Department of Energy

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JAN 2 2 2019

DISTRIBUTION LIST

PPPO-03-5263593-19

Dear Madams/Sirs:

U.S. DEPARTMENT OF ENERGY PORTSMOUTH ANNUAL SITE ENVIRONMENTAL REPORT - 2017

Enclosed for your information is a copy of the *U.S. Department of Energy Portsmouth Annual Site Environmental Report – 2017.* 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, and 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 Data – 2017* is available upon request. Requests for this data can be made by mail to the U.S. Department of Energy's Environmental Information Center at 1862 Shyville Road, Room 207, Piketon, OH 45661, emailed to portseic@ports.pppo.gov, or by telephone at (740) 289-8898 on Monday and Tuesday from 9 a.m. to noon, Wednesday and Thursday from noon to 4 p.m.

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

Sincerely,

Joel B. Bradburne
Deputy Manager
Portsmouth/Paducah Project Office

Enclosure:
Annual Site Environmental Report - 2017

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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)

John Knauff, USW Local 1-689
Paul Davis, SPFPA Local 66
Steve Burton/Mark Johnson, Tri-State Building Trades Council

Mike Throne, Chillicothe Ross Chamber of Commerce
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
Randy Arnett, Southern Ohio Medical Center

John Hemmings, Ohio Valley Regional Development Commission
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Steven Shepherd, Southern Ohio Diversification Initiative
Michael Payton, Southern Ohio Port Authority
Gary Arnett, Pike County Community and Economic Development
Jennifer Jacobs, Jackson County Economic Development

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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 2017

Tuliptree silkmoth

January 2019

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Report – 2017
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0862&D1

January 2019

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

FBP-ER-RCRA-WD-RPT-0288, Revision 3

This document has been approved for public release:

Samuel C. Eldridge (signature on file) 1/24/2019
Classification Office Date

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FIGURES

TABLES

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ACRONYMS AND ABBREVIATIONS

ACP	American Centrifuge Plant
Bq	becquerel
BSFR	bulk survey for release
BWCS	BWXT Conversion Services, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
Ci	curie
D&D	decontamination and decommissioning
DAS	Disposal Authorization Statement
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
EA	environmental assessment
EMS	Environmental Management System
EPEAT	Electronic Product Environmental Assessment Tool
FBP	Fluor-BWXT Portsmouth LLC
Gy	gray
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
MCS	Mid-America Conversion Services, LLC
mg	milligram
mg/L	milligram per liter (equivalent to part per million)
mrem	millirem
mSv	millisievert
ng/L	nanogram per liter
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
Ohio EPA	Ohio Environmental Protection Agency
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/mL	picocurie per milliliter

pCi/m^3	picocurie per cubic meter
PEGASIS	PORTS Environmental Geographic Analytical Spatial Information System
PK	Peter Kiewit
PMA	Portsmouth Mission Alliance, LLC
PORTS	Portsmouth Gaseous Diffusion Plant
ppb	part per billion
ppm	part per million
rad	radiation absorbed dose
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man
SODI	Southern Ohio Diversification Initiative
Sv	sievert
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

DEFINITIONS

absorption – In radiological terms, the taking up of energy from radiation by the medium or tissue through which the radiation is passing.

activity – See "radioactivity."

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 air – The atmosphere around people, plants, and structures. 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.

background radiation – The radiation in humans' natural environment, including cosmic rays and radiation from the naturally-occurring radioactive elements.

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 characterizing a given region.

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 2011a) 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 quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. The unit of absorbed dose is the rad, equal to 0.01 joule per kilogram in any medium. (1 rad = 0.01 gray).

- **dose** – The product of the absorbed dose (rad) in tissue and a quality factor. Dose is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

- **effective dose** – The sum of the doses received by all organs or tissues of the body after each one has been multiplied by the appropriate weighting factor. In this document, the term "effective dose" is often shortened to "dose."

- **collective dose/collective effective dose** – The sums of the doses of all individuals in an exposed population expressed in units of person-rem (or person-sievert). The collective effective dose is also frequently called the "population dose."

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 or by inhalation.

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 remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose.

maximum contaminant level (MCL) – The maximum permissible level of a contaminant in drinking water provided by a public water system.

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).

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.

EXECUTIVE SUMMARY

PURPOSE

This Annual Site Environmental Report is prepared to summarize environmental monitoring and compliance activities conducted at the U.S. Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant (PORTS) for calendar year 2017. Environmental monitoring is conducted to assess the impact, if any, that site operations may have on public health and the environment. The report fulfills a requirement of DOE Order 231.1B, *Environment, Safety and Health Reporting*, for preparation of an annual summary of environmental data to characterize environmental management performance. 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.*

SITE AND OPERATIONS OVERVIEW

PORTS, which produced enriched uranium via the gaseous diffusion process from 1954 to 2001, is one of three uranium enrichment facilities originally built in the United States; the other two were constructed in Oak Ridge, Tennessee and Paducah, Kentucky, respectively. PORTS is located on 5.9 square miles in Pike County, Ohio. The county has approximately 28,270 residents (U.S. Census Bureau 2018).

DOE is responsible for decontamination and decommissioning (D&D) of the gaseous diffusion process buildings and associated facilities, environmental restoration, waste management, depleted uranium hexafluoride (DUF_6) conversion, and management of other non-leased facilities at PORTS. DOE contractors Fluor-BWXT Portsmouth LLC (FBP), Portsmouth Mission Alliance, LLC (PMA), Mid-America Conversion Services, LLC (MCS), and BWXT Conversion Services, LLC (BWCS) managed DOE programs at PORTS in 2017.

FBP was responsible for the following activities:

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

PMA was responsible for 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.

BWCS was responsible for operations associated with the DUF_6 Conversion Facility through January 2017. On February 1, 2017 MCS assumed responsibility for the DUF_6 Conversion Facility including surveillance and maintenance of DUF_6 cylinders, and environmental compliance and monitoring activities

associated with operation of the DUF_6 Conversion 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.

Centrus Energy Corp. (Centrus), formerly USEC, Inc., continues to lease facilities at PORTS that were intended for the development of a gaseous centrifuge uranium enrichment facility – the American Centrifuge Plant (ACP). The project has been shut down, and D&D of the demonstration cascade associated with the project began in 2016.

With the exception of Chapter 2, Compliance Summary; Chapter 4, Environmental Radiological Program Information; and Chapter 5, Environmental Non-Radiological Program Information, this report does not cover Centrus operations at PORTS because their operations are not subject to DOE Orders. Centrus data are included in these chapters to provide a more complete picture of the operations in place at PORTS to detect and assess potential impacts to human health and the environment resulting from PORTS activities.

ENVIRONMENTAL MONITORING AND RADIOLOGICAL DOSE SUMMARY

Extensive environmental monitoring is completed at PORTS to comply with environmental regulations, permit requirements, and DOE Orders, and assess the impact, if any, that site operations may have on public health and the environment. The *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017b) describes the DOE environmental monitoring programs at PORTS, with the exception of groundwater monitoring. Groundwater monitoring, which also includes related surface water monitoring and residential water supply monitoring, is described in the *Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017d).

Environmental monitoring includes the collection of samples of air, water, soil, sediment, and biota (vegetation, deer, fish, crops, milk, and eggs). Samples are collected at varying frequencies (weekly, monthly, quarterly, annually, or biennially). In 2017, environmental monitoring information was collected for the following programs:

- ambient air
- external radiation
- discharges to surface water
- local surface water
- sediment
- soil
- biota (vegetation, deer, fish, crops, milk, and eggs)
- groundwater.

Samples are analyzed for radionuclides, metals, and/or other chemicals that could be present in the environment due to PORTS activities, although many of these analytes also occur naturally or can be present due to human activities not related to PORTS. Over 3000 samples from these programs are collected on an annual basis.

Potential impacts on human health from radionuclides released by PORTS operations are calculated based on environmental monitoring data. This impact, if any, is calculated in terms of a dose. A dose can be caused by radionuclides released into the air and/or water, or radiation emanating directly from buildings or other objects at PORTS. PORTS complies with the following dose limits:

- The U.S. Environmental Protection Agency (U.S. EPA) has established a dose limit of 10 millirem (mrem)/year from radionuclides released to the air in Title 40 of the *Code of Federal Regulations*

(CFR), Part 61, 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).

- The DOE has established a dose limit for members of the general public in DOE Order 458.1, which is as low as reasonably achievable[1], but no more than 100 mrem/year for the dose from radionuclides from all potential pathways of exposure including inhalation, ingestion of water and soil/sediments, consumption of food, and direct external radiation.

To aid in comparing sampling results for air and water to the 100 mrem/year dose limit, the 100 mrem/year limit is converted into a derived concentration standard (DOE 2011a). 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.

Environmental monitoring data collected in 2017 are consistent with data collected in previous years and indicate that radionuclides, metals, and other chemicals released by PORTS operations have a minimal effect on human health and the environment. The following sections summarize the results of environmental monitoring conducted at PORTS in 2017:

Ambient air. Radionuclides in ambient air are monitored at 15 monitoring stations that are located on site, at the site perimeter, within the local area, and west of PORTS in an area not potentially impacted by PORTS operations (the background location). Samples are analyzed monthly or quarterly for radionuclides that can be associated with PORTS operations. These radionuclides are transuranics (manmade elements greater than atomic number 92 [americium-241, neptunium-237, plutonium-238, plutonium-239/240]), a fission product (technetium-99), uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238).

Uranium, uranium isotopes, neptunium-237, and technetium-99 were detected at the ambient air monitoring stations in 2017. The highest levels of each radionuclide in air were 0.08% or less of the DOE derived concentration standards (DOE 2011a). Maximum activities of detected radionuclides were located at stations A41A (Zahns Corner) and A36 (on site near the X-611 Water Treatment Plant) and are listed below (in picocurie per cubic meter [pCi/m^3]):

Radionuclide	Maximum activity (pCi/m^3)	Location	Derived Concentration Standard (DCS) (DOE 2011a)	Percentage of DCS
Neptunium-237	0.00015	A41A	0.18	0.08%
Technetium-99	0.0077	A36	920	0.0008%
Uranium-233/234	0.00025	A36	1.1	0.02%
Uranium-238	0.00017	A36	1.3	0.01%

[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 ambient air monitoring data were used to calculate the potential worst case dose from the air pathway to a hypothetical person living at the monitoring station. This approach is unlikely to underestimate the dose because it assumes an individual resides at the location of the monitoring station breathing the air at that location for 24 hours/day, 365 days/year. The highest net dose calculation for the ambient air stations (0.00046 mrem/year) was at station A36, which is on site near the X-611 Water Treatment Plant. This net dose was calculated by subtracting the dose at the background station from the dose at the monitoring stations closer to PORTS. This hypothetical dose is well below the 10 mrem/year limit applicable to PORTS in NESHAP (40 CFR Part 61, Subpart H).

Fluoride is also monitored at 15 ambient air monitoring stations in and around PORTS. In 2017, fluoride was not detected in 88 percent of the samples collected for the ambient air monitoring program. If fluoride is not detected in a sample, the ambient concentration of fluoride is calculated assuming that fluoride is present at the detection limit. The average ambient concentration of fluoride measured in samples collected at the background station was 0.016 microgram per cubic meter ($\mu g/m^3$). Average ambient concentrations of fluoride measured at the stations around PORTS ranged from 0.0076 $\mu g/m^3$ at station A15 (east-southeast of PORTS on Loop Road) to 0.021 $\mu g/m^3$ at station A12 (east of PORTS on McCorkle Road). There is no standard for fluoride in ambient air. The data indicate that ambient concentrations of fluoride at off-site and background locations are not appreciably different from concentrations at PORTS.

Discharges to surface water. Discharges of chemicals and other parameters that measure water quality are regulated by the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act. Water from PORTS is discharged to off-site water bodies through 11 locations called NPDES outfalls. The Ohio Environmental Protection Agency (Ohio EPA) selects the chemicals monitored at the outfalls based on the chemical characteristics of the water discharged from the outfall. Outfalls are also monitored for radionuclides. Sampling frequencies vary from weekly to quarterly.

Transuranic radionuclides were not detected in any of the samples collected from FBP NPDES external outfalls in 2017. Plutonium-239/240 was detected at 0.036 picocurie per liter (pCi/L) in one sample collected from Centrus NPDES Outfall 013. Uranium discharges from the FBP and Centrus external outfalls were estimated at 7.1 kilograms (kg). Total radioactivity (technetium-99 and isotopic uranium) released from the FBP outfalls was estimated at 0.030 curie (Ci).

Water from the NPDES outfalls is discharged to or eventually flows to the Scioto River. Data for radionuclide discharges is used to calculate a potential worst case dose to a hypothetical member of the public who is exposed to water from the Scioto River. Exposure pathways considered were ingestion of water, ingestion of fish, swimming, boating, and shoreline activities. This exposure scenario is unlikely to underestimate the dose 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 dose from radionuclides released to the Scioto River in 2017 (0.0012 mrem) is significantly less than the 100 mrem/year DOE limit in DOE Order 458.1 for all radiological releases from a facility.

Discharges of chemicals and other non-radiological parameters that affect water quality are regulated by Ohio EPA in NPDES permits issued to FBP, MCS, and Centrus. In 2017, the overall FBP NPDES compliance rate with the NPDES permit was 99%. Discharge limitations at the FBP NPDES monitoring locations were exceeded on 11 occasions.

Four exceedances of a preliminary effluent limit were due to concentrations of mercury in holding pond discharges. In May through August of 2017, the average monthly concentration preliminary effluent limit for mercury was exceeded at Outfall 001 (the X-230J7 East Holding Pond). The outfall was in compliance with the preliminary effluent limit in the other eight months of 2017. The average monthly

concentration preliminary effluent limit is 12 nanograms/liter (ng/L). Average monthly concentrations at Outfall 001 ranged from 16.75 to 23.8 ng/L. FBP has initiated an investigation to identify the source of the mercury detected at Outfall 001 so that corrective measures can be implemented. The drinking water standard for mercury is 2 µg/L (2000 ng/L). The preliminary effluent limit for mercury (12 ng/L) is lower than the drinking water standard (2000 ng/L) to minimize the accumulation of mercury in biota, such as fish and birds.

Three exceedances were due to concentrations of copper at Outfall 004 in September and October of 2017. The exceedances appeared to be due to insufficient amounts of an additive used to control copper corrosion in the recirculating cooling water system during periods of biocide treatment applications. Two exceedances were due to pH measurements that were less than minimum allowable level due to temporary operational issues at Outfalls 002 and 004 that were immediately corrected. Two additional discharge limitations (E. coli and carbonaceous biochemical oxygen demand) were exceeded at Outfall 003 (X-6619 Sewage Treatment Plant) during 2017. These exceedances were corrected within 24 hours.

Ohio EPA did not issue a Notice of Violation for any of these exceedances. The overall Centrus and MCS compliance rates were 100%.

External radiation. External radiation is measured continuously with thermoluminescent dosimeters (TLDs) at five locations near the DUF_6 cylinder storage yards and 19 on-site and off-site locations (12 of the ambient air monitoring stations and seven additional on-site locations). 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 as a whole body dose (in mrem), which is the dose that a person would receive if they were continuously present at the monitored location.

The external radiation measured for the PORTS environmental monitoring program includes both external background radiation and radiation emanating PORTS activities such as storage of DUF_6 cylinders. 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 estimated 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 2017, the average annual dose (8736 hours) recorded at the cylinder yards near Perimeter Road was 739 mrem/year. Based on these assumptions, exposure to an on-site member of the public from radiation from the cylinder yards is approximately 0.74 mrem/year.

A person living in the United States receives an average dose of approximately 311 mrem/year from natural sources of radiation (National Council on Radiation Protection [NCRP] 2009). The potential estimated dose from external radiation to a member of the public (0.74 mrem/year to a member of the public allowed to drive on Perimeter Road past the cylinder yards) is approximately 0.2% of the average yearly natural radiation exposure for a person in the United States and is significantly less than the 100 mrem/year limit to a member of the public in DOE Order 458.1 for all radiological releases from a facility.

Local surface water. Samples of surface water are collected semiannually from three on-site and eleven off-site locations upstream and downstream from PORTS at locations on the Scioto River, Little Beaver Creek, Big Beaver Creek, and Big Run Creek and background locations on local streams approximately 10 miles north, south, east, and west of PORTS. Samples are analyzed for radionuclides.

Maximum detections of technetium-99 and uranium isotopes in local surface water samples were located at off-site sampling locations RW-13 (Big Beaver Creek) and RW-7 (Little Beaver Creek) and are listed below:

Radionuclide	Maximum activity (pCi/L)	Location	Derived Concentration Standard (DCS) (DOE 2011a)	Percentage of DCS
Technetium-99	9.12	RW-13	44,000	0.02%
Uranium-233/234	4.72	RW-7	680	0.7%
Uranium-235/236	0.214	RW-7	720	0.03%
Uranium-238	1.02	RW-7	750	0.1%

These detected concentrations of radionuclides were 0.7% or less of the DOE derived concentration standards (DOE 2011a). This derived concentration standard is based upon direct use of the surface water as drinking water. This comparison is unlikely to underestimate the dose because surface water around PORTS is not used for drinking water.

Sediment. Samples of sediment are collected annually at 18 monitoring locations, which include the 14 locations sampled for the local surface water monitoring program (Scioto River, Little Beaver Creek, Big Beaver Creek, Big Run Creek, and background locations on local streams), three on-site NPDES outfalls on the east and west sides of PORTS, and an upstream monitoring location on Big Beaver Creek. Samples are analyzed for radionuclides, metals, and polychlorinated biphenyls (PCBs).

Neptunium-237 was detected at 0.00975 picocurie per gram (pCi/g) at Big Beaver Creek sampling location RM-13. Plutonium-239/240 was detected at 0.00961 pCi/g at the southern background monitoring location (RM-10S). Technetium-99 was detected in sediment samples collected from Big Beaver Creek at RM-13, Big Run Creek at RM-3, on-site near NPDES Outfall 001 (RM-11), and downstream locations on Little Beaver Creek (RM-7 and RM-8). The highest detection of technetium-99 (3.62 pCi/g) was at on-site location RM-11 (Little Beaver Creek at the X-230J7 East Holding Pond [NPDES Outfall 001]).

Uranium and uranium isotopes were also detected at each of the sediment sampling locations, including upstream and background sampling locations. Maximum detections of uranium and uranium isotopes in sediment samples were detected at on-site sampling locations RM-11 (Little Beaver Creek) and RM-3 (Big Run Creek) as follows.

Uranium: 4.57 micrograms per gram (µg/g) (RM-3 – duplicate sample)
Uranium-233/234: 6.88 pCi/g (RM-11)
Uranium-235/236: 0.291 pCi/g (RM-11)
Uranium-238: 1.52 pCi/g (RM-3 – duplicate sample).

A dose assessment was completed based on the detections of radionuclides in sediment at the off-site sediment sampling location with the detections of radionuclides that could cause the highest dose to a member of the public (RM-7 on Little Beaver Creek). Detections of technetium-99 (3.42 pCi/g), uranium-233/234 (2.55 pCi/g), uranium-235/236 (0.128 pCi/g), and uranium-238 (0.774 pCi/g) result in a calculated dose of 0.019 mrem/year, which is well below the DOE standard of 100 mrem/year in DOE Order 458.1.

PCBs were detected in sediment samples collected from Little Beaver Creek (RM-7, RM-8, and RM-11), Big Beaver Creek (RM-13), Big Run Creek (RM-2 and RM-3), and the Scioto River (RM-1A). The highest detection of PCBs (208 micrograms per kilogram [µg/kg]) was on site in Little Beaver Creek at

the discharge from the X-230J7 Holding Pond (RM-11). None of the detections of PCBs in sediment around PORTS were above the risk-based regional screening level developed by U.S. EPA and utilized by Ohio EPA of 240 µg/kg or parts per billion (ppb) (U.S. EPA 2017).

The results of metals sampling conducted in 2017 indicate that no appreciable differences are evident in the concentrations of metals present in sediment samples taken upstream from PORTS, at background sampling locations, and downstream from PORTS.

Soil. Soil samples are collected annually at 15 locations that are co-located with the ambient air monitoring stations (on-site, fence line, off-site and background locations) and analyzed for radionuclides.

Plutonium-239/240 was detected in soil at six of the 15 ambient air monitoring stations including the background monitoring station (A37). These detections were most likely present due to atmospheric fallout from nuclear weapons testing. The detections were 0.0152 pCi/g or less, which is much less than the soil screening level for plutonium-239/240 – 3.78 pCi/g. These screening levels were calculated using the exposure assumptions in the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017e).

Uranium, uranium-233/234, uranium-235/236, and/or uranium-238 were detected in soil at each of the sampling locations. Uranium and uranium isotopes are usually detected at similar levels at all the soil sampling locations, including the background location (A37), which suggests that the uranium detected in these samples is due to naturally-occurring uranium.

A dose assessment was completed based on the detections of radionuclides in soil at the off-site ambient air station with the concentrations of radionuclides that could cause the highest dose to a member of the public (station A12, east of PORTS on McCorkle Road). Detections of uranium-233/234 (0.513 pCi/g), uranium-235/236 (0.0285 pCi/g), and uranium-238 (0.435 pCi/g) result in a calculated dose of 0.018 mrem/year, which is well below the DOE limit of 100 mrem/year in DOE Order 458.1.

Biota (vegetation, deer, fish, crops, milk, and eggs). Vegetation samples are collected annually at 15 locations that are co-located with the ambient air monitoring stations (on-site, fence line, off-site and background locations). Deer samples are collected annually or as available from deer killed on site in motor vehicle collisions. Fish are collected annually from on-site and off-site streams (Little Beaver Creek, Big Beaver Creek and the Scioto River, as available). Crops, milk, and eggs are collected annually (as available) from the local community. All samples are analyzed for radionuclides. Fish are also analyzed for PCBs.

Radionuclides were not detected in samples of deer (muscle), fish, crops, milk, and eggs collected in 2017.

Uranium, uranium-233/234, and/or uranium-238 were detected in two of the vegetation samples collected in 2017. The dose calculation for vegetation is based on the following detections of radionuclides in vegetation (primarily grass) and soil at ambient air monitoring station A12 (east of PORTS on McCorkle Road):

<u>Vegetation</u>

- uranium-233/234: 0.0363 pCi/g uranium-238: 0.0265 pCi/g

<u>Soil</u>

- uranium-233/234: 0.513 pCi/g uranium-235/236: 0.0285 pCi/g
- uranium-238: 0.435 pCi/g.

The dose assessment for a member of the public based on consumption of beef cattle that would eat grass (and soil) contaminated with these radionuclides calculated a dose of 0.00078 mrem/year, which is well below the DOE Order 458.1 limit of 100 mrem/year.

PCBs were detected in the fish samples collected from Little Beaver Creek at 241 and 290 µg/kg. PCBs were also detected in upstream and downstream Big Beaver Creek fish samples at 22 to 30.6 µg/kg. PCBs were detected in catfish collected from upstream and downstream Scioto River sampling locations at 18.5 and 20.2 µg/kg, respectively. These detections were compared to the Ohio Fish Consumption Advisory Chemical Limits provided in the *State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program* (Ohio EPA 2010). These limits are set for the following consumption rates: unrestricted, 1/week, 1/month, 6/year, and do not eat. The concentrations of PCBs detected in the fish caught on site in Little Beaver Creek (RW-8) are above the 1/week maximum limit (220 µg/kg) and below the 1/month maximum limit (1000 µg/kg). The concentrations of PCBs detected in fish collected from Big Beaver Creek and the Scioto River (18.5 to 30.6 µg/kg) are less than the unrestricted limit (50 µg/kg). 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 (Ohio EPA 2018).

Groundwater. Groundwater contamination at PORTS is contained on site. More than 300 wells are sampled at varying frequencies to monitor corrective actions, movement of groundwater contaminants, and groundwater quality. Samples are analyzed for volatile organic compounds (VOCs), radionuclides, metals, and other parameters, specific to the contaminants present at the monitoring area. In general, concentrations of contaminants detected within the groundwater plumes at PORTS were stable or decreasing in 2017. No VOCs were detected in any of the seven off-site monitoring wells that monitor the X-749/X-120 groundwater plume near the southern boundary of PORTS. Residential water supplies near PORTS were monitored to verify that site contaminants have not migrated into off-site drinking water wells. Results of this program indicate that PORTS has not affected drinking water wells outside the site boundaries.

Dose. To demonstrate compliance with DOE Order 458.1, this Annual Site Environmental Report includes radiological dose calculations for the dose to the public from radionuclides released to the environment based on environmental monitoring data collected by DOE contractors and Centrus (discussed in the previous paragraphs). Figure 1 provides a comparison of the doses from various common radiation sources.

The maximum dose that a member of the public could receive from radiation released by PORTS in 2017 is 0.90 mrem. This maximum dose assumes that the same individual, or representative person, routinely drives on Perimeter Road past the cylinder yards, and lives in the immediate vicinity of PORTS.

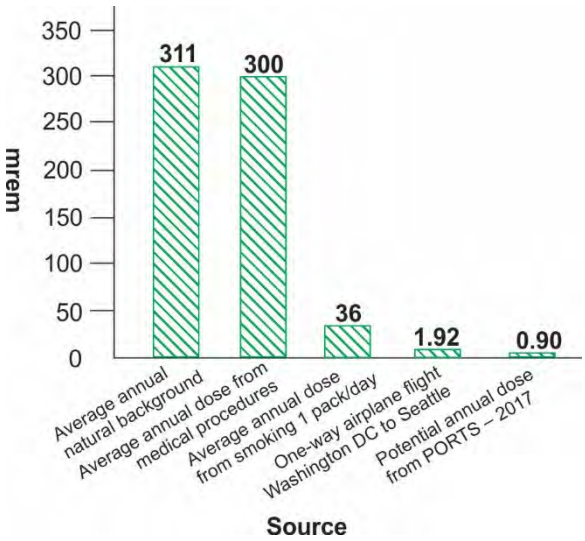

Figure 1. Comparison of dose from various common radiation sources.

The representative person is assumed to be exposed to the maximum dose calculated from each pathway. The dose is based on:

- 0.0012 mrem from radionuclides released to the Scioto River,
- 0.74 mrem from external radiation near the cylinder yards on the northwest portion of Perimeter Road (the dose to a person who works at the Ohio Valley Electric Corporation in 2017 was lower [0.22 mrem]),
- 0.038 mrem based on exposure to radionuclides detected at off-site monitoring locations in 2017 (sediment [0.019 mrem], soil [0.018 mrem], and biota [0.00078 mrem]), and
- 0.12 mrem from radionuclides released to the air (the dose calculated by the U.S. EPA model required to demonstrate compliance with the NESHAP 10 mrem/year standard [40 CFR Part 61 Subpart H]).

This dose (0.90 mrem) is significantly less than the 100 mrem/year limit set in DOE Order 458.1 for the dose to a member of the public from radionuclides from all potential pathways. The dose to a member of the public from airborne radionuclides released by PORTS (0.12 mrem) is also significantly less than the 10 mrem/year standard set by U.S. EPA in NESHAP (40 CFR Part 61 Subpart H). A person living in the United States receives an average dose of approximately 311 mrem/year from natural sources of radiation (NCRP 2009).

ENVIRONMENTAL COMPLIANCE

DOE and/or the responsible DOE contractor (FBP or MCS) have been issued permits for discharge of water to surface streams, air emission permits, and a permit for the storage of hazardous waste.

FBP and MCS are responsible for preparing a number of reports for compliance with 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 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.

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

FBP received a Notice of Violation from Ohio EPA in 2018 related to the operation of PORTS drinking water system in 2017. The Notice of Violation was due to a failure to collect required water samples for *E. coli* from the PORTS drinking water system in October and November of 2017. Notices of this violation were posted throughout the plant as required by Ohio EPA. FBP has implemented procedures to track required sampling so that samples are not missed. No further actions were required.

ENVIRONMENTAL PROGRAMS

D&D, Environmental Restoration, Waste Management, and Public Awareness Programs are conducted at PORTS to protect and inform the local population, improve the quality of the environment, and comply with federal and state regulations.

D&D Program

D&D of the PORTS gaseous diffusion process buildings and associated facilities is proceeding in accordance with *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 (which includes*

the July 16, 2012 Modification thereto) (D&D DFF&O) (Ohio EPA 2012). The D&D DFF&O is a legal agreement between Ohio EPA and DOE that governs the process for D&D of the buildings/structures that are no longer in use at PORTS.

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 2015c). The record of decision for waste disposition selected a combination of on-site and off-site disposal (DOE 2015d), which includes construction of an on-site waste disposal facility (OSWDF).

Implementation of the selected remedial actions began after completion of the records of decision. Activities underway in 2017 in the process buildings included disassembly and removal of equipment, removal of wastes including asbestos, PCBs, and hazardous waste, and deactivation of utilities and other systems. Initial site construction activities for the OSWDF included tree clearing, fencing, and utility installation, as well as construction of erosion and sediment controls, retention ponds for surface water runoff, and installation of office trailers.

Environmental Restoration Program

The Environmental Restoration Program was established by DOE in 1989 to identify, control, and remediate environmental contamination at PORTS. The initial assessment and investigation of PORTS under the Resource Conservation and Recovery Act (RCRA) corrective action process was completed in the 1990s. Corrective actions, also called remedial actions, are underway in each quadrant. The Environmental Restoration Program monitors and maintains five closed landfills in accordance with Ohio EPA regulations and operates four groundwater treatment facilities to treat contaminated groundwater from the on-site groundwater plumes that are contaminated with industrial solvents, including trichloroethene (TCE).

With the beginning of D&D, investigation of areas known as "deferred units" is beginning to occur. Deferred units are areas that were in or adjacent to the gaseous diffusion production and operational areas such that remedial activities would have interrupted operations, or were areas that could have become recontaminated from ongoing operations. 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). Chemical and/or radionuclide contaminants present in the deferred units were contained on site and were not a threat to the public. Ongoing environmental monitoring and on-site worker health and safety programs monitor 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 *Deferred Units RCRA Facility Investigation/Corrective Measures Study Report* (DOE 2017a) was submitted to Ohio EPA on September 27, 2017. Ohio EPA was reviewing the report at the end of 2017 and submitted draft comments to DOE in 2018.

Waste Management Program

The DOE Waste Management Program at PORTS directs the safe storage, treatment, and disposal of waste generated from D&D of facilities that are no longer in use, past plant operations, ongoing plant maintenance, and ongoing environmental restoration projects. In 2017, FBP shipped approximately 2218 tons of waste or other materials to off-site facilities for treatment, disposal, recycling, or reuse.

With the beginning of D&D at PORTS, 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 2017, SODI received approximately 596 tons of materials from PORTS, primarily recyclable metals, recyclable oil, and reusable equipment.

Public Awareness Program

DOE provides a public Environmental Information Center to allow access to all 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 Information Center is open 9 a.m. to noon Monday and Tuesday, noon to 4 p.m. Wednesday and Thursday, or by appointment (call 740-289-8898). The email address is portseic@ports.pppo.gov and web site is energy.gov/pppo/portsmouth-environmental-information-center. The Environmental Information Center Online Document Repository is eic.ports.pppo.gov.

Additional information is provided by the DOE Site Office (740-897-5010) and the FBP Office of Public Affairs (740-897-2964). This Annual Site Environmental Report and other information can also be obtained from the DOE web site for PORTS at energy.gov/pppo or the FBP web site at fbportsmouth.com. PORTS Environmental Geographic Analytical Spatial Information System (PEGASIS) is designed to provide a dynamic mapping and environmental monitoring data display. The web site is https://gisviewer.fbports.com/default.aspx.

Public update meetings and public workshops on specific topics 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 and those on the community relations mailing list, neighbors within 2 miles of the plant, and plant employees.

The PORTS Site Specific Advisory Board, comprised of citizens from the local area, provides public input and recommendations to DOE on 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 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.

An educational outreach program facilitated by a DOE grant administered by Ohio University includes a project in which local high school students produce a summary of the Annual Site Environmental Report for distribution to the public. The DOE Portsmouth/Paducah Project Office web site at energy.gov/pppo provides additional information about this project.

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 history associated with the gaseous diffusion process buildings and other areas that are part of D&D. The PORTS Virtual Museum (portsvirtualmuseum.org) preserves photos, video, oral histories, and other information associated with operation, remediation, and D&D of PORTS.

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1. INTRODUCTION

1.1 SUMMARY

The Portsmouth Gaseous Diffusion Plant (PORTS) is located on a 5.9-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 responsible for 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) assumed responsibility for the DUF_6 Conversion Facility on February 1, 2017. BWXT Conversion Services, LLC (BWCS) was responsible for operations associated with the DUF_6 Conversion Facility through January 2017.

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), MCS, and BWCS managed DOE programs at PORTS in 2017.

Figure 1.1 The Portsmouth Gaseous Diffusion Plant.

FBP was responsible for the following activities:

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

PMA was responsible for 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.

BWCS was responsible for operations associated with the DUF_6 Conversion Facility through January 2017. On February 1, 2017, MCS assumed responsibility for 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. Centrus continues to lease facilities at PORTS that were intended for the development of gaseous centrifuge uranium enrichment technology; however, this project has been shut down. The project included a small scale demonstration facility and a commercial scale uranium enrichment facility (the American Centrifuge Plant [ACP]). The demonstration cascade operated from 2006-2016. The commercial scale ACP was under development. Both of these facilities (the demonstration cascade and the ACP) were housed in existing buildings at PORTS. D&D of the demonstration cascade began in 2016.

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 ***2017 Groundwater Monitoring Report*** (DOE 2018), 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 5.9-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 28,270 residents (U.S. Census Bureau 2018). 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 4,309 residents (U.S. Census Bureau 2018). 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 2,174 (U.S. Census Bureau 2018). A number of residences are located adjacent to the plant boundary.

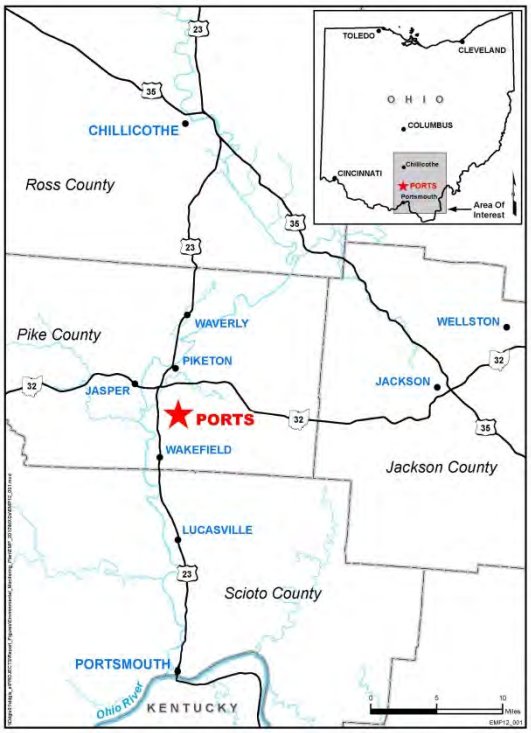

Figure 1.2. Location of PORTS.

Additional cities within 50 miles of the plant are Portsmouth (population 20,443), 22 miles south; Chillicothe (population 21,499), 27 miles north; and Jackson (population 6,252), 18 miles east (U.S. Census Bureau 2018). The total population within 50 miles of the plant is approximately 662,000 persons.

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.

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. The goal of the Environmental Restoration Program is to verify that releases from past operations at PORTS are thoroughly investigated and that remedial actions are taken to protect human health and the environment.

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 operations. Wastes must be identified and stored in accordance with all environmental regulations. The responsible DOE contractor also arranges the transportation and off-site 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.

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 2017, DOE and/or the responsible DOE contractor (FBP or 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.

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 received a Notice of Violation from Ohio EPA in 2018 related to the operation of PORTS drinking water system in 2017. The Notice of Violation was due to a failure to collect required water samples for *E. coli* from the PORTS drinking water system in October and November of 2017. Notices of this violation were posted throughout the plant as required by Ohio EPA. FBP has implemented procedures to track required sampling so that samples are not missed. No further actions were required.

An unplanned release occurred on January 3, 2017 when an oil sheen on water in the X-230J5 Northwest Holding Pond and West Drainage Ditch was discovered during a heavy rainstorm. The release was reported to the National Response Center, Ohio EPA, and Pike County Local Emergency Planning Committee in accordance with the Clean Water Act. After investigation, the release appeared to be transformer oil from the X-530 Switchyard that was present in the storm drainage system. Heavy precipitation allowed a small quantity of oil and water to escape the containment within the storm drain system in the switchyard area and be released to the X-230J5 Northwest Holding Pond and West Drainage Ditch. A maximum of 0.25 gallon of oil was estimated to have been released. The oil sheen was contained by the use of absorbents, skimmers, and a wet vacuum. The area of the sheen was located on site and did not impact the public. Improvements were made to the oil capture system associated with the X-530 Switchyard.

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 or 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 B lists the active environmental permits and registrations held by DOE and/or DOE contractors (FBP and MCS) at the end of 2017.

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, provides additional information about the D&D Program.

Environmental remediation, or the cleanup of soil, groundwater and other environmental media contaminated by PORTS operations, 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, 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 2017, 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 2017, 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 2017:

Table 2.1. Chemicals reported in the Hazardous Chemical Inventory Report for 2017

1,2-propanediol	full range straight run middle distillate	petroleum distillates
aluminum oxide	gasoline	potassium hydroxide
aluminum oxide hydrate	hydrogen fluoride	sodium chloride
argon	kerosene	sodium fluoride
asbestos	lime calcium oxide	sodium hydroxide
calcium chloride	lubricating oils	sodium polyacrylate
carbon dioxide	methanol	sulfuric acid
chlorine	mineral oils	triuranium octaoxide
citric acid	nitric acid	uranium oxide
dichlorotetrafluoroethane (CFC-114)	nitrogen	uranium hexafluoride
diesel fuel #2 (ultralow sulfur)	PCBs	uranium metal
ethylene glycol	perfluoro-1,3-dimethylcyclohexane	uranium tetrafluoride
fluorotrichloromethane (CFC-11)		

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 2017, DOE contractors reported the permitted release and/or off-site treatment of one chemical:

- nitrate compounds: approximately 36,000 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 2017 to Ohio EPA in February 2018. 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 2017.

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 2017d). 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 2018). Chapter 6 discusses these monitoring results for 2017.

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. 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 2017d). Chapter 6 discusses the groundwater monitoring results for these units in 2017. 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 2017 was submitted to Ohio EPA in December 2017.

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. Four PCB transformers were in service at PORTS at the end of 2017: one in the X-530 Switchyard and three pole-mounted transformers within the PORTS facility.

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 2017. The *2017 PCB Document Log for the Portsmouth Gaseous Diffusion Plant* was

prepared in June 2018. Approximately 760.6 tons of PCB waste (gross weight) was generated in 2017. Approximately 75.2 tons of PCB waste (gross weight), which includes 64.4 tons of bulk product, was shipped for disposal in 2017. Waste contaminated with PCBs was generated during 2017 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, was modified in 2017. At PORTS, the Compliance Agreement:

- addresses the use, management, storage, and disposal of PCBs in ventilation duct gaskets and its associated collection and containment system;

- provides a negotiated schedule for clean-up, removal, and management of PCB wastes and contaminated items; and

- requires 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 2017.

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 2017.

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:

- to 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. Chapter 4, Figure 4.1 is a map of 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.

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 2017, 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 2017.

In 2017, 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 2017.

Appendix B 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. The service record and retrofit or retirement plan forms apply to units with a capacity of more than 50 pounds. 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.

An ozone-depleting substance, specifically dichlorotetrafluoroethane (CFC-114), was used as a coolant in the gaseous diffusion cascade system formerly used to produce enriched uranium**.** The CFC-114 was removed from the cascade system in 2012 and was stored in tanks within the X-333 Process Building. Most of this CFC-114 was shipped off site in 2017, but some remained in the X-333 Process Building at the end of 2017.

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 4.3.3, provides the radiological dose calculations from these emissions.

FBP sources. In 2017, 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, the X-326 L-Cage Glove Box, 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 2017 were 0.067 curie (Ci) (6.70E-02 Ci).

MCS sources. In 2017, MCS was responsible for emissions from the DUF_6 Conversion Facility. 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 2017 were 0.0000442 Ci (4.42E-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 2017 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 4.3.5.1, and Chapter 5, Section 5.4.1.1, provide additional information on the FBP NPDES outfalls. Chapter 4, Figure 4.2 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 2017. Chapter 4, Section 4.3.5, 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). Eleven permit limitations associated with the FBP NPDES permit were exceeded during 2017 (see Chapter 5, Section 5.4.1.1). The overall FBP NPDES compliance rate for 2017 was 99%. There were no exceedances of MCS permit limitations in 2017; therefore, the overall MCS NPDES compliance rate for 2017 was 100%.

Most of the FBP NPDES outfalls are also monitored for radionuclides (see Chapter 4, Section 4.3.5). The MCS outfalls are not monitored for radionuclides.

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 2017, 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, including nitrate, lead, disinfection byproducts, total coliform, and chlorine. Sampling results are submitted to Ohio EPA in a monthly report. Section 2.4.2 provides information about a Notice of Violation received by FBP related to operation of the PORTS drinking water system.

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. Seven underground storage tanks in the former gaseous diffusion plant buildings and associated facilities are owned by DOE. At the end of 2017, FBP was responsible for six tanks and Centrus was responsible for one tank. These tanks include six diesel

fuel tanks ranging in size from 550 to 20,000 gallons and a 20,000 gallon gasoline tank. The registrations for these tanks are renewed annually.

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. In 2017, DOE completed an environmental assessment (EA) for potential economic development at PORTS via granting a lease, easement, or title transfer of several parcels of property owned by DOE. DOE prepared the EA to analyze the potential environmental consequences associated with the potential property transfers. The draft EA was available for public comment from January 4, 2017 through April 19, 2017. All comments were considered and responses included in the final EA. Based on the results of the final EA, the potential transfer of property would have no significant impact on the environment. Documents associated with this EA are available on the DOE Portsmouth/Paducah Project Office website (energy.gov/pppo).

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 Portsmouth/Paducah Project Office 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 planned 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. Measures will be taken during construction and operation of the OSWDF 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 July 2017. A summary-level report intended for a general audience is being prepared.

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 2017f); 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 2017, DOE PORTS (FBP, PMA, and MCS) reported that at least 80% of the EMS goal areas for fiscal year 2017 were 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 34.361 acres at PORTS.

A wetland and stream assessment was completed in 2013 for the northeast area of PORTS where the OSWDF will be 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 13693, *Planning for Federal Sustainability in the Next Decade*

Executive Order 13693 establishes a framework to maintain federal leadership in sustainability and greenhouse gas emission reductions. 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 2017 and the results of these inspections.

2.4.1 Environmental Program Inspections

During 2017, 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 2017

Date	DOE contractor	Agency	Type	Notices of Violation
April 25-26	FBP	U.S. EPA	RCRA compliance	None
June 7	FBP	Ohio EPA	Drinking water system (Safe Drinking Water Act)	None
July 12	FBP	Ohio EPA/Pike County Health District	Closed solid waste landfills (X-735, X-749, X-749A)	None
October 26	FBP	Ohio EPA	NPDES compliance	None
November 2	FBP	Ohio EPA	Clean Air Act – Title V permit	None

2.4.2 Notices of Violation

FBP received a Notice of Violation from Ohio EPA in 2018 related to the operation of PORTS drinking water system in 2017. The Notice of Violation was due to a failure to collect required water samples for *E. coli* from the PORTS drinking water system in October and November of 2017. Notices of this violation were posted throughout the plant as required by Ohio EPA. FBP has implemented procedures to track required sampling so that samples are not missed. No further actions were required.

2.5 UNPLANNED RELEASES

An unplanned release occurred on January 3, 2017 when an oil sheen on water in the X-230J5 Northwest Holding Pond and West Drainage Ditch was discovered during a heavy rainstorm. The release was reported to the National Response Center, Ohio EPA, and Pike County Local Emergency Planning Committee in accordance with the Clean Water Act. After investigation, the release appeared to be transformer oil from the X-530 Switchyard that was present in the storm drainage system. Heavy precipitation allowed a small quantity of oil and water to escape the containment within the storm drain system in the switchyard area and be released to the X-230J5 Northwest Holding Pond and West Drainage Ditch. A maximum of 0.25 gallon of oil was estimated to have been released. The oil sheen was contained by the use of absorbents, skimmers, and a wet vacuum. The area of the sheen was located

on site and did not impact the public. Improvements were made to the oil capture system associated with the X-530 Switchyard.

