UJ			
	Uranium-235/236	pCi/L	0.0142 UJ			
	Uranium-238	pCi/L	-0.00886 U			
X701-EW121G	Technetium-99	pCi/L	86.6		74.527	
	Uranium	µg/L	0.229 UJ		0.22 J	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-EW121G	Uranium-233/234	pCi/L	0.0859 UJ		0.08 J	
	Uranium-235/236	pCi/L	0.00812 UJ		0.013 UJ	
	Uranium-238	pCi/L	0.0757 UJ		0.072 J	
X701-EW122G	Technetium-99	pCi/L	266		204.304 QJ	
	Uranium	µg/L	0.478 J		0.547 J	
	Uranium-233/234	pCi/L	0.209 J		0.198 J	
	Uranium-235/236	pCi/L	0.005 UJ		-0.003 UJ	
	Uranium-238	pCi/L	0.16 J		0.184 J	
X701-IRMPZ06G	Technetium-99	pCi/L	0.233 U			
	Uranium	µg/L	1.42 J			
	Uranium-233/234	pCi/L	0.666 J			
	Uranium-235/236	pCi/L	0.0581 UJ			
	Uranium-238	pCi/L	0.469			
X701-TC01G	Americium-241	pCi/L	0.00104 U		-0.008 U	
	Neptunium-237	pCi/L	0.017 U		0.0277 UJ	
	Plutonium-238	pCi/L	0.0131 U		0 U	
	Plutonium-239/240	pCi/L	0.0118 U		0.006 *QUJ	
	Technetium-99	pCi/L	85.8		175.798	
	Uranium	µg/L	8.28 J		5.927 J	
	Uranium-233/234	pCi/L	4.95 J		3.721 J	
	Uranium-235/236	pCi/L	0.25 J		0.18 J	
	Uranium-238	pCi/L	2.74		1.964	
X701-TC03G	Americium-241	pCi/L	0.00477 U		0.023 U	
	Neptunium-237	pCi/L	0.0774 UJ		0.00431 U	
	Plutonium-238	pCi/L	0 U		-0.011 UJ	
	Plutonium-239/240	pCi/L	0.00782 U		0.01 *QUJ	
	Technetium-99	pCi/L	564		467.078	
	Uranium	µg/L	3.96 J		4.905 J	
	Uranium-233/234	pCi/L	1.91 J		1.657 J	
	Uranium-235/236	pCi/L	0.0527 UJ		0.078 J	
	Uranium-238	pCi/L	1.32		1.636	
X701-TC05G	Americium-241	pCi/L	-0.0104 U		0.044 UJ	
	Neptunium-237	pCi/L	0.0492 U		0.00216 U	
	Plutonium-238	pCi/L	0.0326 UJ		0.032 UJ	
	Plutonium-239/240	pCi/L	0.0163 UJ		0.019 *QUJ	
	Technetium-99	pCi/L	596		477.674	
	Uranium	µg/L	27.9 J		25.091 J	
	Uranium-233/234	pCi/L	10.8 J		9.964 J	
	Uranium-235/236	pCi/L	0.65 J		0.62 J	
	Uranium-238	pCi/L	9.28		8.336	
X701-TC10G	Americium-241	pCi/L	-0.00768 U		0.015 U	
	Neptunium-237	pCi/L	0.137 UJ		0 U	
	Plutonium-238	pCi/L	0.0259 UJ		0.019 U	
	Plutonium-239/240	pCi/L	0.0155 U		0.005 U	
	Technetium-99	pCi/L	78.5		77.905 QJ	
	Uranium	µg/L	2.93 J		2.307 J	
	Uranium-233/234	pCi/L	1.05 J		0.833 J	
	Uranium-235/236	pCi/L	0.0698 UJ		0.059 UJ	
	Uranium-238	pCi/L	0.974		0.766	
X701-TC17G	Americium-241	pCi/L	0.00529 U		0.039 U	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC17G	Neptunium-237	pCi/L	0.115 UJ		-0.0123 U	
	Plutonium-238	pCi/L	0.0136 U		0.008 U	
	Plutonium-239/240	pCi/L	0.0272 U		0.06 UJ	
	Technetium-99	pCi/L	287		224.8 QJ	