2.6 SUMMARY OF PERMITS

Appendix B lists the permits held by DOE and/or DOE contractors in 2017.

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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 2015c). The record of decision for waste disposition selected a combination of on-site and off-site disposal (DOE 2015d), which includes construction of an 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, which are areas of potential soil and/or groundwater contamination that were in or adjacent to the gaseous diffusion production and operational areas such that remedial activities prior to D&D would have interrupted operations, or were areas that could have become recontaminated from ongoing operations. Soil and groundwater sampling in the work plan started in 2015 and was completed in 2016. The *Deferred Units RCRA Facility Investigation/Corrective Measures Study Report* (DOE 2017a) was submitted to Ohio EPA on September 27, 2017. Ohio EPA was reviewing the report at the end of 2017 and submitted draft comments to DOE in 2018.

In 2017, FBP shipped approximately 2218 tons of waste or other materials to off-site facilities for treatment, disposal, recycling, or reuse. Activities undertaken by the Environmental Sustainability and Public Awareness programs are also discussed in this chapter.

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.

Community involvement is an important part of the CERCLA process and the D&D DFF&O. Opportunities for public comment are built into the D&D process as described in Sections 3.2.1 and 3.2.2. The PORTS Community Relations Plan (DOE 2010, DOE 2012) identifies opportunities to provide information to the public and obtain public input. Additionally, the PORTS Site Specific Advisory Board 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 2015c). 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;
- Packaging of generated waste for final disposal; and
- Transportation and disposal of the waste in accordance with the waste disposition record of decision.

The Process Buildings Deactivation Remedial Design/Remedial Action Work Plan (DOE 2016c) was developed by DOE and concurred with by Ohio EPA in 2016. The Work Plan provides the information to demonstrate that deactivation activities to prepare the three main process buildings and associated support structures 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 2017 included disassembly and removal of equipment, removal of wastes including asbestos, PCBs, and RCRA hazardous waste, and deactivation of utilities and other systems.

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 2015d). 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 planned OSWDF in the northeast portion of PORTS. Ohio EPA concurred with Phase I and Phase II of the remedial design/remedial action work plan for the OSWDF (DOE 2015e) in 2015, which allowed initial site construction activities such as tree clearing, fencing, utility installation, and installation of erosion and sediment controls. These activities began after approval of the work plan. An addendum to the Phase II work plan was completed and concurred with by Ohio EPA in 2016, which allowed additional construction to support the OSWDF (DOE 2016a). These activities included construction of retention ponds for surface water runoff and installation of office trailers and utilities. The activities authorized by the addendum continued in 2017.

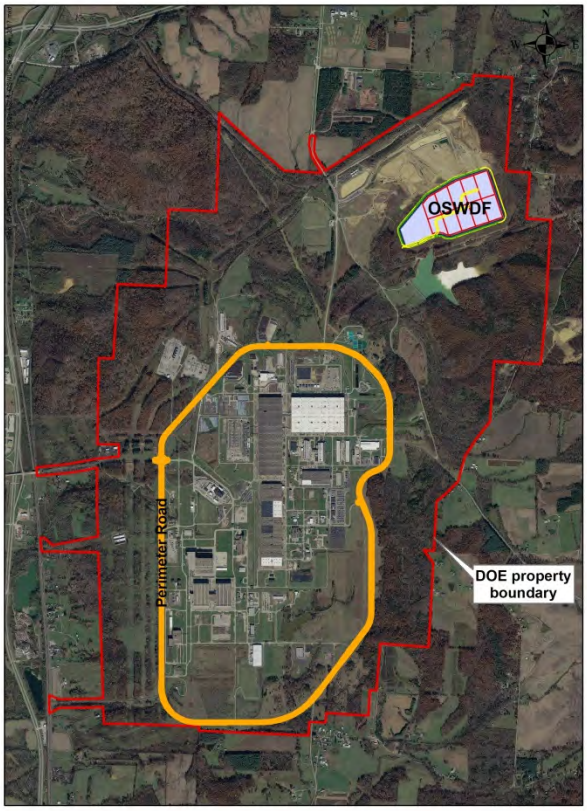

Figure 3.1. Location of the OSWDF at PORTS.

The OSWDF Pre-Final (90%) Design Package was submitted to Ohio EPA on March 9, 2017. After several meetings to discuss the submittal, Ohio EPA provided comments on the Design Package to DOE on July 7, 2017. DOE worked on addressing Ohio EPA's comments for the remainder of 2017 and submitted responses in 2018.

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 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.

With the beginning of D&D, investigation of areas known as "deferred units" has begun. Deferred units are areas that were in or adjacent to the gaseous diffusion production and operational areas such that remedial activities prior to D&D would have interrupted operations, or were areas that could have become recontaminated from ongoing operations. 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 monitor 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 *Deferred Units RCRA Facility Investigation/Corrective Measures Study Report* (DOE 2017a) was submitted to Ohio EPA on September 27, 2017. Ohio EPA was reviewing the report at the end of 2017 and submitted draft comments to DOE in 2018.

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 1997b). 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 2017 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 trichloroethene (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 2011b). 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.

The *Second Five-Year Review for the X-749/X-120 Groundwater Plume at the Portsmouth Gaseous Diffusion Plant* (DOE 2016d) was submitted to Ohio EPA in June 2016. The five-year review presented an evaluation of the effectiveness of the remedial actions implemented for the X-749/X-120 groundwater plume. Ohio EPA approved the report in July 2016 and agreed that the remedial actions are working effectively to meet the remedial action objectives for the X-749/X-120 groundwater plume. 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 recently north of the X-749 Landfill. This area has been investigated as part of the *Deferred Units RCRA Facility Investigation/ Corrective Measures Study Work Plan for Solid Waste Management Units* (DOE 2015a).

Chapter 6, Section 6.4.1.3 and Figure 6.2, provide additional information about the 2017 groundwater monitoring results for the X-749/X-120 groundwater plume.

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

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 1997b). 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.

Five-year reviews for the PK Landfill (DOE 2008d, DOE 2013d) have 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. 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 2018.

Chapter 6, Section 6.4.2.1 and Figure 6.2, provide 2017 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.

Five-year reviews 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 was completed in 2008 (DOE 2008a) and 2013 (DOE 2013a). The reports 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. 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 2018.

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 2017.

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 2016 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 2014). 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 2017.

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 2017.

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 *2017 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides the data for this monitoring (DOE 2018).

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 2016b) was approved by Ohio EPA in June 2016. A summary of the results of the pilot study is included in the *Deferred Units RCRA Facility Investigation/Corrective Measures Study Report* (DOE 2017a).

Chapter 6 provides 2017 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 2017 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. Five-year reviews completed in 2002, 2008, and 2013 (DOE 2002b, DOE 2008c, and DOE 2013c) 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. The next review of the remedial actions implemented at the X-611A area will be submitted to Ohio EPA in 2018.

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.

Five-year reviews completed in 2008 and 2013 found that the landfill caps have achieved remedial action objectives by isolating contaminants in soil and sediment from potential receptors (DOE 2008b and DOE 2013b). 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 2018.

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 *2017 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides the data for this monitoring (DOE 2018).

3.4 WASTE MANAGEMENT PROGRAM

The DOE Waste Management Program directs the safe storage, treatment, and disposal of waste generated by past and present operations and from current D&D and Environmental Restoration projects at PORTS. Waste managed under the program is divided into the following seven categories, which are defined below:

- *LLW* – radioactive waste not classified as high level or transuranic waste. Some LLW is also classified as bulk survey for release (BSFR) waste. BSFR waste consists of solid materials such as building rubble, soil, paper, or plastics that have extremely low levels of radioactivity. BSFR waste is evaluated by an intermediate facility to ensure it meets criteria for radioactivity and other parameters, and then it is disposed at one of four authorized landfills in Tennessee.

- *Hazardous (RCRA) waste* – waste listed under RCRA or waste that exhibits one or more of the four RCRA hazardous characteristics: ignitability, corrosivity, reactivity, and toxicity. Universal waste, which includes common items such as batteries and light bulbs, is a subset of RCRA waste that is subject to reduced requirements for storage, transportation, and disposal or recycling.

- *PCB wastes* – waste containing PCBs, a class of synthetic organic chemicals. Disposal of PCB-contaminated materials is regulated under TSCA.

- *RCRA/low-level radioactive mixed waste* – waste containing both hazardous and radioactive components. The waste is subject to RCRA, which governs the hazardous components, and to the Atomic Energy Act that governs the radioactive components.

- *PCB/low-level radioactive mixed waste* – waste containing both PCB and radioactive components. The waste is subject to TSCA regulations that govern PCB components, and to the Atomic Energy Act that governs radioactive components.

- *PCB/RCRA/low-level radioactive mixed waste* – waste containing PCB and radioactive components that is also a RCRA hazardous waste. The waste is subject to RCRA regulations, TSCA regulations that govern PCBs, and to the Atomic Energy Act that governs radioactive components.

- *Solid waste* – Waste that includes construction and demolition debris, industrial waste, and sanitary waste, as defined by Ohio regulations. These wastes can include waste from construction or demolition activity and office waste. Waste contaminated with asbestos may also be included in this category if it is not included in any of the categories listed above (PCB, RCRA, and/or LLW).

Waste management requirements are varied and are sometimes complex because of the variety of waste streams generated by DOE activities at PORTS. DOE Orders, Ohio EPA regulations, and U.S. EPA regulations must be satisfied to demonstrate compliance with waste management activities. Additional policies have been implemented for management of radioactive, hazardous, and mixed wastes. These policies include the following:

- minimizing waste generation;

- characterizing and certifying wastes before they are stored, processed, treated, or disposed;
- pursuing volume reduction (such as blending and bulking) as well as on-site storage in preparation for safe and compliant final treatment and/or disposal; and
- recycling.

With the beginning of D&D at PORTS, 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 2017, SODI received approximately 596 tons of materials from PORTS, primarily recyclable metals, recyclable oil, and reusable equipment.

In 2017, FBP shipped approximately 2218 tons of materials to off-site facilities for treatment, disposal, recycling, or reuse (see Table 3.2).

The following materials from FBP were sent off-site for recycling in 2017:

- aluminum cans: 2000 lbs
- batteries: 78,623 lbs
- electronic materials (computer equipment, etc.): 12,506 lbs
- recyclable fuel (diesel, gasoline, kerosene): 32,319 lbs
- light bulbs: 5402 lbs
- paper/cardboard: 108,000 lbs
- plastic bottles: 12,500 lbs
- tires: 40,400 lbs
- toner cartridges: 3000 lbs
- recyclable materials to SODI (excess equipment, recyclable metals, recyclable oil, etc.): 596 tons.

3.5 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 2018 Site Sustainability Plan* describes the Environmental Sustainability Program and integrates the tenets of an EMS (see Chapter 2, Section 2.3.6) (DOE 2017c). 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 of DOE projects and activities at PORTS.

Table 3.2. Waste Management Program off-site treatment, disposal, and recycling accomplishments for 2017

Waste type	Waste stream	Quantity (lbs[a])	Treatment or disposal, facility
RCRA	Aerosol cans and other liquids classified as hazardous waste	1396	Environmental Quality Co.
RCRA	Battery acid and air filters contaminated with metals	1559	Michigan Disposal Waste Treatment Plant/Wayne Disposal Inc.
LLW	Used oils	81,392	Diversified Scientific Solutions
LLW	Sludges, contaminated liquids, scrap metal, and other debris	69,315	EnergySolutions Clive, UT
LLW	Contaminated paper	2295	EnergySolutions Bear Creek, TN
LLW	Ash and other solids	676	Materials & Energy Corp.
LLW	D&D waste, uranium materials, scrap metal, and other solids	1,747,657	Nevada National Security Site
LLW/BSFR	Assorted solids (wood, metal, plastic, etc.)	192,370	Omega Waste Logistics
RCRA/LLW	Lab wastes, gas cylinders, and other liquids	3556	Diversified Scientific Solutions
RCRA/LLW	D&D waste, soil, lab wastes, and other materials	70,437	EnergySolutions Clive, UT
RCRA/LLW	Metal turnings, carbon filters, and other materials	124,212	Materials & Energy Corp.
RCRA/LLW	Solids contaminated with RCRA metals	5613	Perma-Fix Florida
LLW/PCB	Oil/water mixture contaminated with PCBs	11,675	Diversified Scientific Solutions
LLW/PCB	PCB ballasts, wire, and other D&D waste	51,803	Nevada National Security Site
RCRA/LLW/ PCB	Used PCB oil	353	Diversified Scientific Solutions
PCB	PCB transformer	427	Environmental Protection Services
Solid waste	D&D waste, concrete, asphalt, metal, office waste, and other solid materials	562,600	Rumpke/Pike Sanitation Landfill
Solid waste	Non-hazardous liquids (antifreeze, refrigerant)	21,011	Environmental Quality Co.

Table 3.2. Waste Management Program off-site treatment, disposal, and recycling accomplishments for 2017 (continued)

Waste type	Waste stream	Quantity (lbs[a])	Treatment or disposal, facility
-	Recyclable aluminum cans, batteries, electronic materials, plastic, batteries, light bulbs, etc. (see Section 3.4)	294,750	Various (not including SODI)
-	Recyclable materials transferred to SODI (see Section 3.4)	1,192,021	-

[a]lbs in net weight (waste only).

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 13693, *Planning for Federal Sustainability in the Next Decade*. Executive Order 13693 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 2018 Site Sustainability Plan for the Portsmouth Gaseous Diffusion Plant* provides goals and progress through fiscal year 2017 for reductions in greenhouse gas emissions, water consumption, recycling/waste diversion, electronic stewardship, and other areas (DOE 2017c). The following accomplishments were listed for fiscal year 2017:

- a decrease of 60% in greenhouse gas emissions (primarily associated for electricity consumption) versus the fiscal year 2008 baseline emissions.
- a decrease in water consumption of 13% in fiscal year 2017 versus fiscal year 2016.

- Replaced chlorine gas used as a disinfectant in the X-611 Water Treatment Plant and X-6619 Sewage Treatment Plant with less hazardous alternatives (sodium hypochlorite and ultraviolet light disinfectant, respectively).

PORTS received a 2-Star Electronic Product Environmental Assessment Tool (EPEAT) Purchasing Award from the Green Electronics Council for its policies and procedures for the purchase of EPEAT-certified products in 2017.

3.6 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.

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.

DOE also maintains a public Environmental Information Center to provide 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. Hours for the Information Center are 9 a.m. to noon Monday and Tuesday, noon to 4 p.m. Wednesday and Thursday, or by appointment (call 740-289-8898). The email address is portseic@ports.pppo.gov and web site is energy.gov/pppo/portsmouth-environmental-information-center. The Environmental Information Center Online Document Repository is eic.ports.pppo.gov.

Other information, including this Annual Site Environmental Report, can also be obtained from the DOE Portsmouth/Paducah Project Office web site at energy.gov/pppo or the FBP web site at fbportsmouth.com. PORTS Environmental Geographic Analytical Spatial Information System (PEGASIS) is designed to provide a dynamic mapping and environmental monitoring data display. The web site is https://gisviewer.fbports.com/default.aspx.

Public update meetings and public workshops on specific topics 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 and those on the community relations mailing list, neighbors within 2 miles of the plant, and plant employees.

An educational outreach program facilitated by a DOE grant administered by Ohio University includes a project in which local high school students produce a summary of the Annual Site Environmental Report for distribution to the public. The DOE Portsmouth/Paducah Project Office web site at energy.gov/pppo provides additional information about this project.

Points of contact have been established for the public to obtain information or direct questions regarding the Environmental Management Program. The DOE Site Office may be contacted at 740-897-5010. The FBP Office of Public Affairs (740-897-2964) also provides information on the program.

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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 operations. In 2017, environmental monitoring information was collected by DOE contractors (FBP and MCS) and Centrus. This chapter includes information 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 PORTS operations. This impact, called a dose, can be caused by radionuclides released to air and/or water, or radiation emanating 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 a dose limit as low as reasonably achievable[1], but no more than 100 mrem/year for the dose from radionuclides from all potential pathways in DOE Order 458.1. A person living in the United States receives an average 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 surface water (the Scioto River), from external radiation, and from radionuclides detected by environmental monitoring programs. The maximum dose a member of the public could receive from radiation released by PORTS in 2017 or detected by environmental monitoring programs in 2017 is 0.90 mrem/year. This summary of the dose calculations assumes that the same individual, or representative person, routinely drives on Perimeter Road past the cylinder yards and lives in the immediate vicinity of PORTS. The 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 doses to the public from PORTS in 2017

Source of dose	Dose (mrem/year)
Airborne radionuclides (off-site individual)	0.12[a]
Radionuclides released to the Scioto River	0.0012
External radiation near cylinder yards (northwest portion of Perimeter Rd)	0.74
Radionuclides detected by environmental monitoring programs	0.038
Total	0.90[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.

4.2 ENVIRONMENTAL RADIOLOGICAL PROGRAM INTRODUCTION

Environmental monitoring programs at PORTS are designed to detect the effects (if any) of PORTS operations 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 operations and to set priorities for environmental improvements.

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 2017b). 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 2017, 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; DOE cannot ensure the quality of Centrus data.

Data from the following environmental monitoring programs 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.

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. Because there are many natural sources of radiation, a person living in the United States receives an average dose of approximately 311 mrem/year from sources of natural radiation (NCRP 2009). Appendix A provides additional information on radiation and dose.

Releases of radionuclides from PORTS activities can result in a dose to a member of the public in addition to the dose received from natural sources of radiation. 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 dose limit as low as reasonably achievable, but no more than 100 mrem/year 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, the 100 mrem/year limit is converted into a derived concentration standard (DOE 2011a). 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.

Small quantities of radionuclides were released to the environment from PORTS operations during 2017. This chapter describes the methods used to estimate the potential doses that could result from radionuclides released from PORTS operations. In addition, this chapter assesses the potential doses that could result from radionuclides historically released by PORTS and detected in 2017 by environmental monitoring programs.

4.3 RADIOLOGICAL EMISSIONS AND DOSES

Exposure to radioactive materials can occur from releases to the atmosphere, surface water, or groundwater and from exposure to external radiation emanating from buildings or other objects. For 2017, doses are estimated for exposure to atmospheric releases, external radiation, and releases to surface water (the Scioto River).

Doses are also estimated for exposure to radionuclides from PORTS operations that were detected in 2017 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, and dairy products). 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 2017, doses are estimated for exposure to radionuclides detected by the monitoring programs for sediment, soil, and vegetation. Radionuclides were not detected in 2017 in samples of residential drinking water, deer (muscle), fish, crops, and dairy products.

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 Dose Terminology

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.

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 (americium-241, neptunium-237, plutonium-238, plutonium-239/240, and uranium-236) are occasionally detected at PORTS and may be included in the calculations to ensure the potential dose from PORTS operations is not underestimated. 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.

A number of specialized measurement units have been defined for characterizing exposures to ionizing radiation. Because the damage associated with exposure to radiation results primarily from the exposure of tissue to ionizing radiation, the units are defined in terms of the amount of ionizing radiation absorbed by human (or animal) tissue and in terms of the biological consequences of the absorbed energy. These units include the following:

- *Absorbed dose* – the quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. The unit of absorbed dose is the rad, equal to 0.01 joule per kilogram in any medium (1 rad = 0.01 gray).

- *Equivalent dose* – the product of the absorbed dose (rad) in tissue and a radiation weighting factor. Equivalent dose is expressed in units of rem or sievert (1 rem = 0.01 sievert).

- *Effective dose* – the sum of the doses received by all organs or tissues of the body after each one has been multiplied by the appropriate tissue weighting factor. It includes the dose from radiation sources internal and/or external to the body. Effective dose is expressed in units of rem (or sievert). In this report, the term "effective dose" is often shortened to "dose."

- *Collective dose* – the sum of the effective doses to all persons in a specified population received in a specified period of time. Collective dose is expressed in units of person-rem or person-sievert. The collective dose is also frequently called the "population dose."

4.3.2 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 a dose to members of the public, which is reported annually to U.S. EPA and Ohio EPA. Section 4.3.3 discusses the results of this dose calculation.

In 2017, 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 activities 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, X-326 L-cage Glove Box (inactive), 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 2017 were calculated to be 0.0670 Ci (6.70E-02 Ci).

MCS was responsible for air emission sources associated with the DUF_6 Conversion Facility. 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 2017 were calculated to be 0.0000442 Ci (4.42E-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 2017.

4.3.3 Dose Calculation Based on Airborne Emissions

A 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 2017 was characterized by calculating the effective dose to the maximally exposed person (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 4.0, 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 4.3.2. 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. 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 dose to an off-site individual from radiological releases from PORTS air emission sources in 2017 was 0.12 mrem/year. This dose is well below the 10-mrem/year limit applicable to PORTS and the approximate 311-mrem/year dose that the average individual in the United States receives from natural sources of radiation (NCRP 2009).

The collective dose (or population dose) is the sum of the individual doses to the entire population within 50 miles of PORTS. In 2017, the population dose from PORTS emissions was 0.47 person-rem/year. The population dose based on PORTS emissions was insignificant; for example, 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).

4.3.4 Dose Calculation Based on Ambient Air Monitoring

DOE collects samples from 15 ambient air monitoring stations (see Figure 4.1) 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). The ambient air monitoring stations measure radionuclides released from DOE point sources (the sources described in Section 4.3.2), 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 operations).

The CAP88 model generates a dose conversion factor that was used to calculate a dose for a given level of each radionuclide in air. The following assumptions were made to calculate the dose at each station: 1) the highest level of each radionuclide detected in 2017 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.

The dose associated with each radionuclide at each ambient air monitoring station was added to obtain the gross dose for each station. The net dose for each station was obtained by subtracting the dose measured at the background station (A37). The net dose for each station ranged from 0 at stations with a lower dose than the background station to 0.00046 mrem/year at station A36, which is on site near the X-611 Water Treatment Plant (see Figure 4.1).

The highest net dose measured at the ambient air monitoring stations (0.00046 mrem/year at station A36) is 0.4% of the dose calculated from the DOE point source emissions (0.12 mrem/year). This dose is significantly less than the 10 mrem/year NESHAP limit for airborne radiological releases (40 CFR Part 61, Subpart H) and 100 mrem/year DOE limit in DOE Order 458.1 for all radiological releases from a facility.

4.3.5 Discharges of Radionuclides from NPDES Outfalls

FBP, MCS, and Centrus were responsible for NPDES outfalls at PORTS during 2017. 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 2017 are included in this section.

4.3.5.1 FBP outfalls

In 2017, 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 4.2). 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, 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.

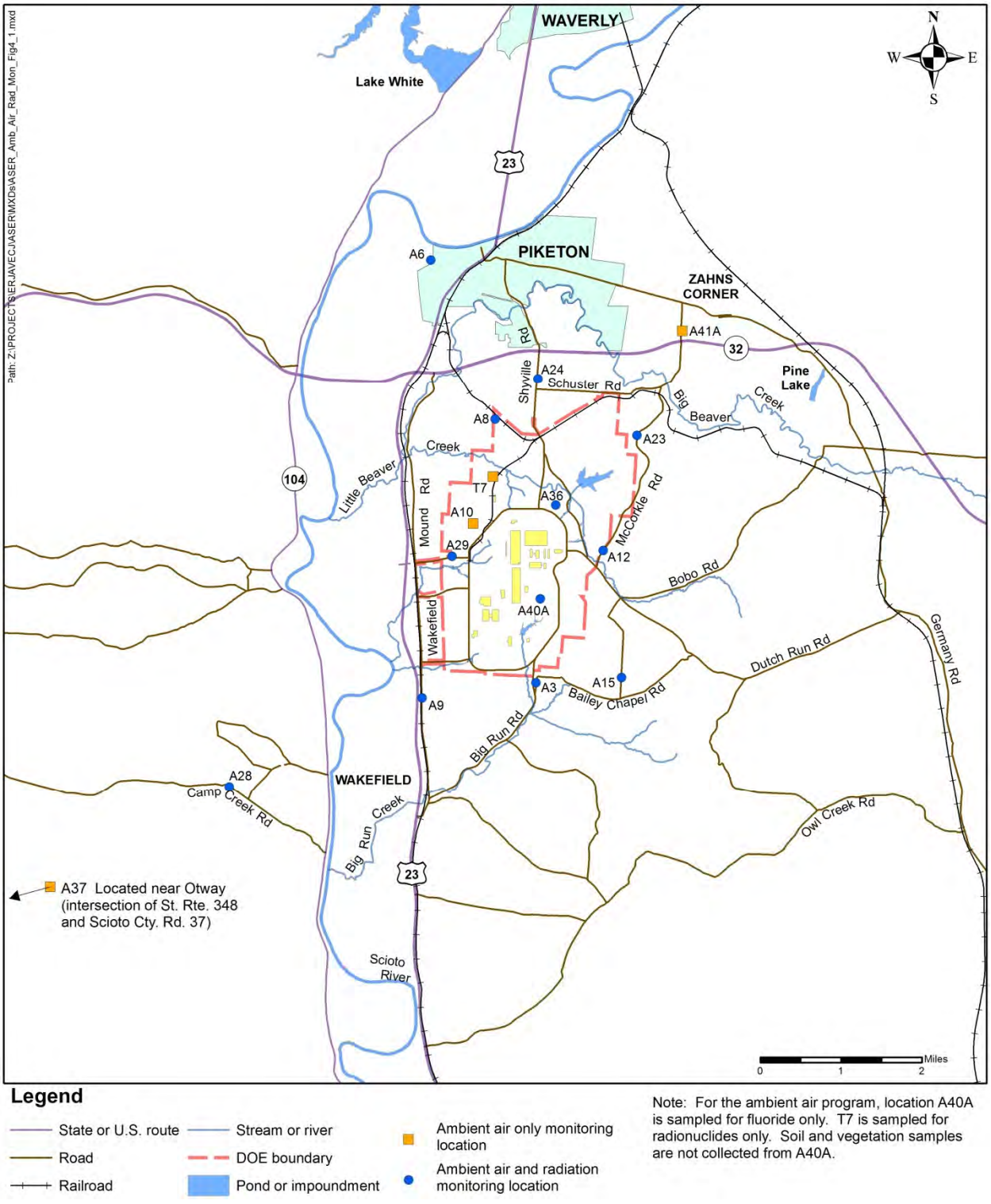

Figure 4.1. DOE ambient air and radiation monitoring locations.

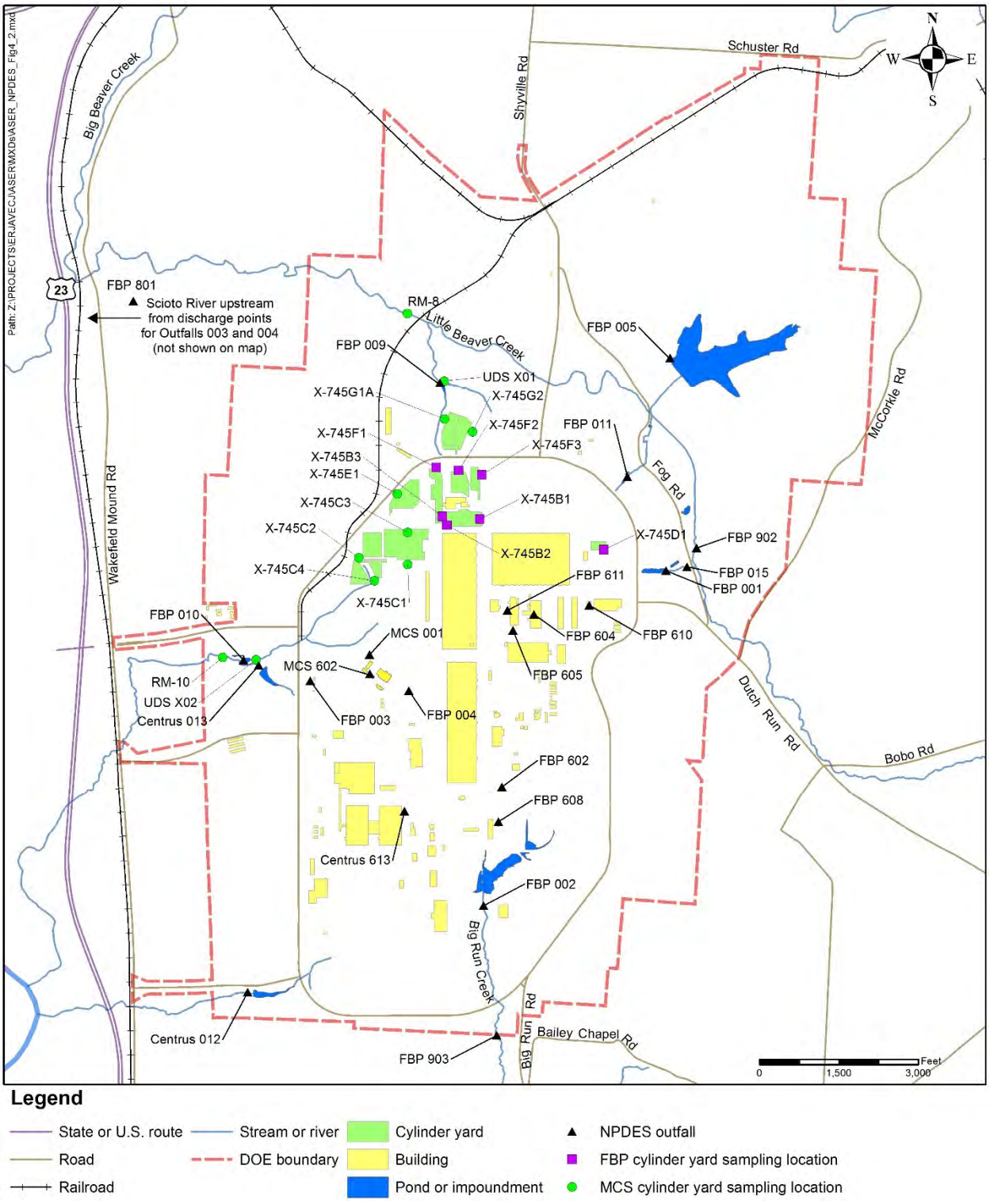

Figure 4.2. PORTS NPDES outfalls/monitoring points and cylinder storage yards sampling locations.

FBP NPDES Outfall 002 (X-230K South Holding Pond) – The X-230K South Holding Pond receives non-contact cooling water, boiler blowdown, steam condensate, foundation drainage, treated runoff from the former coal pile area, storm runoff, fire-fighting training and 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 contained, and pH can be adjusted. Water from this holding pond is discharged to Big Run Creek.

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 DOE groundwater treatment facilities, the X-700 Biodenitrification Facility, the X-705 Decontamination Microfiltration System, and 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 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 rainwater runoff. Currently the lagoon only discharges during periods of excess precipitation.

FBP NPDES Outfall 009 (X-230L North Holding Pond) – The X-230L North Holding Pond receives non-contact cooling water, steam condensate, storm runoff, 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 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, steam condensate, storm runoff, fire-fighting training and 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 commonly referred to as the West 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, steam condensate, storm runoff, 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 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).

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).

Discharges of radionuclides in liquids through FBP NPDES outfalls have no significant impact on public health and the environment. In 2017, uranium discharges from the FBP external outfalls (Outfalls 001, 002, 003, 004, 005, 009, 010, 011, and 015) were estimated at 6.6 kg. Total radioactivity (technetium-99 and isotopic uranium) released from the same outfalls was estimated at 0.030 Ci.

Discharges of radionuclides 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. Discharges of radionuclides from the outfalls are used in the dose calculation for releases to surface water (Section 4.3.6). The dose calculated with these data is significantly less than the 100 mrem/year limit in DOE Order 458.1 for all radiological releases from a facility.

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 2017.

4.3.5.2 Centrus outfalls

In 2017, Centrus was responsible for three NPDES outfalls through which water is discharged from the site (see Figure 4.2). 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 West 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. Technetium-99 was not detected in any of the samples collected from Centrus NPDES outfalls in 2017.

Plutonium-239/240 was detected at 0.036 pCi/L in the third quarter sample collected at Outfall 013. No other transuranic radionuclides were detected in any of the samples collected from Centrus NPDES outfalls in 2017.

Uranium discharges in 2017 from external Centrus NPDES outfalls (Outfalls 012 and 013) were estimated at 0.51 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 4.3.6). The dose calculated with these data and data from external FBP outfalls is significantly less than the 100 mrem/year limit in DOE Order 458.1 for all radiological releases from a facility.

4.3.6 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 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 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 2017e) were also used when available. Environmental pathways considered were ingestion of water, ingestion of fish, swimming, boating, and shoreline activities. This exposure scenario is unlikely to underestimate the dose 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 dose from radionuclides released to the Scioto River in 2017 (0.0012 mrem) is significantly less than the 100 mrem/year DOE limit in DOE Order 458.1 for all radiological releases from a facility.

4.3.7 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 2017b). External radiation is measured using thermoluminescent dosimeters (TLDs), which measure both external background radiation and radiation emanating from the DUF_6 cylinders. Section 4.6.2 and Figure 4.3 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 estimated 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 2017, the average annual dose (8736 hours) recorded at the cylinder yards near Perimeter Road was 739 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 4.3). Based on these assumptions, exposure 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 2017b). The total annual dose measured in 2017 at station A29, near the Ohio Valley Electric Corporation (OVEC), was 88 mrem/year (see Section 4.6.2 and Figure 4.3). The total dose measured at eight of the off-site or background monitoring stations averaged 86 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 (86 mrem/year) and the dose at station A29 (88 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 0.22 mrem.

A person living in the United States receives an average 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 0.22 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 significantly less than the 100 mrem/year limit in DOE Order 458.1 for all radiological releases from a facility.

4.3.8 Radiological Dose Results for DOE Workers and Visitors

The DOE Radiological Protection Organization at PORTS monitors external radiation levels in active DOE facilities at PORTS on a continual basis. This radiation monitoring assists in determining the radiation levels that workers are exposed to and in identifying changes in radiation levels. These measurements provide 1) information for worker protection, 2) a means to trend radiological exposure data for specified facilities, and (3) a means to estimate potential public exposure to radiation from DOE activities at PORTS.

The Radiation Exposure Monitoring System report is an electronic file created annually to comply with DOE Order 231.1B. This report contains exposure results for all monitored DOE employees, DOE contractors, and visitors to DOE areas at PORTS with a positive exposure during the previous calendar year. The 2017 Radiation Exposure Monitoring System report indicated that no visitors received a measurable dose (10 mrem or more).

More than 2500 DOE employees and DOE contractors were monitored throughout 2017. These workers received an average dose of 1.0 mrem. Approximately 1.5% of the monitored workers, primarily workers handling DUF_6 cylinders, received a measurable dose (10 mrem total effective dose or more). No administrative guidelines or regulatory dose limits were exceeded in 2017.

4.3.9 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 operations. 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 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 operations. Technetium-99 and transuranics could come from PORTS operations 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.

DOE sets a limit as low as reasonably achievable, but no more than 100 mrem/year in DOE Order 458.1 for a potential dose to a member of the public via exposure to all radionuclide releases from a DOE facility. To ensure that PORTS meets this standard, dose calculations may be completed for environmental media.

Dose calculations for ambient air and surface water were presented in Sections 4.3.4 and 4.3.6, 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, and dairy products) at off-site sampling locations. If radionuclides are not detected in the samples, a dose assessment is not completed. 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 2017, dose calculations were completed for public exposure to radionuclides detected in sediment, soil, and vegetation. Radionuclides were not detected in 2017 in samples of residential drinking water, deer (muscle), fish, crops, and dairy products.

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. EPA 1997a) 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 2017e) 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 doses to the public from radionuclides detected by the PORTS environmental monitoring program in 2017 are significantly less than the 100 mrem/year limit in DOE Order 458.1.

Table 4.2. Summary of potential doses to the public from radionuclides detected by DOE environmental monitoring programs in 2017

Source of dose	Dose (mrem/year)[a]
Sediment	0.019
Soil	0.018
Vegetation	0.00078
Total	0.038

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

4.3.9.1 Dose calculation for sediment

The dose calculation for sediment is based on the following detections of radionuclides in the sample collected in 2017 from monitoring location RM-7, an off-site sampling location on Little Beaver Creek (see Section 4.6.5 and Figure 4.4):

- technetium-99: 3.42 picocuries per gram (pCi/g)
- uranium-233/234: 2.55 pCi/g
- uranium-235/236: 0.128 pCi/g
- uranium-238: 0.774 pCi/g.

Based on an incidental ingestion rate of 200 milligrams (mg)/day (0.0007 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 2017e), and exposure factors in U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997a), the dose that could be received by an individual from sediment contaminated at these levels is 0.019 mrem/year. Section 4.6.5 provides additional information on the sediment monitoring program as well as a map of sediment sampling locations.

4.3.9.2 Dose calculation for soil

The dose calculation for soil is based on the detections of the following uranium isotopes in the soil sample collected at the ambient air monitoring station A12, east of PORTS on McCorkle Road (see Section 4.6.7 and Figure 4.1):

- uranium-233/234: 0.513 pCi/g
- uranium-235/236: 0.0285 pCi/g
- uranium-238: 0.435 pCi/g.

Based on an incidental ingestion rate of 200 mg/day (0.0007 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 2017e), and exposure factors in U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997a), the dose that could be received by an individual from soil contaminated at these levels is 0.018 mrem/year. Section 4.6.7 provides additional information on the soil monitoring program.

4.3.9.3 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 A12 (east of PORTS on McCorkle Road – see Section 4.6.8.1 and Figure 4.1):

<u>Vegetation</u>
- uranium-233/234: 0.0363 pCi/g
- uranium-238: 0.0265 pCi/g

<u>Soil</u>
- uranium-233/234: 0.513 pCi/g
- uranium-235/236: 0.0285 pCi/g
- uranium-238: 0.435 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 2017e) and U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997a), the dose that could be received by an individual eating beef from cattle that grazed on vegetation and soil contaminated at these levels is 0.00078 mrem/year. Section 4.6.8.1 provides additional information on the vegetation 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 2002a) 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 2017 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 4.4)] 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 2017. 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 (technetium-99 and uranium isotopes) were as follows:

Radionuclide	EDD-SW01	RM-11
Technetium-99	35.3 pCi/L	3.62 pCi/g
Uranium-233/234	2.89 pCi/L	6.88 pCi/g
Uranium-235/236	0.153 pCi/L	0.291 pCi/g
Uranium-238	0.46 pCi/L	1.11 pCi/g.

These values were entered into the RESRAD-BIOTA software that is designed to implement the DOE Technical Standard (DOE 2002a). 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 2017, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations EDD-SW01 (surface water) and RM-11 (sediment) was 0.0191, 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 2017 from the northern side of the PORTS reservation [surface water sampling location LBC-SW04 (see Chapter 6, Section 6.4.15 and Figure 6.13) and soil sampling location A8 (see Figure 4.1)] 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 2017. Section 4.6.7 and Chapter 6, Section 6.4.15 provide additional information about these soil and surface water sampling programs, respectively.

No transuranic radionuclides were detected in 2017 from samples collected LBC-SW04 (surface water) and A8 (soil). The maximum levels of technetium-99 (surface water only) and uranium isotopes were as follows:

Radionuclide	LBC-SW04	A8
Technetium-99	16.1 pCi/L	not detected
Uranium-233/234	1.69 pCi/L	1.12 pCi/g
Uranium-235/236	0.113 pCi/L	0.0494 pCi/g
Uranium-238	0.425 pCi/L	0.953 pCi/g.

These values were entered into the RESRAD-BIOTA software that is designed to implement the DOE Technical Standard (DOE 2002a). 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 2017, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations LBC-SW04 (surface water) and A8 (soil) was 0.000847, 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 2017.

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

The ambient air monitoring stations measure radionuclides released from 1) DOE point sources (the sources discussed in Section 4.3.2), 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).

In 2017, samples were collected from 15 ambient air monitoring stations located within and around PORTS (see Section 4.3.4, Figure 4.1), including a background ambient air monitoring station (A37) located approximately 13 miles southwest of the plant. The analytical results from air sampling stations closer to the plant are compared to the background measurements.

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

Radionuclide	Maximum activity (pCi/m^3)	Location	Derived Concentration Standard (DCS) (DOE 2011a)	Percentage of DCS
Neptunium-237	0.00015	A41A	0.18	0.08%
Technetium-99	0.0077	A36	920	0.0008%
Uranium-233/234	0.00025	A36	1.1	0.02%
Uranium-238	0.00017	A36	1.3	0.01%

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 a dose to a hypothetical person living at the monitoring station. The highest net dose calculation for the ambient air stations (0.00046 mrem/year) was at station A36, which is on site near the X-611 Water Treatment Plant. This hypothetical dose is well below the 10 mrem/year limit applicable to PORTS in NESHAP (40 CFR Part 61, Subpart H). Section 4.3.4 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 4.3), 19 locations that include 12 of the ambient air monitoring stations (see Section 4.3.4, Figure 4.1), and seven additional on-site locations (see Figure 4.3). 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 at five locations around the northwest corner of PORTS just inside Perimeter Road near the cylinder storage yards (see Figure 4.3). The average annual dose for these five locations (#41, #868, #874, #882, and #890) is 739 mrem. Section 4.3.7 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 dose from the cylinder yards to a delivery person (0.74 mrem/year) is significantly less than DOE's 100 mrem/year dose limit to the public for radionuclides from all potential pathways.

In 2017, the average annual dose measured at eight off-site or background locations (A3, A6, A9, A12, A15, A23, A24, and A28) was 86 mrem. Two locations within PORTS measured levels of radiation approximately 50% higher or more than the average off-site radiation (86 mrem): location #874 (626 mrem) near the X-745C Cylinder Storage Yard and location #862 (124 mrem) 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 to 10 mrem 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

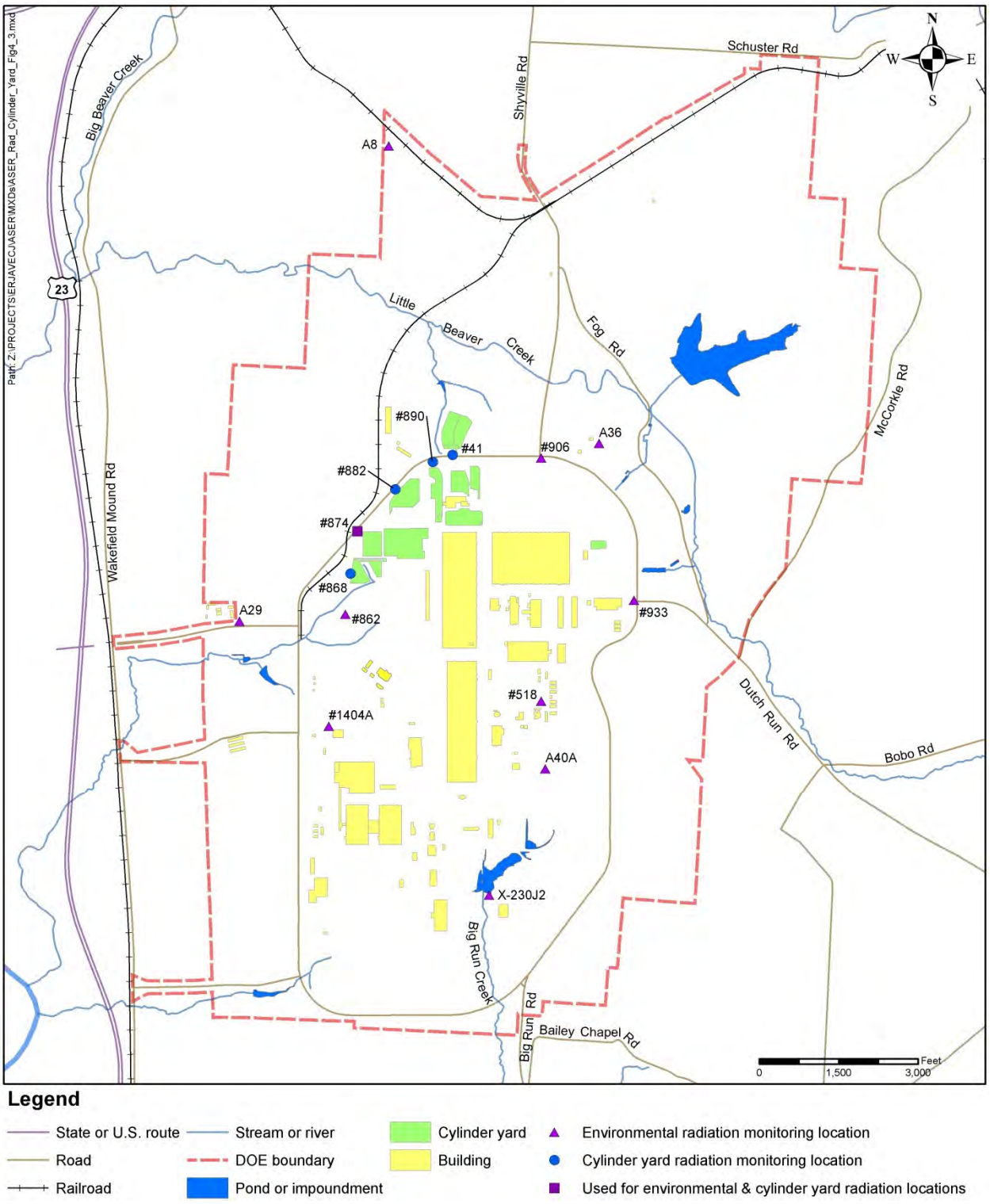

Figure 4.3. On-site radiation and cylinder yard dose monitoring locations.

in Section 4.3.7. Section 4.3.7 also includes a dose calculation for the representative off-site member of the public who works at OVEC near station A29. The potential estimated dose to this off-site worker (0.22 mrem/year) is significantly less than the 100 mrem/year dose limit to the public for radionuclides from all potential pathways in DOE Order 458.1.

Section 4.3.8 provides dose results for DOE workers, including workers in the cylinder yards. No administrative guidelines or regulatory dose limits were exceeded in 2017.

4.6.3 Surface Water from Cylinder Storage Yards

In 2017, 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 2017 by FBP and MCS, respectively.

4.6.3.1 FBP cylinder storage yards

In 2017, FBP collected surface water samples from seven locations at the X-745B, X-745D, and X-745F Cylinder Storage Yards. Figure 4.2 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: 303 pCi/L (X-745B1, November 2017)
Beta activity: 232 pCi/L (X-745B1, November 2017)
Uranium: 44.5 µg/L (X-745B2, April 2017).

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 4.3.5.1) are used in the dose calculation for releases to surface water (see Section 4.3.6). The dose from radionuclides released to surface water (the Scioto River) in 2017 (0.0012 mrem) is significantly less than the 100 mrem/year limit for all radiological releases from a facility 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 X-745C, X-745E, and X-745G Cylinder Storage Yards. Figure 4.2 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: 7.1 pCi/L (X-745G2, August 2017)
Beta activity: 10.5 pCi/L (X-745C2, July 2017)
Uranium: 13 µg/L (X-745C4, February 2017).

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 4.3.5.1) are used in the dose calculation for releases to surface water (see Section 4.3.6). The dose from radionuclides released to surface water (the Scioto River) in 2017 (0.0012 mrem) is significantly less than the 100 mrem/year limit for all radiological releases from a facility 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. These samples were taken from the Scioto River, Little Beaver Creek, Big Beaver Creek, and Big Run Creek (see Figure 4.4). 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 2017b).

No transuranic radionuclides were detected in the local surface water samples collected during 2017. 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 (DCS) (DOE 2011a)	Percentage of DCS
Technetium-99	9.12	RW-13	44,000	0.02%
Uranium-233/234	4.72	RW-7	680	0.7%
Uranium-235/236	0.214	RW-7	720	0.03%
Uranium-238	1.02	RW-7	750	0.1%

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 an upstream location on Big Beaver Creek (see Figure 4.4). 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 2017b).

Neptunium-237 was detected at 0.00975 pCi/g in the duplicate sample collected at Big Beaver Creek sampling location RM-13. Plutonium-239/240 was detected at 0.00961 pCi/g at the southern background sampling location RM-10S (the creek at State Route 728 and Pleasant Drive). No other transuranics were detected in the sediment samples collected in 2017.

Technetium-99 is often detected in sediment samples collected at locations downstream from PORTS. In 2017, technetium-99 was detected in the samples collected from the following locations:

- Big Beaver Creek at RM-13,
- Big Run Creek at RM-3, and
- Little Beaver Creek (RM-11, RM-7 and RM-8).

The highest detection (3.62 pCi/g) was at on-site location RM-11 (Little Beaver Creek at the X-230J7 East Holding Pond).

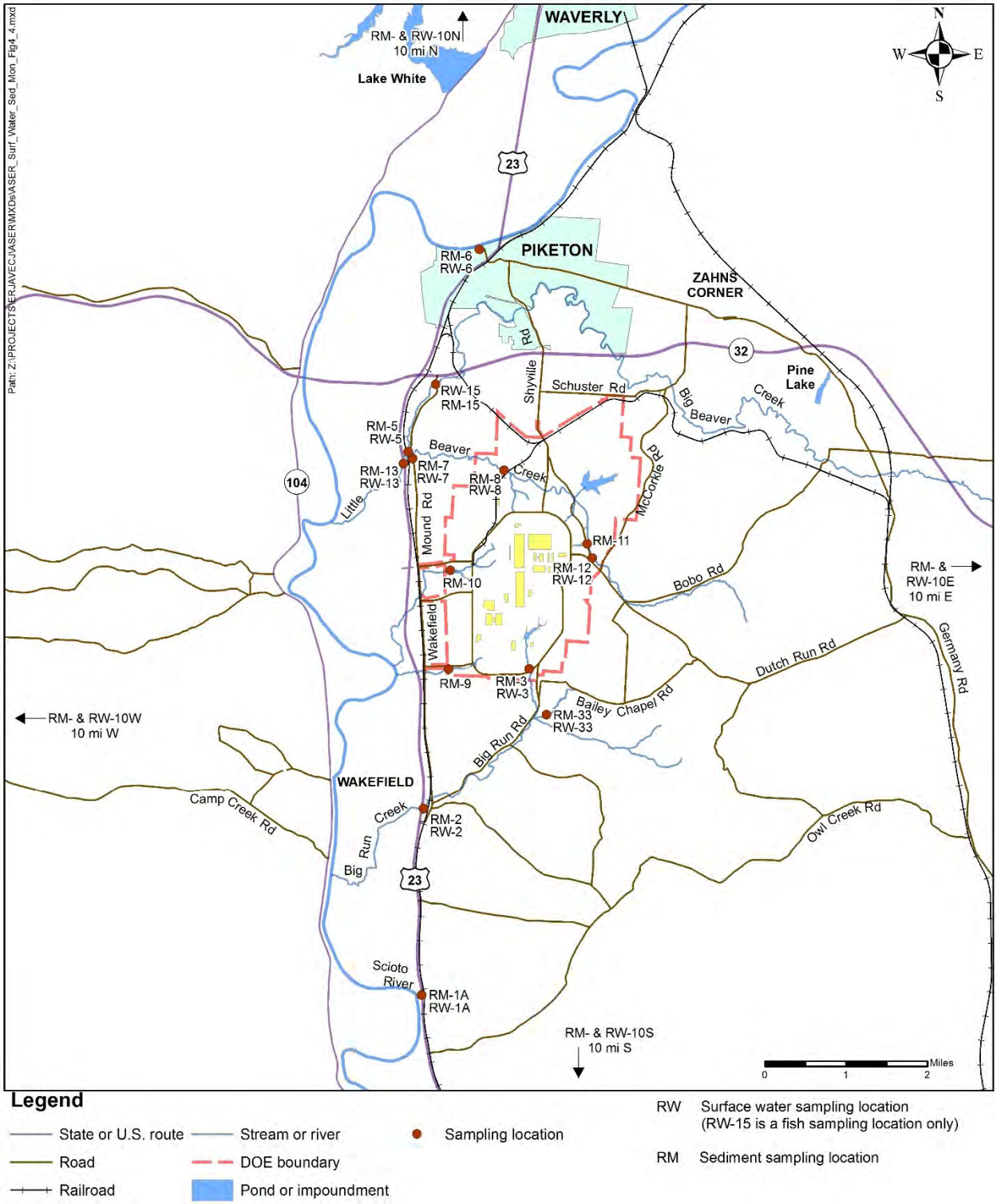

Figure 4.4. Local surface water and sediment monitoring locations.

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 RM-11 (Little Beaver Creek) and RM-3 (Big Run Creek) as follows.

Uranium: 4.57 micrograms per gram (µg/g) (RM-3 – duplicate sample)
Uranium-233/234: 6.88 pCi/g (RM-11)
Uranium-235/236: 0.291 pCi/g (RM-11)
Uranium-238: 1.52 pCi/g (RM-3 – duplicate sample).

Uranium and uranium isotopes detected in the 2017 samples have been detected at similar levels in previous sampling events from 2002 through 2016.

Section 4.3.9.1 provides a dose assessment based on the detections of technetium-99 (3.42 pCi/g), uranium-233/234 (2.55 pCi/g), uranium-235/236 (0.128 pCi/g), and uranium-238 (0.774 pCi/g) at the off-site sediment sampling location with the detections of radionuclides that could cause the highest dose to a member of the public (RM-7 on Little Beaver Creek). The total potential dose to a member of the public resulting from PORTS operations (0.90 mrem/year), which includes this dose calculation (0.019 mrem/year), is well below the DOE standard 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 4.5) 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.

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 above background for alpha activity and 50 pCi/g above background for beta-gamma activity). In 2017, settleable solids were not detected at concentrations above 40 mg/L at any of the monitoring locations; therefore, monitoring results for the settleable solids monitoring program are in compliance with DOE Order 458.1. Detections of settleable solids that monitor PORTS effluent and background locations ranged from 5 to 23.6 mg/L.

4.6.7 Soil

Soil samples are collected annually from ambient air monitoring locations (see Figure 4.1) 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 2017b).

Plutonium-239/240 was detected in soil at six of the 15 ambient air monitoring stations including the background monitoring station (A37). The highest off-site detection was 0.0152 pCi/g at station A9 (southwest of the plant on Old U.S. Route 23). These detections are much less than the soil screening level for plutonium-239/240 in residential soil (3.78 pCi/g) calculated using the exposure assumptions in

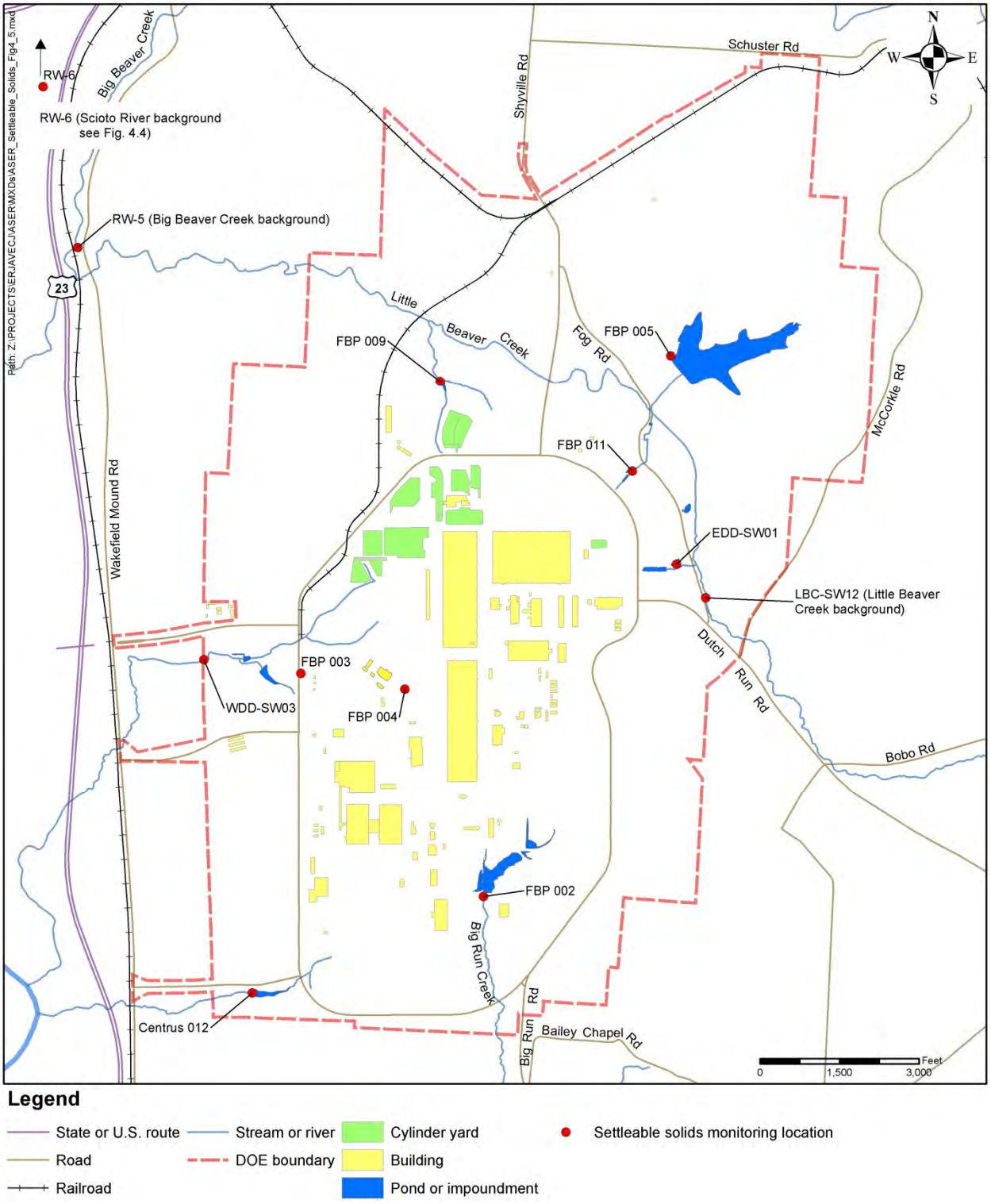

Figure 4.5. DOE settleable solids monitoring locations.

the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2017e). No other transuranic radionuclides were detected at off-site sampling locations in 2017.

Technetium-99 was not detected in any of the soil samples collected during 2017. 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 all the soil sampling locations, including the background location (A37), which suggests that the uranium detected in these samples is due to naturally-occurring uranium.

Section 4.3.9.2 provides a dose assessment based on the detections of uranium-233/234 (0.513 pCi/g), uranium-235/236 (0.0285 pCi/g), and uranium-238 (0.435 pCi/g) in soil at the off-site ambient air station with the detections of radionuclides that could cause the highest dose to a member of the public (station A12, east of PORTS on McCorkle Road). The total potential dose to a member of the public resulting from PORTS operations (0.90 mrem/year), which includes this dose calculation (0.018 mrem/year), is well below the DOE 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 2017b) 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 4.1). 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).

Uranium, uranium-233/234, and uranium-238 were detected in the vegetation sample collected at Station A12 (east of PORTS on McCorkle Road) and uranium-233/234 was detected at Station A9 (southwest of PORTS on old US Route 23). Uranium and/or uranium isotopes were also detected at on-site sampling locations A10, A36, and A8. Uranium and uranium isotopes are detected occasionally in vegetation samples, and have been detected at similar levels in previous sampling. Section 4.3.9.3 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 A12. The total potential dose to a member of the public resulting from PORTS operations (0.90 mrem/year), which includes this dose calculation (0.00078 mrem/year), is well below the DOE Order 458.1 limit of 100 mrem/year.

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 August and October of 2017. No radionuclides were detected in any of the deer samples collected in 2017.

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 4.4. In 2017, 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 2017.

4.6.8.4 Crops

In 2017, crop samples, including corn, tomatoes, and beans, 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). No radionuclides were detected in the crop samples collected during 2017.

4.6.8.5 Milk and eggs

Samples were collected in 2017 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 2017.

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.

No real property was released from PORTS in 2017. Sections 4.7.1 and 4.7.2 provide information about personal property released from FBP and MCS, respectively.

4.7.1 FBP releases

FBP uses pre-approved authorized limits established by DOE Orders to evaluate and release materials defined as personal property. In 2017, FBP authorized approximately 1625 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.

4.7.2 MCS releases

In late 2017, MCS shipped dilute hydrogen fluoride rinse water resulting from hydrogen fluoride storage tank cleanout and inspection; no hydrogen fluoride was actually produced by the DUF_6 Conversion Facility, which converts DUF_6 into uranium oxide and aqueous hydrogen fluoride. Each shipment must meet the release limit of less than 3 picocuries/milliliter (pCi/mL), or 0.003 pCi/L, of total uranium activity. Approximately 9,025 gallons of dilute hydrogen fluoride were shipped. The average total uranium activity of the shipment was 0.016 pCi/mL (0.000016 pCi/L).

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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.

Non-radiological data collected in 2017 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 2017b) 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 information for discharges to water is provided for informational purposes only; DOE is not certifying the accuracy of the Centrus data.

Data from the following environmental monitoring programs 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. In addition, the ambient air monitoring program measures fluoride at monitoring stations within PORTS boundaries and in the surrounding area. Chapter 4, Figure 4.1 is a map of the PORTS ambient air monitoring locations.

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 2017: 17.36 tons of particulate matter and 2.144 tons of organic compounds. Emissions for

2017 are associated with the X-627 Groundwater Treatment Facility, the X-670A Cooling Tower, X-333 Coolant System, 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 2017 (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 2017, FBP reported emissions of 14,695 metric tons of carbon dioxide, 0.28 metric ton of methane, and 0.028 metric ton of nitrous oxide. These emissions result from combustion of natural gas used at the X-690 Boilers.

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 2017, 27.2 tons of asbestos-containing materials (net weight) were shipped from PORTS.

5.3.2 Ambient Air Monitoring

In addition to the radionuclides discussed in Chapter 4, DOE ambient air monitoring stations also measure fluoride. 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.

In 2017, samples for fluoride were collected weekly from 15 ambient air monitoring stations in and around PORTS (see Chapter 4, Figure 4.1), including a background ambient air monitoring station (A37) located approximately 13 miles southwest of the plant.

In 2017, fluoride was not detected in 88 percent of the samples collected for the ambient air monitoring program. If fluoride is not detected in a sample, the ambient concentration of fluoride is calculated assuming that fluoride is present at the detection limit. The average ambient concentration of fluoride measured in samples collected at background station A37 was 0.016 microgram per cubic meter ($\mu g/m^3$). Average ambient concentrations of fluoride measured at the stations around PORTS ranged from 0.0076 $\mu g/m^3$ at station A15 (east-southeast of PORTS on Loop Road) to 0.021 $\mu g/m^3$ at station A12 (east of PORTS on McCorkle Road). There is no standard for fluoride in ambient air. The data indicate that ambient concentrations of fluoride at off-site and background locations are not appreciably different from concentrations at PORTS.

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 surface water downstream from the cylinder storage yards.

5.4.1 Water Discharges (NPDES Outfalls)

In 2017, DOE contractors (FBP and MCS) were responsible for 21 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 2017.

5.4.1.1 FBP NPDES outfalls

In 2017, 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 4.3.5.1, 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 4.2).

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 2017 are as follows:

- FBP NPDES Outfall 001 (X-230J7 East Holding Pond) – cadmium, chlorine, copper, dissolved solids, fluoride, mercury, oil and grease, pH, silver, suspended solids, and zinc.
- FBP NPDES Outfall 002 (X-230K South Holding Pond) – cadmium, fluoride, mercury, ammonia-nitrogen, oil and grease, pH, selenium, silver, suspended solids, and thallium.
- FBP NPDES Outfall 003 (X-6619 Sewage Treatment Plant) – acute toxicity, ammonia-nitrogen, carbonaceous biochemical oxygen demand, chlorine (May-October only), copper, E. coli (May-October only), mercury, nitrite + nitrate, oil and grease, pH, silver, thallium, suspended solids, and zinc.
- FBP NPDES Outfall 004 (Cooling Tower Blowdown) – acute toxicity, chlorine, copper, dissolved solids, mercury, oil and grease, pH, suspended solids, and zinc.
- FBP NPDES Outfall 005 (X-611B Lime Sludge Lagoon) – lead, mercury, pH, selenium, and suspended solids.
- FBP NPDES Outfall 009 (X-230L North Holding Pond) – bis(2-ethylhexyl)phthalate, copper, fluoride, mercury, oil and grease, pH, silver, suspended solids, and zinc.
- FBP NPDES Outfall 010 (X-230J5 Northwest Holding Pond) – lead, mercury, oil and grease, pH, selenium, suspended solids, and zinc.
- FBP NPDES Outfall 011 (X-230J6 Northeast Holding Pond) – cadmium, chlorine, copper, fluoride, oil and grease, pH, selenium, suspended solids, thallium, 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 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, 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. In 2017, discharge limitations at the FBP NPDES monitoring locations were exceeded on 11 occasions (see Table 5.1).

Table 5.1 FBP NPDES exceedances in 2017

Outfall	Parameter (unit)[a]	Limit	Result	Date
001	Mercury (ng/L)	12 ng/L	18.3	May
001	Mercury (ng/L)	(maximum	23.8	June
001	Mercury (ng/L)	monthly average)	16.75	July
001	Mercury (ng/L)		19.7	August
004	Copper (µg/L)	66 µg/L	140	September 6
004	Copper (µg/L)	(maximum daily)	67	September 20
004	Copper (µg/L)		83	October 5
002	pH (SU)	6.5 SU	5.1	June 21
004	pH (SU)	(minimum daily)	6.25	March 2
003	E.coli (#/100 mL)	284/100 mL (maximum daily)	1010	June 21
003	Carbonaceous biochemical oxygen demand (kg/day)	22.7 kg/day (maximum daily loading)	23.7	May 9

[a]Units: nanogram per liter (ng/L). microgram per liter (µg/L). Standard Unit (SU). Number of organisms per 100 milliters ((#/100 mL). kilogram per day (kg/day).

The average monthly concentration preliminary effluent limit for mercury was exceeded at Outfall 001 (the X-230J7 East Holding Pond) in May through August of 2017. FBP has initiated an investigation to identify the source of the mercury detected at Outfall 001 so that corrective measures can be implemented. The drinking water standard for mercury is 2 µg/L (2000 ng/L). The preliminary effluent limit for mercury (12 ng/L) is lower than the drinking water standard (2000 ng/L) to minimize the accumulation of mercury in biota, such as fish and birds.

In September and October of 2017, the maximum daily concentration limit for copper (66 µg/L) at Outfall 004 (recirculating cooling water blowdown) was exceeded in three samples. The exceedances appeared to be due to insufficient amounts of an additive used to control copper corrosion in the recirculating cooling water system during periods of biocide treatment applications. Adjustments were made to the feed system that controls the additives used in the recirculating cooling water system.

Discharge limits for pH were exceeded twice in 2017: once in June at Outfall 002 and once in March at Outfall 004. At Outfall 002, the exceedance was caused by an overfeed of citric acid from a defective feed pump in the pH neutralization control system. At Outfall 004, the exceedance was caused by a temporary overfeed of a dechlorinating chemical. Compliance was restored at both outfalls in less than two hours.

Two discharge limitations were exceeded at Outfall 003 (X-6619 Sewage Treatment Plant) during 2017. The maximum daily concentration limit for E. coli (284/100 mL) was exceeded due to a malfunction in the sewage treatment system that caused a backup of sludge in the west clarifier. The conditions that caused the exceedance were corrected within several hours. A sample collected the following day was well within the discharge limitation at 1/100 mL. The maximum daily loading limit for carbonaceous biochemical oxygen demand was exceeded due to a release of cooling water containing propylene glycol from an air compressor into the sanitary sewer system. Upon discovery, the wastewater contaminated with propylene glycol was isolated in an off-line aeration basin to be properly treated.

In 2017, 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 4.2 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 2017; 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 2017; 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 4.2). Two outfalls discharge directly to surface water, and one outfall discharges to FBP NPDES Outfall 003 before leaving the site. Chapter 4, Section 4.3.5.2, 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) – cadmium, chlorine, copper, iron, oil and grease, pH, selenium, silver, suspended solids, total PCBs, thallium, and TCE.

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

- Centrus NPDES Outfall 613 (X-6002A Recirculating Hot Water Plant particle separator) – chlorine, pH, 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 2017; 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 4.2) and analyzed for PCBs. PCBs were not detected in any of the surface water samples (filtered or unfiltered) collected during 2017. Section 5.5.2 presents the results for sediment samples collected as part of this program.

5.5 SEDIMENT

In 2017, 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 an upstream location on Big Beaver Creek (see Chapter 4, Figure 4.4). In 2017, samples were analyzed for 20 metals and PCBs, in addition to the radiological parameters discussed in Chapter 4.

PCBs were detected in sediment samples collected upstream and downstream from PORTS. PCBs were detected in downstream samples collected from Little Beaver Creek (RM-7, RM-8, and RM-11), Big Beaver Creek (RM-13), Big Run Creek (RM-2 and RM-3), and the Scioto River (RM-1A). PCBs were also detected in the sample collected from the upstream sampling location on the Scioto River (RM-6).

None of the detections of PCBs in sediment around PORTS were above the risk-based regional screening level for PCB-1254/1260 developed by U.S. EPA and utilized by Ohio EPA: 240 micrograms per kilogram (µg/kg) or parts per billion (ppb) (U.S. EPA 2017). The highest detection of PCBs (208 µg/kg) was on site in Little Beaver Creek at the discharge from the X-230J7 Holding Pond (RM-11).

The results of metals sampling conducted in 2017 indicate that no appreciable differences are evident in the concentrations of metals present in sediment samples taken upstream from PORTS, at background sampling locations, 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 4.2).

In 2017, PCBs were detected in at least one of the sediment samples collected at each location. The maximum concentration of PCBs (230 µg/kg) was detected at sampling location UDS X02. The concentrations of PCBs detected in 2017 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 2017).

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 locations on Little Beaver Creek (RW-8), Big Beaver Creek (RW-13 and RW-15), and the Scioto River (RW-1A and RW-6). In 2017, fish were caught at each of these locations. Chapter 4, Figure 4.4, 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. The fish samples collected at Little Beaver Creek (RW-8) and Big Beaver Creek (RW-13 and RW-15) were bass. The fish samples collected from the Scioto River (RW-1A and RW-6) were drum and catfish, respectively.

PCBs were detected in the bass collected from Little Beaver Creek at 241 and 290 µg/kg (regular and duplicate samples, respectively). PCBs were also detected in upstream and downstream Big Beaver Creek bass samples at 22 and 30.6 µg/kg, respectively. PCBs were detected in catfish and drum collected from upstream and downstream Scioto River sampling locations at 18.5 and 20.2 µg/kg, respectively. These detections were compared to the Ohio Fish Consumption Advisory Chemical Limits provided in the *State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program* (Ohio EPA 2010). These limits are set for the following consumption rates: unrestricted, 1/week, 1/month, 6/year, and do not eat. The concentration of PCBs detected in the fish caught on site in Little Beaver Creek (RW-8) is above the 1/week maximum limit (220 µg/kg) and below the 1/month maximum limit (1000 µg/kg). The concentrations of PCBs detected in fish collected from Big Beaver Creek (22 and 30.6 µg/kg) and the Scioto River (18.5 and 20.2 µg/kg) are less than the unrestricted limit (50 µg/kg).

The Ohio Sport Fish Consumption Advisory, available from Ohio EPA, Division of Surface Water, 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 EPA 2018). 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 contaminants detected within these plumes were stable or decreasing during 2017.

The groundwater plume at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility is near the southern boundary of PORTS. In 2017, no VOCs were detected in any of the seven 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. Data collected in 2017 indicate that the groundwater extraction wells installed in the X-749/X-120 groundwater plume are succeeding in reducing TCE concentrations within the plume.

The *2017 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 2018). 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 2017. The following sections provide an overview of the PORTS groundwater monitoring program followed by a review of the history and 2017 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.

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 January through June of 2017 was completed in accordance with the *Integrated Groundwater Monitoring Plan* dated July 2015 (DOE 2015b). Groundwater monitoring in July through December of 2017 was completed in accordance with the *Integrated Groundwater Monitoring Plan* dated August 2017 (DOE 2017d). 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 or 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.

6.4 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 2017d). 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,

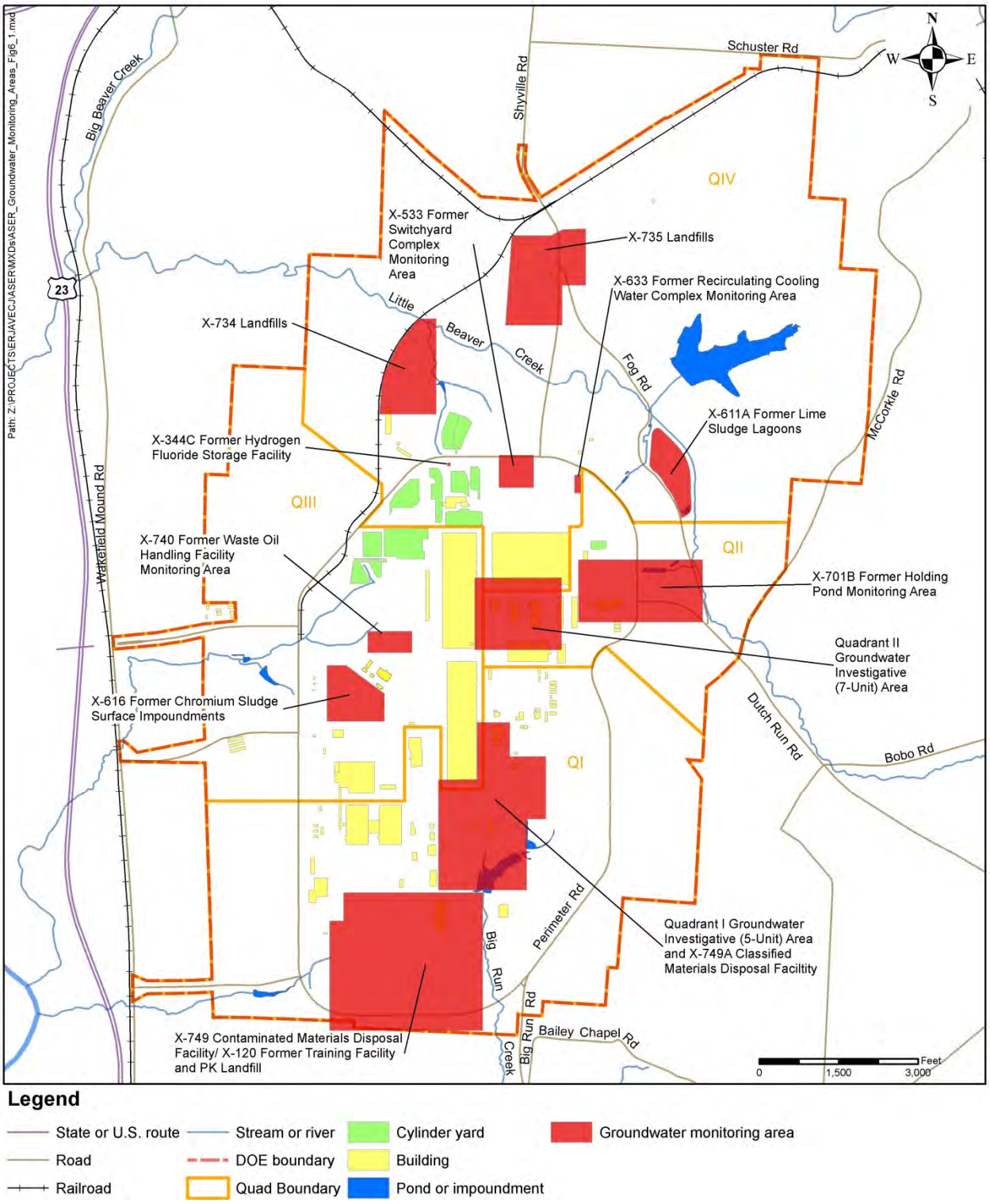

Figure 6.1. Groundwater monitoring areas at PORTS.

- 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,
- 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 2017d).

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 NPDES 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 2017.

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.

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2017

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
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

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2017 (continued)

Monitoring Area or Program	Analytes	
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	
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.

6.4.1.1 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 emanating 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.

Ninety-eight wells and one sump/extraction well were sampled during 2017 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.

Ninety-eight wells and one sump/extraction well were sampled during 2017 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 2017

The most extensive and most concentrated constituents associated with the X-749/X-120 plume (see Figure 6.2) are VOCs, particularly TCE.

In general, concentrations of TCE were stable or decreasing within the X-749/X-120 groundwater plume. The area within the plume where TCE concentrations are less than 5 µg/L changed slightly in 2017 compared to 2016 (5 µg/L defines the boundary of the groundwater plume). TCE was detected at 5.1 µg/L in the third quarter sample collected from well X749-36G, which is on the southern edge of the area. TCE was detected at approximately 3 µg/L in samples collected between 2013 and 2016. Concentrations of TCE remained less than 5 µg/L in 2017 in the other three wells that define the area (X120-05G, X749-PZ07G, and X749-42G).

Groundwater in the area north of the X-749 Landfill was investigated in 2015 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. Analytical data for this investigation are provided in the *Deferred Units Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Report* (DOE 2017a).

The boundary of the eastern portion of X-749 groundwater plume that emanates from the east side of the X-749 Landfill remained similar to previous years. In the northern portion of the X-749/X-120 groundwater plume (the area directly north of the X-749 Landfill), concentrations of TCE remained elevated in two wells, PK-09G and X749-115G. Concentrations of TCE detected in wells within the X-749 Landfill remained stable or decreased in 2017, with concentrations of TCE above 100 µg/L isolated in the western portion of the landfill.

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 2017 in well X120-11G (215 µg/L) is similar to average concentrations in 2014–2016 (235-200 µg/L) and has decreased from 2013 (245 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 2017.

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 2017 in well X749-67G (208 µg/L) has decreased from the average annual concentrations detected in 2013–2016 (see Figure 6.2). The average concentration of TCE detected in 2017 in well X749-110G (22 µg/L) has decreased from the average annual concentrations detected in 2013–2016 (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.

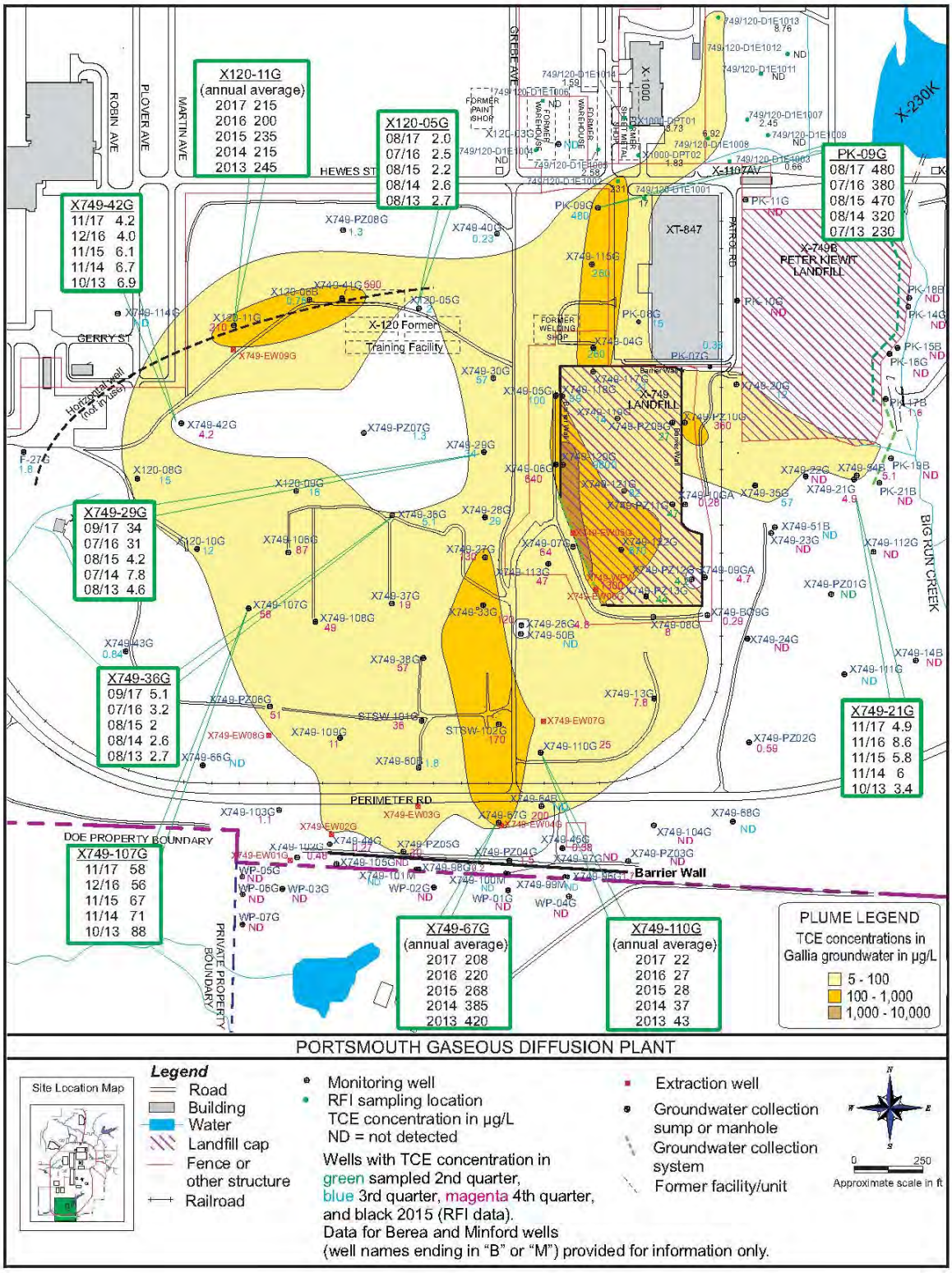

Figure 6.2. TCE-contaminated Gallia groundwater plume at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017.

The concentrations of TCE detected in on-site monitoring wells downgradient of the X-749 South Barrier Wall area groundwater extraction wells (wells X749-EW01G, EW02G, EW03G, and EW04G) have decreased to below 5 µg/L in most sampling events since 2011, with the exception of well X749-67G (discussed in the previous paragraph). However, TCE was detected at 30 µg/L in the fourth quarter sample collected from well X749-PZ05G, which caused the southern edge of the plume to expand. TCE and other VOCs were detected in some or all of the quarterly samples collected from well X749-103G at concentrations of 1.1 µg/L or less. Continued operation of groundwater extraction wells X749-EW01G and X749-EW02G in the South Barrier Wall area may be causing low concentrations of VOCs to move into the area monitored by well X749-103G. The groundwater extraction well system in the X-749 South Barrier Wall area is being evaluated. No VOCs were detected in any of the seven off-site monitoring wells.

Samples from selected groundwater monitoring wells in the X-749/X-120 groundwater plume 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). If detected, radionuclides were present in groundwater at levels below Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters and 30 µg/L for uranium).

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 emanating from the PK Landfill into Big Run Creek. In 1994, a portion of Big Run Creek was relocated approximately 50 feet to the east. A groundwater collection system was installed in the old creek channel to capture the seeps emanating from the landfill. A second collection system was constructed in 1997 on the southeastern landfill boundary to contain the groundwater plume migrating toward Big Run Creek from the southern portion of the PK Landfill. 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 2017, nine wells, two sumps, and two manholes were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells, sumps, and manholes in this area.

6.4.2.1 Monitoring results for the PK Landfill in 2017

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 2017, vinyl chloride was detected in samples collected from wells PK-17B and PK-21B at concentrations ranging from 11 to 14 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.

Thirty-four wells were sampled in 2017 as part of the monitoring program for the Quadrant I Groundwater Investigative (5-Unit) Area. 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 2017

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.

TCE is increasing 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 540 µg/L in 2017, which has increased from 220 µg/L in 2016 (see Figure 6.3).

TCE also increased in well X326-09G, which monitors the northwestern portion of the plume on the south end of the X-326 Process Building. TCE was detected at 71,000 µg/L in third quarter of 2017, which has increased from 22,000-27,000 µg/L in 2013-2016.

The eastern edge of the groundwater plume changed slightly in 2017 based on detections of TCE in wells X231A-01G (2.3 µg/L) and X622-PZ01G (2.8 µg/L). TCE is usually detected in these wells at concentrations just above or below the preliminary remediation goal (5 µg/L), and was below the preliminary remediation goal in 2017 (see Figure 6.3). No other significant changes in TCE concentrations were identified in wells that monitor the Quadrant I Groundwater Investigative (5-Unit) Area in 2017.

Samples from selected wells that monitor the Quadrant I Groundwater Investigative (5-Unit) Area 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). If detected, radionuclides were present at levels below Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium).

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

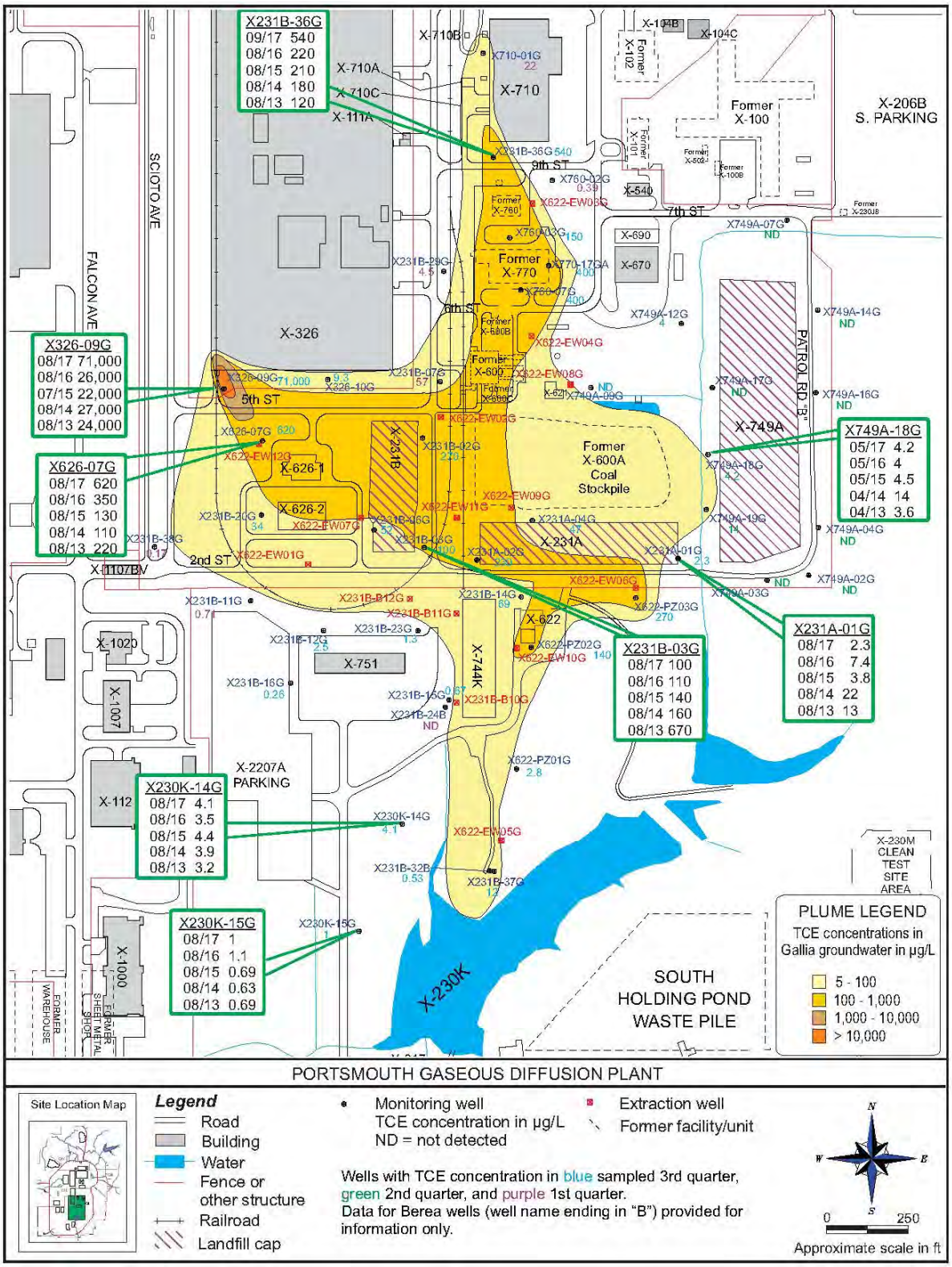

Figure 6.3. TCE-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017.

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 2017. 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 2017

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 2017.

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 2017

A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant II Groundwater Investigative (7-Unit) Area (see Figure 6.4).

Concentrations of TCE detected in the Quadrant II Groundwater Investigative (7-Unit) Area plume were generally stable or decreasing in 2017, with the exception of X701-45G in the southern perimeter of the plume. TCE increased to 11 µg/L in 2017 in well X701-45G. TCE is also increasing in well X701-27G, which monitors the eastern side of the plume (see Figure 6.4).