	Uranium	µg/L	27.6 J		25.363 J	
	Uranium-233/234	pCi/L	11.2 J		9.797 J	
	Uranium-235/236	pCi/L	0.612 J		0.486 J	
	Uranium-238	pCi/L	9.18		8.448	
X701-TC22G	Americium-241	pCi/L	0.00198 U		0.021 U	
	Neptunium-237	pCi/L	0.102 U		0.00399 U	
	Plutonium-238	pCi/L	0.00149 U		0.012 U	
	Plutonium-239/240	pCi/L	0.0164 U		-0.005 *QUJ	
	Technetium-99	pCi/L	219		169.071	
	Uranium	µg/L	1.1 J		2.53 J	
	Uranium-233/234	pCi/L	0.505 J		0.963 J	
	Uranium-235/236	pCi/L	0.013 UJ		0.074 J	
	Uranium-238	pCi/L	0.368		0.839	
X701-TC28G	Americium-241	pCi/L	0.011 U		0.029 U	
	Neptunium-237	pCi/L	0.0263 UJ		-0.006 U	
	Plutonium-238	pCi/L	0.0257 U		0.011 U	
	Plutonium-239/240	pCi/L	0.00303 U		0.095 J	
	Technetium-99	pCi/L	298		245.969 QJ	
	Uranium	µg/L	9.93 J		10.952 J	
	Uranium-233/234	pCi/L	4.27 J		4.629 J	
	Uranium-235/236	pCi/L	0.327 J		0.206 J	
	Uranium-238	pCi/L	3.28		3.649	
X701-TC48G	Americium-241	pCi/L	-0.0014 U		0.009 UJ	
	Neptunium-237	pCi/L	0.0169 U		0.0292 U	
	Plutonium-238	pCi/L	0.0276 UJ		-0.023 U	
	Plutonium-239/240	pCi/L	0.00827 U		-0.009 U	
	Technetium-99	pCi/L	370		389.409 QJ	
	Uranium	µg/L	47.6 J		58.845 J	
	Uranium-233/234	pCi/L	17.6 J		22.286 J	
	Uranium-235/236	pCi/L	0.937 J		0.943 J	
	Uranium-238	pCi/L	15.8		19.63	
X701-TC54G	Americium-241	pCi/L	0.000174 U		0.025 U	
	Neptunium-237	pCi/L	0.0533 U		0.00193 U	
	Plutonium-238	pCi/L	-0.00187 U		0.01 UJ	
	Plutonium-239/240	pCi/L	0.0242 U		0.002 *QUJ	
	Technetium-99	pCi/L	330		269.198	
	Uranium	µg/L	1.89 J		2.408 J	
	Uranium-233/234	pCi/L	0.779 J		0.883 J	
	Uranium-235/236	pCi/L	0.0456 UJ		0.112 J	
	Uranium-238	pCi/L	0.628		0.792	
X701-TC61G	Americium-241	pCi/L	0.00743 U		0.003 U	
	Neptunium-237	pCi/L	0.0624 U		-0.00608 U	
	Plutonium-238	pCi/L	0.0219 U		0.012 U	
	Plutonium-239/240	pCi/L	0.00643 U		0.025 *QUJ	
	Technetium-99	pCi/L	334		235.917	
	Uranium	µg/L	1.2 J		0.743 J	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC61G	Uranium-233/234	pCi/L	0.46 J		0.293 J	
	Uranium-235/236	pCi/L	0.0304 UJ		0.026 UJ	
	Uranium-238	pCi/L	0.398		0.246	
X701-TC67G	Americium-241	pCi/L	0.00885 U		0.033 U	
	Neptunium-237	pCi/L	0.0758 U		-0.00412 U	
	Plutonium-238	pCi/L	-0.00145 U		0.002 U	
	Plutonium-239/240	pCi/L	0.013 U		-0.002 *QUJ	
	Technetium-99	pCi/L	45.5		40.785	
	Uranium	µg/L	0.144 UJ		0.226 J	
	Uranium-233/234	pCi/L	0.325 UJ		0.053 UJ	
	Uranium-235/236	pCi/L	-0.00358 UJ		0.009 UJ	
	Uranium-238	pCi/L	0.049 U		0.075 J	