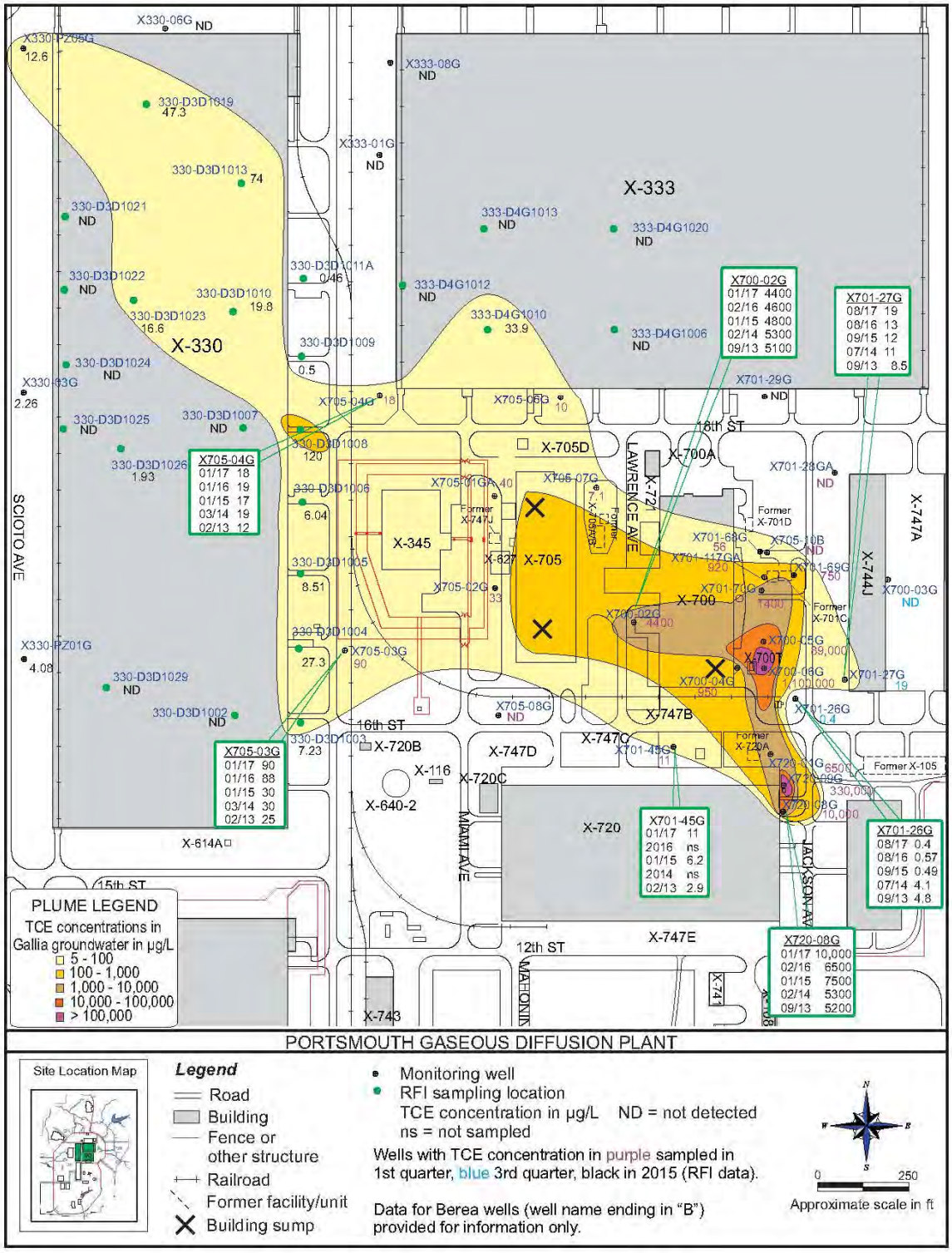

Figure 6.4. TCE-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017.

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.

Samples from selected wells that monitor the Quadrant II Groundwater Investigative (7-Unit) Area 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). If detected, radionuclides were present at levels below Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium).

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 emanating 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.

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

6.4.6.1 Monitoring results for the X-701B Former Holding Pond in 2017

In general, concentrations of TCE detected in wells within the X-701B plume in 2017 were similar to previous years. TCE is decreasing in well X701-EW121G, which is downgradient of the IRM treatment area. Over the last five years, TCE has decreased in well X701-EW121G from 140,000 µg/L in the third quarter of 2013 to 76,000 µg/L in the third quarter of 2017 (see Figure 6.5).

The southern edge of the X-701B plume has expanded based on the detection of TCE in the sample collected from well X701-23G at 5.6 µg/L. TCE has increased from 0.95 µg/L in this well in 2013 to 5.6 µg/L in 2017. The concentration of TCE detected in well X701-79G, which also monitors the southern portion of the plume, increased to 230 µg/L in 2017. TCE was detected at 160 µg/L in 2016 and less than 100 µg/L in 2013-2015 (see Figure 6.5). TCE is also increasing in well X701-24G, which monitors the eastern portion of the plume. During and just after implementation of the IRM, TCE concentrations typically detected in well X701-24G decreased to less than 10,000 µg/L. TCE concentrations have rebounded in this well since 2015.

Samples from 48 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). Technetium-99 or uranium were detected above Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium) in four wells near the former X-701B Pond and east retention basin and in wells installed within the IRM area. Concentrations of radionuclides present in groundwater in the X-701B area can be affected by the oxidant used in the 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.

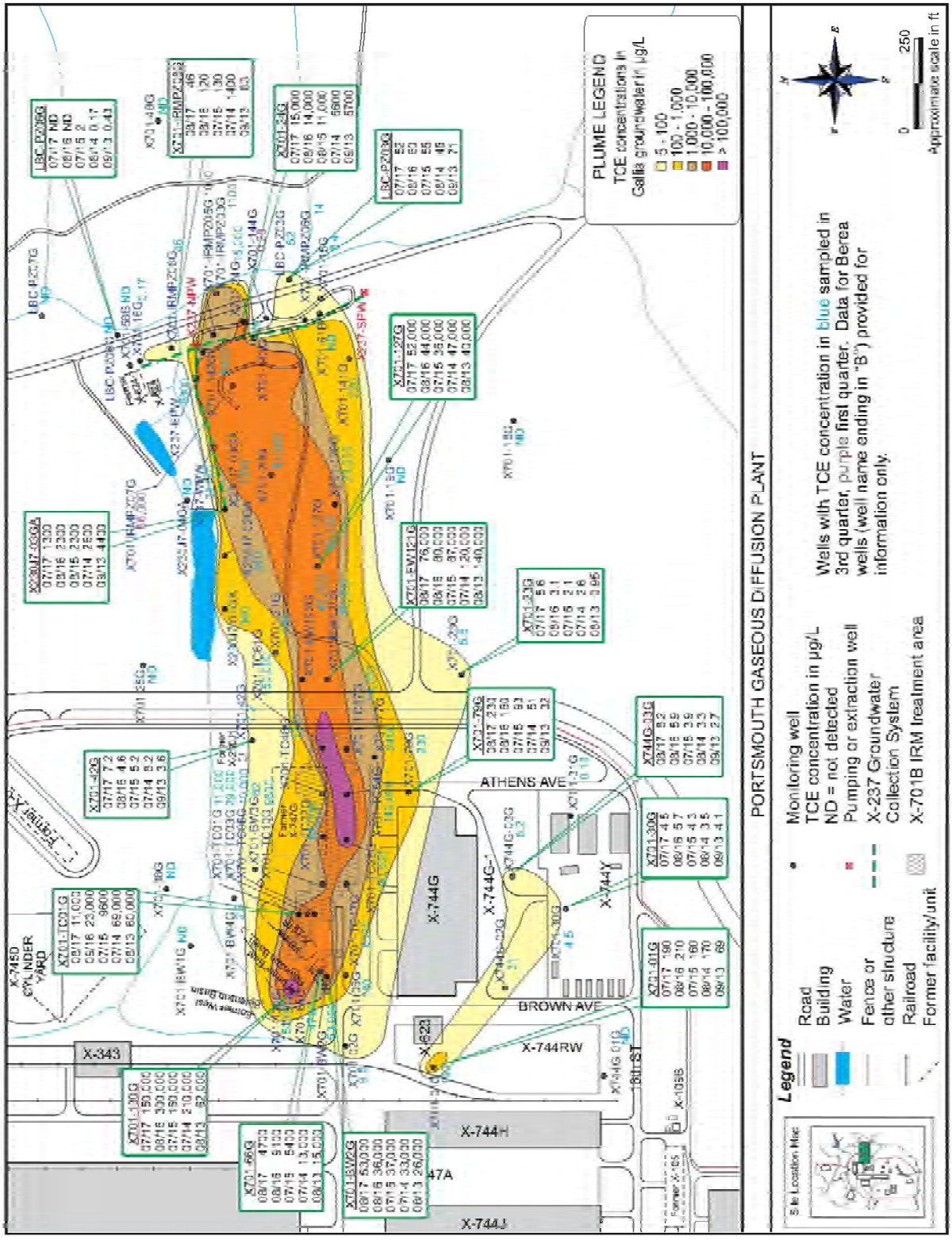

Figure 6.5. TCE-contaminated Gallia groundwater plume at the X-701B Former Holding Pond – 2017.

6.4.7.1 Monitoring results for the X-633 Former Recirculating Cooling Water Complex in 2017

Chromium was detected in both of the X-633 monitoring wells in 2017. Samples collected from well X633-07G contained chromium at concentrations above the preliminary remediation goal of 100 µg/L: 1400 µg/L (second quarter) and 1300 µg/L (fourth quarter). Samples collected from well X633-PZ04G also contained chromium but at concentrations well below the preliminary remediation goal. These results are typical for these wells. Figure 6.6 shows the chromium concentrations detected in the X-633 Former Recirculating Cooling Water Complex wells.

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 2017

Chromium is of special concern at X-616 because of the previous use of the area. In 2017, 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 2017.

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.

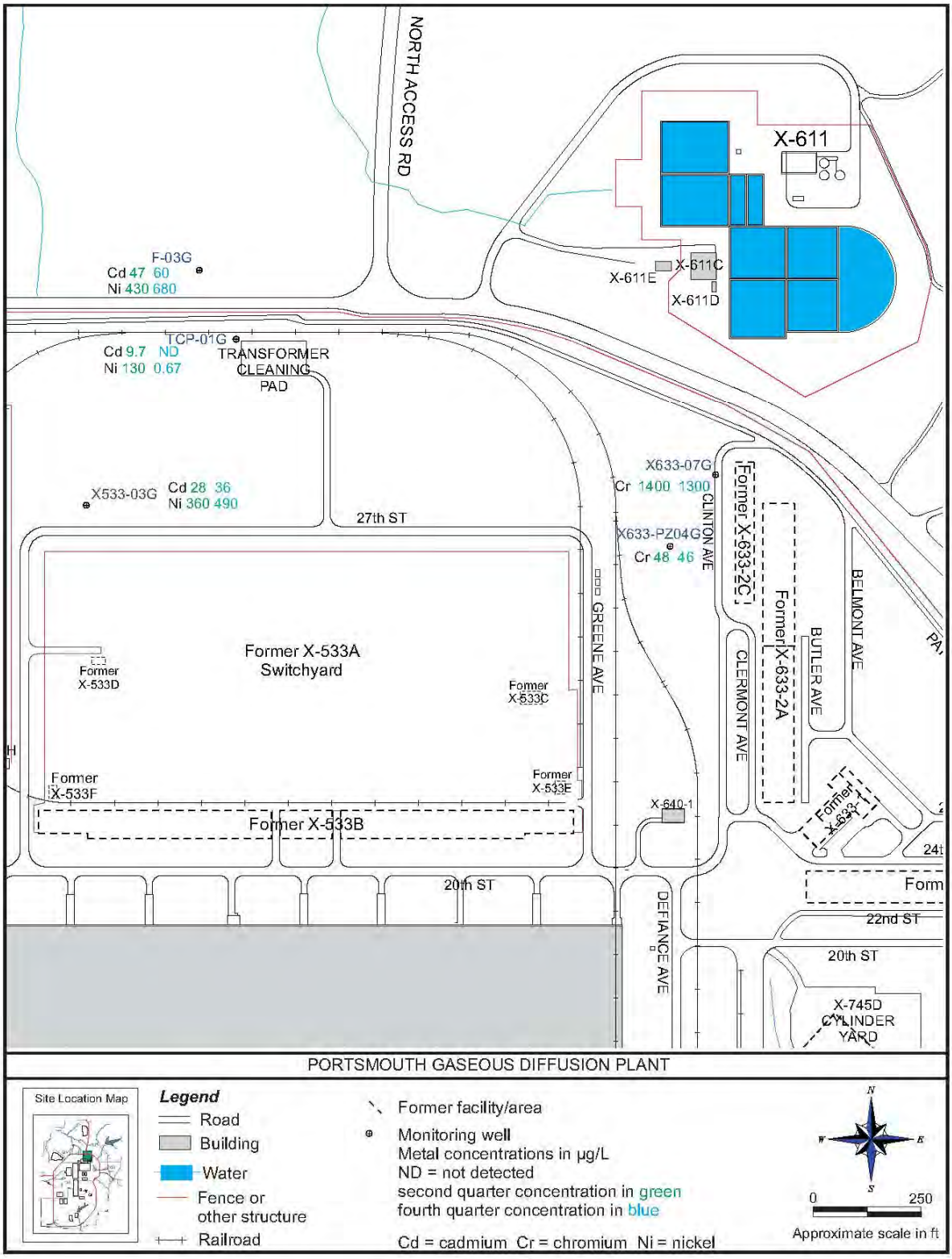

Figure 6.6. Metal concentrations in groundwater at the X-633 Former Recirculating Cooling Water Complex and X-533 Former Switchyard Complex – 2017.

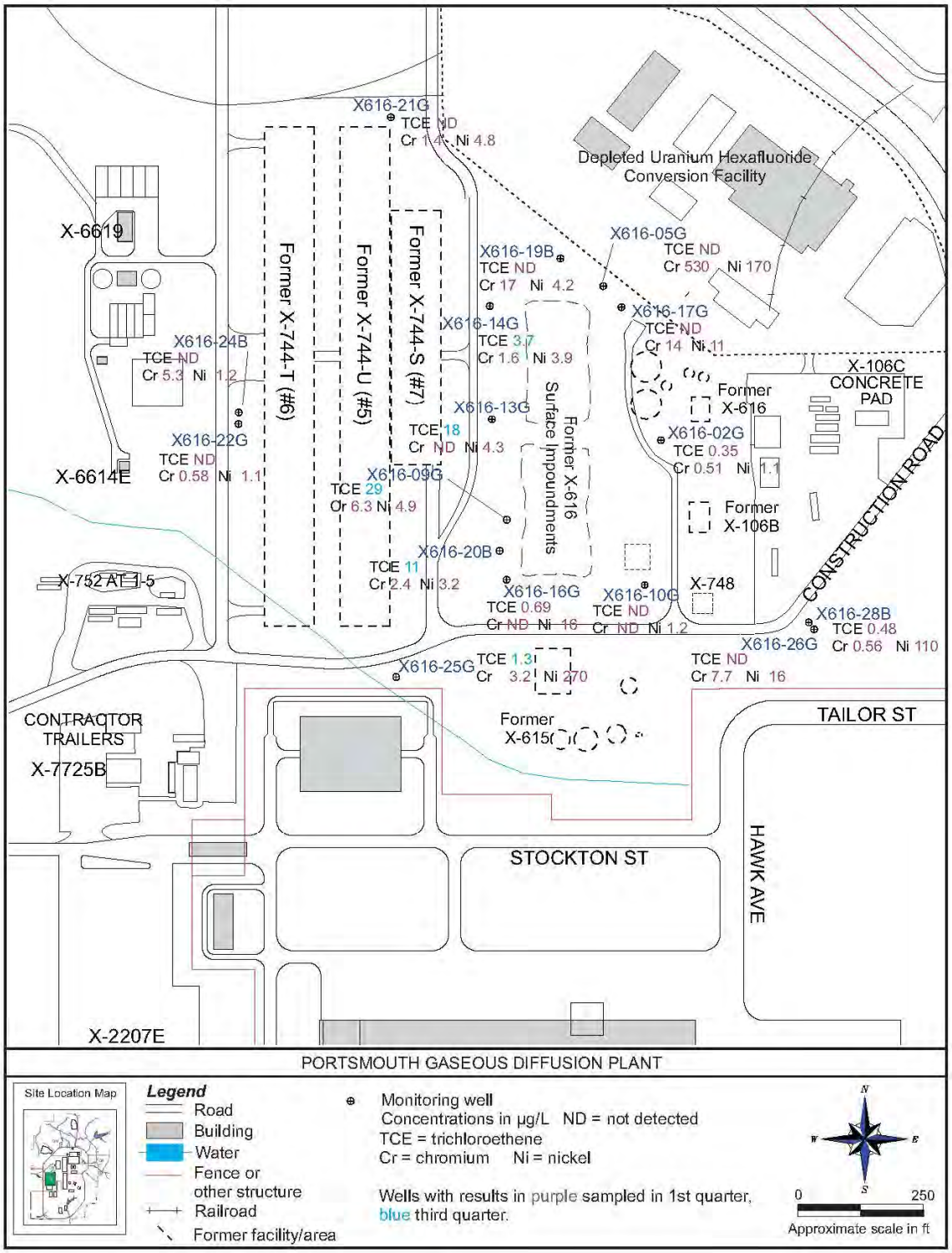

Figure 6.7. TCE and metal concentrations in groundwater at the X-616 Former Chromium Sludge Surface Impoundments – 2017.

Twenty-three wells that monitor the X-740 Former Waste Oil Handling Facility were sampled during 2017.

6.4.9.1 Monitoring results for the X-740 Former Waste Oil Handling Facility in 2017

The TCE groundwater plume near the X-740 Former Waste Oil Handling Facility in Quadrant III became smaller in 2017 (see Figure 6.8). Concentrations of TCE decreased to below 5 µg/L in wells X740-02G and X740-04G that monitor the eastern and northeastern boundaries of the plume. In addition, the area of higher TCE concentrations within the plume is no longer present because TCE decreased to less than 100 µg/L in well X740-10G (41 µg/L), which was the only Gallia well in which TCE was detected at greater than 100 µg/L in 2016. Concentrations of TCE are decreasing due to the bioremediation project that took place in this area (see Chapter 3, Section 3.3.3).

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 2017

The six monitoring wells at X-611A are sampled and analyzed semiannually for beryllium and chromium. In 2017, chromium was detected in the samples collected from four of the six wells in this area at concentrations between 0.54 and 14 µg/L, which are below the preliminary remediation goal (100 µg/L).

In 2017, beryllium was detected in two of the six wells in this area at concentrations of 1.7 µg/L or less, 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 2017.

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.

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.

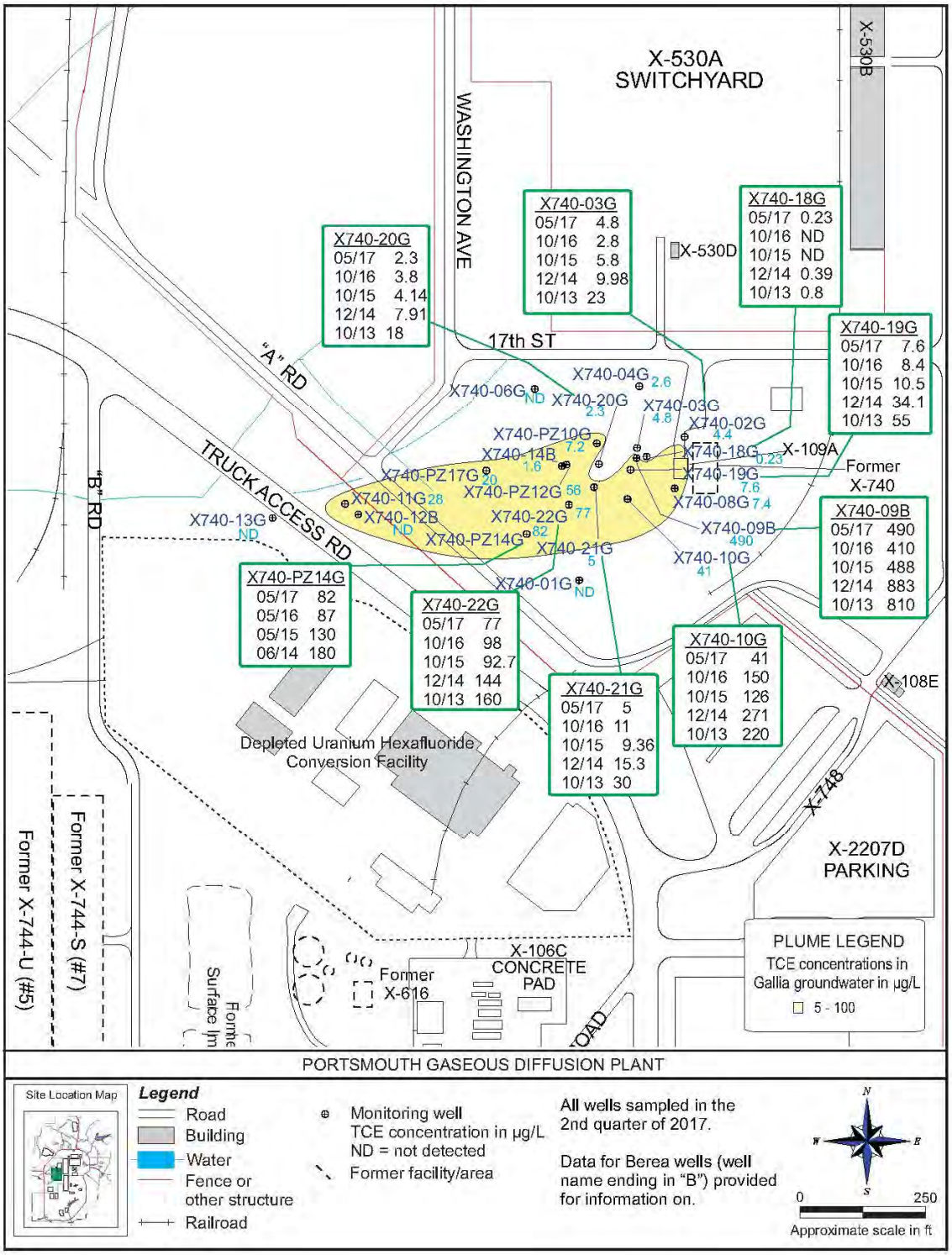

Figure 6.8. TCE-contaminated Gallia groundwater plume near the X-740 Former Waste Oil Handling Facility – 2017.

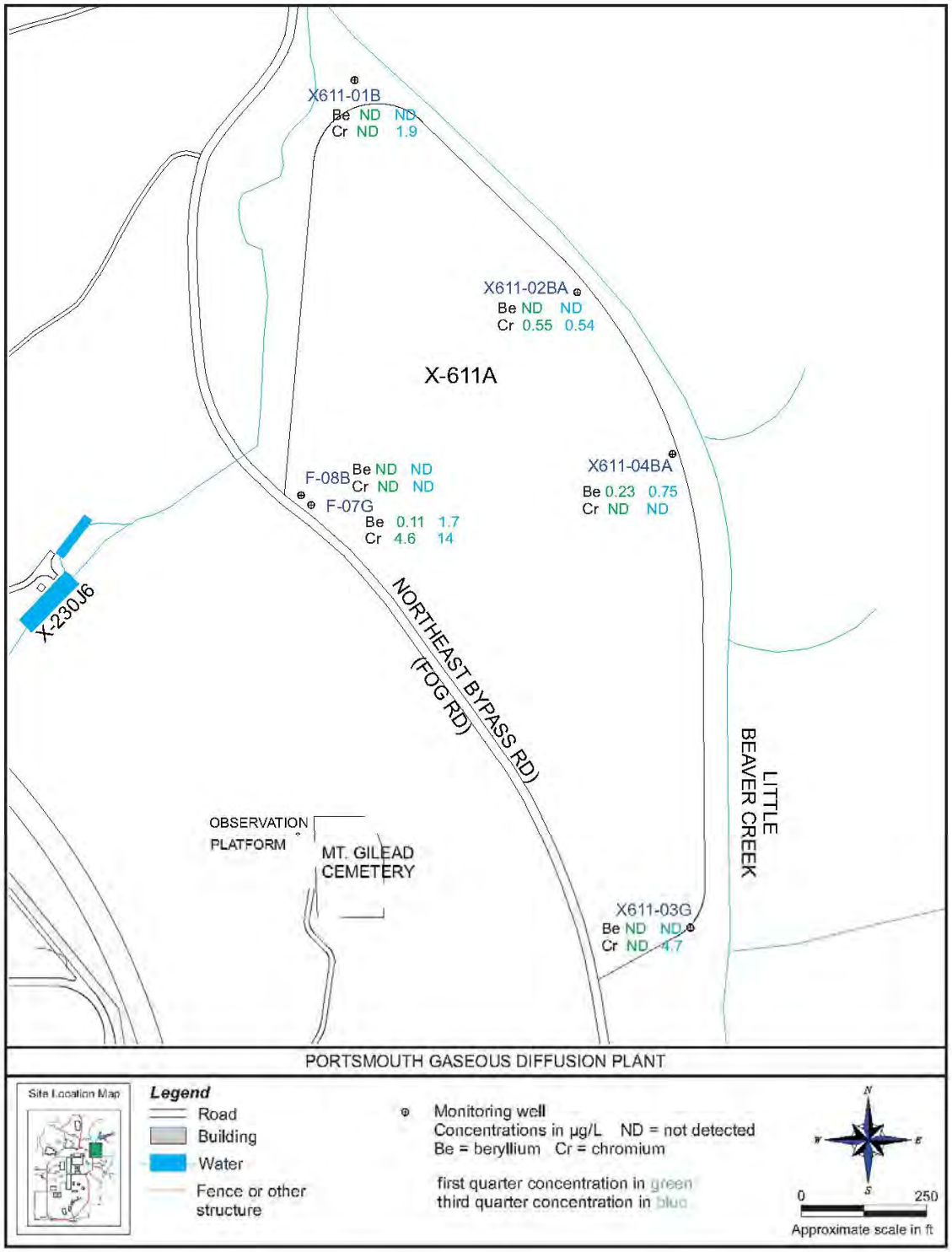

Figure 6.9. Metal concentrations in groundwater at the X-611A Former Lime Sludge Lagoons – 2017.

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 2017d). 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 2017 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 2017

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 2017.

The detection monitoring program for X-735 Berea wells continued in 2017. 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. None of the control limits used to determine a statistically significant change in the indicator parameters requiring Ohio EPA notification was exceeded in the X-735 Berea wells in 2017.

Samples from each 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).

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.

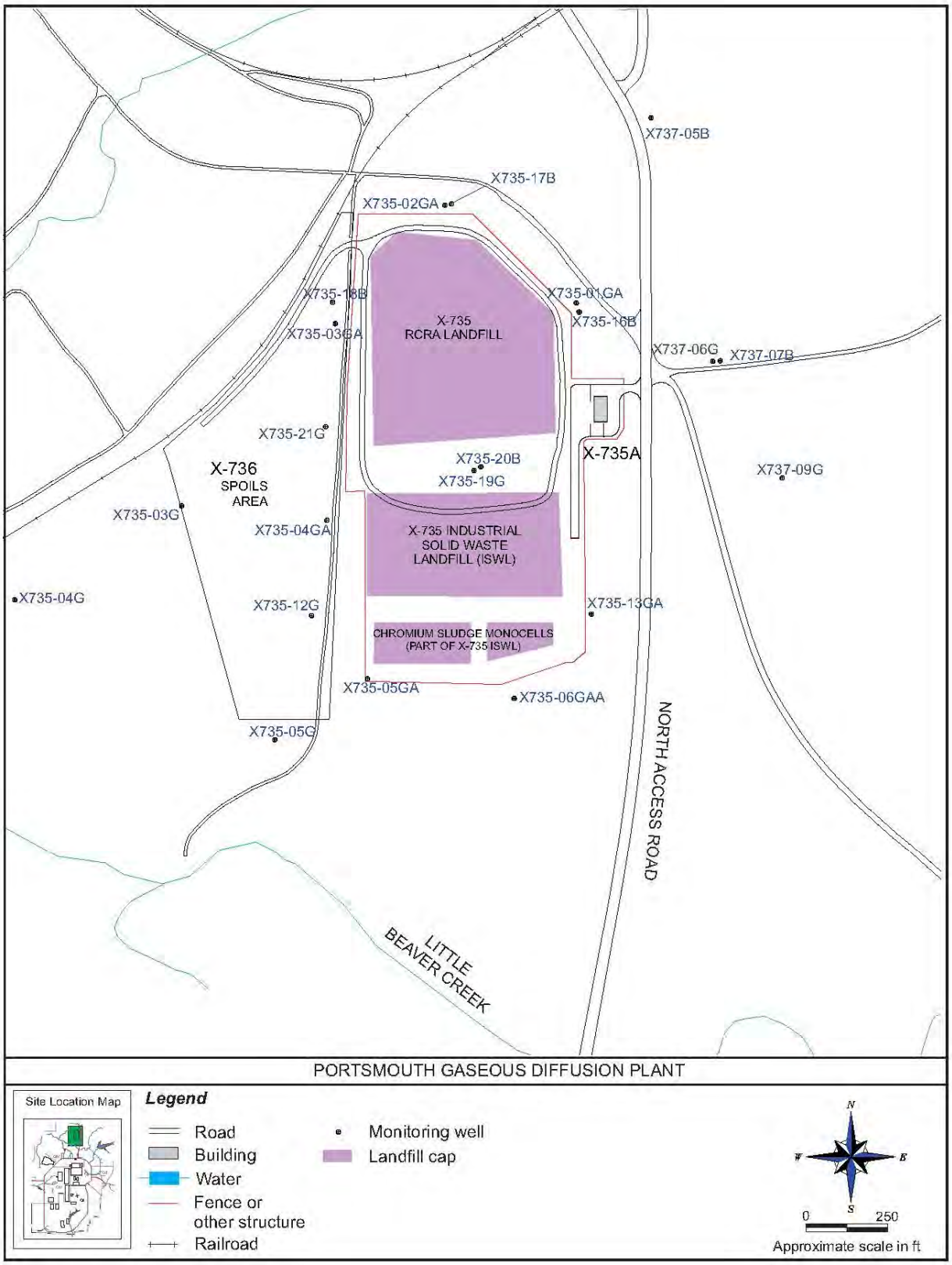

Figure 6.10. Monitoring wells at the X-735 Landfills.

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 2017

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 2017, no VOCs were detected at concentrations above the preliminary remediation goals in the samples collected from the X-734 monitoring wells.

Samples from the 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.

Samples collected from each well in the second quarter were also analyzed for transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238). No transuranics or technetium-99 were detected in the samples. Detections of uranium and uranium isotopes were typical for these wells and below the drinking water standard (30 µg/L for uranium).

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 2017

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 2017 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 9.7 to 60 µg/L, and concentrations of nickel detected in the wells ranged from 130 to 680 µg/L. Figure 6.6 shows the concentrations of metals detected in the X-533 wells in 2017.

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 well 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).

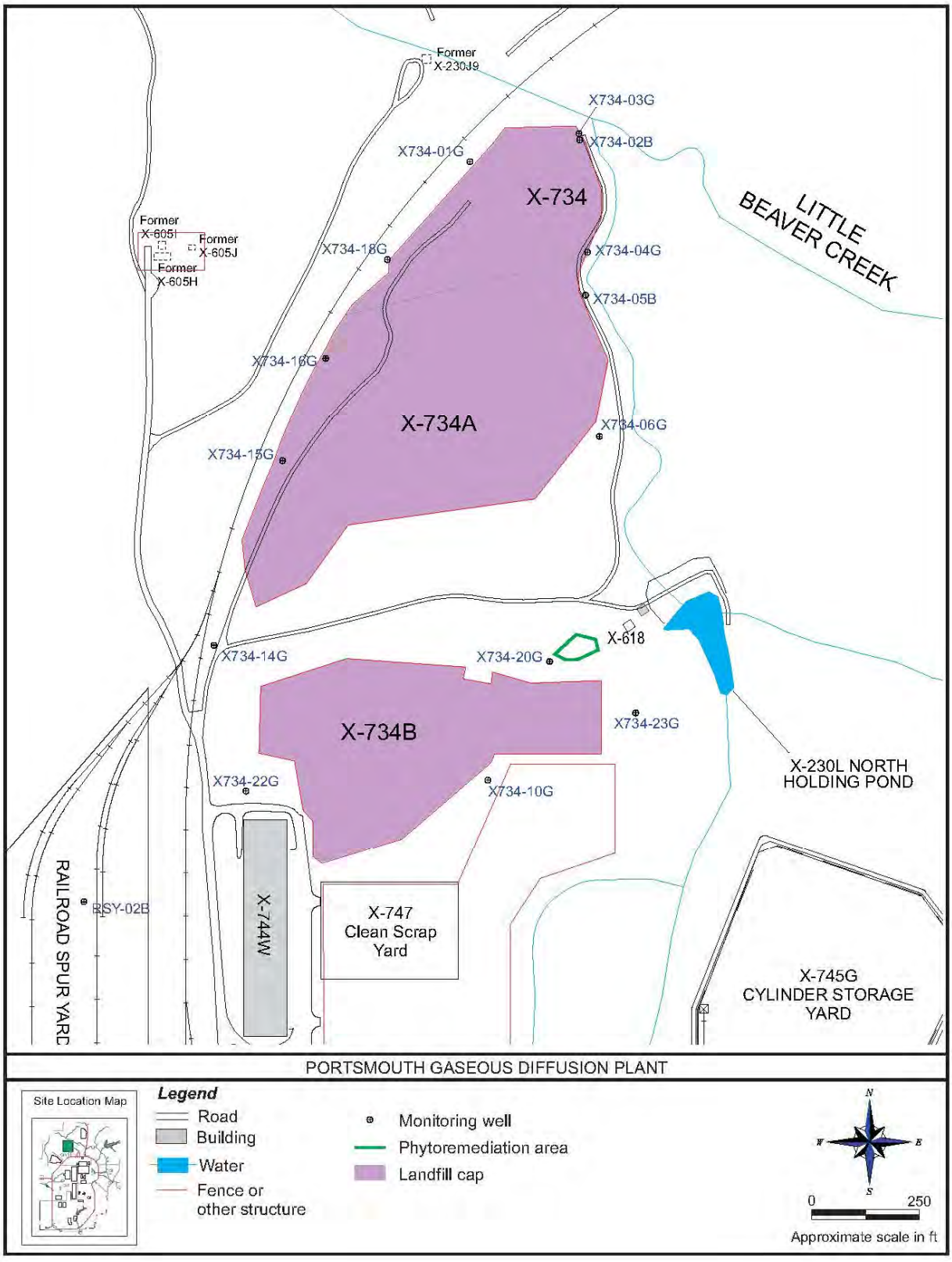

Figure 6.11. Monitoring wells at the X-734 Landfills.

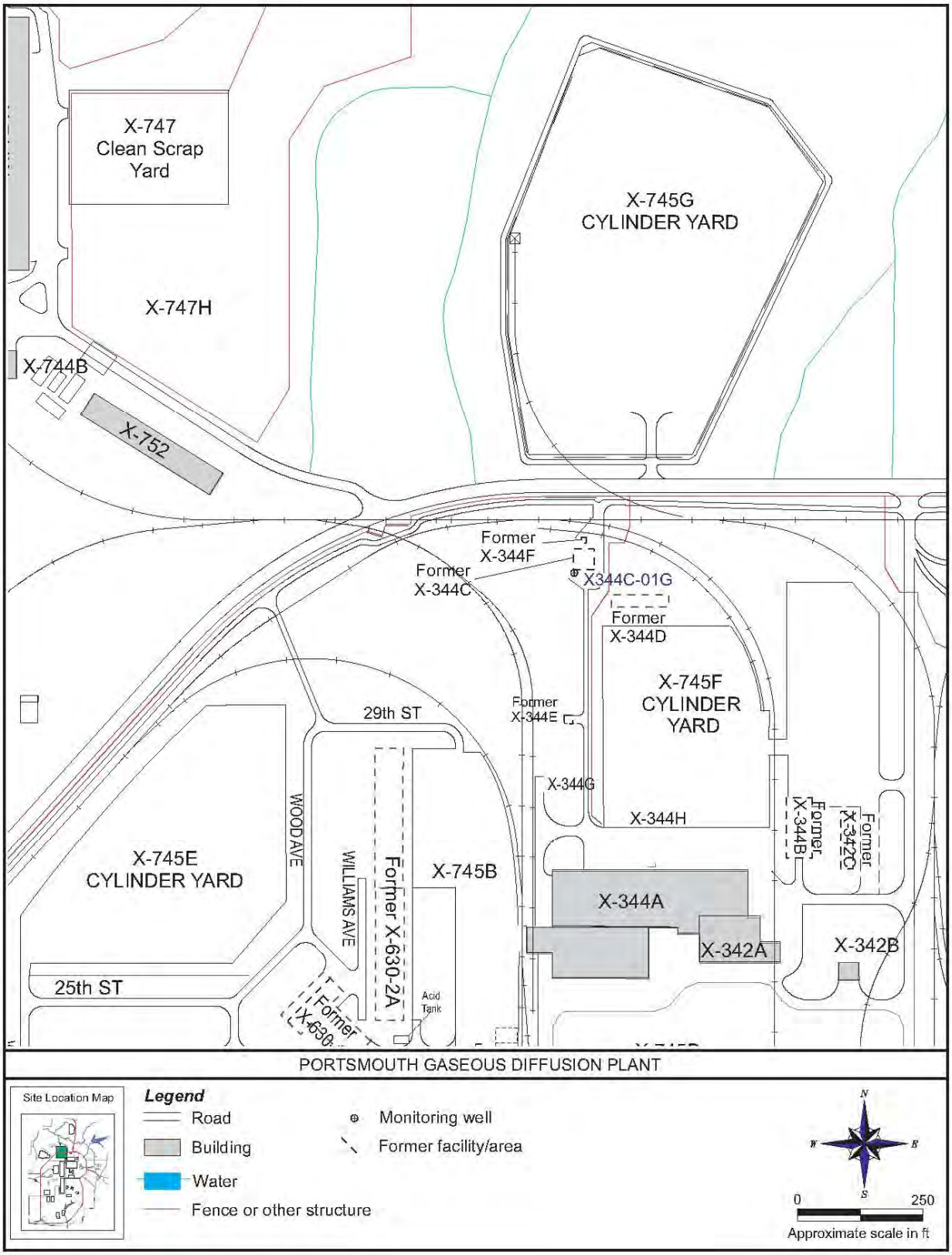

Figure 6.12. Monitoring well at the X-344C Former Hydrogen Fluoride Storage Building.

6.4.14.1 Monitoring results for the X-344C Former Hydrogen Fluoride Storage Building in 2017

Four VOCs, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, TCE, and vinyl chloride, were detected in the sample collected in the first quarter of 2017 at low concentrations less than 2 µg/L, which are below the preliminary remediation goals. These detections are consistent with the data collected at this well in 2009 through 2016.

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.

6.4.15.1 Monitoring results for surface water in 2017

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 well 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).

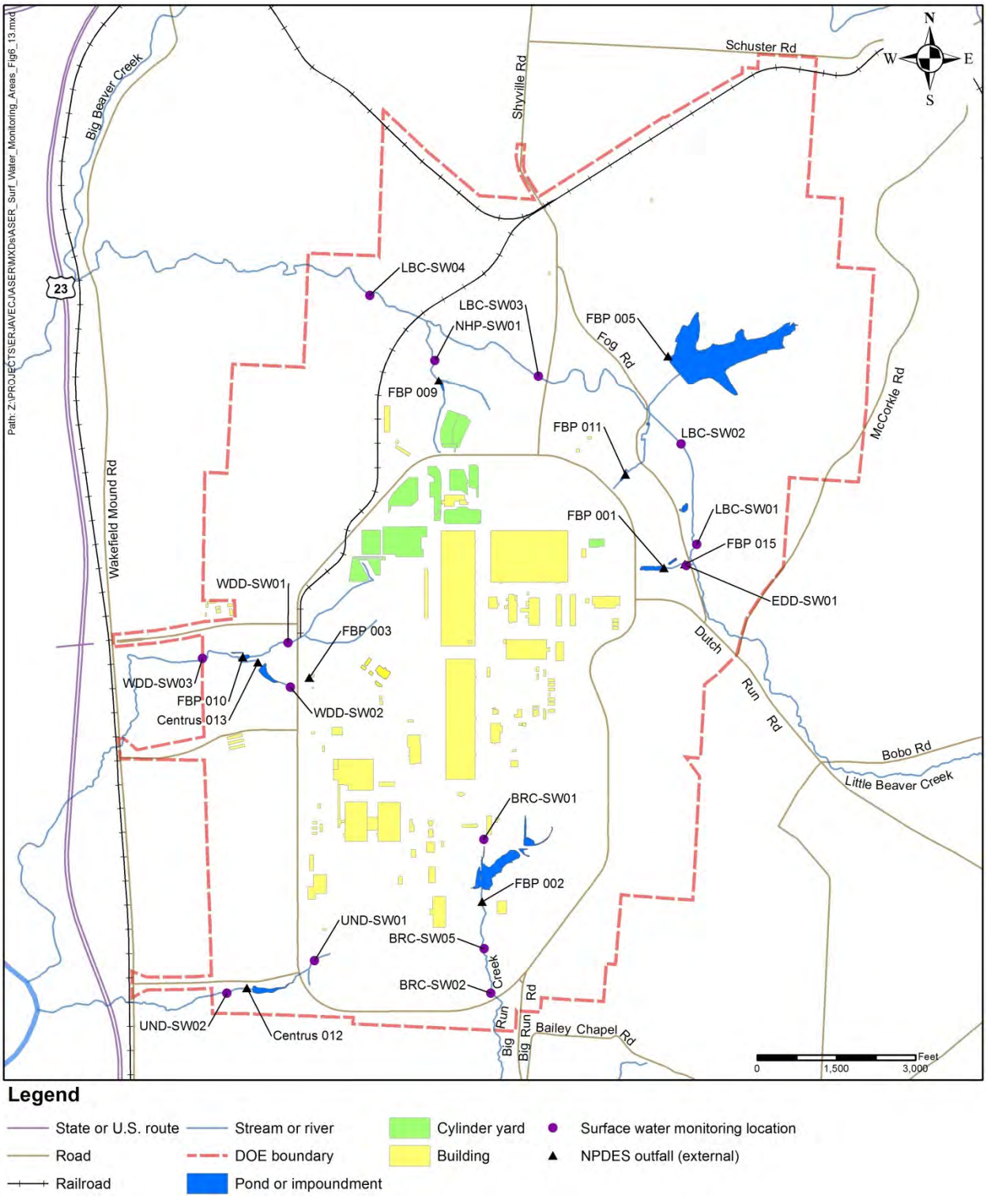

Figure 6.13. Surface water monitoring locations.

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). In 2017, TCE was detected at 1.0 to 4.4 µg/L in each of the four samples collected from the Southwestern Drainage Ditch at UND-SW01. *Cis*-1,2-dichloroethene, 1,1-dichloroethane, and 1,1-dichloroethene were also detected at estimated concentrations less than 0.5 µg/L in samples collected at UND-SW01. VOCs were not detected in the samples collected from the Southwestern Drainage Ditch at UND-SW02. The detections of TCE were well 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.

TCE and *cis*-1,2-dichloroethene were detected in samples collected from the East Drainage Ditch and Little Beaver Creek at a maximum concentration of 1.5 µg/L. TCE and other VOCs are routinely detected in East Drainage Ditch and Little Beaver Creek at low concentrations. All detections of TCE were well 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 2017 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 2017.

Technetium-99 was detected at levels up to 35.3 pCi/L in samples collected from the East Drainage Ditch (EDD-SW01) and Little Beaver Creek (LBC-SW01, LBC-SW02, LBC-SW03, and LBC-SW04). These detections are within the historical range of technetium-99 detected in surface water at PORTS, and are 0.08% or less of derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011a).

The concentrations of uranium detected in the surface water samples were 0.25% 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 2011a). The detections of uranium and uranium isotopes in surface water during 2017 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 2017d).

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 2017. Two residential drinking water sources that are included in the water supply monitoring program (RES-004 and RES-005) were not able to be sampled in 2017 because the well pumps were not operable. 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 2017. 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.

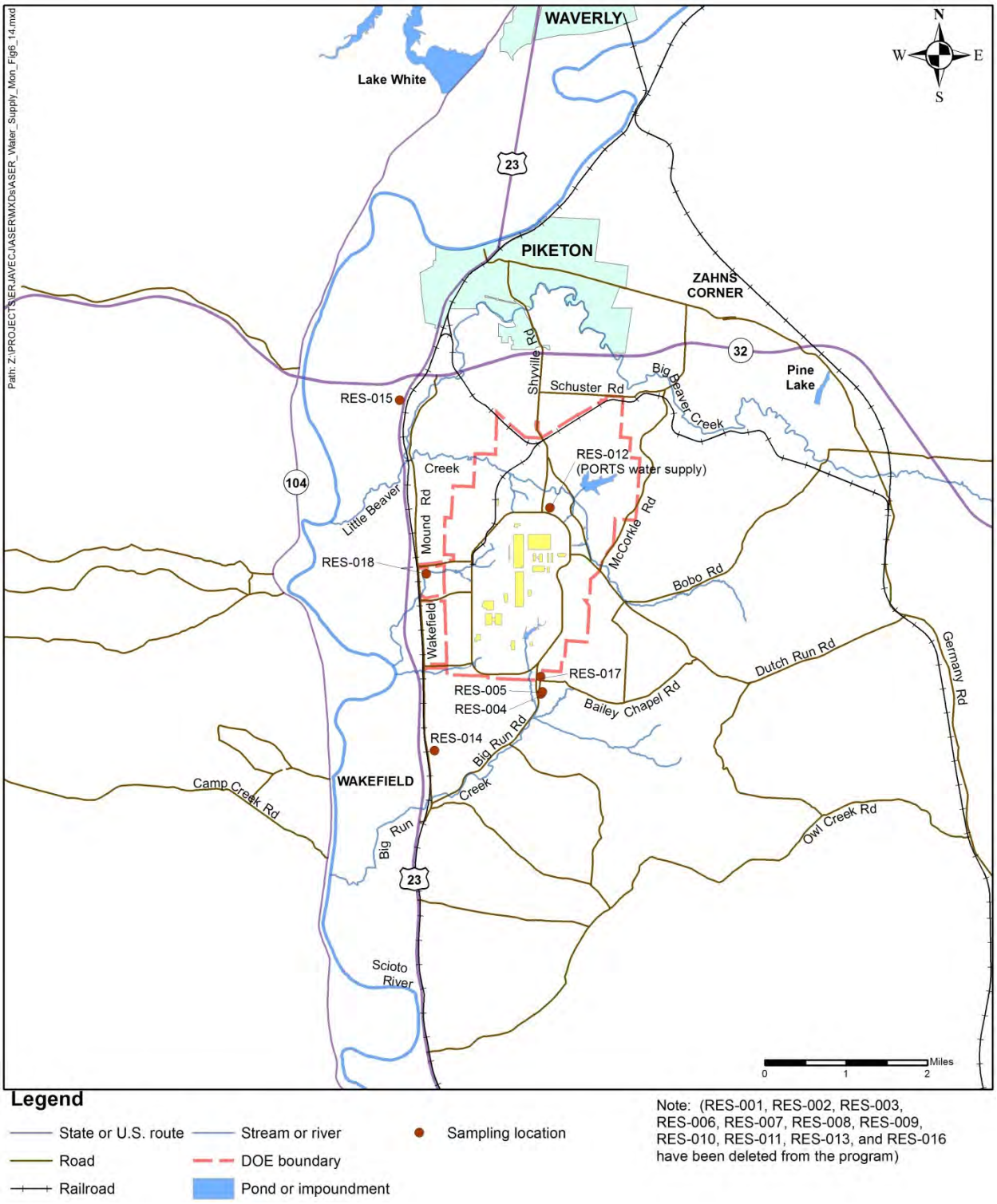

Figure 6.14. Water supply monitoring locations.

In the first and third quarters of 2017, TCE was detected at estimated concentrations ranging from 0.16 to 0.58 µg/L in the 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. The total concentration of these trihalomethanes was less than 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 2017. 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.

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 6.13). Trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in chlorinated drinking water, were detected in samples collected from the Western Drainage Ditch at concentrations well 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).

Technetium-99 was detected at 16.1 and 7.59 pCi/L in the first and fourth quarter samples collected at the surface water exit pathway monitoring location on Little Beaver Creek (LBC-SW04). These detections were 0.037% or less of the derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011a).

VOCs were also detected in several on-site groundwater monitoring wells that are part of the exit pathway monitoring program. TCE and other VOCs were detected in several 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 8.4 µg/L which is above the Ohio EPA drinking water standard (5 µg/L). All other detections of TCE and other VOCs in the exit pathway monitoring wells were below Ohio EPA drinking water standards.

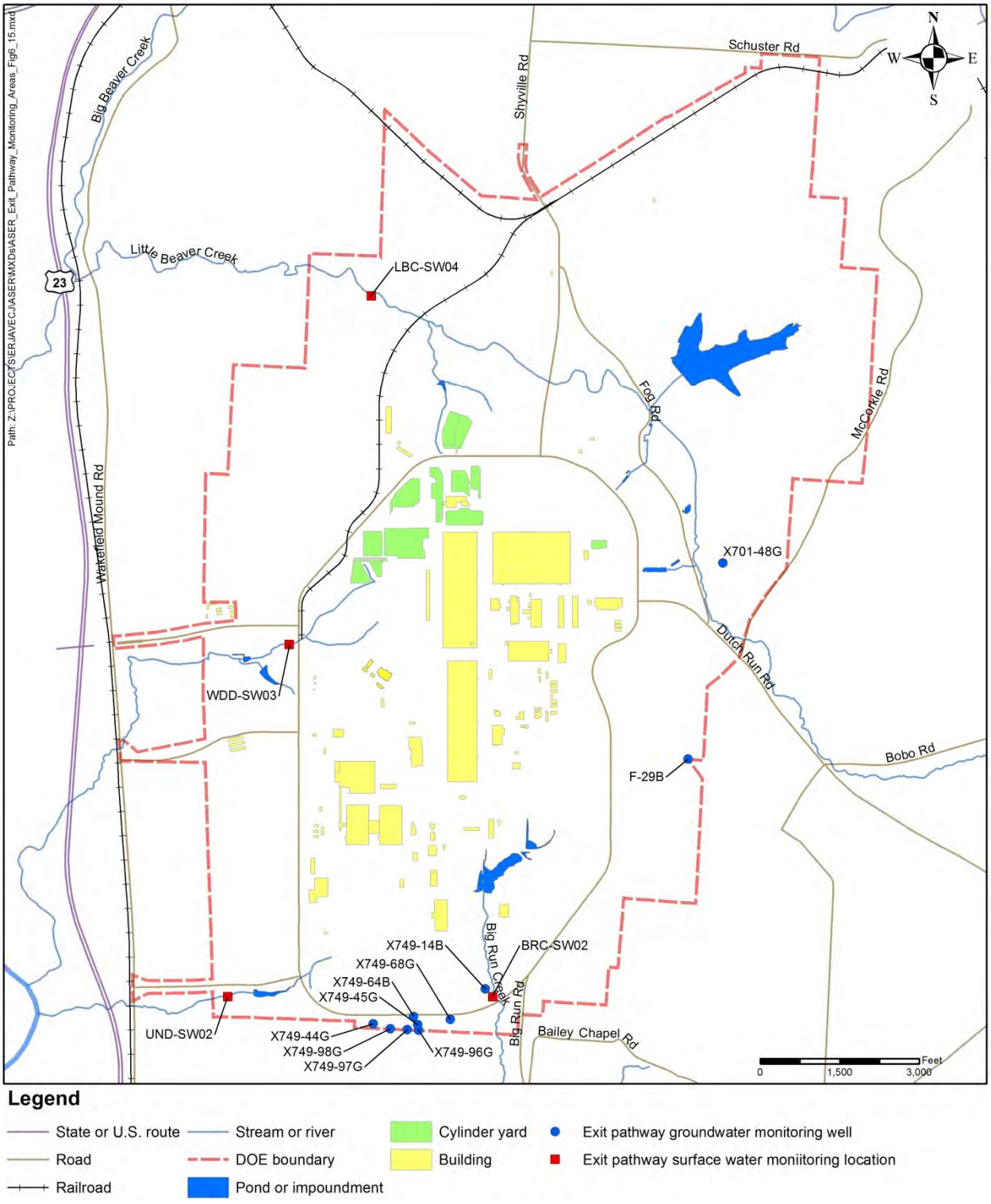

Figure 6.15. Exit pathway monitoring locations.

Samples from exit pathway monitoring wells were analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and uranium-238). If detected, radionuclides were present at levels below Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium).

6.6 GROUNDWATER TREATMENT FACILITIES

In 2017, a combined total of approximately 35.5 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 21.4 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 2017[a]

Facility	Gallons of water treated	Gallons of TCE removed
X-622	20,403,000	1.9
X-623	11,580	< 0.0002
X-624	3,545,300	9.2
X-627	11,502,399	10.3

[a]Source: *2017 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2018)

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 20.4 million gallons of groundwater during 2017, thereby removing approximately 1.9 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 2017.

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 2017, the X-623 Groundwater Treatment Facility operated intermittently to treat miscellaneous water associated with site activities in accordance with the NPDES permit. The X-623 Groundwater Treatment Facility did not operate in January, February, March, April, May, July, November, and December of 2017.

The facility treated 11,580 gallons of water during 2017, thereby removing less than 0.002 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 2017.

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 3.5 million gallons of water in 2017, thereby removing approximately 9.2 gallons 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 2017.

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).

Almost 11.5 million gallons of groundwater were processed during 2017, thereby removing approximately 10.3 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 2017.

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, and sample analysis. 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 2017 participated in the DOE Consolidated Audit Program and Mixed-Analyte Performance Evaluation Program.

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 2017 to ensure a consistent system for collecting, assessing, and documenting environmental data of known and documented quality.

7.3 FIELD SAMPLING AND MONITORING

Personnel involved in field 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. These procedures specify sampling protocol, sampling devices, containers, and preservatives to be used. Chain-of-custody procedures (used with all samples) are documented, and samples are controlled and protected from the point of collection to the generation of analytical results.

Data generated from field 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 blanks, trip blanks, and duplicate 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.

7.4 ANALYTICAL QUALITY ASSURANCE

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.

After analytical laboratory data are received by DOE contractors, they 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.

In 2017, samples collected for DOE environmental monitoring programs at PORTS such as NPDES monitoring, groundwater monitoring required by the *Integrated Groundwater Monitoring Plan* (DOE 2017d), and environmental monitoring required by the *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2017b), were sent to analytical laboratories that participated in DOE programs to ensure data quality. 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.

8. REFERENCES

American Nuclear Society 1986. *Glossary of Terms in Nuclear Science and Technology*, LaGrange Park, IL.

Biological Effects of Ionizing Radiations 1990. *Health Effects of Exposure to Low Levels of Ionizing Radiation*, Committee on the Biological Effects of Ionizing Radiations (BEIR V), National Research Council, National Academy of Sciences, National Academy Press, Washington, D.C.

DOE 1995. Memorandum, Pelletier to Pearson: *Requirements for Control of Settleable Solids*, Air, Water and Radiation Division: EH-412, Washington D.C., December 6.

DOE 1998a. *Quadrant III Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1360&D3, POEF-ER-4619&D3, U.S. Department of Energy, Piketon, OH, April.

DOE 1998b. *Quadrant IV Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1332&D3, POEF-ER-4609&D3, U.S. Department of Energy, Piketon, OH, August.

DOE 2000. *Quadrant I Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant*, *Piketon, Ohio*, DOE/OR/12-1248&D6, U.S. Department of Energy, Piketon, OH, May.

DOE 2001. *Quadrant II Cleanup Alternatives Study/Corrective Measures Study Final Report for Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/OR/12-1223&D5, U.S. Department of Energy, Piketon, OH, February.

DOE 2002a. *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota,* DOE-STD-1153-2002, U.S. Department of Energy, Washington, D.C., July.

DOE 2002b. *X-611A Prairie and X-749B Peter Kiewit Landfill Five-Year Evaluation Report for the Portsmouth Gaseous Diffusion Plant*, DOE/OR/11-3110&D1, U.S. Department of Energy, Piketon, OH, August.

DOE 2003. *Five-Year Evaluation Report for the X-740 Phytoremediation Project at the Portsmouth Gaseous Diffusion Plant*, *Piketon, Ohio,* DOE/OR/11-3135&D1, U.S. Department of Energy, Piketon, OH, October.

DOE 2007a. *Corrective Measures Plan for the X-735 Landfill at the Portsmouth Gaseous Diffusion Plant*, *Piketon, Ohio,* DOE/PPPO/03-0019&D4, U.S. Department of Energy, Piketon, OH, October.

DOE 2007b. *Supplemental Evaluation to the 2003 Five Year Evaluation Report for the X-740 Phytoremediation Area at the Portsmouth Gaseous Diffusion Plant*, *Piketon, Ohio,* DOE/PPPO/03-0038&D1, U.S. Department of Energy, Piketon, OH, January.

DOE 2008a. *First Five-Year Review for the Five-Unit Groundwater Investigative Area and X-231A/ X-231B Oil Biodegradation Plots at the Portsmouth Gaseous Diffusion Plant*, *Piketon, Ohio,* DOE/PPPO/03-0054&D2, U.S. Department of Energy, Piketon, OH, April.

DOE 2008b. *First Five-Year Review for the X-734 Landfill Area at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0073&D2, U.S. Department of Energy, Piketon, OH, December.

DOE 2008c. *Second Five-Year Review for the X-611A Prairie at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0072&D2, U.S. Department of Energy, Piketon, OH, December.

DOE 2008d. *Second Five-Year Review for the X-749B Peter Kiewit Landfill at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0053&D2, U.S. Department of Energy, Piketon, OH, March.

DOE 2010. *Community Relations Plan for the U.S. Department of Energy's Decontamination and Decommissioning Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0128&D1, U.S. Department of Energy, Piketon, OH, June.

DOE 2011a. *Derived Concentration Technical Standard,* DOE-STD-1196-2011, U.S. Department of Energy, Washington, D.C., April.

DOE 2011b. *First Five-Year Review for the X-749/X-120 Groundwater Plume at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0187V1&D1, DOE/PPPO/03-0187V2&D1, U.S. Department of Energy, Piketon, OH, January.

DOE 2012. *Addendum to the Community Relations Plan for the U.S. Department of Energy's Decontamination and Decommissioning Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0128&D2/A1, U.S. Department of Energy, Piketon, OH, September.

DOE 2013a. *Second Five-Year Review for the Five-Unit Groundwater Investigative Area and X-231A/ X-231B Oil Biodegradation Plots at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0490&D1, U.S. Department of Energy, Piketon, OH, September.

DOE 2013b. *Second Five-Year Review for the X-734 Landfill Area at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0559&D1, U.S. Department of Energy, Piketon, OH, December.

DOE 2013c. *Third Five-Year Review for the X-611A Prairie at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0482&D2, U.S. Department of Energy, Piketon, OH, July.

DOE 2013d. *Third Five-Year Review for the X-749B Peter Kiewit Landfill at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0489&D1, U.S. Department of Energy, Piketon, OH, September.

DOE 2014. *Final Report for the 7-Unit Interim Remedial Measure at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0606&D1, U.S. Department of Energy, Piketon, OH, October.

DOE 2015a. *Deferred Units Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Work Plan at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0252&D3, U.S. Department of Energy, Piketon, OH, March.

DOE 2015b. *Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0032&D8, U.S. Department of Energy, Piketon, OH, July.

DOE 2015c. *Record of Decision for Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0425&D2, U.S. Department of Energy, Piketon, OH, July.

DOE 2015d. *Record of Decision for the Site-wide Waste Disposition Evaluation Project at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0513&D2, U.S. Department of Energy, Piketon, OH, June.

DOE 2015e. *Remedial Design/Remedial Action Work Plan for the On-site Waste Disposal Facility Initial Site Preparation and Construction Activities at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0691&D1, U.S. Department of Energy, Piketon, OH, September.

DOE 2016a. *Addendum to Remedial Design/ Remedial Action Work Plan for On-site Waste Disposal Facility Initial Site Preparation and Construction Activities at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio, Phase II Initial Site Construction – Addendum,* DOE/PPPO/03-0691&D1/A1, U.S. Department of Energy, Piketon, OH, September.

DOE 2016b. *Final Report for the X-740 Pilot Study at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPO/03-0748&D1, U.S. Department of Energy, Piketon, OH, May.

DOE 2016c. *Remedial Design/Remedial Action Work Plan and Remedial Design for the Process Buildings Deactivation at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio – Deactivation of X-326, X-330, X-333, X-111A, X-111B, X-232C1, X-232C2, X232C3, X-232C4, and X-232C5,* DOE/PPPO/03-0665&D2, U.S. Department of Energy, Piketon, OH, April.

DOE 2016d. *Second Five-Year Review for the X-749/X-120 Groundwater Plume at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0756&D1, U.S. Department of Energy, Piketon, OH, June.

DOE 2017a. *Deferred Units Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Report at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0772&D1, U.S. Department of Energy, Piketon, OH, September.

DOE 2017b. *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0009&D5, U.S. Department of Energy, Piketon, OH, April.

DOE 2017c. *Fiscal Year 2018 Site Sustainability Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio*, DOE/PPPO/03-0838&D1, U.S. Department of Energy, Piketon, OH, December.

DOE 2017d. *Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0032&D10, U.S. Department of Energy, Piketon, OH, August.

DOE 2017e. *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0127&D9, U.S. Department of Energy, Piketon, OH, June.

DOE 2017f. *The Role of the Portsmouth Gaseous Diffusion Plant in Cold War History*, DOE/PPPO/03-0683&D1, U.S. Department of Energy, Piketon, OH February.

DOE 2018. *2017 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0847&D1, U.S. Department of Energy, Piketon, OH, March.

FBP 2014. *Comprehensive Summary Report of Cultural Resource Investigations Conducted at the Portsmouth Gaseous Diffusion Plant (PORTS Facility), Scioto and Seal Townships, Pike County, Ohio,* FBP-ER-GEN-BG-RPT-0055, Revision 4, Gray & Pape, Inc., Cincinnati, OH, May.

Hamby, D. M. 1991. *LADTAP XL: An Improved Electronic Spreadsheet Version of LADTAP II*, DE93003179, Westinghouse Savannah River Company, Aiken, SC.

Health Physics Society 2010. *Environmental Radiation* (Fact Sheet – Adopted January 2010), available at hps.org (accessed March 2, 2016).

Jannik and Dixon 2006. *LADTAP-PA: A Spreadsheet for Estimating Dose Resulting from E-Area Groundwater Contamination at the Savannah River Site*, Savannah River National Laboratory, Aiken, SC.

McGraw-Hill 1989. *McGraw-Hill Dictionary of Scientific and Technical Terms,* 4th ed., McGraw-Hill, Inc., NY.

National Council on Radiation Protection 2009. *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No. 160, National Council on Radiation Protection and Measurements, Bethesda, MD.

Ohio EPA 1996a. *Decision Document Peter Kiewit Landfill, U.S. DOE Portsmouth, Pike County, Ohio*, Ohio Environmental Protection Agency, Columbus, OH, May.

Ohio EPA 1996b. *Decision Document X-611A Solid Waste Management Unit U.S. DOE Portsmouth, Pike County, Ohio*, Ohio Environmental Protection Agency, Columbus, OH, June.

Ohio EPA 1999a. *Ohio Environmental Protection Agency's Decision Document for Quadrant III of the Portsmouth Gaseous Diffusion Plant*, Ohio Environmental Protection Agency, Columbus, OH, March.

Ohio EPA 1999b. *The Decision Document for the X-734 Landfill Area in Quadrant IV of the Portsmouth Gaseous Diffusion Plant*, Ohio Environmental Protection Agency, Columbus, OH, September.

Ohio EPA 2000. *U.S. DOE Portsmouth QIV Decision Document*, Ohio Environmental Protection Agency, Columbus, OH, September.

Ohio EPA 2001. *U.S. DOE Portsmouth Quadrant I Decision Document Portsmouth Gaseous Diffusion Plant*, Ohio Environmental Protection Agency, Columbus, OH, March.

Ohio EPA 2003. *Ohio EPA's Decision Document for the X-701B SWMU in Quadrant II of the U.S. DOE Portsmouth Facility, Piketon, Ohio*, Ohio Environmental Protection Agency, Columbus, OH, December.

Ohio EPA 2010. *State of Ohio Cooperative Fish Tissue Monitoring Program Sport Fish Tissue Consumption Advisory Program*, State of Ohio, Columbus, OH, October.

Ohio EPA 2012. *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, Columbus, OH, July 16.

Ohio EPA 2018. *Ohio Sport Fish Consumption Advisory,* Ohio EPA Division of Surface Water, Columbus, OH, April.

U.S. Census Bureau 2018. U.S. Census Bureau, census.gov, population estimates for 2017, (accessed July 10, 2018).

U.S. EPA 1988. *Federal Guidance Report No. 11 (FGR 11) Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Immersion, and Ingestion*, EPA-520/1-88-020, U.S. Environmental Protection Agency, Washington, D.C.

U.S. EPA 1997a. *Exposure Factors Handbook,* EPA/600/P-95/002Fa, U.S. Environmental Protection Agency, Washington, D.C.

U.S. EPA 1997b. *Record of Decision/Statement of Basis Peter Kiewit Landfill United States Department of Energy Portsmouth Gaseous Diffusion Plant Pike County, Ohio,* U.S. Environmental Protection Agency, Washington, D.C. May.

U.S. EPA 2017. Regional Screening Level (RSL) Summary Table (TR=1E-06, HQ=1) June 2017, Screening level for PCB-1254/PCB-1260 in residential soil, epa.gov/risk/risk-based-screening-table-generic-tables (accessed November 3, 2017).

Westinghouse Savannah River Company 1994. *Savannah River Site Environmental Report for 1993, Summary Pamphlet,* Savannah River, GA.

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APPENDIX A

RADIATION

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This appendix presents basic facts concerning radiation. The information is intended as a basis for understanding the dose associated with releases from 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* 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, sources, and pathways of radiation; radiation measurement; and dose information.

A.1 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 A.1 depicts 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.

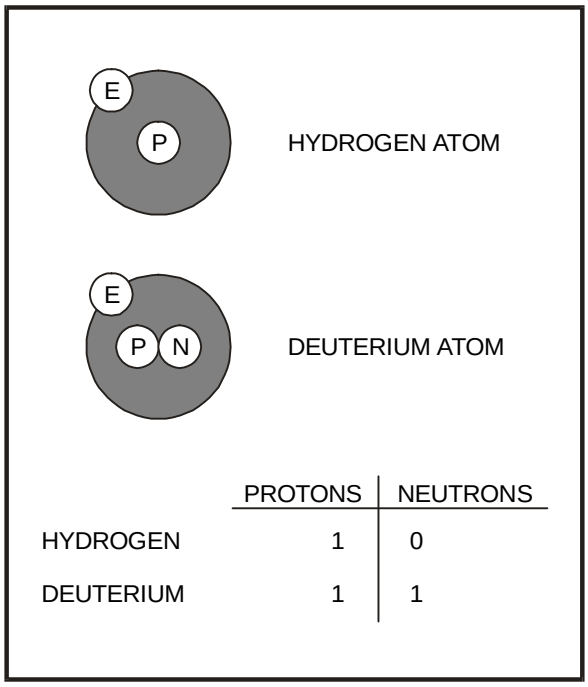

Figure A.1. Isotopes of the element hydrogen

Some isotopes are stable, or nonradioactive; some are radioactive. Radioactive isotopes are called radioisotopes, or radionuclides. In an attempt to become stable, radionuclides "throw away," or emit, rays or particles. This emission of rays and particles is known as radioactive decay. 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.

A.2 RADIATION

Radiation, or radiant energy, is energy in the form of waves or particles moving through space. Visible light, heat, radio waves, and alpha particles are examples of radiation. When people feel warmth from the sunlight, they are actually absorbing the radiant energy emitted by the sun.

Electromagnetic radiation is radiation in the form of electromagnetic waves; examples include gamma rays, ultraviolet light, and radio waves. Particulate radiation is radiation in the form of particles; examples include alpha and beta particles. Radiation also is characterized as ionizing or nonionizing radiation by the way in which it interacts with matter.

A.2.1 Ionizing Radiation

Normally, an atom has an equal number of protons and electrons; however, atoms can lose or gain electrons in a process known as ionization. Some forms of radiation can ionize atoms by "knocking" electrons off atoms. Examples of ionizing radiation include alpha, beta, and gamma 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. Figure A.2 shows the penetrating potential of different types of ionizing radiation.

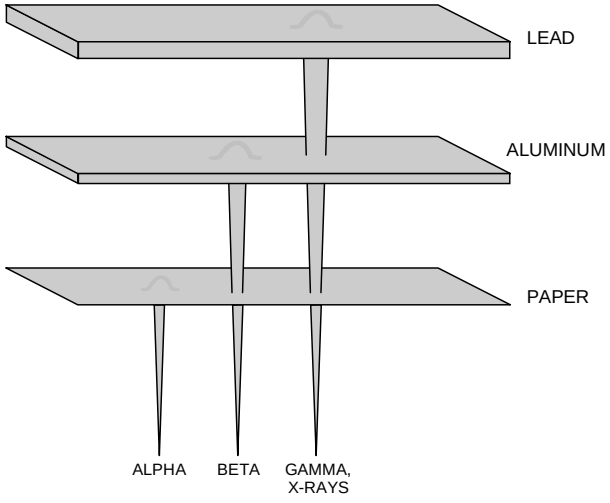

Figure A.2. Penetrating power of radiation.

A.2.2 Nonionizing Radiation

Nonionizing radiation bounces off or passes through matter without displacing electrons. Examples include visible light and radio waves. Currently, it is unclear whether nonionizing radiation is harmful to human health. In the discussion that follows, the term radiation is used to describe ionizing radiation.

A.3 SOURCES OF RADIATION

Radiation is everywhere. Most occurs naturally, but a small percentage is human-made. Naturally occurring radiation is known as background radiation.

A.3.1 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 space, terrestrial, or internal, depending on its origin.

A.3.1.1 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 space or cosmic radiation. Because the atmosphere provides some shielding against space radiation, the intensity of this radiation increases with altitude above sea level. For example, a person in Denver, Colorado, is exposed to more space radiation than a person in Death Valley, California.

A.3.1.2 Terrestrial radiation

Terrestrial radiation refers to radiation emitted from radioactive materials in the earth's rocks, soils, and minerals. Radon (Rn); radon progeny, the relatively short-lived decay products of radium-226 (^{226}Ra); potassium (^{40}K); isotopes of thorium (Th); and isotopes of uranium (U) are the elements responsible for most terrestrial radiation.

A.3.1.3 Internal radiation

Radioactive material in the environment can enter the body through the air people breathe and the food they eat; it also can enter through an open wound. Natural radionuclides that can be inhaled and ingested include isotopes of uranium, thorium, radium, radon, polonium, bismuth, and lead in the ^{238}U and ^{232}Th decay series. In addition, the body contains isotopes of potassium (^{40}K), rubidium (^{87}Rb), and carbon (^{14}C).

A.3.2 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. Atmospheric testing of atomic weapons was a source of human-made radiation, but testing has been suspended in the United States and most parts of the world. Fallout from atmospheric weapons testing is not currently a significant contributor to background radiation (Health Physics Society 2010).

A.3.2.1 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 space radiation).

A.3.2.2 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.

A.3.2.3 Industrial and occupational sources

Other sources of radiation include emissions of radioactive materials from nuclear facilities such as uranium mines, fuel processing plants, 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. These occupations include positions in medicine, aviation, research, education, and government.

A.4 PATHWAYS OF RADIATION

Radiation and radioactive materials in the environment can reach people through many routes (see Figure A.3). Potential routes for radiation are referred to as pathways. For example, 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. Or people could simply inhale the radioactive material in the air. 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 radiation in the fish. Or people swimming in the water would be exposed.

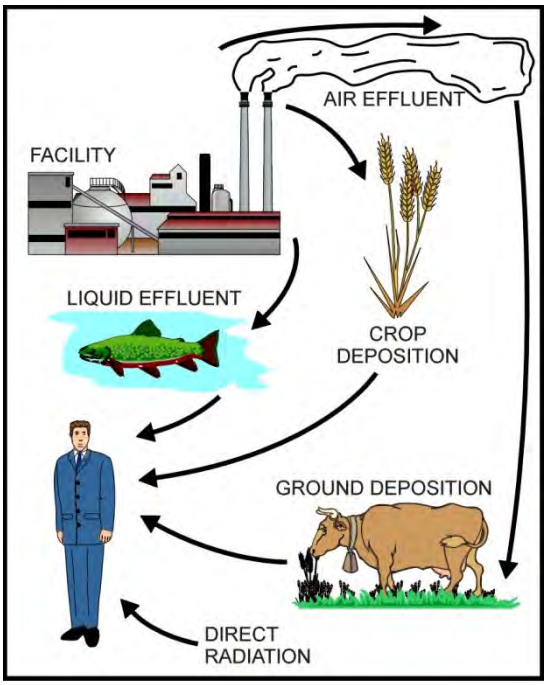

Figure A.3. Possible radiation pathways.

A.5 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.

A.5.1 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 Ci = 3.7E+10 (37,000,000,000) atom disintegrations per second (dps). In the international system of units, 1 dps = 1 becquerel (Bq). Table A.1 provides units of radiation measure and applicable conversions.

Table A.1. Units of radiation measures

Current System	International System	Conversion
curie (Ci)	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

A.5.2 Absorbed Dose

The total amount of energy absorbed per unit mass as a result of exposure to radiation is expressed in a unit of measure known as a rad. In the international system of units, 100 rad equals 1 gray (Gy). In terms of human health, however, it is the effect of the absorbed energy that is important, not the actual amount.

A.5.3 Dose

The measure of potential biological damage caused by exposure to and subsequent absorption of radiation 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 expressed as a millirem (mrem) or 1/1000 of a rem. In the international system of units, 100 rem equals 1 sievert (Sv); 100 mrem equals 1 millisievert (mSv). Specific types of dose are defined as follows:

- **equivalent dose** – The product of the absorbed dose (rad) in tissue and a radiation weighting factor. Equivalent dose is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).

- **committed equivalent dose** – The calculated equivalent dose to a tissue or organ over a 50-year period after known intake of a radionuclide into the body. Contributions from external dose are not included. Committed equivalent dose is expressed in units of rem (or sievert).

- **committed effective dose** – The sum of the committed equivalent doses to various tissues in the body, each multiplied by the appropriate tissue weighting factor. Committed effective dose is expressed in units of rem (or sievert).

- **effective dose** – The sum of the doses received by all organs or tissues of the body after each one has been multiplied by the appropriate tissue weighting factor. It includes the dose from radiation sources internal and/or external to the body. Effective dose is expressed in units of rem (or sievert). In this report, the term "effective dose" is often shortened to "dose".

- **collective dose** – The sum of the effective doses to all persons in a specified population received in a specified period of time. Collective dose is expressed in units of person-rem (or person-sievert). This dose is also called the population dose.

A.6 DOSE

Determining dose is an involved process using complex mathematical equations based on several factors, including the type of radiation, the rate of exposure, weather conditions, and typical diet. Basically, ionizing radiation is generated from radioactive decay, or activity. People absorb some of the energy to which they are exposed. This absorbed energy is calculated as part of an individual's dose. Whether radiation is natural or human-made, its effects on people are the same.

A.6.1 Comparison of Dose Levels

Table A.2 presents a scale of dose levels. Included is an example of the type of exposure that may cause such a dose or the special significance of such a dose. This information is intended to familiarize the reader with the type of doses individuals may receive.

A.6.1.1 Dose from space radiation

The average annual dose received by residents of the United States from space radiation is about 33 mrem (0.33 mSv) (NCRP 2009). The average dose to a person living in Honolulu, Hawaii (at sea level and near the equator) is about 20 mrem (0.2 mSv), while the average dose to a person living in Colorado Springs, Colorado (high altitude and latitude) is about 70 mrem (0.7 mSv) (Health Physics Society 2010).

Table A.2. Comparison and description of various dose levels[a]

Dose level	Description
0.85 mrem (0.0085 mSv)	Approximate daily dose from natural background radiation, including radon
1.92 mrem (0.0192 mSv)	Cosmic dose to a person on a one-way airplane flight from Washington D.C. to Seattle
10 mrem (0.10 mSv)	Annual exposure limit, set by 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 (0.36 mSv)	Average annual dose to a person who smokes one pack of cigarettes per day
36 mrem (0.36 mSv)	Mammogram (two views)
46 mrem (0.46 mSv)	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 (0.60 mSv)	X-ray (single exposure) of abdomen or hip
100 mrem (1.00 mSv)	Annual limit of dose from all DOE facilities to a member of the public who is not a radiation worker
244 mrem (2.44 mSv)	Average dose from an upper gastrointestinal diagnostic X-ray series
300 mrem (3.00 mSv)	Average annual dose to a person in the United States from all sources of medical radiation
311 mrem (3.11 mSv)	Average annual dose to a person in the United States from all sources of natural background radiation
700 mrem (7.0 mSv)	Computed tomography – chest
1-5 rem (0.01-0.05 Sv)	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
5 rem (0.05 Sv)	Annual limit for occupational exposure of radiation workers set by the Nuclear Regulatory Commission and DOE
10 rem (0.10 Sv)	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% (Biological Effects of Ionizing Radiation 1990)
25 rem (0.25 Sv)	U.S. EPA guideline for voluntary maximum dose to emergency workers for non-lifesaving work during an emergency
75 rem (0.75 Sv)	U.S. EPA guideline for maximum dose to emergency workers volunteering for lifesaving work
50-600 rem (0.50-6.00 Sv)	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).

A.6.1.2 Dose from terrestrial radiation

The average annual dose received from terrestrial gamma radiation is about 21 mrem (0.21 mSv) in the United States (NCRP 2009). Similar to space 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.

A.6.1.3 Dose from internal radiation

Inhalation of the short-lived decay products of radon are the major contributors to the annual dose equivalent for internal radionuclides (mostly ^{222}Rn). They contribute an average dose of about 228 mrem (2.28 mSv) per year (NCRP 2009). The average dose from ingestion of radionuclides is about 29 mrem (0.29 mSv) per year, which can be attributed to the naturally occurring radioisotope of potassium, ^{40}K; and radioisotopes of thorium (Th), uranium (U), and their decay series (NCRP 2009).

A.6.1.4 Dose from consumer products

The U.S. average annual dose received by an individual from consumer products is about 13 mrem (0.13 mSv) (NCRP 2009). Almost 90 percent of this dose results from smoking cigarettes, commercial air travel, and building materials (radionuclides present in brick, masonry, cement, concrete, and other materials).

A.6.1.5 Dose from medical sources

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 (a more sophisticated type of x-ray), and 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 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.

A.6.1.6 Doses from industrial and occupational sources

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 (0.01 mSv) per year to the average dose to an individual (NCRP 2009).

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APPENDIX B

ENVIRONMENTAL PERMITS

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Table B.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
Permit to Install X-627 Groundwater Treatment Facility (06-07283)	P474, T104, T105	3/15/2005	None	Active
Permit to Install and Operate X-326 L-cage Glove Box (P0104170)	P022	11/12/2008	11/12/2018	Active
Permit to Install and Operate X-735 Landfill Cap and Venting System (northern portion) (P0104170)	P023	11/12/2008	11/12/2018	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-720 Instrument Cleaning Room Hood 4 (06-07928)	P065	11/03/2005	None	Active
Permit to Install X-720 Motor Shop Steam Cleaning Booth (06-07928)	P067	11/03/2005	None	Active
Permit to Install X-344 Pigtail Gulper (06-07760)	P430	05/17/2005	None	Active
Permit to Install X-701B In Situ Chemical Oxidation with Recirculation Treatment System (06-07666)	P475, T106	03/15/2005	None	Inactive
Permit to Install X-720 Instrument Cleaning Room Glove Box (06-07000)	P474	11/19/2002	None	Active
Permit to Install X-705 Dry Ice Blaster with HEPA Filter (06-06752)	P473	04/11/2002	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

Table B.1. DOE environmental permits and registrations at PORTS (continued)

Permit/registered source	Source no.	Issue date	Expiration date	Status
	FBP– Clean Air Act Permits (continued)			
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
	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*MD	6/1/2017 (effective date)	8/31/2020	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*BD	5/13/2014	5/31/2019	Active
	FBP – Hazardous Waste Permit			
RCRA Part B Permit (DOE/FBP)	Ohio Permit No. 04-66-0680	3/25/2011	3/25/2021	Active
	FBP – Registrations			
Underground Storage Tank Registration	66005107		Renewed annually	Active

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
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 2011a), Table A.3.

DOE/PPPO/03-0862&D1

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U.S. Department of Energy

Portsmouth Gaseous Diffusion Plant

Annual Site Environmental Data 2017

Tuliptree silkmoth

December 2018

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Data – 2017
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0863&D1

December 2018

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

FBP-ER-RCRA-WD-RPT-0289, Revision 1

This document has been approved for public release:

Samuel C. Eldridge (signature on file) 12/20/2018
Classification Office Date

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TABLES

ACRONYMS AND ABBREVIATIONS

#/100 mL	number per 100 mL
ACP	American Centrifuge Plant
BWCS	BWXT Conversion Services, LLC
°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
ND	not detected
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 2017 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 – 2017* (DOE 2018b).

Radiological monitoring data presented in this Data Report and discussed in the *Annual Site Environmental Report for 2017* indicate that the maximum dose a member of the public could receive from radionuclides released by PORTS in 2017 or detected by environmental monitoring programs in 2017 is 0.90 millirem (mrem). This dose is significantly less than the 100 mrem limit set in DOE Order 458.1, *Radiation Protection of the Public and the Environment.*

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 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 – 2017* (DOE 2018b) provides more information about non-radiological chemicals released from PORTS or detected by PORTS monitoring programs during 2017.

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2. ENVIRONMENTAL MONITORING

This section provides environmental monitoring data collected in 2017 by DOE contractors Fluor-BWXT Portsmouth LLC (FBP), Mid-America Conversion Services, LLC (MCS), and BWXT Conversion Services, LLC (BWCS). MCS assumed operation of the depleted uranium hexafluoride conversion facility at PORTS from BWCS on February 1, 2017. 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 – 2017
- Table 2.2. FBP NPDES permit summary – 2017
- Table 2.3. MCS NPDES permit summary – 2017
- Table 2.4. FBP NPDES discharge and compliance rates – 2017
- Table 2.5. MCS NPDES discharge and compliance rates – 2017
- Table 2.6. Centrus NPDES discharge monitoring results – 2017
- Table 2.7 Radionuclides in surface water runoff samples from FBP and MCS cylinder storage yards – 2017
- Table 2.8. Drainage basin monitoring of surface water and sediment for MCS cylinder storage yards – 2017
- Table 2.9. Ambient air monitoring program summary for radionuclides and fluoride – 2017
- Table 2.10. External radiation monitoring program (mrem) – 2017
- Table 2.11. External radiation monitoring (mrem) at locations near cylinder storage yards – 2017
- Table 2.12. Settleable solids monitoring results – 2017
- Table 2.13. Local surface water monitoring program results – 2017
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- Table 2.15. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2017
- Table 2.16. Biota (fish) monitoring program results – 2017
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- Table 2.18. Biota (deer) monitoring program results – 2017
- Table 2.19. Biota (off-site dairy) monitoring program results – 2017.

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2017

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
001	Americium-241	4(4)	< 0.00493	< 0.0462	
	Neptunium-237	4(4)	0	< 0.0188	
	Plutonium-238	4(4)	0	< 0.013	
	Plutonium-239/240	4(4)	< 0.0222	< 0.0391	
	Technetium-99	12(4)	< 0.0884	89.2	
	Uranium	12(0)	0.359	3.3	1.03
	Uranium-233/234	12(0)	0.697	6.55	1.88
	Uranium-235/236	12(8)	< 0.0233	0.332	
	Uranium-238	12(0)	0.115	1.06	0.330
002	Americium-241	4(4)	< 0.00534	< 0.037	
	Neptunium-237	4(4)	0	< 0.00486	
	Plutonium-238	4(4)	0	< 0.0292	
	Plutonium-239/240	4(4)	0	< 0.0268	
	Technetium-99	12(11)	0	3.77	
	Uranium	12(0)	0.312	1.05	0.72
	Uranium-233/234	12(0)	0.489	1.15	0.70
	Uranium-235/236	12(12)	< 0.0181	< 0.0764	
	Uranium-238	12(0)	0.101	0.346	0.234
003	Americium-241	4(4)	< 0.00974	< 0.0255	
	Neptunium-237	4(4)	0	< 0.00938	
	Plutonium-238	4(4)	0	< 0.0142	
	Plutonium-239/240	4(4)	0	< 0.0332	
	Technetium-99	12(2)	< 4.53	55.7	
	Uranium	12(0)	0.367	2.61	1.70
	Uranium-233/234	12(0)	0.195	2.14	1.42
	Uranium-235/236	12(7)	< 0.027	0.14	
	Uranium-238	12(0)	0.119	0.856	0.559
004	Americium-241	4(4)	< 0.0103	< 0.0529	
	Neptunium-237	4(4)	0	< 0.0114	
	Plutonium-238	4(4)	0	< 0.0103	
	Plutonium-239/240	4(4)	< 0.00535	< 0.0258	
	Technetium-99	12(12)	0	< 4.5	
	Uranium	12(12)	< 0.0308	< 0.196	
	Uranium-233/234	12(11)	< 0.0307	0.103	
	Uranium-235/236	12(12)	0	< 0.0257	
	Uranium-238	12(12)	< 0.0103	< 0.0659	

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2017 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
005	Americium-241	1(1)	< 0.0296		
	Neptunium-237	1(1)	0		
	Plutonium-238	1(1)	0		
	Plutonium-239/240	1(1)	< 0.00519		
	Technetium-99	4(4)	0	< 1.06	
	Uranium	4(3)	< 0.14	0.251	
	Uranium-233/234	4(2)	< 0.059	0.0906	
	Uranium-235/236	4(4)	< 0.00559	< 0.0291	
	Uranium-238	4(4)	< 0.0453	< 0.0797	
009	Americium-241	4(4)	0	< 0.0793	
	Neptunium-237	4(4)	0	< 0.00937	
	Plutonium-238	4(4)	0	< 0.00636	
	Plutonium-239/240	4(4)	< 0.0112	< 0.0509	
	Technetium-99	12(11)	0	3.98	
	Uranium	12(0)	1.91	6.49	4.07
	Uranium-233/234	12(0)	0.776	2.89	1.62
	Uranium-235/236	12(8)	< 0.0281	0.151	
	Uranium-238	12(0)	0.638	2.16	1.36
010	Americium-241	6(6)	< 0.0209	< 0.041	
	Neptunium-237	6(6)	0	< 0.03118	
	Plutonium-238	6(6)	0	< 0.09153	
	Plutonium-239/240	6(6)	0	< 0.04727	
	Technetium-99	14(11)	0	12.3	
	Uranium	14(0)	1.251	2.66	1.71
	Uranium-233/234	14(0)	0.522	1.49	0.851
	Uranium-235/236	14(14)	< 0.0165	< 0.0952	
	Uranium-238	14(0)	0.4157	0.885	0.568
011	Americium-241	4(4)	< 0.0119	< 0.0307	
	Neptunium-237	4(4)	0	0	
	Plutonium-238	4(4)	0	< 0.0203	
	Plutonium-239/240	4(4)	< 0.00678	< 0.033	
	Technetium-99	12(12)	0	< 4.94	
	Uranium	12(0)	0.697	2.52	1.49
	Uranium-233/234	12(0)	0.325	1.19	0.672
	Uranium-235/236	12(11)	< 0.00711	0.0906	
	Uranium-238	12(0)	0.231	0.836	0.495
015	Americium-241	4(4)	< 0.0251	< 0.0478	
	Neptunium-237	4(4)	0	< 0.0238	
	Plutonium-238	4(4)	0	< 0.0137	
	Plutonium-239/240	4(4)	< 0.00497	< 0.0274	
	Technetium-99	12(11)	0	< 5.62	
	Uranium	12(0)	0.588	1.85	1.03
	Uranium-233/234	12(0)	0.442	1.83	0.951
	Uranium-235/236	12(10)	< 0.0177	0.093	
	Uranium-238	12(0)	0.195	0.607	0.340

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2017 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
608	Americium-241	4(4)	< 0.00495	< 0.0344	
	Neptunium-237	4(4)	0	< 0.0102	
	Plutonium-238	4(4)	0	< 0.0108	
	Plutonium-239/240	4(4)	< 0.0107	< 0.051	
	Technetium-99	12(1)	< 4.82	174	77.4
	Uranium	12(0)	0.349	1.17	0.732
	Uranium-233/234	12(0)	0.148	0.667	0.327
	Uranium-235/236	12(12)	< 0.0115	< 0.0569	
	Uranium-238	12(0)	0.111	0.393	0.242
610	Americium-241	3(3)	0	< 0.0372	
	Neptunium-237	3(3)	0	0	
	Plutonium-238	3(3)	0	< 0.0162	
	Plutonium-239/240	3(3)	< 0.0122	< 0.022	
	Technetium-99	4(1)	< 5.02	38.4	
	Uranium	4(0)	0.816	7.42	3.91
	Uranium-233/234	4(0)	0.786	9.66	4.99
	Uranium-235/236	4(1)	< 0.0786	0.496	
	Uranium-238	4(0)	0.262	2.41	1.27
611	Americium-241	4(4)	< 0.0196	< 0.0407	
	Neptunium-237	4(4)	< 0.0134	< 0.0449	
	Plutonium-238	4(4)	0	< 0.0211	
	Plutonium-239/240	4(4)	0	< 0.0527	
	Technetium-99	12(0)	5.31	640	241
	Uranium	12(0)	4.03	18.9	5.87
	Uranium-233/234	12(0)	3.36	20.8	5.77
	Uranium-235/236	12(0)	0.146	1.37	0.331
	Uranium-238	12(0)	1.32	6.15	1.92
		Centrus Outfalls			
012	Americium-241	4(4)	< 0.031	< 0.039	
	Neptunium-237	4(4)	< 0.052	< 0.084	
	Plutonium-238	4(4)	< 0.038	< 0.07	
	Plutonium-239/240	4(4)	< 0.024	< 0.07	
	Technetium-99	52(52)	< 5.88	< 8.52	
	Uranium	52(0)	0.31	1.80	1.01
013	Americium-241	4(4)	< 0.034	< 0.042	
	Neptunium-237	4(4)	< 0.031	< 0.109	
	Plutonium-238	4(4)	< 0.038	< 0.055	
	Plutonium-239/240	4(3)	< 0.029	< 0.061	
	Technetium-99	52(52)	< 6.68	< 8.64	
	Uranium	52(0)	0.23	2.2	0.92

[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. Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out. 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.