Table 4.8. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X633-07G	Chromium	µg/L		93.3		355
X633-PZ04G	Chromium	µg/L		56.5		88.1

Table 4.9. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-02G	Acetone	µg/L	3.9 J			
X616-05G	Acetone	µg/L	4.3 J			
	Trichlorofluoromethane	µg/L	0.42 JQ			
X616-09G	1,1,1-Trichloroethane	µg/L	2.9		3 J	
	1,1-Dichloroethane	µg/L	3.1		3.3	
	1,1-Dichloroethene	µg/L	41		49 J	
	cis-1,2-Dichloroethene	µg/L	3.6		3 J	
	Trichloroethene	µg/L	28		33 J	
	Trichlorofluoromethane	µg/L	1.7 J		2.3	
X616-13G	1,1,1-Trichloroethane	µg/L	3.5		4.1	
	1,1-Dichloroethane	µg/L	1.3		1.7	
	1,1-Dichloroethene	µg/L	36		53	
	Chloroform	µg/L	0.16 U		0.19 J	
	cis-1,2-Dichloroethene	µg/L	0.76 J		1.1	
	Trichloroethene	µg/L	22		27	
	Trichlorofluoromethane	µg/L	12 Q		14	
X616-14G	1,1,1-Trichloroethane	µg/L	1.4		0.16 U	
	1,1-Dichloroethane	µg/L	0.22 U		0.5 J	
	1,1-Dichloroethene	µg/L	12		15	
	Acetone	µg/L	1.9 U		2.1 J	
	Trichloroethene	µg/L	4.2		4.2	
	Trichlorofluoromethane	µg/L	2.2		2.6	
X616-16G	1,1-Dichloroethene	µg/L	0.26 J			
	cis-1,2-Dichloroethene	µg/L	0.47 J			
	Trichloroethene	µg/L	0.78 J			
X616-20B	1,1,1-Trichloroethane	µg/L	0.62 J		0.16 U	
	1,1-Dichloroethane	µg/L	0.91 J		1.6	
	1,1-Dichloroethene	µg/L	15		24	
	cis-1,2-Dichloroethene	µg/L	0.98 J		1.2	
	Trichloroethene	µg/L	24		29	
X616-25G	1,1-Dichloroethane	µg/L	0.22 U		0.3 J	
	1,1-Dichloroethene	µg/L	0.23 U		0.34 J	
	cis-1,2-Dichloroethene	µg/L	0.54 J		0.61 J	
	Trichloroethene	µg/L	2		1.3	
X616-28B	1,1,1-Trichloroethane	µg/L	1			
	1,1-Dichloroethene	µg/L	0.59 J			
	Trichloroethene	µg/L	0.64 J			

Table 4.10. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-05G	Chromium	µg/L	2300 BJ			

Table 4.11. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-02G	1,1-Dichloroethane	µg/L		1.66 J		
	1,1-Dichloroethene	µg/L		2.62 J		
	Trichloroethene	µg/L		3.5 Q		
X740-03G	1,1-Dichloroethane	µg/L		3.16		
	1,1-Dichloroethene	µg/L		39.3		
	1,2-Dichloroethane	µg/L		5.77		
	Chloroethane	µg/L		1.99 J		
	cis-1,2-Dichloroethene	µg/L		206 DQ		
	trans-1,2-Dichloroethene	µg/L		0.813 J		
	Trichloroethene	µg/L		1.03 JQ		
	Vinyl chloride	µg/L		7.32		
X740-08G	1,1-Dichloroethane	µg/L		11.5		
	1,1-Dichloroethene	µg/L		1.61 J		
	cis-1,2-Dichloroethene	µg/L		13.9 Q		
	trans-1,2-Dichloroethene	µg/L		3.86		
	Trichloroethene	µg/L		5.91 Q		
X740-09B	1,1,1-Trichloroethane	µg/L		3.34		
	1,1-Dichloroethane	µg/L		18.5		
	1,1-Dichloroethene	µg/L		185 D		
	1,2-Dichloroethane	µg/L		45.4		
	Chloroform	µg/L		0.628 J		
	cis-1,2-Dichloroethene	µg/L		1240 DQ		
	Tetrachloroethene	µg/L		3.94 Q		
	trans-1,2-Dichloroethene	µg/L		2.74		
	Trichloroethene	µg/L		208 DQ		
	Vinyl chloride	µg/L		6.2		
X740-10G	1,1-Dichloroethene	µg/L		3.51		
	1,2-Dichloroethane	µg/L		0.822 J		
	cis-1,2-Dichloroethene	µg/L		26.5 Q		
	Trichloroethene	µg/L		9.55 Q		
X740-11G	1,1-Dichloroethene	µg/L		5.86		
	1,2-Dichloroethane	µg/L		1.96 J		
	cis-1,2-Dichloroethene	µg/L		0.541 JQ		
	Trichloroethene	µg/L		22.8 Q		
X740-13G	cis-1,2-Dichloroethene	µg/L		0.396 JQ		
X740-14B	1,1-Dichloroethene	µg/L		1.11 J		
	Trichloroethene	µg/L		5.61 Q		
X740-18G	1,2-Dichloroethane	µg/L		0.552 J		
	cis-1,2-Dichloroethene	µg/L		11.1 Q		
	Vinyl chloride	µg/L		1.46 J		
X740-19G	1,1,1-Trichloroethane	µg/L		0.751 J		
	cis-1,2-Dichloroethene	µg/L		2.5		
	Trichloroethene	µg/L		1.81 J		
X740-20G	Trichloroethene	µg/L		0.688 J		
X740-21G	Trichloroethene	µg/L		0.922 J		
X740-22G	1,1-Dichloroethene	µg/L		2.77 J		
	1,2-Dichloroethane	µg/L		0.764 J		
	Bromodichloromethane	µg/L		1.28 J		
	cis-1,2-Dichloroethene	µg/L		4.25		
	Trichloroethene	µg/L		19.6		

Table 4.11. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-PZ10G	Trichloroethene	µg/L		1.88 J		
X740-PZ12G	1,1,1-Trichloroethane	µg/L		1.28 J		
	1,1-Dichloroethene	µg/L		2.66 J		
	1,2-Dichloroethane	µg/L		1.6 J		
	Trichloroethene	µg/L		35.4		
X740-PZ14G	1,1,1-Trichloroethane	µg/L		0.966 J		
	1,1-Dichloroethene	µg/L		3.99		
	1,2-Dichloroethane	µg/L		1.16 J		
	cis-1,2-Dichloroethene	µg/L		1.73 J		
	Trichloroethene	µg/L		27.5		
X740-PZ17G	1,1,1-Trichloroethane	µg/L		1.05 J		
	1,1-Dichloroethene	µg/L		2.3 J		
	1,2-Dichloroethane	µg/L		0.884 J		
	Trichloroethene	µg/L		12.5		

Table 4.12. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-07G	Beryllium	µg/L	1.7		0.25 J	
	Chromium	µg/L	4.9		19	
F-08B	Beryllium	µg/L	0.08 U		0.14 J	
	Chromium	µg/L	0.5 U		0.5 U	
X611-01B	Beryllium	µg/L	0.08 U		0.08 U	
	Chromium	µg/L	1.7 J		2.2	
X611-02BA	Beryllium	µg/L	0.08 U		0.11 J	
	Chromium	µg/L	0.55 J		0.5 U	
X611-03G	Beryllium	µg/L	0.08 U		0.24 JQ	
	Chromium	µg/L	0.65 J		2.2 J	
X611-04BA	Beryllium	µg/L	0.27 J		0.11 J	
	Chromium	µg/L	0.5 U		1.9 J	

Table 4.13. VOCs detected at the X-735 Landfills – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-02GA	1,1-Dichloroethane	µg/L		0.839 J		
X735-03G	Trichloroethene	µg/L		0.894 J		
X735-03GA	1,2-Dichlorobenzene	µg/L		0.592 J		
	trans-1,4-Dichloro-2-butene	µg/L		0.9 J		
X735-05GA	Styrene	µg/L		0.865 J		
X735-18B	Chloromethane	µg/L		0.739 J		

Table 4.14. Results for radionuclides at the X-735 Landfills – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-03G	Technetium-99	pCi/L		-6.033 U		
	Uranium	µg/L		0.37 J		
	Uranium-233/234	pCi/L		0.167 J		
	Uranium-235/236	pCi/L		-0.002 UJ		
	Uranium-238	pCi/L		0.125 J		
X735-04G	Technetium-99	pCi/L		-3.286 U		
	Uranium	µg/L		0.13 UJ		
	Uranium-233/234	pCi/L		0.086 UJ		
	Uranium-235/236	pCi/L		0.011 UJ		
	Uranium-238	pCi/L		0.042 U		
X735-05G	Technetium-99	pCi/L		-0.697 U		
	Uranium	µg/L		0.474 J		
	Uranium-233/234	pCi/L		0.154 J		
	Uranium-235/236	pCi/L		0.003 UJ		
	Uranium-238	pCi/L		0.159 J		
X735-12G	Technetium-99	pCi/L		2.726 U		
	Uranium	µg/L		-0.001 UJ		
	Uranium-233/234	pCi/L		0.089 UJ		
	Uranium-235/236	pCi/L		-0.003 UJ		
	Uranium-238	pCi/L		0 U		