Table 2.2. FBP NPDES permit summary – 2017

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	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		
Copper, total recoverable	µg/L	1/quarter	24-hr composite		
Dissolved solids	mg/L	1/week	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	12	
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		
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		
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)
Chlorine, total residual[c]	mg/L	Daily	Grab		0.038
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 – 2017 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	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		0.038
Copper, total recoverable	µg/L	1/month	24-hr composite		66 (0.160)
Dissolved solids	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 – 2017 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	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	Composite		
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		5.6
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		0.038
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		
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 – 2017 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	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		
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 – 2017 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	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 Far Field Monitoring)					
Water temperature	°C	2/week	24-hr maximum	27.8[c]	29.4[c]
FBP Monitoring Station 903 (Downstream Far Field 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. MCS NPDES permit summary – 2017

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	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
Dissolved solids, sum of	mg/L	1/week	24-hr composite		1500
Flow rate	GPD	Daily	24-hr total		
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		
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 2.4. FBP NPDES discharge and compliance rates – 2017

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
Outfall 001 (X-230J7 East Holding Pond)						
Cadmium, total recoverable	-	4(2)	< 0.04	0.058		µg/L
Chlorine, total residual	-	48(16)	< 0.02	0.07		mg/L
Copper, total recoverable		4(0)	1.3	2.7	2.2	µg/L
Dissolved solids	-	48(0)	130	330	192	mg/L
Flow rate	-	365	0.148	2.463	0.604	MGD
Fluoride, total	-	4(2)	< 0.06	0.12		mg/L
Mercury, total (low level)	-	14(0)	2.49	25.8	11.9	ng/L
monthly average[d]	67	12	2.49	23.8	10.9	ng/L
Oil & grease	100	48(42)	< 1.6	9.1		mg/L
monthly average[d]	100	12	0	2.3		mg/L
pH	100	53	6.98	8.60	7.99	SU
Precipitation, total	-	365	0	2.52	0.12	in.
Silver, total recoverable	-	12(8)	< 0.02	0.036		µg/L
Total suspended solids	100	48(5)	< 1.1	26	3.2	mg/L
monthly average[d]	100	12	1.2	8.8	3.2	mg/L
Zinc, total recoverable	-	4(0)	8.6	43	29	µg/L
Outfall 002 (X-230K South Holding Pond)						
Cadmium, total recoverable	-	4(3)	< 0.04	0.0575		µg/L
Flow rate	-	365	0.017	2.083	0.528	MGD
Fluoride, total	-	4(0)	0.072	0.13	0.093	mg/L
Mercury, total (low level)	-	4(0)	1.345	6.145	3.065	ng/L
Nitrogen, ammonia (NH_3)		12(3)	< 0.022	0.22		mg/L
Oil & grease	100	48(43)	< 1.65	2.0		mg/L
pH	98	48	5.10	8.80	8.03	SU
Selenium, total recoverable		12(12)	< 1	< 1		µg/L
Silver, total recoverable	-	4(2)	< 0.02	0.011		µg/L
Thallium, total recoverable	-	4(4)	< 0.066	< 0.066		µg/L
Total suspended solids	100	48(2)	< 1.1	20	6.6	mg/L
monthly average[d]	100	12	2.5	12	6.6	mg/L
Outfall 003 (X-6619 Sewage Treatment Plant)						
Acute toxicity, *Ceriodaphnia dubia*	-	4(4)	< 1	< 1		TUa
Acute toxicity, *Pimephales promelas*	-	4(4)	< 1	< 1		TUa
Carbonaceous biochemical oxygen demand, 5-day	100	48(29)	< 5.0	14.65		mg/L
monthly average[d]	100	12	0	10		mg/L
Carbonaceous biochemical oxygen demand, 5-day (loading)	98	48	0	24		kg/day
monthly average[d]	100	12	0	11		kg/day
Chlorine, total residual[b]	100	31(6)	< 0.02	0.03		mg/L
Copper, total recoverable	-	5(0)	1.4	23	6.1	µg/L
E. coli[b]	96	25(5)	< 1	1010		#/100 mL
Flow rate	-	365	0.179	0.627	0.319	MGD

Table 2.4. FBP NPDES discharge and compliance rates – 2017 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
Outfall 003 (X-6619 Sewage Treatment Plant)						
Mercury, total (low level)	-	14(0)	2.24	18.4	8.57	ng/L
monthly average[d]	-	12	2.24	14.2	8.29	ng/L
Mercury, total (low level) (loading)	-	14	0.00000253	0.0000210	0.00000951	kg/day
monthly average[d]	-	12	0.00000253	0.0000187	0.0000101	kg/day
Nitrite plus nitrate (NH_3)	-	5(0)	6.7	9.4	8.4	mg/L
Nitrogen, ammonia	-	24(12)	< 0.022	5.1		mg/L
Oil & grease	-	5(5)	< 1.8	< 1.9		mg/L
pH	100	213	6.95	8.79	7.73	SU
Silver, total recoverable	-	5(3)	< 0.02	0.21		µg/L
Thallium, total recoverable		5(5)	< 0.066	< 0.066		µg/L
Total suspended solids	100	48(1)	0.8	16	4.1	mg/L
monthly average[d]	100	12	1.3	11	4.1	mg/L
Total suspended solids (loading)	100	48	0	17	5.0	kg/day
monthly average[d]	100	12	1.5	12	4.9	kg/day
Zinc, total recoverable	-	5(0)	23	160	23	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
Chlorine, total residual	100	62(41)	< 0.02	0.03		mg/L
Copper, total recoverable	77	13(0)	26	140	55	µg/L
Copper, total recoverable (loading)	100	13(0)	0.0025	0.020	0.0074	kg/day
Dissolved solids	100	12(0)	440	860	620	mg/L
monthly average[d]	100	12	440	860	620	mg/L
Dissolved solids (loading)	100	12	23	111	73	kg/day
monthly average[d]	100	12	53	115	81	kg/day
Flow rate	-	271	0.005	0.125	0.035	MGD
Mercury, total (low level)	-	4(0)	1.34	2.92	2.31	ng/L
Oil & grease	100	12(12)	< 1.6	< 2		mg/L
monthly average[d]	100	12	0	0		mg/L
pH	92	13	6.25	8.20	7.05	SU
Total suspended solids	100	13(0)	1.6	20	6.7	mg/L
monthly average[d]	100	12	1.6	15	6.0	mg/L
Total suspended solids (loading)	100	12	0.07	3.0	0.92	kg/day
monthly average[d]	100	12	0.21	2.3	0.81	kg/day
Zinc, total recoverable	-	4(0)	43	81	54	µg/L
Outfall 005 (X-611B Lime Sludge Lagoons)						
Flow rate	-	22	0.003	7.069	0.831	MGD
Lead, total recoverable		4(0)	0.28	1	0.54	µg/L
Mercury, total (low level)		4(0)	1.76	5.42	3.04	ng/L
pH	100	7	8.41	9.41	9.09	SU
Selenium, total recoverable		4(4)	< 1	< 1		µg/L
Total suspended solids	100	5(0)	5.2	10	7.0	mg/L
monthly average[d]	100	4	6.0	10	7.2	mg/L

Table 2.4. FBP NPDES discharge and compliance rates – 2017 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
Outfall 009 (X-230L North Holding Pond)						
Bis(2-ethylhexyl)phthalate	100	12(12)	< 0.57	< 0.65		µg/L
monthly average[d]	100	12	0	0		µg/L
Copper, total recoverable		12(0)	0.50	3.8	2.0	µg/L
Flow rate	-	365	0.044	2.093	0.569	MGD
Fluoride, total	-	4(0)	0.06	0.15	0.10	mg/L
Mercury, total		4(0)	1.92	2.58	2.27	ng/L
Oil & grease	100	12(11)	< 1.6	2.0		mg/L
monthly average[d]	100	12	0	2.0		mg/L
pH	100	48	7.43	8.67	8.10	SU
Silver, total recoverable	100	12(10)	< 0.02	0.026		µg/L
monthly average[d]	100	12	0	0.026		µg/L
Total suspended solids	100	42(4)	< 1.1	43	8.3	mg/L
monthly average[d]	100	12	1.8	19	8.4	mg/L
Zinc, total recoverable	-	4(0)	5.2	37	22	µg/L
Outfall 010 (X-230J5 Northwest Holding Pond)						
Flow rate	-	365	0.004	1.818	0.457	MGD
Lead, total recoverable		12(1)	< 0.1	2.3	0.76	µg/L
Mercury, total	-	4(0)	1.53	3.53	2.45	ng/L
Oil & grease	100	13(13)	< 1.6	< 1.9		mg/L
monthly average[d]	100	12	0	0		mg/L
pH	100	162	7.20	8.64	7.95	SU
Precipitation, total	-	365	0	2.52	0.12	in.
Selenium, total recoverable	100	12(12)	< 1	< 1		µg/L
Total suspended solids	100	24(2)	< 1.1	25	6.6	mg/L
monthly average[d]	100	12	0	13	6.3	mg/L
Zinc, total recoverable	-	12(0)	5.2	43	21	µg/L
Outfall 011 (X-230J6 Northeast Holding Pond)						
Cadmium, total recoverable	-	4(2)	< 0.04	0.10		µg/L
Chlorine, total residual	-	24(11)	< 0.02	0.03		mg/L
Copper, total recoverable	-	12(0)	0.61	3.5	1.89	µg/L
Flow rate	-	365	0.002	0.335	0.031	MGD
Fluoride, total	-	4(0)	0.07	1.6	0.12	mg/L
Oil & grease	100	24(22)	< 1.6	3.0		mg/L
monthly average[d]	100	12	0	1.5		mg/L
pH	100	27	7.40	8.92	8.07	SU
Precipitation, total	-	365	0	2.52	0.12	in.
Selenium, total recoverable		12(12)	< 1.0	< 1.0		µg/L
Thallium, total recoverable		4(1)	< 0.066	0.092		µg/L
Total suspended solids	100	24(2)	< 1.1	12	3.8	mg/L
monthly average[d]	100	12	0.55	7.8	3.8	mg/L
Zinc, total recoverable	-	12(0)	5.8	74	41	µg/L

Table 2.4. FBP NPDES discharge and compliance rates – 2017 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
Outfall 015 (X-624 Groundwater Treatment Facility)						
Arsenic, total recoverable	-	4(3)	< 0.5	0.625		µg/L
Barium, total recoverable	-	4(0)	25	32	30	µg/L
Flow rate	-	363	0.001	0.0308	0.010	MGD
PCBs	100	4(4)	< 0.098	< 0.11		µg/L
pH	100	24	7.35	8.07	7.81	SU
Silver, total recoverable	-	12(9)	< 0.02	0.061		µg/L
Trichloroethene	100	24(5)	< 0.16	2.9		µg/L
monthly average[d]	100	12	0.078	2.3		µg/L
Outfall 602 (X-621 Coal Pile Runoff Treatment Facility)						
Flow rate	-	21	0.036	0.210	0.112	MGD
Iron, total	100	10(0)	87	270	148	µg/L
monthly average[d]	100	8	87	270	148	µg/L
Manganese, total	100	10(0)	66.5	230	115	µg/L
monthly average[d]	100	8	66.5	230	120	µg/L
pH	100	10	7.53	9.68	8.56	SU
Precipitation, total	-	242	0	2.53	0.15	in.
Total suspended solids	100	10(0)	5.6	16	9.0	mg/L
monthly average[d]	100	8	6	13	8.7	mg/L
Outfall 604 (X-700 Biodenitrification Facility)						
Copper, total	-	4(0)	0.80	1.5	1.2	µg/L
Flow rate	-	33	0.0024	0.01059	0.0098	MGD
Iron, total	-	4(0)	150	220	193	µg/L
Nickel, total	-	4(0)	0.73	0.90	0.84	µg/L
Nitrogen, nitrate	-	4(0)	3.95	50.6	28	mg/L
pH	100	4	7.62	8.70	8.15	SU
Zinc, total	-	4(0)	4.2	11	7.4	µg/L
Outfall 605 (X-705 Microfiltration Treatment System)[e]						
Outfall 608 (X-622 Groundwater Treatment Facility)						
Flow rate	-	365	0.0004	0.0923	0.056	MGD
pH	-	24	7.00	8.29	7.97	SU
Trichloroethene	100	24(18)	< 0.16	1.7		µg/L
1,2-*trans*-dichloroethene	100	24(24)	< 0.15	< 0.15		µg/L
monthly average[d]	100	12	0	0		µg/L
Outfall 610 (X-623 Groundwater Treatment Facility)						
Flow rate	-	4	0.001	0.0066	0.0029	MGD
pH	-	4	7.71	8.20	7.91	SU
Trichloroethene	100	4(4)	< 0.16	< 0.16		µg/L
monthly average[d]	100	4	0	0		µg/L
1,2-*trans*-dichloroethene	100	4(4)	< 0.15	< 0.15		µg/L
monthly average[d]	100	4	0	0		µg/L

Table 2.4. FBP NPDES discharge and compliance rates – 2017 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
Outfall 611 (X-627 Groundwater Treatment Facility)						
Flow rate	-	365	0.007	0.0568	0.032	MGD
pH	-	24	7.13	8.50	8.05	SU
Trichloroethene	100	24(2)	< 0.16	1.9	0.83	µg/L
monthly average[d]	100	12	0.31	1.5	0.83	µg/L
Monitoring Station 801 (upstream monitoring)						
48-hr acute toxicity, *Ceriodaphnia dubia*	-	6(5)	0	5		% affected
96-hr acute toxicity, *Pimephales promelas*	-	7(4)	0	10		% affected
Monitoring Station 902 (downstream far field monitoring)						
Water temperature	100	97	1.49	28.70	17.50	°C
monthly average	100	12	5.52	26.74	17.45	°C
Monitoring Station 903 (downstream far field monitoring)						
Water temperature	100	97	1.95	27.54	17.02	°C
monthly average	100	12	5.98	25.99	16.98	°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 (and iron and manganese at Outfall 605) if flow increases as a result of precipitation or snow melt and conditions set in the permit are met.
[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. 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.
[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.
[e]The X-705 Microfiltration Treatment System (Outfall 605) did not operate in 2017.

Table 2.5. MCS NPDES discharge and compliance rates – 2017

Parameter	NPDES compliance rate (%)	Number of measurements	Result			Units
			Minimum	Maximum	Average	
		Outfall 001[a]				
		Outfall 602				
Flow rate	100	365	289	15,591	8279	GPD
pH	100	256	5.89	8.79	6.93	SU

[a]This outfall was not used for process water discharges in 2017; therefore, monitoring was not required.

Table 2.6. Centrus NPDES discharge monitoring results – 2017

Parameter	Number of samples[a]	Concentration			Unit
		Minimum	Maximum	Average[b]	
Outfall 012 (X-230M Southwest Holding Pond)					
Cadmium	12(0)	0.061	0.48	0.24	µg/L
Chlorine	26(0)	0	0.08	0.03	mg/L
Copper	12(0)	0.40	2.4	1.3	µg/L
Flow rate	365	0.0032	1.489	0.216	MGD
Iron	12(0)	280	1200	609	µg/L
Oil and grease	24(23)	< 1.6	2.3		mg/L
PCBs, total	1(1)	< 0.1			µg/L
pH	24	7.52	8.69	8.19	SU
Selenium	12(12)	< 1	< 1		µg/L
Silver	12(9)	< 0.02	0.025		µg/L
Suspended solids	24(0)	1.6	13	5.8	mg/L
Thallium	12(11)	< 0.066	0.094		µg/L
Trichloroethene	12(12)	< 0.16	< 0.16		µg/L
Outfall 013 (X-230N West Holding Pond)					
Antimony	12(0)	0.32	0.86	0.49	µg/L
Arsenic	12(0)	0.51	0.97	0.77	µg/L
Chlorine	24(0)	0	0.05	0.03	mg/L
Copper	12(0)	0.83	2.4	1.6	µg/L
Flow rate	365	0.0127	1.790	0.166	MGD
Oil and grease	24(21)	< 1.7	8.7		mg/L
PCBs, total	1(1)	< 0.098			µg/L
pH	24	7.74	8.68	8.24	SU
Suspended solids	24(0)	1.2	23	4.4	mg/L
Thallium	12(9)	< 0.066	0.12		µg/L
Zinc	12(0)	3.4	59	20	µg/L
Outfall 613 (X-6002 Particulate Separator)					
Chlorine	16(0)	0	2.4	0.20	mg/L
Flow rate	273	0	0.022	0.0002	MGD
Suspended solids	16(4)	0.03	5.6		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. 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.

Table 2.7. Radionuclides in surface water runoff samples from FBP and MCS cylinder storage yards – 2017

Sample location	Parameter	Unit	Number of samples[a]	Minimum[b]	Maximum	Average[c]
			FBP cylinder storage yards			
X745-B1	Alpha activity	pCi/L	10(5)	< 0.278	303	
	Beta activity	pCi/L	10(3)	< 1.84	232	
	Uranium	µg/L	10(1)	0.157	21.1	3.21
X745-B2	Alpha activity	pCi/L	10(2)	< 4.12	70.2	
	Beta activity	pCi/L	10(4)	< 1.72	72.5	
	Uranium	µg/L	10(0)	1.57	44.5	14.4
X745-B3	Alpha activity	pCi/L	10(3)	< 1.18	66.4	
	Beta activity	pCi/L	10(2)	< 3.19	105	
	Uranium	µg/L	10(1)	< 0.067	5.15	1.39
X745-D1	Alpha activity	pCi/L	10(5)	< 0.0514	12.1	
	Beta activity	pCi/L	10(1)	< 3.75	17.2	9.86
	Uranium	µg/L	10(0)	0.166	7.84	3.17
X745-F1	Alpha activity	pCi/L	11(7)	0	81.7	
	Beta activity	pCi/L	11(4)	< 0.63	74.9	
	Uranium	µg/L	11(0)	0.187	5.62	1.53
X745-F2	Alpha activity	pCi/L	11(7)	< 0.362	19.2	
	Beta activity	pCi/L	11(2)	3.92	23.1	
	Uranium	µg/L	11(0)	0.93	7.45	2.92
X745-F3	Alpha activity	pCi/L	11(8)	< 1.3	10.1	
	Beta activity	pCi/L	11(7)	< 0.754	11.8	
	Uranium	µg/L	11(0)	1.29	3.19	2.10
			MCS cylinder storage yards			
X745-C1	Alpha activity	pCi/L	12(0)	0.939	3.76	2.24
	Beta activity	pCi/L	12(0)	0.953	7.28	3.42
	Uranium	µg/L	12(0)	0.81	3.4	2.1
X745-C2	Alpha activity	pCi/L	13(0)	1.20	6.44	3.35
	Beta activity	pCi/L	13(0)	1.07	10.5	3.88
	Uranium	µg/L	13(0)	1.4	12	5.1
X745-C3	Alpha activity	pCi/L	12(0)	0.414	2.53	1.50
	Beta activity	pCi/L	12(0)	0.532	3.40	2.03
	Uranium	µg/L	12(1)	0	3.4	1.6
X745-C4	Alpha activity	pCi/L	12(1)	0	5.58	2.35
	Beta activity	pCi/L	12(0)	1.49	5.68	3.34
	Uranium	µg/L	12(0)	1.2	13	4.3
X745-E1	Alpha activity	pCi/L	12(1)	0	2.44	1.20
	Beta activity	pCi/L	12(0)	3.86	8.98	5.63
	Uranium	µg/L	12(1)	0	1.9	0.93

Table 2.7. Radionuclides in surface water runoff samples from FBP and MCS cylinder storage yards – 2017 (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(0)	0.714	4.37	2.52
	Beta activity	pCi/L	12(0)	1.21	8.48	4.30
	Uranium	µg/L	12(0)	1.6	4.1	2.7
X745-G2	Alpha activity	pCi/L	12(0)	1.25	7.10	2.41
	Beta activity	pCi/L	12(0)	1.63	5.90	3.40
	Uranium	µg/L	12(0)	1.1	3.8	2.3

[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. Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out. 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.

Table 2.8. Drainage basin monitoring of surface water and sediment for MCS cylinder storage yards – 2017

Location	Parameter[a]	First quarter[b]			Second quarter[b]		
		SW-F	SW-UF	Sed	SW-F	SW-UF	Sed
UDS X01	Total PCB	0.21U	0.20U	11U	0.21U	0.21U	10U
RM-8	Total PCB	0.21U	0.21U	210	0.21U	0.22U	91
UDS X02	Total PCB	0.21U	0.21U	230	0.21U	0.21U	68
RM-10	Total PCB	0.21U	0.21U	17J	0.21U	0.21U	24J

Location	Parameter[a]	Third quarter[b]			Fourth quarter[b]		
		SW-F	SW-UF	Sed	SW-F	SW-UF	Sed
UDS X01	Total PCB	0.35U	0.34U	41J	0.33U	0.33U	27J
RM-8	Total PCB	0.35U	0.36U	25J	0.33U	0.34U	13U
UDS X02	Total PCB	0.35U	0.34U	12U	0.33U	0.33U	67
RM-10	Total PCB	0.39U	0.33U	13U	0.33U	0.34U	12U

[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 the method detection limit but less than the reporting limit; U – undetected.

Table 2.9. Ambient air monitoring program summary for radionuclides and fluoride – 2017

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)	2.1E-06	4.0E-06	
	Fluoride	20(20)	8.8E-03	2.0E-02	
	Neptunium-237	4(4)	0	2.5E-06	
	Plutonium-238	4(4)	0	1.4E-06	
	Plutonium-239/240	4(4)	0	2.2E-06	
	Technetium-99	12(4)	1.6E-05	3.9E-03	
	Uranium	12(12)	4.0E-05	9.7E-05	
	Uranium-233/234	12(11)	1.7E-05	4.5E-05	
	Uranium-235/236	12(12)	0	5.4E-06	
	Uranium-238	12(12)	1.3E-05	3.2E-05	
A10	Americium-241	4(4)	1.8E-06	5.1E-06	
	Fluoride	39(37)	7.7E-03	2.3E-02	
	Neptunium-237	4(4)	0	3.1E-06	
	Plutonium-238	4(4)	0	3.3E-06	
	Plutonium-239/240	4(4)	0	3.2E-06	
	Technetium-99	12(2)	1.2E-04	2.5E-03	
	Uranium	12(12)	4.2E-05	1.4E-04	
	Uranium-233/234	12(10)	2.1E-05	4.9E-05	
	Uranium-235/236	12(12)	4.8E-07	6.2E-06	
	Uranium-238	12(12)	1.4E-05	4.6E-05	
A29	Americium-241	4(4)	1.3E-06	6.7E-06	
	Fluoride	49(49)	8.1E-03	2.3E-02	
	Neptunium-237	4(4)	0	1.3E-06	
	Plutonium-238	4(4)	0	2.0E-06	
	Plutonium-239/240	4(4)	6.8E-07	4.7E-06	
	Technetium-99	12(6)	0	2.1E-03	
	Uranium	12(12)	2.7E-05	1.1E-04	
	Uranium-233/234	12(12)	1.4E-05	5.1E-05	
	Uranium-235/236	12(12)	5.3E-07	3.5E-06	
	Uranium-238	12(12)	8.8E-06	3.7E-05	
A36	Americium-241	4(4)	7.1E-07	5.1E-06	
	Fluoride	35(33)	9.5E-03	2.6E-02	
	Neptunium-237	4(4)	1.2E-06	2.5E-06	
	Plutonium-238	4(4)	0	5.0E-06	
	Plutonium-239/240	4(4)	0	3.6E-06	
	Technetium-99	12(3)	3.4E-05	7.7E-03	
	Uranium	12(9)	3.5E-05	5.0E-04	
	Uranium-233/234	12(8)	2.5E-05	2.5E-04	
	Uranium-235/236	12(12)	5.2E-07	8.6E-06	
	Uranium-238	12(9)	1.1E-05	1.7E-04	
A40A	Fluoride	45(42)	7.6E-03	2.1E-02	

Table 2.9. Ambient air monitoring program summary for radionuclides and fluoride – 2017 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
		On-site air samplers			
T7	Americium-241	4(4)	1.4E-06	3.9E-06	
	Neptunium-237	4(4)	0	1.4E-06	
	Plutonium-238	4(4)	0	2.0E-06	
	Plutonium-239/240	4(4)	6.8E-07	4.1E-06	
	Technetium-99	12(4)	6.0E-05	1.7E-03	
	Uranium	12(12)	3.1E-05	1.1E-04	
	Uranium-233/234	12(11)	1.7E-05	5.5E-05	
	Uranium-235/236	12(12)	0	5.0E-06	
	Uranium-238	12(12)	1.1E-05	3.8E-05	
		Off-site air samplers			
A3	Americium-241	4(4)	2.0E-06	6.0E-06	
	Fluoride	36(30)	7.1E-03	2.8E-02	
	Neptunium-237	4(4)	0	1.3E-06	
	Plutonium-238	4(4)	0	0	
	Plutonium-239/240	4(4)	6.7E-07	4.8E-06	
	Technetium-99	11(4)	6.6E-06	5.7E-03	
	Uranium	11(11)	5.1E-05	1.0E-04	
	Uranium-233/234	11(10)	1.8E-05	4.9E-05	
	Uranium-235/236	11(11)	1.6E-06	3.8E-06	
	Uranium-238	11(11)	1.7E-05	3.4E-05	
A6	Americium-241	4(4)	2.0E-06	4.8E-06	
	Fluoride	38(34)	5.7E-03	2.6E-02	
	Neptunium-237	4(4)	0	1.2E-06	
	Plutonium-238	4(4)	0	1.4E-06	
	Plutonium-239/240	4(4)	1.3E-06	3.4E-06	
	Technetium-99	12(8)	0	3.6E-03	
	Uranium	12(12)	4.9E-05	1.3E-04	
	Uranium-233/234	12(11)	1.6E-05	4.4E-05	
	Uranium-235/236	12(12)	9.6E-07	5.1E-06	
	Uranium-238	12(12)	1.6E-05	4.5E-05	
A9	Americium-241	4(4)	7.0E-07	3.1E-06	
	Fluoride	51(50)	8.6E-03	2.4E-02	
	Neptunium-237	4(4)	0	6.6E-07	
	Plutonium-238	4(4)	0	3.0E-06	
	Plutonium-239/240	4(4)	7.5E-07	4.4E-06	
	Technetium-99	12(7)	0	3.4E-03	
	Uranium	12(11)	4.4E-05	1.3E-04	
	Uranium-233/234	12(11)	1.9E-05	5.0E-05	
	Uranium-235/236	12(12)	1.0E-06	4.5E-06	
	Uranium-238	12(11)	1.4E-05	4.4E-05	

Table 2.9. Ambient air monitoring program summary for radionuclides and fluoride – 2017 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
A12	Americium-241	4(4)	1.9E-06	3.0E-06	
	Fluoride	39(18)	8.0E-03	4.2E-02	
	Neptunium-237	4(4)	0	0	
	Plutonium-238	4(4)	0	7.6E-07	
	Plutonium-239/240	4(4)	2.0E-06	3.9E-06	
	Technetium-99	12(4)	2.2E-05	2.1E-03	
	Uranium	12(12)	4.3E-05	1.2E-04	
	Uranium-233/234	12(11)	1.4E-05	6.6E-05	
	Uranium-235/236	12(12)	7.4E-07	5.0E-06	
	Uranium-238	12(12)	1.4E-05	3.8E-05	
A15	Americium-241	4(4)	1.3E-06	4.3E-06	
	Fluoride	10(10)	5.9E-03	8.8E-03	
	Neptunium-237	4(4)	0	6.6E-07	
	Plutonium-238	4(4)	7.1E-07	2.2E-06	
	Plutonium-239/240	4(4)	1.4E-06	2.8E-06	
	Technetium-99	12(5)	0	3.3E-03	
	Uranium	12(12)	2.6E-05	1.0E-04	
	Uranium-233/234	12(12)	1.0E-05	3.9E-05	
	Uranium-235/236	12(12)	0	3.9E-06	
	Uranium-238	12(12)	8.3E-06	3.3E-05	
A23	Americium-241	4(4)	2.0E-06	5.8E-06	
	Fluoride	37(29)	7.3E-03	2.0E-02	
	Neptunium-237	4(4)	6.0E-07	2.1E-06	
	Plutonium-238	4(4)	0	3.0E-06	
	Plutonium-239/240	4(4)	6.6E-07	5.1E-06	
	Technetium-99	12(4)	5.0E-05	3.0E-03	
	Uranium	12(11)	4.0E-05	1.4E-04	
	Uranium-233/234	12(10)	1.9E-05	6.3E-05	
	Uranium-235/236	12(12)	4.8E-07	3.9E-06	
	Uranium-238	12(11)	1.3E-05	4.7E-05	
A24	Americium-241	4(4)	1.9E-06	4.9E-06	
	Fluoride	44(42)	8.8E-03	2.3E-02	
	Neptunium-237	4(4)	0	2.5E-06	
	Plutonium-238	4(4)	0	2.2E-06	
	Plutonium-239/240	4(4)	1.5E-06	3.3E-06	
	Technetium-99	12(3)	0	2.5E-03	
	Uranium	12(11)	3.8E-05	1.3E-04	
	Uranium-233/234	12(9)	1.9E-05	6.4E-05	
	Uranium-235/236	12(12)	4.9E-07	4.7E-06	
	Uranium-238	12(11)	1.2E-05	4.3E-05	

Table 2.9. Ambient air monitoring program summary for radionuclides and fluoride – 2017 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
A28	Americium-241	4(4)	1.9E-06	8.8E-06	
	Fluoride	51(47)	7.3E-03	3.4E-02	
	Neptunium-237	4(3)	0	2.1E-05	
	Plutonium-238	4(4)	0	2.5E-06	
	Plutonium-239/240	4(4)	1.9E-06	3.7E-06	
	Technetium-99	12(9)	0	1.9E-03	
	Uranium	12(12)	4.1E-05	1.1E-04	
	Uranium-233/234	12(12)	1.3E-05	3.3E-05	
	Uranium-235/236	12(12)	5.1E-07	3.2E-06	
	Uranium-238	12(12)	1.4E-05	3.5E-05	
A37 (background)	Americium-241	4(4)	1.9E-06	7.9E-06	
	Fluoride	42(38)	9.0E-03	2.3E-02	
	Neptunium-237	4(4)	0	2.0E-06	
	Plutonium-238	4(4)	6.4E-07	1.3E-06	
	Plutonium-239/240	4(4)	0	3.8E-06	
	Technetium-99	12(9)	7.4E-06	3.1E-03	
	Uranium	12(12)	4.2E-05	1.1E-04	
	Uranium-233/234	12(12)	1.2E-05	3.1E-05	
	Uranium-235/236	12(12)	4.9E-07	3.5E-06	
	Uranium-238	12(12)	1.4E-05	3.7E-05	
A41A	Americium-241	4(4)	1.2E-06	5.0E-06	
	Fluoride	51(36)	7.1E-03	4.3E-02	
	Neptunium-237	4(3)	0	1.5E-04	
	Plutonium-238	4(4)	0	2.9E-06	
	Plutonium-239/240	4(4)	1.3E-06	5.0E-06	
	Technetium-99	12(7)	6.9E-06	3.6E-03	
	Uranium	12(11)	4.6E-05	1.2E-04	
	Uranium-233/234	12(11)	1.9E-05	5.2E-05	
	Uranium-235/236	12(12)	5.1E-07	4.6E-06	
	Uranium-238	12(11)	1.5E-05	3.9E-05	

[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 detection limit for the sample.
[c]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).
Ambient concentrations of uranium and uranium isotopes reported in 2017 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.
Ambient concentrations of radionuclides should be considered estimated due to a slightly higher than acceptable deviation (up to -1.55% with an acceptable limit of ±1%) in flow meter calibration for 2017.
[d]Values reported as "0" may actually be negative results. Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out. 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 a value at the detection limit to calculate the average for the parameter.

Table 2.10. External radiation monitoring program (mrem) – 2017

Location	First quarter	Second quarter	Third quarter	Fourth quarter	Cumulative annual whole body dose[a]
A12	20	21	24	20	85
A15	20	24	25	20	89
A23	20	20	25	20	85
A24	21	24	25	22	92
A28	20	21	22	19	82
A29	20	23	25	20	88
A3	19	23	24	19	85
A36	19	21	23	19	82
A40A	19	20	23	21	83
A6	20	20	24	19	83
A8	23	24	25	24	96
A9	20	23	25	20	88
UPOLE-1404A	19	21	23	18	81
UPOLE-518	18	21	23	19	81
UPOLE-862	28	33	36	27	124
UPOLE-874	144	165	166	151	626
UPOLE-906	17	20	21	17	75
UPOLE-933	18	19	23	17	77
X230-J2	21	22	25	20	88

[a]The annual occupational whole body dose limit set by Title 10 of the *Code of Federal Regulations* Part 20 is 5000 mrem.

Table 2.11. External radiation monitoring (mrem) at locations near cylinder storage yards – 2017

Location	First quarter	Second quarter	Third quarter	Fourth quarter	Cumulative annual whole body dose[a]
UPOLE-41	151	125	134	116	526
UPOLE-868	286	314	370	299	1269
UPOLE-874	149	166	170	145	630
UPOLE-882	235	252	285	244	1016
UPOLE-890	72	59	69	53	253

[a]The annual occupational whole body dose limit set by Title 10 of the *Code of Federal Regulations* Part 20 is 5000 mrem.

Table 2.12. Settleable solids monitoring results – 2017

Sampling location	Parameter[a]	Unit	Results[b] June	Results[b] October
Little Beaver Creek				
EDD-SW01 (FBP Outfalls 001& 015)	Settleable solids	mg/L	4U 10[c]	23.6
	Suspended solids	mg/L	4*U 17*[c]	28.4
FBP Outfall 005	Settleable solids	mg/L	4U[d]	ns
	Suspended solids	mg/L	4U[d]	ns
FBP Outfall 009	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	4*U	4UJ
FBP Outfall 011	Settleable solids	mg/L	4U	4U 4U[c]
	Suspended solids	mg/L	4*U	4UJ 4UJ[c]
Big Run Creek				
FBP Outfall 002	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	4*U	4UJ
Scioto River				
ACP NPDES Outfall 012	Settleable solids	mg/L	5	4U
	Suspended solids	mg/L	5*	4U
WDD-SW03 (FBP Outfall 010 & ACP Outfall 013)	Settleable solids	mg/L	4U	4U 4U[c]
	Suspended solids	mg/L	4*U	4UJ 4UJ[c]
FBP Outfall 003	Settleable solids	mg/L	4U 4U[c]	17.2
	Suspended solids	mg/L	4*U 4*U[c]	23.6
FBP Outfall 004	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	7*	4UJ
Background locations				
RW-6 (Scioto River)	Settleable solids	mg/L	16	21.2
	Suspended solids	mg/L	36*	21.2
RW-5 (Big Beaver Creek)	Settleable solids	mg/L	7	4U
	Suspended solids	mg/L	12*	4UJ
LBC-SW12 (Little Beaver Creek)	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	4*U	4UJ

[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: * – duplicate analysis is not within control limits. J – estimated. U – undetected. ns – not sampled.
[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.
[d]Sample collected in January 2017.

Table 2.13. Local surface water monitoring program results – 2017

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]	
Scioto River	Americium-241	-0.00617U	0.0453U	
RW-1A	Neptunium-237	0.00562U	-0.00492U	
(downstream)	Plutonium-238	0.00611U	0.00509U	
	Plutonium-239/240	0U	0.0204U	
	Technetium-99	-1.9U	3.19U	
	Uranium	1.67	2.18	
	Uranium-233/234	0.667	0.639	
	Uranium-235/236	0.0345U	0.0292U	
	Uranium-238	0.556	0.729	
Scioto River	Americium-241	0.0369U	0U	
RW-6	Neptunium-237	0.0067U	0.0095U	
(upstream)	Plutonium-238	0U	0U	
	Plutonium-239/240	0U	0.0216U	
	Technetium-99	-3.05U	-0.0221U	
	Uranium	2.46	2.03	
	Uranium-233/234	0.694	0.662	
	Uranium-235/236	0.0359U	0.0248U	
	Uranium-238	0.821	0.677	
Little Beaver	Americium-241	0.00576U	0.00523U	
Creek	Neptunium-237	0.017U	0U	
RW-7	Plutonium-238	-0.00551U	0.00515U	
(downstream)	Plutonium-239/240	0.0165U	0U	
	Technetium-99	5.84U	5.85UJ	
	Uranium	1.18	3.13	
	Uranium-233/234	1.5	4.72	
	Uranium-235/236	0.111U	0.214	
	Uranium-238	0.379	1.02	
RW-8	Americium-241	0.0253U	0.0146U	
(downstream)	Neptunium-237	0.006U	0.00488U	
	Plutonium-238	-0.0202U	0.00574U	
	Plutonium-239/240	0.0135U	0.0115U	
	Technetium-99	3.21U	4.5UJ	
	Uranium	0.812	2.64	
	Uranium-233/234	1.06	3.29	
	Uranium-235/236	0.0536U	0.137	
	Uranium-238	0.265	0.865	
RW-12	Americium-241	0.0372U	0.0259U	0.0409U[d]
(upstream)	Neptunium-237	-0.0165U	0U	0U[d]
	Plutonium-238	0.00609U	0U	0.00558U[d]
	Plutonium-239/240	0.00609U	0.0232U	0.00559U[d]
	Technetium-99	0.565U	3.94U	1.74U[d]
	Uranium	0.107U	0.0735U	0.0668U[d]
	Uranium-233/234	0.075U	0.0504UJ	0.0404UJ[d]
	Uranium-235/236	0.00622U	0.0114U	0U[d]
	Uranium-238	0.035U	0.0229U	0.0224U[d]

Table 2.13. Local surface water monitoring program results – 2017 (continued)

Location	Parameter[a]	Second quarter[b,c]		Fourth quarter[b,c]	
Big Beaver Creek RW-13 (downstream)	Americium-241	0.0242U	0.0113U[d]	0.0234U	
	Neptunium-237	0U	0U[d]	-0.00535U	
	Plutonium-238	-0.00634U	0.0223U[d]	0U	
	Plutonium-239/240	0.00634U	0.0223U[d]	0.0111U	
	Technetium-99	0.832U	-0.0999U[d]	9.12	
	Uranium	0.297	0.228U[d]	1.26J	
	Uranium-233/234	0.291	0.328[d]	1.46	
	Uranium-235/236	0.00682U	0.0376U[d]	0.0878UJ	
	Uranium-238	0.0987	0.0706U[d]	0.41	
RW-5 (upstream)	Americium-241	0.0274U		0.0101U	
	Neptunium-237	0.00487U		0.0104U	
	Plutonium-238	-0.00675U		-0.00546U	
	Plutonium-239/240	0.0337U		0.0164U	
	Technetium-99	0.72U		1.41U	
	Uranium	0.33		0.273J	
	Uranium-233/234	0.0844U		0.109	
	Uranium-235/236	0.015U		0.00564U	
	Uranium-238	0.109		0.0908J	
Big Run Creek RW-2 (downstream)	Americium-241	0.0105U		0.0344U	
	Neptunium-237	-0.0153U		0.00504U	
	Plutonium-238	0.0118U		0.0105U	
	Plutonium-239/240	0.0178U		0.0105U	
	Technetium-99	0.653U		1.19U	
	Uranium	0.179U		0.417J	
	Uranium-233/234	0.128		0.252	
	Uranium-235/236	0.00613U		0.0336U	
	Uranium-238	0.0592U		0.135	
RW-3 (downstream)	Americium-241	0.0165U	0.0232U[d]	0.0152U	0.0101U[d]
	Neptunium-237	0U	0.0054U[d]	0.0106U	0U[d]
	Plutonium-238	0.017U	-0.00591U[d]	0.00582	0.0156U[d]
	Plutonium-239/240	0.0227U	0.00591U[d]	0.0233U	0.0104U[d]
	Technetium-99	0.899U	0.277U[d]	2.16U	2.22U[d]
	Uranium	1.05	0.752[d]	0.482J	0.684J[d]
	Uranium-233/234	0.82	0.739[d]	0.489	0.403[d]
	Uranium-235/236	0.0581U	0.019U[d]	0.0239U	0.0173U[d]
	Uranium-238	0.342	0.25[d]	0.158	0.227[d]

Table 2.13. Local surface water monitoring program results – 2017 (continued)

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]
Big Run Creek (continued)	Americium-241	0.0113U	0.0203U
	Neptunium-237	0U	0.00472U
RW-33 (upstream)	Plutonium-238	-0.0178U	0.00551U
	Plutonium-239/240	0.0178U	0.011U
	Technetium-99	-1.67U	1.86U
	Uranium	0.0956U	0.0684U
	Uranium-233/234	0.0252U	0.0512UJ
	Uranium-235/236	0.0125U	0.0106U
	Uranium-238	0.0302U	0.0213U
Background creeks	Americium-241	0.0132U	0.0191U
RW-10N	Neptunium-237	0.00588U	0.0134U
	Plutonium-238	-0.00668U	0U
	Plutonium-239/240	0.0468U	0.0166U
	Technetium-99	-1.01U	2.96U
	Uranium	0.302U	0.471J
	Uranium-233/234	0.189	0.125
	Uranium-235/236	0.00733U	0.00576U
	Uranium-238	0.1	0.157
RW-10S	Americium-241	0.0333U	0.0354U
	Neptunium-237	-0.00493U	0U
	Plutonium-238	0.00612U	0.0167U
	Plutonium-239/240	0.0184U	0.0223U
	Technetium-99	-1.16U	3.85U
	Uranium	0.131U	0.17UJ
	Uranium-233/234	0.0906	0.0592UJ
	Uranium-235/236	0.025U	0.017U
	Uranium-238	0.0403U	0.0546UJ
RW-10E	Americium-241	0.0349U	0.0106U
	Neptunium-237	-0.00517U	-0.0152U
	Plutonium-238	-0.00592U	0.00544U
	Plutonium-239/240	0.00592U	0U
	Technetium-99	-2.54U	2.21U
	Uranium	0.0726U	0.0566U
	Uranium-233/234	0.0195U	0.0363UJ
	Uranium-235/236	0U	0.00564U
	Uranium-238	0.0244U	0.0182U