Table 4.15. VOCs detected at the X-734 Landfills – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X734-05B	Benzene	µg/L		0.378 U		0.759 J
	Ethylbenzene	µg/L		0.464 U		0.275 J
	Toluene	µg/L		0.323 U		0.224 J
X734-14G	Chloromethane	µg/L		1.06 J		0.3 U
X734-16G	Acetone	µg/L		6.69 U		7.25 J
X734-18G	1,1,1-Trichloroethane	µg/L		0.74 J		0.16 U
X734-20G	1,1,1-Trichloroethane	µg/L		0.73 J		0.16 U
X734-23G	cis-1,2-Dichloroethene	µg/L		4.93		4.42
	trans-1,2-Dichloroethene	µg/L		0.586 U		0.332 J
	Vinyl chloride	µg/L		1.41 J		1.45

Table 4.16. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-03G	Cadmium	µg/L		45.9		31.9 B
	Nickel	µg/L		528		361
TCP-01G	Cadmium	µg/L		12.7		8.41 B
	Nickel	µg/L		143		104
X533-03G	Cadmium	µg/L		30		36 B
	Nickel	µg/L		345		400

Table 4.17. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X344C-01G	cis-1,2-Dichloroethene	µg/L	1.5			
	Trichloroethene	µg/L	0.51 J			

Table 4.18. VOCs detected at surface water monitoring locations – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Acetone	µg/L	30	6.69 U	23.1 UJ	28.4
BRC-SW05	1,1,1-Trichloroethane	µg/L	0.16 U	0.767 J	0.722 JU	0.16 U
	1,4-Dichlorobenzene	µg/L	0.16 J	0.832 U	0.832 JU	0.16 U
	Acetone	µg/L	2.5 UJ	6.69 U	6.69 JU	2.39 J
EDD-SW01	1,1,2,2-Tetrachloroethane	µg/L	0.21 U	0.509 U	0.509 U	0.386 J
	1,1-Dichloroethene	µg/L	0.23 U	0.86 U	0.86 U	0.72 J
	Bromodichloromethane	µg/L	0.17 U	1.4 J	2.95	0.17 U
	Chloroform	µg/L	0.17 J	0.61 U	2 J	0.16 U
	cis-1,2-Dichloroethene	µg/L	4.1	2.45	0.439 J	101
	Dibromochloromethane	µg/L	0.17 U	1.23 J	2.84	0.17 U
	Tetrachloroethene	µg/L	0.2 U	0.763 U	0.763 U	0.521 J
	trans-1,2-Dichloroethene	µg/L	0.15 U	0.586 U	0.586 U	0.892 J
	Trichloroethene	µg/L	10	4.16	0.961 JQ	167
LBC-SW01	Bromodichloromethane	µg/L	0.17 U	0.369 U	2.49	0.17 U
	Chloroform	µg/L	0.16 U	0.61 U	1.3 J	0.16 U
	cis-1,2-Dichloroethene	µg/L	14	16.8	1.67 J	7.57
	Dibromochloromethane	µg/L	0.17 U	0.342 U	2.41	0.17 U
	Trichloroethene	µg/L	24	16.6	1.01 JQ	10.2
LBC-SW02	Bromodichloromethane	µg/L	0.17 U	0.369 U	1.99 J	0.17 U
	cis-1,2-Dichloroethene	µg/L	7.1	3.49	0.828 J	7.7
	Dibromochloromethane	µg/L	0.17 U	0.342 U	2.04	0.17 U
	Trichloroethene	µg/L	12	3.73	0.638 QU	10.7
LBC-SW03	Bromodichloromethane	µg/L	0.17 U	0.369 U	0.369 U	0.456 J
	Chloroform	µg/L	0.16 U	0.61 U	0.61 U	0.351 J
LBC-SW04	cis-1,2-Dichloroethene	µg/L	0.16 J	0.37 U	0.37 U	0.75 J
	Trichloroethene	µg/L	0.31 J	0.638 U	0.638 QU	0.825 J
NHP-SW01	Chloroform	µg/L	0.16 U	0.61 U	0.61 U	0.414 J
	Dibromochloromethane	µg/L	0.17 U	0.342 U	1.76 J	0.17 U
UND-SW01	1,1-Dichloroethene	µg/L	0.23 U	0.86 U	0.86 JU	0.542 J
	cis-1,2-Dichloroethene	µg/L	0.2 J	0.452 J	0.517 J	0.355 J
	Trichloroethene	µg/L	2.9	3.85	5.57 BUJ	3.41
UND-SW02	1,1-Dichloroethene	µg/L	0.23 U	0.86 U	0.86 JU	0.588 J
	cis-1,2-Dichloroethene	µg/L	0.15 U	0.37 U	0.37 JU	0.417 J
	Trichloroethene	µg/L	0.16 U	0.638 U	2.12 BUJ	3.41
WDD-SW01	Bromodichloromethane	µg/L	0.61 J	0.369 U	0.369 JQU	0.17 U
	Chloroform	µg/L	0.96 J	0.61 U	0.61 JU	0.16 U
	Dibromochloromethane	µg/L	0.94 J	0.342 U	0.342 JQU	0.17 U
WDD-SW02	2-Butanone	µg/L	2 U	1.26 U	1.63 J	2 U
WDD-SW03	Chloroform	µg/L	0.2 J	0.61 U	0.61 JU	0.16 U

Table 4.19. Results for radionuclides at surface water monitoring locations – 2020

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Americium-241	pCi/L		0 U		0.013 U
	Neptunium-237	pCi/L		0.022 *QU		0 U
	Plutonium-238	pCi/L		0.0043 U		0.044 U
	Plutonium-239/240	pCi/L		-0.0043 U		0.029 U
	Technetium-99	pCi/L	0.658 U	-0.34 U	1.904 QUJ	11.202 U
	Uranium	µg/L	1.45 J	0.767 J	0.222 J	0.827 J
	Uranium-233/234	pCi/L	1.22 J	0.684 J	0.322 J	0.696
	Uranium-235/236	pCi/L	0.0607 UJ	0.029 UJ	0.009 UJ	0.039 U
	Uranium-238	pCi/L	0.477	0.253	0.073 J	0.272
BRC-SW02	Americium-241	pCi/L		0.008 U		-0.011 U
	Neptunium-237	pCi/L		0.0073 *QU		0.00734 U
	Plutonium-238	pCi/L		0.0073 U		-0.018 U
	Plutonium-239/240	pCi/L		0.0073 U		0 U
	Technetium-99	pCi/L	1.14 U	-0.47 U	3.53 QUJ	0.622 U
	Uranium	µg/L	0.645 UJ	0.674 J	0.79 J	0.625 J
	Uranium-233/234	pCi/L	0.642 J	0.655 J	0.635 J	0.462
	Uranium-235/236	pCi/L	0.0464 UJ	0.033 UJ	0.039 J	0.023 U
	Uranium-238	pCi/L	0.21 J	0.221 J	0.259	0.206 J
BRC-SW05	Americium-241	pCi/L		-0.022 U		0.014 U
	Neptunium-237	pCi/L		-0.0077 *QU		-0.00238 U
	Plutonium-238	pCi/L		0.015 U		0.054 U
	Plutonium-239/240	pCi/L		0 U		0.027 U
	Technetium-99	pCi/L	-0.0559 U	-1 U	3.162 QUJ	2.058 U
	Uranium	µg/L	1.18 J	0.603 J	0.638 J	0.481 J
	Uranium-233/234	pCi/L	0.93 J	0.546 J	0.505 J	0.476
	Uranium-235/236	pCi/L	0.0647 UJ	0.008 UJ	0.019 UJ	0.015 U
	Uranium-238	pCi/L	0.387	0.202 J	0.212 J	0.159 J
EDD-SW01	Americium-241	pCi/L		0.002 U		-0.018 U
	Neptunium-237	pCi/L		0.018 U		-0.0085 U
	Plutonium-238	pCi/L		0.0087 U		0.002 U
	Plutonium-239/240	pCi/L		0 U		0.002 U
	Technetium-99	pCi/L	41.5	10	7.761 QJ	12.626
	Uranium	µg/L	4.97 J	1.306 J	0.396 J	2.441 J
	Uranium-233/234	pCi/L	8.71 J	3.023 J	0.833 J	3.744 J
	Uranium-235/236	pCi/L	0.6 UJ	0.117 UJ	0.047 UJ	0.166 J
	Uranium-238	pCi/L	1.58	0.421 J	0.126 J	0.794
LBC-SW01	Americium-241	pCi/L		0.006 U		0.022 U
	Neptunium-237	pCi/L		0.0037 *QU		-0.00909 U
	Plutonium-238	pCi/L		0 U		0.027 U
	Plutonium-239/240	pCi/L		0 U		0.002 U
	Technetium-99	pCi/L	9.77	7.8	5.049 *QUJ	1.378 U
	Uranium	µg/L	1.41 J	1.57 J	0.402 J	0.781 J
	Uranium-233/234	pCi/L	1.92 J	2.844 J	0.745 J	1.08 J
	Uranium-235/236	pCi/L	0.144 UJ	0.151 J	0.028 UJ	0.025 UJ
	Uranium-238	pCi/L	0.451	0.504	0.131 J	0.259
LBC-SW02	Americium-241	pCi/L		0.016 U		-0.011 U
	Neptunium-237	pCi/L		0.017 *QU		0.00398 U
	Plutonium-238	pCi/L		-0.0024 U		0.017 U
	Plutonium-239/240	pCi/L		-0.0024 U		0.019 U
	Technetium-99	pCi/L	8.68	8.4	4.971 *QUJ	3.579 U