Table 2.13. Local surface water monitoring program results – 2017 (continued)

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]
Background creeks	Americium-241	-0.00619U	0.0242U
RW-10W	Neptunium-237	0.00611U	-0.00957U
	Plutonium-238	0U	0U
	Plutonium-239/240	-0.0062U	0.0217U
	Technetium-99	-0.655U	2.91U
	Uranium	0.0161U	0.0685U
	Uranium-233/234	0.0217U	0.0443UJ
	Uranium-235/236	0U	0.00551U
	Uranium-238	0.00541U	0.0221U

[a]Results are reported in µg/L (uranium) and pCi/L (all other parameters).
[b]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[c]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.
[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 2.14. Sediment monitoring program results – 2017

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	7710D	4010D	4770D	6040D
Americium-241	pCi/g	0.00301U	0.000458U	0.00125U	0U
Antimony	mg/kg	0.0735DJ	0.0723DJ	0.125DJ	0.0455DU
Arsenic	mg/kg	11.9	8.35	16.3	12
Barium	mg/kg	96.1D	48.3D	65.3D	83.9D
Beryllium	mg/kg	0.38D	0.272D	0.459D	0.619D
Cadmium	mg/kg	0.543D	0.33D	0.948D	0.0725D
Calcium	mg/kg	39000D	41800D	2090D	876D
Chromium	mg/kg	11.5	7.35	14.8D	10.1
Copper	mg/kg	21.7D	11.1	17.6D	6.56
Iron	mg/kg	21000D	14200D	42400D	21700D
Lead	mg/kg	15.6	9.39	12.1	12.5
Magnesium	mg/kg	17500D	17900D	1840D	864D
Manganese	mg/kg	573D	383D	1110D	618D
Mercury	mg/kg	0.0426J	0.0249J	0.0161J	0.0171J
Neptunium-237	pCi/g	0.00045U	0U	0U	0.0103U
Nickel	mg/kg	23.5D	15.6D	39.7D	7.2
Plutonium-238	pCi/g	0U	0.000592U	-0.00163U	-0.00117U
Plutonium-239/240	pCi/g	0.00178U	0.00414U	0.00272U	0.00293U
PCB, total	µg/kg	47.6	68.2	17.7U	19.9U
Selenium	mg/kg	0.812D	0.565D	0.413D	0.922D
Silicon	mg/kg	654D	538D	450D	515D
Silver	mg/kg	0.471U	0.485U	0.448U	0.488U
Technetium-99	pCi/g	-0.0265U	-0.0106U	-0.0401U	-0.00569U
Thallium	mg/kg	0.274D	0.173D	0.176D	0.118D
Uranium	µg/g	1.51	0.982	1.47	1.06
Uranium-233/234	pCi/g	0.442	0.296	0.517	0.355
Uranium-235/236	pCi/g	0.0237	0.0169	0.0257	0.0203
Uranium-238	pCi/g	0.504	0.328	0.491	0.352
Zinc	mg/kg	92.9D	60.7D	146D	25.8D

Table 2.14. Sediment monitoring program results – 2017 (continued)

Parameter	Unit	Location/results[a,b]			
		Little Beaver Creek			
		RM-12 Upstream	*RM-11 X-230J7 Discharge*	*RM-8 Downstream @ Outfall 009 Discharge*	*RM-7 Downstream @ Confluence*
Aluminum	mg/kg	8860D	3750D	7290D	5010D
Americium-241	pCi/g	0.000504U	0.00212U	0.00355U	0.00225U
Antimony	mg/kg	0.0474DU	0.405D	0.1DJ	0.107DJ
Arsenic	mg/kg	10.5	16.5	28.2	14.6
Barium	mg/kg	71.1D	30.1D	126D	67.7D
Beryllium	mg/kg	0.62D	0.314D	0.904D	0.456D
Cadmium	mg/kg	0.0474DU	0.533D	0.926D	0.534D
Calcium	mg/kg	570D	51400D	5550D	27900D
Chromium	mg/kg	14.6D	11.1	28.3D	13.4D
Copper	mg/kg	8.64	26.9D	18.8D	14.6D
Iron	mg/kg	23500D	19400D	40100D	22800D
Lead	mg/kg	15.7	15.1	29.3D	27.3D
Magnesium	mg/kg	1110D	23500D	2600D	14300D
Manganese	mg/kg	110D	423D	1870D	744D
Mercury	mg/kg	0.0234J	0.528	0.0731J	0.0572J
Neptunium-237	pCi/g	-0.00115U	0.00403U	0.0103U	0.00876U
Nickel	mg/kg	12.8D	23.6D	46.9D	24.1D
Plutonium-238	pCi/g	0.0013U	0.00173U	0.00263U	0.00161U
Plutonium-239/240	pCi/g	0.0013U	0.00604U	0.0046U	0.00588U
PCB, total	µg/kg	19.2U	208	175	57.1
Selenium	mg/kg	0.57D	1.57D	1.02D	0.647D
Silicon	mg/kg	544D	467D	500D	486D
Silver	mg/kg	0.476U	0.494U	0.474U	0.485U
Technetium-99	pCi/g	-0.127U	3.62	2.49	3.42
Thallium	mg/kg	0.126D	0.24D	0.26D	0.184D
Uranium	µg/g	0.81	3.43	3.39	2.36
Uranium-233/234	pCi/g	0.34	6.88	3.14	2.55
Uranium-235/236	pCi/g	0.0128U	0.291	0.16	0.128
Uranium-238	pCi/g	0.27	1.11	1.11	0.774
Zinc	mg/kg	39.2D	329D	149D	92.1D

Table 2.14. Sediment monitoring program results – 2017 (continued)

Parameter	Unit	Location/results[a,b]		
			Big Beaver Creek	
		RM-15 Upstream	*RM-15 Upstream (duplicate sample)*	*RM-5 Confluence with Little Beaver Creek*
Aluminum	mg/kg	3270D	3170D	5260D
Americium-241	pCi/g	0.00199U	0.00132U	0.00134U
Antimony	mg/kg	0.0533*DNJ	0.0619*DNJ	0.0468DU
Arsenic	mg/kg	7.4	7.73	8.16
Barium	mg/kg	37D	39.5D	65.9D
Beryllium	mg/kg	0.264D	0.255D	0.378D
Cadmium	mg/kg	0.255D	0.254D	0.302D
Calcium	mg/kg	8920D	8450D	10400D
Chromium	mg/kg	6.85	7.95	9.83
Copper	mg/kg	8.65	8.37	10.9
Iron	mg/kg	13400D	13500D	17000D
Lead	mg/kg	7.63	7.23	11.7
Magnesium	mg/kg	4060D	4100D	5520D
Manganese	mg/kg	460D	463D	749D
Mercury	mg/kg	0.0116	0.0125	0.0201J
Neptunium-237	pCi/g	0.001U	0.000591U	0.000522U
Nickel	mg/kg	16.6D	16.6D	17.3D
Plutonium-238	pCi/g	0.00112U	0U	0.00337U
Plutonium-239/240	pCi/g	0U	0.00263U	0U
PCB, total	µg/kg	19.8U	19.4U	18.9U
Selenium	mg/kg	0.412D	0.417D	0.469D
Silicon	mg/kg	543D	588D	480D
Silver	mg/kg	0.47U	0.485U	0.49U
Technetium-99	pCi/g	-0.0688U	-0.0037U	-0.00502U
Thallium	mg/kg	0.108D	0.105D	0.123D
Uranium	µg/g	0.967	0.811	0.912
Uranium-233/234	pCi/g	0.286J	0.228J	0.337
Uranium-235/236	pCi/g	0.0137	0.0152	0.0169
Uranium-238	pCi/g	0.323	0.27	0.304
Zinc	mg/kg	47.4D	45.6D	52.2D

Table 2.14. Sediment monitoring program results – 2017 (continued)

Parameter	Unit	Location/results[a,b]	
		Big Beaver Creek	
		RM-13 Downtream	*RM-13 Downtream (duplicate sample)*
Aluminum	mg/kg	4960D	4210D
Americium-241	pCi/g	0U	0.0012U
Antimony	mg/kg	0.222DJ	0.173DJ
Arsenic	mg/kg	25.2	19.1
Barium	mg/kg	61.7D	45.9D
Beryllium	mg/kg	0.513D	0.436D
Cadmium	mg/kg	0.794D	0.53D
Calcium	mg/kg	16600D	25000D
Chromium	mg/kg	22.5D	15.3D
Copper	mg/kg	24D	17.8D
Iron	mg/kg	33400D	27400D
Lead	mg/kg	16.8	12.1
Magnesium	mg/kg	5950D	8160D
Manganese	mg/kg	570D	504D
Mercury	mg/kg	0.0308J	0.0249J
Neptunium-237	pCi/g	0.00503U	0.00975
Nickel	mg/kg	31D	25.8D
Plutonium-238	pCi/g	-0.000582U	-0.000575U
Plutonium-239/240	pCi/g	0.00349U	0.00288U
PCB, total	µg/kg	24.3	22.4
Selenium	mg/kg	0.528D	0.479D
Silicon	mg/kg	406D	411D
Silver	mg/kg	0.473U	0.469U
Technetium-99	pCi/g	2.8	2.1
Thallium	mg/kg	0.157D	0.137D
Uranium	µg/g	2.38	2.04
Uranium-233/234	pCi/g	1.95	1.51
Uranium-235/236	pCi/g	0.0859	0.0872
Uranium-238	pCi/g	0.786	0.672
Zinc	mg/kg	105D	86.3D

Table 2.14. Sediment monitoring program results – 2017 (continued)

Parameter	Unit	Location/results[a,b]			
		Big Run Creek			
		RM-33 Upstream	*RM-3 Downstream*	*RM-3 Downstream (duplicate sample)*	*RM-2 Downstream @ Wakefield*
Aluminum	mg/kg	6690D	7740D	8730D	7330D
Americium-241	pCi/g	0.00249U	0.000703U	0.0029U	0.00238U
Antimony	mg/kg	0.302D	0.158DJ	0.17DJ	0.054DJ
Arsenic	mg/kg	37.6	39.8	49.9	20.4
Barium	mg/kg	51.7D	98.9D	145D	70.5D
Beryllium	mg/kg	1.22D	1.06D	1.42D	0.548D
Cadmium	mg/kg	0.475D	0.41D	0.45D	0.418D
Calcium	mg/kg	2740D	1910D	1880D	1150D
Chromium	mg/kg	46.6D	24.9D	32D	19D
Copper	mg/kg	19.1D	16.4D	20.4D	14.3D
Iron	mg/kg	86600D	49200D	67300D	28300D
Lead	mg/kg	37.5D	33.9D	49.9D	20.4
Magnesium	mg/kg	1750D	1070D	1030D	1420D
Manganese	mg/kg	759D	1780D	2980D	933D
Mercury	mg/kg	0.0318J	0.0381J	0.0379J	0.0363J
Neptunium-237	pCi/g	0.00128U	0.000789U	0.00341U	0.000893U
Nickel	mg/kg	38D	28.2D	36.5D	23D
Plutonium-238	pCi/g	0U	0.00123U	0.000552U	0.00139U
Plutonium-239/240	pCi/g	0.000665U	0.00432U	0.0011U	0.00697U
PCB, total	µg/kg	19.3U	32.1	34.8	40.9
Selenium	mg/kg	0.512D	0.893D	0.855D	0.586D
Silicon	mg/kg	291D	535D	540D	531D
Silver	mg/kg	0.454U	0.482U	0.481U	0.474U
Technetium-99	pCi/g	-0.0479U	0.356	0.393	0.067U
Thallium	mg/kg	0.15D	0.275D	0.34D	0.163D
Uranium	µg/g	2.78	3.84	4.57	1.46
Uranium-233/234	pCi/g	0.987	2.05	2.37	0.856
Uranium-235/236	pCi/g	0.0489	0.104	0.125	0.0449
Uranium-238	pCi/g	0.928	1.27	1.52	0.485
Zinc	mg/kg	154D	107D	120D	76.3D

Table 2.14. Sediment monitoring program results – 2017 (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	4450D	5820D	951D	5890D
Americium-241	pCi/g	0.00131U	0.00354U	0.00142U	0.00329U
Antimony	mg/kg	0.0614DJ	0.0643DJ	0.0488DU	0.455D
Arsenic	mg/kg	6.84	23	5.22	41
Barium	mg/kg	51D	71D	12.4D	58.2D
Beryllium	mg/kg	0.362D	0.613D	0.143D	0.906D
Cadmium	mg/kg	0.686D	0.0882D	0.0488DU	2.09D
Calcium	mg/kg	7210D	2770D	157D	3200D
Chromium	mg/kg	7.8	29.4DJ	6.67	21.9D
Copper	mg/kg	11.3	9.7	1.43J	24.6D
Iron	mg/kg	13700D	41800D	8830D	50400D
Lead	mg/kg	13.1	20.5	2.87	21.6
Magnesium	mg/kg	4100D	1290D	83.5D	2130D
Manganese	mg/kg	445D	1110D	109D	888D
Mercury	mg/kg	0.026J	0.0187J	0.0111U	0.0188J
Neptunium-237	pCi/g	0.00148U	0.000642U	0U	0.000739U
Nickel	mg/kg	23.9D	13.6D	2.37	53.5D
Plutonium-238	pCi/g	0.00295U	0.000566U	-0.00134U	0.00108U
Plutonium-239/240	pCi/g	0.00236U	0.00961	0U	0.00163U
PCB, total	µg/kg	19.8UJ	19.8UJ	18.8U	17.9U
Selenium	mg/kg	0.493D	0.327DJ	0.0976DU	0.726D
Silicon	mg/kg	501D	533D	188D	463D
Silver	mg/kg	0.486U	0.466U	0.463U	0.498U
Technetium-99	pCi/g	-0.083U	-0.0682U	-0.0592U	-0.041U
Thallium	mg/kg	0.135D	0.0632DJ	0.0488DU	0.357D
Uranium	µg/g	1.02	1.09	0.186	3.31
Uranium-233/234	pCi/g	0.368	0.437	0.0602	1.16
Uranium-235/236	pCi/g	0.021	0.0192	0.00205U	0.0584
Uranium-238	pCi/g	0.338	0.363	0.0622	1.1
Zinc	mg/kg	68.2D	53.7D	9	189D

[a]Abbreviations and data qualifiers are as follows: * – duplicate analysis is not within control limits. D – the result is reported from a dilution. J – the reported result is estimated. N – sample spike recovery is not within control limits. U – undetected.
[b]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.

Table 2.15. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2017

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	0.00129U	0.00277U	0U	0.00449UJ
Neptunium-237	-0.000324U	-0.00154U	0.000336U	0.000795U
Plutonium-238	0.000414U	-0.000348U	0.00126U	0.000361U
Plutonium-239/240	0.00166U	-0.000348U	-0.00126U	0.00578UJ
Technetium-99	0.0481U	0.0402U	0.0216U	0.0484U
Uranium	0.00927U	2.86	0.00211U	1.05
Uranium-233/234	0.00648	1.12	0.000647U	0.369
Uranium-235/236	0.0011U	0.0494	0.000402U	0.0159
Uranium-238	0.00295U	0.953	0.000647U	0.35
	A10 – On site on northwest segment of Perimeter Road		*A29 – On site at OVEC*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00148U	0.00192U	-0.000634U	0.0021U
Neptunium-237	0U	0U	-0.000666U	0.00125U
Plutonium-238	0U	-0.000671U	-0.000775U	0.000343U
Plutonium-239/240	0.00325U	0.00201U	0.000388U	0.00618U
Technetium-99	0.0586U	0.0321U	0.0467U	0.0432U
Uranium	0.0311	0.839	0.0119U	0.944
Uranium-233/234	0.0135	0.352	0.00493U	0.272
Uranium-235/236	0.000714U	0.0172	0U	0.0172
Uranium-238	0.0103	0.279	0.00401U	0.315
	A36 – On site at X-611 Water Treatment Plant		*A6 – North of PORTS in Piketon*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00135U	0.00863J	0.000604U	0.00303U
Neptunium-237	0.000332U	-0.000595U	0.000667U	-0.000953U
Plutonium-238	0.000786U	0.000349U	0.000356U	0.000394U
Plutonium-239/240	0.000393U	0.0154	0.000356U	0.00472UJ
Technetium-99	0.0494U	0.0191U	0.04U	0.0244U
Uranium	0.016U	0.742	0.00631U	1.01
Uranium-233/234	0.00656	0.353	0.00308U	0.298
Uranium-235/236	0U	0.0182	0.00104U	0.0204
Uranium-238	0.00537U	0.247	0.00196U	0.338

Table 2.15. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2017 (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	0.000631U	0.00365U	0.000638U	0.00045U
Neptunium-237	-0.000346U	0U	0U	0U
Plutonium-238	0.000345U	-0.000376U	0.000711U	0.000336U
Plutonium-239/240	0.00172U	0.00865	0.00249U	0.00235U
Technetium-99	-0.0165U	0.00363U	0.0327U	0.0458U
Uranium	0.00171U	0.777	0.00393U	0.818
Uranium-233/234	0.00143U	0.283	0.000865U	0.291
Uranium-235/236	0U	0.0188	0.00108U	0.0124
Uranium-238	0.000574U	0.258	0.00115U	0.273
	A23 – Northeastern PORTS boundary		*A12 – Eastern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00283U	0.00179U	0.00273U	0.000614U
Neptunium-237	0U	-0.000527U	-0.000688U	0.000373U
Plutonium-238	-0.000711U	-0.000811U	0.000348U	0U
Plutonium-239/240	0.000711U	0.00122U	0.00174U	0.00624UJ
Technetium-99	0.0779U	0.0306U	0.0605U	0.0688U
Uranium	0.0121U	0.72	0.08	1.31
Uranium-233/234	0.00169U	0.254	0.0363	0.513
Uranium-235/236	0.000702U	0.015	0.00243U	0.0285
Uranium-238	0.00395U	0.24	0.0265	0.435
	A15 – Southeast of PORTS on Loop Road		*A3 – Southern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00228U	0.00333UJ	0.000305U	0.00405UJ
Neptunium-237	0.000645U	0.000347U	0U	0U
Plutonium-238	0.000488U	-0.000342U	0.000369U	0.000954U
Plutonium-239/240	0.00244U	0.0144	0.00185U	0.00604J
Technetium-99	0.0523U	0.0855UJ	-0.00913U	0.0782U
Uranium	0.00694U	0.889	0.00162U	0.858
Uranium-233/234	0.000947U	0.321	0.0012U	0.307
Uranium-235/236	0.000785U	0.0169	-0.000374U	0.0172
Uranium-238	0.00221U	0.296	0.000601U	0.286

Table 2.15. Soil and biota (vegetation) monitoring at ambient air monitoring stations – 2017 (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	0.000914U	0.00667UJ	0.00127U	0.00425U
Neptunium-237	-0.000339U	0.000332U	0.000906U	0.00073U
Plutonium-238	0.000351U	0.00292U	0.00117U	-0.00035U
Plutonium-239/240	0.000703U	0.0152	0.00117U	0.00491UJ
Technetium-99	0.0378U	0.0605U	0.0443U	0.0498U
Uranium	0.0141U	0.843	0.00626U	0.808
Uranium-233/234	0.00519	0.271	0.00234U	0.276
Uranium-235/236	0.000679U	0.0119	0.000364U	0.0143
Uranium-238	0.00464U	0.282	0.00205U	0.269
	A37 – Background station near Otway			
	Vegetation	Soil		
Americium-241	0.00187U	0.0073UJ		
Neptunium-237	0U	0U		
Plutonium-238	0.00106U	0U		
Plutonium-239/240	0.000354U	0.0145		
Technetium-99	0.0243U	0.0554U		
Uranium	0.00543U	0.927		
Uranium-233/234	0.00343U	0.325		
Uranium-235/236	0.000711U	0.0128		
Uranium-238	0.00172U	0.31		
	Duplicate vegetation samples		*Duplicate soil samples*	
	A28	A37	A10	A41A
Americium-241	0.00183U	0.000939U	0.00187U	0.000389U
Neptunium-237	-0.00062U	0.00102U	0.000315U	-0.000426U
Plutonium-238	-0.000377U	0U	-0.000355U	0.000374U
Plutonium-239/240	0.00113U	0.00109U	0.00213U	0.0015U
Technetium-99	0.0491U	-0.0352U	0.0158U	0.087U
Uranium	0.00899U	0.00263U	0.84	0.839
Uranium-233/234	0.00229U	0.00221U	0.378	0.297
Uranium-235/236	0.00107U	0.000344U	0.0127	0.0148
Uranium-238	0.00286U	0.000829U	0.28	0.28

[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]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.

Table 2.16. Biota (fish) monitoring program results – 2017

Parameter	Unit	Location/fish/results[a,b]		
		Scioto River (RW-1A) drum	*Scioto River (RW-6) catfish*	*Big Beaver Creek (RW-15) bass*
Americium-241	pCi/g	0.0028U	0.00212U	0.00132U
Neptunium-237	pCi/g	0.0019U	-0.000322U	0.000291U
Plutonium-238	pCi/g	0.000315U	0.000703U	-0.000317U
Plutonium-239/240	pCi/g	0.00157U	0.00106U	0.00126U
PCB, total	µg/kg	20.2	18.5Q	22
Technetium-99	pCi/g	-0.0805U	-0.1U	-0.0324U
Uranium	µg/g	0.00114UJ	-0.000228UJ	0.000718UJ
Uranium-233/234	pCi/g	0.000322U	0.00159U	0.000312U
Uranium-235/236	pCi/g	0.000401UJ	-0.000494UJ	0.00155UJ
Uranium-238	pCi/g	0.000322U	0U	0U
		Big Beaver Creek (RW-13) bass	*Little Beaver Creek (RW-8) bass*	*Little Beaver Creek (RW-8) bass (duplicate sample)*
Americium-241	pCi/g	0.00131U	0U	0.00229U
Neptunium-237	pCi/g	-0.000323U	0.000662U	0.000592U
Plutonium-238	pCi/g	0.000674U	0.000351U	0.000891U
Plutonium-239/240	pCi/g	0.00101U	0.0021U	0.00089U
PCB, total	µg/kg	30.6	241D	290D
Technetium-99	pCi/g	-0.064U	-0.119U	-0.0945U
Uranium	µg/g	0.000358UJ	0.00228UJ	0.00106UJ
Uranium-233/234	pCi/g	0.00186U	0.000642U	0.00119U
Uranium-235/236	pCi/g	0.000773UJ	0.000798UJ	0.00037UJ
Uranium-238	pCi/g	0U	0.000642U	0.000298U

[a]Abbreviations and data qualifiers are as follows: U – undetected. D – the result is reported from a dilution. Q – one or more quality control criteria failed. J – estimated.
[b]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.

Table 2.17. Biota (crops) monitoring program results – 2017

Parameter	Unit	Location/crop/results[a,b]		
		Off-site #2 corn	*Off-site #2 cucumbers*	*Off-site #2 tomatoes*
Americium-241	pCi/g	0.000929U	0.000335U	0.000346U
Neptunium-237	pCi/g	-0.000303U	-0.000657U	0.000351U
Plutonium-238	pCi/g	-0.000295U	0.000347U	0.000359U
Plutonium-239/240	pCi/g	0.000885U	0.000694U	-0.000359U
Technetium-99	pCi/g	-0.068U	-0.0259U	-0.0422U
Uranium	µg/g	0.000159U	0.0024U	0.00292U
Uranium-233/234	pCi/g	-0.000276U	0.00135U	0.000615U
Uranium-235/236	pCi/g	0.000344U	0.000842U	0.000382U
Uranium-238	pCi/g	0U	0.000677U	0.000922U
		Off-site #3 cucumbers	*Off-site #3 cucumbers (duplicate sample)*	*Off-site #3 gourds*
Americium-241	pCi/g	0.00163U	0.00209U	0.00222U
Neptunium-237	pCi/g	0U	-0.000319U	0.000295U
Plutonium-238	pCi/g	-0.000316U	0.000357U	-0.000343U
Plutonium-239/240	pCi/g	0U	0.00107U	0.000685U
Technetium-99	pCi/g	-0.0149U	-0.0144U	-0.0224U
Uranium	µg/g	0.000000153U	0.00107U	0.000882U
Uranium-233/234	pCi/g	0.000952U	0.000302U	0.00178U
Uranium-235/236	pCi/g	0U	0.000375U	0U
Uranium-238	pCi/g	0U	0.000302U	0.000296U
		Off-site #3 tomatoes	*Off-site #4 corn*	*Off-site #4 green beans*
Americium-241	pCi/g	0.00067U	0.00142U	0.00195U
Neptunium-237	pCi/g	-0.000937U	-0.000317U	-0.000309U
Plutonium-238	pCi/g	-0.00141U	0.000395U	-0.000644U
Plutonium-239/240	pCi/g	0.000703U	0.00079U	0.00129U
Technetium-99	pCi/g	-0.0113U	-0.0691U	-0.0472U
Uranium	µg/g	0.000166U	-0.000000108U	0.00378U
Uranium-233/234	pCi/g	0U	-0.000669U	0.00029U
Uranium-235/236	pCi/g	0.000359U	0U	0.00072U
Uranium-238	pCi/g	0U	0U	0.00116U

Table 2.17. Biota (crops) monitoring program results – 2017 (continued)

Parameter	Unit	Location/crop/results[a,b]		
		Off-site #4 tomatoes	*Off-site #5 blackberries*	
Americium-241	pCi/g	0.000327U	0.00206U	
Neptunium-237	pCi/g	0.00104U	0U	
Plutonium-238	pCi/g	0U	0U	
Plutonium-239/240	pCi/g	0U	0.0012U	
Technetium-99	pCi/g	0.00552U	-0.0311U	
Uranium	µg/g	-0.00214U	0.000331U	
Uranium-233/234	pCi/g	0.000657U	0U	
Uranium-235/236	pCi/g	-0.000409U	0.000715U	
Uranium-238	pCi/g	-0.000657U	0U	
		Off-site #5 corn	*Off-site #5 corn (duplicate sample)*	*Off-site #5 hops*
Americium-241	pCi/g	0.000315U	0.00212U	0.00179U
Neptunium-237	pCi/g	-0.000579U	0U	0U
Plutonium-238	pCi/g	0.00058U	-0.000708U	0U
Plutonium-239/240	pCi/g	0.00029U	0.00283U	0.0012U
Technetium-99	pCi/g	-0.0329U	-0.0837U	0.0145U
Uranium	µg/g	0.00205U	0.00207U	0.00376U
Uranium-233/234	pCi/g	0.000289U	0.000582U	0.000822U
Uranium-235/236	pCi/g	0.000719U	0.000724U	-0.000682U
Uranium-238	pCi/g	0.000578U	0.000582U	0.00137U
		Off-site #6 corn	*Off-site #6 tomatoes*	*Off-site #6 zucchini*
Americium-241	pCi/g	0.00261U	0.00128U	0.00156U
Neptunium-237	pCi/g	0.000289U	0U	0.000979U
Plutonium-238	pCi/g	0.000343U	0.000637U	0.0007U
Plutonium-239/240	pCi/g	0.00137U	0.00191U	0.0014U
Technetium-99	pCi/g	-0.0849U	0.00681U	0.0389U
Uranium	µg/g	-0.000755U	0.00106U	0.00422U
Uranium-233/234	pCi/g	0.000315U	0.000894U	0.000338U
Uranium-235/236	pCi/g	0.000392U	0.000371U	0.000421U
Uranium-238	pCi/g	-0.000315U	0.000298U	0.00135U

[a]Abbreviations and data qualifiers are as follows: U – undetected.
[b]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.

Table 2.18. Biota (deer) monitoring program results – 2017

Parameter	Unit	August 2017[a,b]	October 2017[a,b]	October 2017[a,b]
		liver		
Americium-241	pCi/g	0.00152U	0.000301U	0.00275UJ
Neptunium-237	pCi/g	-0.00042U	0.0003U	0U
Plutonium-238	pCi/g	0.00133U	-0.00073U	0U
Plutonium-239/240	pCi/g	0U	0.000367U	0.000727U
Technetium-99	pCi/g	-0.0118U	0.0758U	0.0332U
Uranium	µg/g	0.00136UJ	0.000964U	0.000586U
Uranium-233/234	pCi/g	0.00137U	0.00163U	-0.00051U
Uranium-235/236	pCi/g	0UJ	0.000338U	0.00127U
Uranium-238	pCi/g	0.000458U	0.000271U	0U
		muscle		
Americium-241	pCi/g	0.000845U	0.00091U	0.000857U
Neptunium-237	pCi/g	-0.00078U	-0.00033U	-0.00029U
Plutonium-238	pCi/g	0.000453U	-0.00031U	-0.00031U
Plutonium-239/240	pCi/g	0.000454U	0.00094U	0.000314U
Technetium-99	pCi/g	-0.0213U	0.0826U	0.0485U
Uranium	µg/g	0.0054UJ	0.00275U	0.00203U
Uranium-233/234	pCi/g	0.000433U	0.000545U	0U
Uranium-235/236	pCi/g	0.000538UJ	0.000678U	-0.00047U
Uranium-238	pCi/g	0.00173U	0.000818U	0.000757U
		kidney		
Americium-241	pCi/g	0.0015U	0.000779U	0.000293U
Neptunium-237	pCi/g	0.000385U	0.000548U	-0.00026U
Plutonium-238	pCi/g	0U	-0.00028U	0U
Plutonium-239/240	pCi/g	0.00211U	0.00111U	0.000377U
Technetium-99	pCi/g	-0.00558U	0.045U	0.0891UJ
Uranium	µg/g	0.00207UJ	0.00398U	0.000827U
Uranium-233/234	pCi/g	0.000861U	0.000772U	0.000556U
Uranium-235/236	pCi/g	-0.00107UJ	0.00032U	0U
Uranium-238	pCi/g	0.000861U	0.00129U	0.000278U

[a]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[b]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.

Table 2.19. Biota (off-site dairy) monitoring program results– 2017

Parameter	Unit	Milk[a,b]	Eggs[a,b]
Americium-241	pCi/g	0U	0.000319U
Neptunium-237	pCi/g	-0.00031U	0U
Plutonium-238	pCi/g	0U	0U
Plutonium-239/240	pCi/g	0.0012U	-0.00034U
Technetium-99	pCi/g	-0.114U	-0.0782U
Uranium	µg/g	0.00175U	0.00176U
Uranium-233/234	pCi/g	-0.0008U	0U
Uranium-235/236	pCi/g	0.000333U	0U
Uranium-238	pCi/g	0.000536U	0.000591U

[a]Abbreviations and data qualifiers are as follows: U – undetected.
[b]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.

3. 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 – 2017
- Table 3.2. Predicted radiation doses from airborne releases at PORTS – 2017
- Table 3.3. Dose calculations for ambient air monitoring stations – 2017.

Table 3.1. Emissions (Ci/year) from DOE air emission sources – 2017

Radionuclide	Group 1[a]	Group 2[b]	Group 3[c]	DUF_6 facility[d]
Americium-241	2.95E-07	-	5.43E-06	-
Neptunium-237	4.19E-08	-	1.16E-05	-
Plutonium-238	6.04E-08	-	5.56E-07	-
Plutonium-239/240	2.45E-07	-	3.92E-05	-
Technetium-99	5.25E-04	2.34E-03	6.10E-02	-
Uranium-233/234	5.64E-05	2.46E-05	1.10E-03	1.70E-06
Uranium-235	4.12E-06	3.01E-06	6.16E-05	7.90E-08
Uranium-238	4.357E-04	2.41E-05	3.11E-04	4.20E-06
Thorium-228	3.74E-08	1.39E-07	1.39E-07	-
Thorium-230	3.75E-05	4.27E-06	3.28E-06	-
Thorium-231	3.61E-06	2.46E-05	3.54E-05	2.1E-07
Thorium-232	2.29E-09	1.49E-07	1.13E-07	-
Thorium-234	4.18E-04	3.01E-06	4.30E-05	1.9E-05
Protactinium-234m	4.18E-04	3.01E-06	4.30E-05	1.9E-05
Total	1.90E-03	2.43E-03	6.27E-02	4.42E-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 – 2017

Effective dose to:	
Maximally exposed individual (mrem/year)	0.12
Population[a] (person-rem/year)	0.47

[a]Population within 50 miles (80 kilometers) of plant site.

Table 3.3. Dose calculations for ambient air monitoring stations – 2017

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A3	Americium-241	3.6E-09		
	Neptunium-237	1.4E-09		
	Plutonium-238	0		
	Plutonium-239/240	2.4E-09		
	Technetium-99	5.8E-04		
	Uranium-233/234	9.4E-07		
	Uranium-235/236	2.5E-08	(0.00058)	(0.00026)
	Uranium-238	3.5E-07	5.8E-04	2.6E-04
A6	Americium-241	2.9E-09		
	Neptunium-237	1.3E-09		
	Plutonium-238	7.8E-10		
	Plutonium-239/240	1.7E-09		
	Technetium-99	3.6E-04		
	Uranium-233/234	7.5E-07		
	Uranium-235/236	3.3E-08	(0.00037)	(0.000050)
	Uranium-238	4.6E-07	3.7E-04	5.0E-05
A8	Americium-241	2.4E-09		
	Neptunium-237	2.8E-09		
	Plutonium-238	1.1E-09		
	Plutonium-239/240	1.1E-09		
	Technetium-99	3.9E-04		
	Uranium-233/234	7.6E-07		
	Uranium-235/236	3.5E-08	(0.00039)	(0.000070)
	Uranium-238	3.0E-07	3.9E-04	7.0E-05
A9	Americium-241	1.9E-09		
	Neptunium-237	7.4E-10		
	Plutonium-238	7.0E-10		
	Plutonium-239/240	2.2E-09		
	Technetium-99	3.4E-04		
	Uranium-233/234	8.5E-07		
	Uranium-235/236	2.9E-08	(0.00034)	(0.000020)
	Uranium-238	8.9E-07	3.4E-04	2.0E-05

Table 3.3. Dose calculations for ambient air monitoring stations – 2017 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A10	Americium-241	6.8E-07		
	Neptunium-237	5.0E-08		
	Plutonium-238	2.0E-09		
	Plutonium-239/240	1.5E-08		
	Technetium-99	2.5E-04		
	Uranium-233/234	1.1E-06		
	Uranium-235/236	4.1E-08	(0.00025)	
	Uranium-238	4.7E-07	2.5E-04	0
A12	Americium-241	1.9E-06		
	Neptunium-237	3.6E-08		
	Plutonium-238	1.7E-09		
	Plutonium-239/240	1.5E-08		
	Technetium-99	1.7E-04		
	Uranium-233/234	1.1E-06		
	Uranium-235/236	3.3E-08	(0.00017)	
	Uranium-238	3.9E-07	1.7E-04	0
A15	Americium-241	8.8E-07		
	Neptunium-237	7.2E-08		
	Plutonium-238	2.6E-09		
	Plutonium-239/240	1.9E-08		
	Technetium-99	3.3E-04		
	Uranium-233/234	3.3E-07		
	Uranium-235/236	2.5E-08	(0.00033)	(0.000010)
	Uranium-238	3.4E-07	3.3E-04	1.0E-05
A23	Americium-241	5.9E-07		
	Neptunium-237	3.8E-08		
	Plutonium-238	1.7E-09		
	Plutonium-239/240	1.6E-08		
	Technetium-99	3.0E-04		
	Uranium-233/234	7.7E-07		
	Uranium-235/236	2.6E-08	(0.00030)	
	Uranium-238	9.7E-07	3.0E-04	0
A24	Americium-241	1.7E-06		
	Neptunium-237	2.8E-07		
	Plutonium-238	4.7E-09		
	Plutonium-239/240	2.5E-08		
	Technetium-99	2.5E-04		
	Uranium-233/234	9.4E-07		
	Uranium-235/236	2.6E-08	(0.00026)	
	Uranium-238	8.7E-07	2.6E-04	0

Table 3.3. Dose calculations for ambient air monitoring stations – 2017 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A28	Americium-241	3.2E-07		
	Neptunium-237	1.1E-07		
	Plutonium-238	1.4E-09		
	Plutonium-239/240	1.3E-08		
	Technetium-99	1.9E-04		
	Uranium-233/234	3.7E-07		
	Uranium-235/236	2.1E-08	(0.00019)	
	Uranium-238	3.6E-07	1.9E-04	0
A29	Americium-241	7.9E-07		
	Neptunium-237	4.8E-08		
	Plutonium-238	1.1E-09		
	Plutonium-239/240	1.6E-08		
	Technetium-99	2.1E-04		
	Uranium-233/234	4.3E-07		
	Uranium-235/236	2.3E-08	(0.00022)	
	Uranium-238	3.8E-07	2.2E-04	0
A36	Americium-241	3.1E-09		
	Neptunium-237	2.8E-09		
	Plutonium-238	2.8E-09		
	Plutonium-239/240	1.8E-09		
	Technetium-99	7.8E-04		
	Uranium-233/234	2.5E-06		
	Uranium-235/236	3.5E-08	(0.00078)	(0.00046)
	Uranium-238	3.4E-06	7.8E-04	4.6E-04
A37	Americium-241	4.8E-09		
	Neptunium-237	2.3E-09		
	Plutonium-238	7.0E-10		
	Plutonium-239/240	1.9E-09		
	Technetium-99	3.2E-04		
	Uranium-233/234	2.7E-07		
	Uranium-235/236	2.3E-08	(0.00032)	
	Uranium-238	3.8E-07	3.2E-04	-
A41A	Americium-241	3.0E-09		
	Neptunium-237	3.3E-07		
	Plutonium-238	1.6E-09		
	Plutonium-239/240	2.5E-09		
	Technetium-99	3.6E-04		
	Uranium-233/234	7.5E-07		
	Uranium-235/236	3.0E-08	(0.00037)	(0.000050)
	Uranium-238	7.9E-07	3.7E-04	5.0E-05

Table 3.3. Dose calculations for ambient air monitoring stations – 2017 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
T7	Americium-241	2.4E-09		
	Neptunium-237	1.5E-09		
	Plutonium-238	3.7E-10		
	Plutonium-239/240	2.1E-09		
	Technetium-99	1.7E-04		
	Uranium-233/234	7.2E-07		
	Uranium-235/236	3.3E-08	(0.00017)	
	Uranium-238	3.9E-07	1.7E-04	0

[a]Parameters listed in **bold** type were detected at least once in the samples collected in 2017 (see Table 2.9).
[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).
[c]The total dose is provided in scientific notation and standard numeric format (in parentheses).
[d]The net dose is calculated by subtracting the total dose at Station A37 (background) from the total dose calculated for each station (the net dose is recorded as zero for stations with a gross dose less than the background station). The net dose is provided in scientific notation and standard numeric format (in parentheses).

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4. GROUNDWATER

This section summarizes analytical results for routine groundwater monitoring at PORTS in 2017 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 2017. 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.

Two VOCs, acetone and methylene chloride, were frequently detected in both environmental and blank samples (field and trip blanks) collected in 2017. Acetone and methylene chloride are common laboratory contaminants that are not typically detected in the PORTS groundwater plumes. Detections of acetone and methylene chloride are often 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.

Other VOCs, including 2-butanone, tetrachloroethene, TCE, and 1,2-dichlorobenzene were detected in trip and/or field blanks during 2017. 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, 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 2017 meet this purpose.

Complete groundwater monitoring results for sampling completed as required by the *Integrated Groundwater Monitoring Plan* (DOE 2015, DOE 2017) are provided in the *2017 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2018a). The *2017 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 2017 at the 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 ten 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 – 2017

- Table 4.2. Results for radionuclides at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017

- Table 4.3. VOCs detected at the PK Landfill – 2017

- Table 4.4. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017

- Table 4.5. Results for radionuclides at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017

- Table 4.6. VOCs detected at the X-749A Classified Materials Disposal Facility – 2017

- Table 4.7. Results for radionuclides at the X-749A Classified Materials Disposal Facility – 2017

- Table 4.8. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017

- Table 4.9. Results for radionuclides at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017

- Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017

- Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017

- Table 4.12. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2017

- Table 4.13. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2017
- Table 4.14. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2017
- Table 4.15. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2017
- Table 4.16. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2017
- Table 4.17. VOCs detected at the X-735 Landfills – 2017
- Table 4.18. Results for radionuclides at the X-735 Landfills – 2017
- Table 4.19. VOCs detected at the X-734 Landfills – 2017
- Table 4.20. Results for radionuclides at the X-734 Landfills – 2017
- Table 4.21. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2017
- Table 4.22. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2017
- Table 4.23. VOCs detected at surface water monitoring locations – 2017
- Table 4.24. Results for radionuclides at surface water monitoring locations – 2017.