Table 4.19. Results for radionuclides at surface water monitoring locations – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-SW02	Uranium	µg/L	0.891 J	1.514 J	0.419 J	0.559 J
	Uranium-233/234	pCi/L	1.48 J	2.255 J	0.705 J	0.781 J
	Uranium-235/236	pCi/L	0.104 UJ	0.124 J	0.021 UJ	0.06 UJ
	Uranium-238	pCi/L	0.283	0.489	0.137 J	0.179 J
LBC-SW03	Americium-241	pCi/L		0.008 U		0.044 U
	Neptunium-237	pCi/L		0.013 *QU		-0.00853 U
	Plutonium-238	pCi/L		0.013 U		0.005 U
	Plutonium-239/240	pCi/L		0 U		0.008 U
	Technetium-99	pCi/L	-0.911 U	2.8 UJ	2.553 *QUJ	-0.459 U
	Uranium	µg/L	3.06 J	0.423 J	0.283 J	4.208 J
	Uranium-233/234	pCi/L	1.64 J	0.907 J	0.426 J	2.049 J
	Uranium-235/236	pCi/L	0.154 UJ	0.043 UJ	0.021 UJ	0.069 UJ
	Uranium-238	pCi/L	1	0.136 J	0.092 J	1.403
LBC-SW04	Americium-241	pCi/L		0.005 U		0.006 U
	Neptunium-237	pCi/L		0.0094 *QU		-0.0703 U
	Plutonium-238	pCi/L		0.0023 U		0.015 U
	Plutonium-239/240	pCi/L		-0.0047 U		0.008 U
	Technetium-99	pCi/L	5.62 J	2.2 UJ	4.823 *QUJ	-0.417 U
	Uranium	µg/L	1.44 J	0.564 J	0.968 J	1.072 J
	Uranium-233/234	pCi/L	1.52 J	0.984 J	0.615 J	0.843 J
	Uranium-235/236	pCi/L	0.127 UJ	0.022 UJ	0.024 UJ	0.036 UJ
	Uranium-238	pCi/L	0.465	0.186 J	0.322	0.355
NHP-SW01	Americium-241	pCi/L		0.004 U		0.002 U
	Neptunium-237	pCi/L		-0.003 *QU		-0.0668 U
	Plutonium-238	pCi/L		0.009 U		-0.015 U
	Plutonium-239/240	pCi/L		0.006 U		0.025 U
	Technetium-99	pCi/L	1.97 U	-0.89 U	1.227 *QUJ	1.043 U
	Uranium	µg/L	1.01 J	1.839 J	1.83 J	3.842 J
	Uranium-233/234	pCi/L	1.19 J	0.734 J	0.898 J	1.96 J
	Uranium-235/236	pCi/L	0.133 UJ	0.013 UJ	0.047 UJ	0.086 J
	Uranium-238	pCi/L	0.317	0.616	0.608	1.278
UND-SW01	Americium-241	pCi/L		0.004 U		-0.011 U
	Neptunium-237	pCi/L		-0.0092 *QU		0.00901 U
	Plutonium-238	pCi/L		-0.014 U		0 U
	Plutonium-239/240	pCi/L		-0.0046 U		-0.005 U
	Technetium-99	pCi/L	-0.182 U	-0.49 U	0.503 QUJ	-1.271 U
	Uranium	µg/L	2.19 J	2.515 J	1.789 J	1.855
	Uranium-233/234	pCi/L	0.84 J	1.08 J	0.746 J	0.802
	Uranium-235/236	pCi/L	0.13 UJ	0.04 UJ	0.023 UJ	0.021 U
	Uranium-238	pCi/L	0.716	0.839	0.598	0.62
UND-SW02	Americium-241	pCi/L		0.007 U		-0.009 U
	Neptunium-237	pCi/L		0 U		0 U
	Plutonium-238	pCi/L		0 U		0.014 U
	Plutonium-239/240	pCi/L		-0.0028 U		-0.009 U
	Technetium-99	pCi/L	1.54 U	-0.85 U	1.739 QUJ	-0.355 U
	Uranium	µg/L	1.66 J	1.066 J	0.713 J	1.869
	Uranium-233/234	pCi/L	0.65 J	0.639 J	0.344 J	0.583
	Uranium-235/236	pCi/L	0.072 UJ	0.017 UJ	0.011 UJ	0.027 U
	Uranium-238	pCi/L	0.547	0.355	0.238 J	0.624
WDD-SW01	Americium-241	pCi/L		0.038 U		0.008 U

Table 4.19. Results for radionuclides at surface water monitoring locations – 2020 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
WDD-SW01	Neptunium-237	pCi/L		0.0076 *QU		-0.00532 U
	Plutonium-238	pCi/L		0.035 U		0.03 U
	Plutonium-239/240	pCi/L		-0.0051 U		-0.007 U
	Technetium-99	pCi/L	1.95 U	0.65 U	3.269 QUJ	-1.443 *U
	Uranium	µg/L	2.31 J	2.086 J	1.26 J	1.377 J
	Uranium-233/234	pCi/L	1.56 J	1.057 J	0.591 J	0.727 J
	Uranium-235/236	pCi/L	0.0723 UJ	0.037 UJ	0.032 J	0.032 UJ
	Uranium-238	pCi/L	0.763	0.695	0.419	0.458
WDD-SW02	Americium-241	pCi/L		0.032 U		0.009 U
	Neptunium-237	pCi/L		0.0024 *QU		0.00433 U
	Plutonium-238	pCi/L		0 U		-0.011 U
	Plutonium-239/240	pCi/L		0.0049 U		0.016 U
	Technetium-99	pCi/L	-0.775 U	-1.2 U	2.551 QUJ	-2.195 *U
	Uranium	µg/L	2.59 J	2.124 J	1.193 J	1.324 J
	Uranium-233/234	pCi/L	1.68 J	1.83 J	0.719 J	0.762 J
	Uranium-235/236	pCi/L	0.0823 UJ	0.085 UJ	0.058 J	0.02 UJ
	Uranium-238	pCi/L	0.856	0.701	0.392	0.442
WDD-SW03	Americium-241	pCi/L		0.023 U		0.007 U
	Neptunium-237	pCi/L		-0.006 U		0.0204 U
	Plutonium-238	pCi/L		-0.003 U		0.022 U
	Plutonium-239/240	pCi/L		0.012 U		0.009 U
	Technetium-99	pCi/L	1.29 U	-0.1 U	2.786 QUJ	4.016 U
	Uranium	µg/L	2.31 J	1.977 J	0.715 J	0.968 J
	Uranium-233/234	pCi/L	1.33 J	0.878 J	0.313 J	0.791 J
	Uranium-235/236	pCi/L	0.0627 UJ	0.013 UJ	0.018 UJ	0.025 UJ
	Uranium-238	pCi/L	0.767	0.663	0.238 J	0.322

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