Tables for VOCs and radionuclides detected at exit pathway monitoring location F-29B are not provided because none were detected. Results for exit pathway monitoring locations sampled during 2017 (that are part of the monitoring programs for other areas) are provided in the tables for their respective monitoring areas as follows:

- Tables 4.1 and 4.2: VOCs and/or radionuclides 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).
- Table 4.11: Results for radionuclides at X-701B Former Holding Pond area well X701-48G (VOCs were not detected in well X701-48G in 2017).
- Tables 4.23 and 4.24: VOCs and/or 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
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 – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-27G	1,1-Dichloroethane	µg/L			0.71 J	
	cis-1,2-Dichloroethene	µg/L			0.73 J	
	Trichloroethene	µg/L			1.8 Q	
PK-07G	Trichloroethene	µg/L			0.38 J	
PK-08G	cis-1,2-Dichloroethene	µg/L			0.34 J	
	Trichloroethene	µg/L			15	
PK-09G	cis-1,2-Dichloroethene	µg/L			8.6 D	
	Trichloroethene	µg/L			480 D	
STSW-101G	1,1,1-Trichloroethane	µg/L		4.6		3.9
	1,1,2-Trichloroethane	µg/L		0.46 J		0.32 U
	1,1-Dichloroethane	µg/L		15 J		14
	1,1-Dichloroethene	µg/L		35 J		31
	1,2-Dichloroethane	µg/L		2.8		1.9
	Chloroform	µg/L		1.2		0.96 J
	cis-1,2-Dichloroethene	µg/L		10		9.3
	Tetrachloroethene	µg/L		0.71 J		0.7 J
	Trichloroethene	µg/L		37 J		36
STSW-102G	1,1,1-Trichloroethane	µg/L		5.1		5
	1,1-Dichloroethane	µg/L		55		75 D
	1,1-Dichloroethene	µg/L		28		34 J
	1,2-Dichloroethane	µg/L		19		21
	Acetone	µg/L		1.9 U		7.4 JQ
	Benzene	µg/L		0.17 J		0.16 U
	Chloroform	µg/L		2.9		3
	cis-1,2-Dichloroethene	µg/L		18		19
	trans-1,2-Dichloroethene	µg/L		0.15 U		0.21 J
	Trichloroethene	µg/L		160 DJ		170 D
	Vinyl chloride	µg/L		0.22 J		0.22 J
WP-01G	Acetone	µg/L		1.9 U		5 J
WP-06G	Acetone	µg/L		1.9 U		8.8 J
X120-03G	Chloroform	µg/L			0.25 J	
X120-05G	Trichloroethene	µg/L			2	
X120-06B	Trichloroethene	µg/L			0.76 J	
X120-08G	1,1,1-Trichloroethane	µg/L			3.2	
	1,1,2-Trichloroethane	µg/L			0.61 J	
	1,1-Dichloroethane	µg/L			7.4	
	1,1-Dichloroethene	µg/L			24 J	
	1,2-Dichloroethane	µg/L			0.77 J	
	Chloroform	µg/L			0.83 J	
	cis-1,2-Dichloroethene	µg/L			0.68 J	
	Tetrachloroethene	µg/L			0.22 J	
	Trichloroethene	µg/L			15 J	
X120-09G	1,1,1-Trichloroethane	µg/L			3.7	
	1,1,2-Trichloroethane	µg/L			0.5 J	
	1,1-Dichloroethane	µg/L			7.1	
	1,1-Dichloroethene	µg/L			21	
	1,2-Dichloroethane	µg/L			0.77 J	
	Chloroform	µg/L			0.76 J	
	cis-1,2-Dichloroethene	µg/L			0.79 J	
	Tetrachloroethene	µg/L			0.26 J	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X120-09G	Trichloroethene	µg/L			16	
X120-10G	1,1,1-Trichloroethane	µg/L			4.4	
	1,1,2-Trichloroethane	µg/L			1.2	
	1,1-Dichloroethane	µg/L			15	
	1,1-Dichloroethene	µg/L			50 J	
	1,2-Dichloroethane	µg/L			1.2	
	Chloroform	µg/L			1.4	
	cis-1,2-Dichloroethene	µg/L			0.72 J	
	Methylene chloride	µg/L			0.77 J	
	Trichloroethene	µg/L			12 J	
X120-11G	1,1-Dichloroethene	µg/L		0.59 J		0.76 J
	Acetone	µg/L		1.9 QU		13
	cis-1,2-Dichloroethene	µg/L		8.7		11
	trans-1,2-Dichloroethene	µg/L		0.21 J		0.29 J
	Trichloroethene	µg/L		220 D		210 D
	Vinyl chloride	µg/L		0.1 JQU		0.19 J
X749-04G	Chloroform	µg/L			0.24 J	
	cis-1,2-Dichloroethene	µg/L			0.48 J	
	Tetrachloroethene	µg/L			0.56 J	
	Trichloroethene	µg/L			260 D	
X749-05G	1,1-Dichloroethane	µg/L			0.61 J	
	1,1-Dichloroethene	µg/L			0.35 J	
	Carbon tetrachloride	µg/L			0.29 J	
	Chloroform	µg/L			0.86 J	
	cis-1,2-Dichloroethene	µg/L			0.88 J	
	Tetrachloroethene	µg/L			1.7	
	Trichloroethene	µg/L			100 D	
X749-06G	1,1,1-Trichloroethane	µg/L		28 D		22 D
	1,1,2-Trichloroethane	µg/L		1.3 QU		3.7 D
	1,1-Dichloroethane	µg/L		160 D		200 D
	1,1-Dichloroethene	µg/L		110 D		120 D
	1,2-Dichloroethane	µg/L		4.1 D		3.5 D
	Benzene	µg/L		0.64 U		0.33 DJ
	Chloroform	µg/L		16 D		16 D
	cis-1,2-Dichloroethene	µg/L		39 D		50 D
	Tetrachloroethene	µg/L		12 D		14 D
	Trichloroethene	µg/L		610 D		640 D
	Vinyl chloride	µg/L		0.4 U		1.2 DJ
X749-07G	1,1,1,2-Tetrachloroethane	µg/L		0.17 J		
	1,1,1-Trichloroethane	µg/L		8.3		7.5
	1,1-Dichloroethane	µg/L		35 J		30
	1,1-Dichloroethene	µg/L		21 J		18
	1,2-Dichloroethane	µg/L		19 J		14
	Chloroform	µg/L		1.4		1.2
	cis-1,2-Dichloroethene	µg/L				6
	Tetrachloroethene	µg/L		0.35 J		0.38 J
	Trichloroethene	µg/L		70 DQJ		64 D
	Vinyl chloride	µg/L		0.1 U		0.28 J
X749-08G	1,1,1-Trichloroethane	µg/L		7.5		4.2
	1,1-Dichloroethane	µg/L		1.9		1.1

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-08G	1,1-Dichloroethene	µg/L		7.6		4.5
	Chloroform	µg/L		0.21 J		0.16 U
	cis-1,2-Dichloroethene	µg/L				1.1
	Trichloroethene	µg/L		14		8
X749-09GA	1,1,1-Trichloroethane	µg/L		14		6.8
	1,1-Dichloroethane	µg/L		4.3		2.1
	1,1-Dichloroethene	µg/L		9.8		4.9
	1,2-Dichloroethane	µg/L		0.69 J		0.13 U
	Chloroform	µg/L		0.36 J		0.16 U
	cis-1,2-Dichloroethene	µg/L		3.1		1.3
	trans-1,2-Dichloroethene	µg/L		0.23 J		0.15 U
	Trichloroethene	µg/L		13		4.7
X749-10GA	1,1-Dichloroethane	µg/L		2.8		1.5
	1,1-Dichloroethene	µg/L		4.9		2.8
	cis-1,2-Dichloroethene	µg/L				1.3
	Trichloroethene	µg/L		0.27 J		0.28 J
	Vinyl chloride	µg/L		0.97 J		0.54 J
X749-13G	1,1,1-Trichloroethane	µg/L		2.3		2.8
	1,1-Dichloroethane	µg/L		0.84 J		0.86 J
	1,1-Dichloroethene	µg/L		3.2		4.4
	Acetone	µg/L		2.3 J		1.9 U
	Chloroform	µg/L		0.16 U		0.2 J
	cis-1,2-Dichloroethene	µg/L		0.75 J		0.79 J
	Trichloroethene	µg/L		7.2 J		7.8
X749-14B	Acetone	µg/L		2.4 J		1.9 U
X749-20G	1,1,1-Trichloroethane	µg/L			0.51 J	
	1,1-Dichloroethane	µg/L			1.3	
	1,1-Dichloroethene	µg/L			1	
	cis-1,2-Dichloroethene	µg/L			1	
	Methylene chloride	µg/L			1.2 J	
	Trichloroethene	µg/L			12	
X749-21G	1,1,1-Trichloroethane	µg/L		1.5		4
	1,1-Dichloroethane	µg/L		0.48 J		1.3
	1,1-Dichloroethene	µg/L		0.93 J		2.6
	cis-1,2-Dichloroethene	µg/L		0.22 J		0.6 J
	Trichloroethene	µg/L		2.2		4.9
X749-22G	1,1,1-Trichloroethane	µg/L		0.18 J		0.16 U
	1,1-Dichloroethane	µg/L		2.9		3.2
	1,1-Dichloroethene	µg/L		3.6		4.2
	cis-1,2-Dichloroethene	µg/L		1.1		1.2
	Vinyl chloride	µg/L		0.63 J		0.64 J
X749-26G	1,1,1-Trichloroethane	µg/L		3.7		0.9 J
	1,1-Dichloroethane	µg/L		11		2.5
	1,1-Dichloroethene	µg/L		15 J		2.5
	1,2-Dichloroethane	µg/L		5.1		1.1
	Chloroform	µg/L		1.2		0.21 J
	cis-1,2-Dichloroethene	µg/L		2.9		0.47 J
	Tetrachloroethene	µg/L		0.28 J		0.2 U
	Trichloroethene	µg/L		25 J		4.8 J
X749-27G	1,1,1-Trichloroethane	µg/L		30		16

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-27G	1,1,2-Trichloroethane	µg/L		1.1 Q		1
	1,1-Dichloroethane	µg/L		130 DQ		41
	1,1-Dichloroethene	µg/L		180 DQ		83 D
	1,2-Dichloroethane	µg/L		75 DQ		14
	Acetone	µg/L		1.9 U		6.2 J
	Benzene	µg/L		0.16 J		0.16 U
	Chloroethane	µg/L		1.5 J		0.48 J
	Chloroform	µg/L		14 Q		5.7
	cis-1,2-Dichloroethene	µg/L		32		13
	Tetrachloroethene	µg/L		1.6		1.5
	trans-1,2-Dichloroethene	µg/L		0.33 JQ		0.15 J
	Trichloroethene	µg/L		230 D		130 D
	Vinyl chloride	µg/L		0.1 U		0.19 J
X749-28G	1,1,1-Trichloroethane	µg/L			4.3	
	1,1-Dichloroethane	µg/L			3.2	
	1,1-Dichloroethene	µg/L			9.4	
	1,2-Dichloroethane	µg/L			0.35 J	
	Chloroform	µg/L			0.67 J	
	cis-1,2-Dichloroethene	µg/L			0.64 J	
	Methylene chloride	µg/L			1.3 BJ	
	Trichloroethene	µg/L			29 J	
X749-29G	1,1-Dichloroethene	µg/L			0.32 J	
	Chloroform	µg/L			0.3 J	
	cis-1,2-Dichloroethene	µg/L			0.61 J	
	Trichloroethene	µg/L			34	
X749-30G	1,1-Dichloroethene	µg/L			1.7	
	Chloroform	µg/L			0.59 J	
	cis-1,2-Dichloroethene	µg/L			1.2	
	Trichloroethene	µg/L			57	
X749-33G	1,1,1-Trichloroethane	µg/L		11		14
	1,1,2-Trichloroethane	µg/L		0.32 QU		1.3
	1,1-Dichloroethane	µg/L		37 Q		41
	1,1-Dichloroethene	µg/L		55 Q		76 D
	1,2-Dichloroethane	µg/L		15 Q		15
	Acetone	µg/L		1.9 U		8.1 J
	Chloroethane	µg/L		0.51 J		0.43 J
	Chloroform	µg/L		4.2 Q		4.9
	cis-1,2-Dichloroethene	µg/L		5.9		9.3
	Tetrachloroethene	µg/L		1.2		1.4
	Trichloroethene	µg/L		100 D		120 D
X749-35G	1,1,1-Trichloroethane	µg/L			36	
	1,1-Dichloroethane	µg/L			5.7	
	1,1-Dichloroethene	µg/L			19	
	cis-1,2-Dichloroethene	µg/L			3.5	
	Tetrachloroethene	µg/L			0.24 J	
	Trichloroethene	µg/L			57	
	Vinyl chloride	µg/L			0.34 J	
X749-36G	1,1,1-Trichloroethane	µg/L			0.74 J	
	1,1-Dichloroethane	µg/L			1.5	
	1,1-Dichloroethene	µg/L			5.2	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-36G	Chloroform	µg/L			0.22 J	
	cis-1,2-Dichloroethene	µg/L			0.31 J	
	Trichloroethene	µg/L			5.1	
X749-37G	1,1,1-Trichloroethane	µg/L		1.9		2.1
	1,1-Dichloroethane	µg/L		7.6 Q		8.9
	1,1-Dichloroethene	µg/L		15 Q		21 J
	1,2-Dichloroethane	µg/L		0.13 JQU		0.74 J
	Chloroform	µg/L		0.36 JQ		0.37 J
	cis-1,2-Dichloroethene	µg/L		3.3		3.9
	Tetrachloroethene	µg/L		0.34 J		0.4 J
	Trichloroethene	µg/L		17		19 J
X749-38G	1,1,1-Trichloroethane	µg/L		5.6		8.9
	1,1,2-Trichloroethane	µg/L		0.61 J		0.32 U
	1,1-Dichloroethane	µg/L		14		23
	1,1-Dichloroethene	µg/L		39		58
	1,2-Dichloroethane	µg/L		1.5		2.4
	Acetone	µg/L		1.9 U		2.6 J
	Chloroform	µg/L		1.3		1.8
	cis-1,2-Dichloroethene	µg/L		10		14
	Tetrachloroethene	µg/L		0.88 J		1.2
	Trichloroethene	µg/L		41		57 D
X749-40G	Chloroform	µg/L			0.43 J	
	Trichloroethene	µg/L			0.23 J	
X749-41G	Acetone	µg/L		7.6 U		22 D
	Chloroform	µg/L		0.64 U		0.36 DJ
	cis-1,2-Dichloroethene	µg/L		2.4 DJ		2.7 D
	trans-1,2-Dichloroethene	µg/L		1.1 DJ		0.85 DJ
	Trichloroethene	µg/L		370 D		590 D
X749-42G	1,1,1-Trichloroethane	µg/L		0.54 J		0.52 J
	1,1-Dichloroethane	µg/L		0.83 J		1.1
	1,1-Dichloroethene	µg/L		3.3		3.8
	Acetone	µg/L		1.9 U		5.9 J
	Chloroform	µg/L		0.16 U		0.18 J
	Trichloroethene	µg/L		3.1		4.2
X749-43G	1,1,1-Trichloroethane	µg/L			0.24 J	
	1,1-Dichloroethane	µg/L			0.47 J	
	1,1-Dichloroethene	µg/L			1.2 J	
	Trichloroethene	µg/L			0.84 J	
X749-44G	1,1-Dichloroethane	µg/L	0.22 U	0.18 J	0.3 J	0.16 J
	1,1-Dichloroethene	µg/L	0.23 U	0.14 U	0.23 J	0.14 U
	Trichloroethene	µg/L	0.36 J	0.25 J	0.6 J	0.27 J
X749-45G	1,1,1-Trichloroethane	µg/L	0.24 J	0.16 U	0.16 U	0.16 U
	1,1-Dichloroethane	µg/L	4.1	1.5	0.25 J	0.23 J
	1,1-Dichloroethene	µg/L	2.8	0.93 J	0.17 J	0.14 U
	1,2-Dichloroethane	µg/L	1.2	0.13 U	0.13 U	0.13 U
	Acetone	µg/L	1.9 U	1.9 U	1.9 U	20
	cis-1,2-Dichloroethene	µg/L	4.9	1.2	0.21 J	0.2 J
	Trichloroethene	µg/L	8.4	3.6	0.73 J	0.58 J
X749-50B	1,1-Dichloroethane	µg/L			0.88 J	
	Methylene chloride	µg/L			0.87 J	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-51B	Methylene chloride	µg/L			0.85 J	
X749-54B	1,1-Dichloroethane	µg/L		2.6 Q		2.8
	Acetone	µg/L		1.9 U		6.6 J
	Trichloroethene	µg/L		0.72 J		5.1
	Vinyl chloride	µg/L		0.1 U		0.45 J
X749-60B	Trichloroethene	µg/L			1.8	
X749-64B	Methylene chloride	µg/L			0.83 J	
X749-67G	1,1,1-Trichloroethane	µg/L	6	7.8	7.6	6
	1,1,2-Trichloroethane	µg/L	0.46 J	0.32 JQU	0.47 J	0.38 J
	1,1-Dichloroethane	µg/L	73 D	66 D	85 D	74 D
	1,1-Dichloroethene	µg/L	54	53 J	58	50
	1,2-Dichloroethane	µg/L	24	30 JQ	24	22
	Chloroethane	µg/L	0.91 J	1 J	0.81 J	0.69 J
	Chloroform	µg/L	3.5	4	3.4	3.2
	cis-1,2-Dichloroethene	µg/L	42	45 J	37	36
	Tetrachloroethene	µg/L	0.31 J	0.23 J	0.24 J	0.2 U
	trans-1,2-Dichloroethene	µg/L	0.42 J	0.44 J	0.39 J	0.31 J
	Trichloroethene	µg/L	220 D	170 D	240 D	200 D
	Vinyl chloride	µg/L	0.27 J	0.4 J	0.33 J	0.24 J
X749-96G	Trichloroethene	µg/L		0.16 U		1.7
X749-97G	1,1-Dichloroethane	µg/L	0.76 J	0.16 U	0.16 U	0.2 J
	1,1-Dichloroethene	µg/L	0.25 J	0.14 U	0.14 U	0.14 U
	1,2-Dichloroethane	µg/L	0.2 J	0.13 U	0.13 U	0.13 U
	cis-1,2-Dichloroethene	µg/L	0.39 J	0.15 U	0.15 U	0.15 U
	Toluene	µg/L	0.17 U	0.21 J	0.5 J	0.17 QU
	Trichloroethene	µg/L	1.4	0.28 J	0.16 U	0.16 U
X749-98G	Acetone	µg/L		3.5 J		1.9 U
	Trichloroethene	µg/L		0.16 U		0.2 J
X749-102G	1,1,1-Trichloroethane	µg/L	0.17 J	0.19 J	0.16 U	0.16 U
	1,1-Dichloroethane	µg/L	0.76 J	0.72 J	0.19 J	0.33 J
	1,1-Dichloroethene	µg/L	1	0.92 J	0.21 J	0.47 J
	1,2-Dichloroethane	µg/L	0.14 J	0.13 U	0.13 U	0.13 U
	cis-1,2-Dichloroethene	µg/L	0.16 J	0.15 U	0.15 U	0.15 U
	Trichloroethene	µg/L	1.2	1.1	0.28 J	0.48 J
X749-103G	1,1,1-Trichloroethane	µg/L	0.18 J	0.16 U	0.16 U	0.16 U
	1,1-Dichloroethane	µg/L	0.24 J	0.22 U	0.56 J	0.75 J
	1,1-Dichloroethene	µg/L	0.33 J	0.24 J	0.9 J	1.1
	Acetone	µg/L	1.9 U	1.9 U	1.9 U	16
	cis-1,2-Dichloroethene	µg/L	0.15 U	0.15 U	0.15 U	0.19 J
	Trichloroethene	µg/L	0.44 J	0.34 J	0.87 J	1.1
X749-106G	1,1,1-Trichloroethane	µg/L		12		31
	1,1,2-Trichloroethane	µg/L		1.2		2
	1,1-Dichloroethane	µg/L		22		36
	1,1-Dichloroethene	µg/L		69 D		97 D
	1,2-Dichloroethane	µg/L		2.1		3.2
	Acetone	µg/L		1.9 U		5.4 J
	Chloroform	µg/L		2.2		3.6
	cis-1,2-Dichloroethene	µg/L		3.4		5
	Tetrachloroethene	µg/L		0.88 J		1.5
	Trichloroethene	µg/L		50		87 D

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-106G	Vinyl chloride	µg/L		0.1 U		0.22 J
X749-107G	1,1,1-Trichloroethane	µg/L		14		12
	1,1,2-Trichloroethane	µg/L		1.6		1.6
	1,1-Dichloroethane	µg/L		27		26
	1,1-Dichloroethene	µg/L		83 D		70 DJ
	1,2-Dichloroethane	µg/L		2.6		2.6
	Chloroform	µg/L		2.9		2.4
	cis-1,2-Dichloroethene	µg/L		4.4		4.1
	Tetrachloroethene	µg/L		0.96 J		0.85 J
	Trichloroethene	µg/L		57 D		58
X749-108G	1,1,1-Trichloroethane	µg/L		28		11
	1,1,2-Trichloroethane	µg/L		1.8		1.2
	1,1-Dichloroethane	µg/L		31		23
	1,1-Dichloroethene	µg/L		86 D		63 D
	1,2-Dichloroethane	µg/L		2.9		2.2
	Chloroform	µg/L		3.5		2
	cis-1,2-Dichloroethene	µg/L		4.8		3.7
	Tetrachloroethene	µg/L		1.4		0.92 J
	trans-1,2-Dichloroethene	µg/L		0.15 J		0.15 U
	Trichloroethene	µg/L		83 D		49
X749-109G	1,1,1-Trichloroethane	µg/L		1.9		1.3
	1,1-Dichloroethane	µg/L		7.3		5.7
	1,1-Dichloroethene	µg/L		12		8.8
	1,2-Dichloroethane	µg/L		1.6		1
	Acetone	µg/L		1.9 U		8.8 J
	Chloroform	µg/L		0.47 J		0.34 J
	cis-1,2-Dichloroethene	µg/L		4.7		3.2
	Tetrachloroethene	µg/L		0.28 J		0.2 U
	Trichloroethene	µg/L		15		11
X749-110G	1,1,1-Trichloroethane	µg/L		0.64 J		1
	1,1-Dichloroethane	µg/L		3.9		4.8
	1,1-Dichloroethene	µg/L		4.1		7
	1,2-Dichloroethane	µg/L		1.5		1.5
	Acetone	µg/L		2.9 J		1.9 U
	Chloroform	µg/L		0.53 J		0.43 J
	cis-1,2-Dichloroethene	µg/L		4.6		5.9
	trans-1,2-Dichloroethene	µg/L		0.15 U		0.26 J
	Trichloroethene	µg/L		19		25
X749-112G	Acetone	µg/L		3.2 J		1.9 U
X749-113G	1,1,1-Trichloroethane	µg/L		10		13
	1,1-Dichloroethane	µg/L		16		20
	1,1-Dichloroethene	µg/L		21		32
	1,2-Dichloroethane	µg/L		9.7		10
	Acetone	µg/L		2.9 J		1.9 QU
	Chloroform	µg/L		1.9		2.1
	cis-1,2-Dichloroethene	µg/L		2.2		3.1
	Tetrachloroethene	µg/L		0.29 J		0.37 JQ
	Trichloroethene	µg/L		38		47
	Vinyl chloride	µg/L		0.1 U		0.13 J
X749-114G	Benzene	µg/L			0.26 J	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-114G	cis-1,2-Dichloroethene	µg/L			1.2	
X749-115G	Acetone	µg/L			2 J	
	Chloroform	µg/L			0.16 J	
	cis-1,2-Dichloroethene	µg/L			6.9	
	Trichloroethene	µg/L			260 D	
X749-117G	Chloroform	µg/L			1.9	
	cis-1,2-Dichloroethene	µg/L			0.25 J	
	Trichloroethene	µg/L			21	
X749-118G	1,1-Dichloroethane	µg/L			1.7	
	1,1-Dichloroethene	µg/L			0.3 J	
	Carbon tetrachloride	µg/L			0.21 J	
	Chloroform	µg/L			0.4 J	
	cis-1,2-Dichloroethene	µg/L			1.8	
	Tetrachloroethene	µg/L			2	
	Trichloroethene	µg/L			99 D	
X749-119G	Acetone	µg/L			2.1 J	
	Chloroform	µg/L			1.2	
	cis-1,2-Dichloroethene	µg/L			0.48 J	
	Trichloroethene	µg/L			14	
X749-120G	1,1,1-Trichloroethane	µg/L			600 D	
	1,1,2-Trichloroethane	µg/L			81 D	
	1,1-Dichloroethane	µg/L			5300 D	
	1,1-Dichloroethene	µg/L			2400 D	
	1,2-Dichloroethane	µg/L			86 D	
	Acetone	µg/L			460 D	
	Benzene	µg/L			7 DJ	
	Chloroform	µg/L			290 D	
	cis-1,2-Dichloroethene	µg/L			1600 D	
	Methylene chloride	µg/L			72 DJ	
	Tetrachloroethene	µg/L			330 D	
	Trichloroethene	µg/L			9800 D	
X749-121G	1,1,1-Trichloroethane	µg/L			45	
	1,1,2-Trichloroethane	µg/L			0.8 JQ	
	1,1-Dichloroethane	µg/L			15	
	1,1-Dichloroethene	µg/L			380 D	
	1,2-Dichloroethane	µg/L			1.7	
	Acetone	µg/L			11 Q	
	Chloroethane	µg/L			4.9	
	Chloroform	µg/L			1.2	
	cis-1,2-Dichloroethene	µg/L			10	
	Tetrachloroethene	µg/L			0.33 J	
	trans-1,2-Dichloroethene	µg/L			0.46 J	
	Trichloroethene	µg/L			82 D	
	Vinyl chloride	µg/L			1.3	
X749-122G	1,1,1-Trichloroethane	µg/L			230 D	
	1,1,2-Trichloroethane	µg/L			1.7 DJQ	
	1,1-Dichloroethane	µg/L			64 D	
	1,1-Dichloroethene	µg/L			220 D	
	1,2-Dichloroethane	µg/L			3.4 D	
	Acetone	µg/L			8.5 DJQ	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-122G	Benzene	µg/L			2.5 D	
	Chloroform	µg/L			2.5 D	
	cis-1,2-Dichloroethene	µg/L			40 D	
	trans-1,2-Dichloroethene	µg/L			0.86 DJ	
	Trichloroethene	µg/L			670 D	
	Vinyl chloride	µg/L			1.6 DJ	
X749-BG9G	Trichloroethene	µg/L		0.27 J		0.29 J
X749-PZ02G	1,1-Dichloroethene	µg/L		0.14 QU		0.27 J
	Trichloroethene	µg/L		0.38 J		0.59 J
X749-PZ04G	1,1,1-Trichloroethane	µg/L	0.21 J	0.16 U	0.16 U	0.16 U
	1,1-Dichloroethane	µg/L	0.74 J	0.74 J	0.56 J	0.48 J
	1,1-Dichloroethene	µg/L	0.28 J	0.32 J	0.21 J	0.16 J
	1,2-Dichloroethane	µg/L	0.23 J	0.13 U	0.13 U	0.16 J
	cis-1,2-Dichloroethene	µg/L	0.24 J	0.15 U	0.16 J	0.15 U
	Trichloroethene	µg/L	1.9	1.8	1.2	1.5
X749-PZ05G	cis-1,2-Dichloroethene	µg/L	0.15 U	0.15 U	0.15 U	0.17 J
	Trichloroethene	µg/L	0.16 U	0.16 U	0.47 J	30
X749-PZ06G	1,1,1-Trichloroethane	µg/L		9.5		9.5
	1,1,2-Trichloroethane	µg/L		1.1		1.1
	1,1-Dichloroethane	µg/L		23		25 J
	1,1-Dichloroethene	µg/L		71 D		68 D
	1,2-Dichloroethane	µg/L		2		2.2
	Chloroform	µg/L		2.1		2.1
	cis-1,2-Dichloroethene	µg/L		3.8		3.9
	Tetrachloroethene	µg/L		0.56 J		0.53 J
	Trichloroethene	µg/L		49		51 J
X749-PZ07G	1,1,1-Trichloroethane	µg/L			0.16 J	
	1,1-Dichloroethane	µg/L			0.2 J	
	1,1-Dichloroethene	µg/L			0.61 J	
	Trichloroethene	µg/L			1.3	
X749-PZ08G	1,1-Dichloroethane	µg/L		0.32 J		
	Chloroform	µg/L		0.17 J		
	cis-1,2-Dichloroethene	µg/L		0.73 J		
	Trichloroethene	µg/L		1.3		
X749-PZ09G	1,1,1-Trichloroethane	µg/L		1.4		
	1,1-Dichloroethane	µg/L		3		
	1,1-Dichloroethene	µg/L		5.7		
	cis-1,2-Dichloroethene	µg/L		15		
	Trichloroethene	µg/L		27		
	Vinyl chloride	µg/L		0.55 J		
X749-PZ10G	1,1,1-Trichloroethane	µg/L		7.6 D		6.7 D
	1,1-Dichloroethane	µg/L		0.78 DJ		0.63 DJ
	1,1-Dichloroethene	µg/L		82 D		90 D
	1,2-Dichloroethane	µg/L		0.6 DJ		0.56 DJ
	Acetone	µg/L		3.8 U		70 DQ
	Chloroform	µg/L		23 D		25 D
	cis-1,2-Dichloroethene	µg/L		0.48 DJ		0.62 DJ
	Trichloroethene	µg/L		370 D		360 D
X749-PZ11G	1,1,1-Trichloroethane	µg/L		7.3		
	1,1-Dichloroethane	µg/L		4.7		

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-PZ11G	1,1-Dichloroethene	µg/L		4.4		
	Benzene	µg/L		0.18 J		
	cis-1,2-Dichloroethene	µg/L		13		
	trans-1,2-Dichloroethene	µg/L		0.3 J		
	Trichloroethene	µg/L		47 J		
	Vinyl chloride	µg/L		1.1		
X749-PZ12G	1,1,1-Trichloroethane	µg/L		3.5		
	1,1-Dichloroethane	µg/L		25		
	1,1-Dichloroethene	µg/L		23		
	1,2-Dichloroethane	µg/L		0.44 J		
	Benzene	µg/L		0.78 J		
	cis-1,2-Dichloroethene	µg/L		7.7		
	trans-1,2-Dichloroethene	µg/L		0.49 J		
	Trichloroethene	µg/L		4.2		
	Vinyl chloride	µg/L		1.5		
X749-PZ13G	1,1,1-Trichloroethane	µg/L		17		
	1,1-Dichloroethane	µg/L		36		
	1,1-Dichloroethene	µg/L		60		
	1,2-Dichloroethane	µg/L		1.8		
	Benzene	µg/L		3.2		
	Chloroethane	µg/L		0.63 J		
	Chloroform	µg/L		0.7 J		
	cis-1,2-Dichloroethene	µg/L		17		
	trans-1,2-Dichloroethene	µg/L		0.53 J		
	Trichloroethene	µg/L		44		
	Vinyl chloride	µg/L		1.5		
X749-WPW	1,1,1-Trichloroethane	µg/L		54		87 D
	1,1,2-Trichloroethane	µg/L		0.71 J		3.2 U
	1,1-Dichloroethane	µg/L		56		65 D
	1,1-Dichloroethene	µg/L		94 D		180 D
	1,2-Dichloroethane	µg/L		12		1.3 U
	Acetone	µg/L		4.3 J		19 U
	Benzene	µg/L		0.47 J		6.9 DJ
	Carbon tetrachloride	µg/L		0.24 J		1.9 U
	Chloroform	µg/L		15		1.6 U
	cis-1,2-Dichloroethene	µg/L		29		350 D
	Tetrachloroethene	µg/L		3.1		2 U
	trans-1,2-Dichloroethene	µg/L		0.22 J		1.5 U
	Trichloroethene	µg/L		300 D		1300 D
	Vinyl chloride	µg/L		6.1		1 U

Table 4.2. Results for radionuclides at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
STSW-101G	Technetium-99	pCi/L		1.96 U		
	Uranium	µg/L		0.301 UJ		
	Uranium-233/234	pCi/L		0.053 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.101 J		
STSW-102G	Technetium-99	pCi/L		33.6		
	Uranium	µg/L		1.59		
	Uranium-233/234	pCi/L		0.754		
	Uranium-235/236	pCi/L		0.0169 U		
	Uranium-238	pCi/L		0.533		
WP-01G	Technetium-99	pCi/L		-1.75 U		
	Uranium	µg/L		0.086 U		
	Uranium-233/234	pCi/L		0.0311 U		
	Uranium-235/236	pCi/L		0.0193 U		
	Uranium-238	pCi/L		0.0259 U		
WP-02G	Technetium-99	pCi/L		-2.52 U		
	Uranium	µg/L		0.107 U		
	Uranium-233/234	pCi/L		0.0206 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.036 U		
WP-03G	Technetium-99	pCi/L		-2.28 U		
	Uranium	µg/L		0.173 UJ		
	Uranium-233/234	pCi/L		0.0885 UJ		
	Uranium-235/236	pCi/L		0.00648 U		
	Uranium-238	pCi/L		0.0573 UJ		
WP-04G	Technetium-99	pCi/L		-2.42 U		
	Uranium	µg/L		0.0692 U		
	Uranium-233/234	pCi/L		0.029 U		
	Uranium-235/236	pCi/L		-0.0060 U		
	Uranium-238	pCi/L		0.0242 U		
WP-05G	Technetium-99	pCi/L		-1.91 U		
	Uranium	µg/L		0.135 U		
	Uranium-233/234	pCi/L		0.0655 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0453 UJ		
WP-06G	Technetium-99	pCi/L		-4.11 U		
	Uranium	µg/L		8.31 J		
	Uranium-233/234	pCi/L		2.68		
	Uranium-235/236	pCi/L		0.121 J		
	Uranium-238	pCi/L		2.77		
WP-07G	Technetium-99	pCi/L		-0.929 U		
	Uranium	µg/L		0.229 UJ		
	Uranium-233/234	pCi/L		0.0337 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0769 UJ		
X120-08G	Technetium-99	pCi/L			3.19 U	
	Uranium	µg/L			0.546 J	
	Uranium-233/234	pCi/L			0.259	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.184 J	

Table 4.2. Results for radionuclides at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-06G	Technetium-99	pCi/L		14.4		
	Uranium	µg/L		0.274		
	Uranium-233/234	pCi/L		0.0476 U		
	Uranium-235/236	pCi/L		0.0118 U		
	Uranium-238	pCi/L		0.0904		
X749-07G	Americium-241	pCi/L		0.0159 U		
	Neptunium-237	pCi/L		0.0202 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.0278 U		
	Technetium-99	pCi/L		12.6		
	Uranium	µg/L		0.192 UJ		
	Uranium-233/234	pCi/L		0.101 J		
	Uranium-235/236	pCi/L		0.012 U		
	Uranium-238	pCi/L		0.0626 UJ		
X749-08G	Americium-241	pCi/L		0.0321 U		
	Neptunium-237	pCi/L		0.00945 U		
	Plutonium-238	pCi/L		-0.0055 U		
	Plutonium-239/240	pCi/L		0.011 U		
	Technetium-99	pCi/L		8.36		
	Uranium	µg/L		0.184 UJ		
	Uranium-233/234	pCi/L		0.122 J		
	Uranium-235/236	pCi/L		0.00583 U		
	Uranium-238	pCi/L		0.0609 UJ		
X749-10GA	Americium-241	pCi/L		0.00517 U		
	Neptunium-237	pCi/L		0.00963 U		
	Plutonium-238	pCi/L		-0.0052 U		
	Plutonium-239/240	pCi/L		0.0104 U		
	Technetium-99	pCi/L		0.166 U		
	Uranium	µg/L		0.112 U		
	Uranium-233/234	pCi/L		0.0425 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0378 UJ		
X749-13G	Technetium-99	pCi/L		1.5 U		
	Uranium	µg/L		0.655 J		
	Uranium-233/234	pCi/L		0.267		
	Uranium-235/236	pCi/L		0.0292 U		
	Uranium-238	pCi/L		0.216 J		
X749-14B	Americium-241	pCi/L		0.0325 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.0119 U		
	Plutonium-239/240	pCi/L		0.00593 U		
	Technetium-99	pCi/L		-1.21 U		
	Uranium	µg/L		0.2 UJ		
	Uranium-233/234	pCi/L		0.024 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0672 UJ		
X749-20G	Technetium-99	pCi/L			34.9	
	Uranium	µg/L			1.47	
	Uranium-233/234	pCi/L			0.476	
	Uranium-235/236	pCi/L			0.023 U	

Table 4.2. Results for radionuclides at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-20G	Uranium-238	pCi/L			0.489	
X749-26G	Technetium-99	pCi/L		6.17 UJ		
	Uranium	µg/L		0.0456 U		
	Uranium-233/234	pCi/L		0.0181 U		
	Uranium-235/236	pCi/L		0.0113 U		
	Uranium-238	pCi/L		0.0136 U		
X749-27G	Technetium-99	pCi/L		83		
	Uranium	µg/L		0.169 UJ		
	Uranium-233/234	pCi/L		0.0559 UJ		
	Uranium-235/236	pCi/L		0.0058 U		
	Uranium-238	pCi/L		0.0559 UJ		
X749-28G	Technetium-99	pCi/L			3.88 U	
	Uranium	µg/L			0.086 U	
	Uranium-233/234	pCi/L			0.0382 U	
	Uranium-235/236	pCi/L			-0.00528 U	
	Uranium-238	pCi/L			0.0297 U	
X749-33G	Technetium-99	pCi/L		14		
	Uranium	µg/L		0.0412 U		
	Uranium-233/234	pCi/L		0.0369 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0138 U		
X749-37G	Technetium-99	pCi/L		-4E-15 U		
	Uranium	µg/L		0.672 J		
	Uranium-233/234	pCi/L		0.272		
	Uranium-235/236	pCi/L		0.0226 U		
	Uranium-238	pCi/L		0.222 J		
X749-44G	Americium-241	pCi/L		0.0359 U		
	Neptunium-237	pCi/L		-0.0096 U		
	Plutonium-238	pCi/L		0.0204 U		
	Plutonium-239/240	pCi/L		0.0305 U		
	Technetium-99	pCi/L		-1.73 U		
	Uranium	µg/L		0.402 J		
	Uranium-233/234	pCi/L		0.163 J		
	Uranium-235/236	pCi/L		0.019 U		
	Uranium-238	pCi/L		0.132 J		
X749-45G	Americium-241	pCi/L		0.0125 U		
	Neptunium-237	pCi/L		-0.0145 U		
	Plutonium-238	pCi/L		-0.0166 U		
	Plutonium-239/240	pCi/L		0.0111 U		
	Technetium-99	pCi/L		-1.79 U		
	Uranium	µg/L		0.0308 U		
	Uranium-233/234	pCi/L		0.0158 U		
	Uranium-235/236	pCi/L		0.0327 U		
	Uranium-238	pCi/L		0.00525 U		
X749-54B	Technetium-99	pCi/L		-2.58 U		
	Uranium	µg/L		0.0542 U		
	Uranium-233/234	pCi/L		0 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0182 U		
X749-64B	Americium-241	pCi/L			0.0499 U	

Table 4.2. Results for radionuclides at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-64B	Neptunium-237	pCi/L			0.00478 U	
	Plutonium-238	pCi/L			0.0103 U	
	Plutonium-239/240	pCi/L			-0.00515 U	
	Technetium-99	pCi/L			3.06 U	
	Uranium	µg/L			0.986 J	
	Uranium-233/234	pCi/L			1.4	
	Uranium-235/236	pCi/L			0.0112 U	
	Uranium-238	pCi/L			0.33	
X749-67G	Technetium-99	pCi/L		26.3		
	Uranium	µg/L		0.361		
	Uranium-233/234	pCi/L		0.0801 U		
	Uranium-235/236	pCi/L		0.0235 U		
	Uranium-238	pCi/L		0.118		
X749-68G	Americium-241	pCi/L			0.0292 U	
	Neptunium-237	pCi/L			0 U	
	Plutonium-238	pCi/L			0.00715 U	
	Plutonium-239/240	pCi/L			0.0286 U	
	Technetium-99	pCi/L			2.97 U	
	Uranium	µg/L			0.621 J	
	Uranium-233/234	pCi/L			0.228	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.209 J	
X749-96G	Americium-241	pCi/L		0.0348 U		
	Neptunium-237	pCi/L		0.00904 U		
	Plutonium-238	pCi/L		0.0163 U		
	Plutonium-239/240	pCi/L		0.0217 U		
	Technetium-99	pCi/L		-1.39 U		
	Uranium	µg/L		0.127 U		
	Uranium-233/234	pCi/L		0.0664 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0427 UJ		
X749-97G	Americium-241	pCi/L		0.0198 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.00544 U		
	Plutonium-239/240	pCi/L		0.0272 U		
	Technetium-99	pCi/L		-1.31 U		
	Uranium	µg/L		0.198 UJ		
	Uranium-233/234	pCi/L		0.0744 UJ		
	Uranium-235/236	pCi/L		0.0123 U		
	Uranium-238	pCi/L		0.0645 UJ		
X749-98G	Americium-241	pCi/L		0.0228 U		
	Neptunium-237	pCi/L		0.00443 U		
	Plutonium-238	pCi/L		0.0118 U		
	Plutonium-239/240	pCi/L		0.0355 U		
	Technetium-99	pCi/L		-1.68 U		
	Uranium	µg/L		0.118 U		
	Uranium-233/234	pCi/L		0.0593 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0395 UJ		
X749-106G	Technetium-99	pCi/L		1.15 U		

Table 4.2. Results for radionuclides at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-106G	Uranium	µg/L		0.0607 U		
	Uranium-233/234	pCi/L		0.00465 U		
	Uranium-235/236	pCi/L		0.0116 U		
	Uranium-238	pCi/L		0.0186 U		
X749-108G	Technetium-99	pCi/L		3.25 U		
	Uranium	µg/L		0.0952 U		
	Uranium-233/234	pCi/L		0.00914 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.032 U		
X749-109G	Technetium-99	pCi/L		-1.06 U		
	Uranium	µg/L		0.459 J		
	Uranium-233/234	pCi/L		0.155 J		
	Uranium-235/236	pCi/L		0.0227 U		
	Uranium-238	pCi/L		0.151 J		
X749-110G	Technetium-99	pCi/L		1.35 U		
	Uranium	µg/L		11.1 J		
	Uranium-233/234	pCi/L		3.43		
	Uranium-235/236	pCi/L		0.195 J		
	Uranium-238	pCi/L		3.69		
X749-113G	Technetium-99	pCi/L		7.73		
	Uranium	µg/L		0.168 UJ		
	Uranium-233/234	pCi/L		0.0517 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0564 UJ		
X749-120G	Technetium-99	pCi/L			73.2	
	Uranium	µg/L			0.399 J	
	Uranium-233/234	pCi/L			0.0751 JU	
	Uranium-235/236	pCi/L			0.011 U	
	Uranium-238	pCi/L			0.133 J	
X749-121G	Technetium-99	pCi/L			703	
	Uranium	µg/L			0.732 J	
	Uranium-233/234	pCi/L			0.281	
	Uranium-235/236	pCi/L			0.0113 U	
	Uranium-238	pCi/L			0.244	
X749-PZ02G	Technetium-99	pCi/L		-0.396 U		
	Uranium	µg/L		0.0461 U		
	Uranium-233/234	pCi/L		0.00914 U		
	Uranium-235/236	pCi/L		0.0114 U		
	Uranium-238	pCi/L		0.0137 U		
X749-PZ04G	Technetium-99	pCi/L		1.76 U		
	Uranium	µg/L		0.148 U		
	Uranium-233/234	pCi/L		0.0488 U		
	Uranium-235/236	pCi/L		0.00607 U		
	Uranium-238	pCi/L		0.0488 U		
X749-PZ09G	Technetium-99	pCi/L		220		
	Uranium	µg/L		6		
	Uranium-233/234	pCi/L		2.17		
	Uranium-235/236	pCi/L		0.135		
	Uranium-238	pCi/L		2		
X749-PZ10G	Technetium-99	pCi/L		21.3		

Table 4.2. Results for radionuclides at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-PZ10G	Uranium	µg/L		0.103 U		
	Uranium-233/234	pCi/L		0.108		
	Uranium-235/236	pCi/L		0.0117 U		
	Uranium-238	pCi/L		0.0328 U		
X749-PZ11G	Technetium-99	pCi/L		0.43 U		
	Uranium	µg/L		1.67		
	Uranium-233/234	pCi/L		0.759		
	Uranium-235/236	pCi/L		0.0423 U		
	Uranium-238	pCi/L		0.554		
X749-PZ12G	Technetium-99	pCi/L		1.72 U		
	Uranium	µg/L		0.315		
	Uranium-233/234	pCi/L		0.118		
	Uranium-235/236	pCi/L		0.019 U		
	Uranium-238	pCi/L		0.103		
X749-PZ13G	Technetium-99	pCi/L		1.01 U		
	Uranium	µg/L		0.807		
	Uranium-233/234	pCi/L		0.44		
	Uranium-235/236	pCi/L		0.0291 U		
	Uranium-238	pCi/L		0.267		
X749-WPW	Americium-241	pCi/L		0.0409 UJ		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.00503 U		
	Plutonium-239/240	pCi/L		0.0151 U		
	Technetium-99	pCi/L		1720		
	Uranium	µg/L		0.579 J		
	Uranium-233/234	pCi/L		0.27		
	Uranium-235/236	pCi/L		0.012 U		
	Uranium-238	pCi/L		0.193 J		

Table 4.3 VOCs detected at PK Landfill – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
MH GW-4	Acetone	µg/L			9.5 J	
	cis-1,2-Dichloroethene	µg/L			0.42 J	
MH GW-5	1,1-Dichloroethane	µg/L			0.37 J	
	Acetone	µg/L			7.6 J	
	cis-1,2-Dichloroethene	µg/L			1.7	
PK-10G	Trichloroethene	µg/L		0.18 J		0.16 U
PK-15B	Acetone	µg/L		4.9 J		1.9 QU
	Vinyl chloride	µg/L		0.38 J		0.1 U
PK-16G	Acetone	µg/L		4.3 J		1.9 JU
	cis-1,2-Dichloroethene	µg/L		0.22 J		0.15 U
PK-17B	1,1-Dichloroethane	µg/L		3		3.6
	1,1-Dichloroethene	µg/L		0.45 J		0.67 J
	Acetone	µg/L		2 J		1.9 U
	Benzene	µg/L		0.37 J		0.34 J
	Chlorobenzene	µg/L		1.3		1.7
	cis-1,2-Dichloroethene	µg/L		38 J		58
	trans-1,2-Dichloroethene	µg/L		1.4		1.8
	Trichloroethene	µg/L		0.77 J		1.6
	Vinyl chloride	µg/L		14 J		14
PK-19B	1,1-Dichloroethane	µg/L		0.31 J		0.16 U
	Chloroethane	µg/L		2.2		2
	Tetrachloroethene	µg/L		0.22 J		0.2 U
PK-21B	1,1-Dichloroethane	µg/L		110 D		120 D
	1,1-Dichloroethene	µg/L		1		0.61 J
	1,2-Dichloroethane	µg/L		0.13 U		0.27 J
	Benzene	µg/L		0.7 J		0.34 J
	cis-1,2-Dichloroethene	µg/L		9.5		9.8
	Trichloroethene	µg/L		0.32 J		0.16 U
	Vinyl chloride	µg/L		13		11
PK-PL6	1,1,1-Trichloroethane	µg/L	0.2 J	1.3	1.1	1.5
	1,1-Dichloroethane	µg/L	0.94 J	4.1	3.3	7.1
	1,1-Dichloroethene	µg/L	0.23 U	0.75 J	0.57 J	1.2
	cis-1,2-Dichloroethene	µg/L	0.74 J	1.1	1.3	1.6
	Trichloroethene	µg/L	0.17 J	1.1	0.99 J	1.4
	Vinyl chloride	µg/L	0.1 U	0.17 J	0.1 U	0.1 U
PK-PL6A	1,1,1-Trichloroethane	µg/L	2.5	3.9	1.8	2.4
	1,1-Dichloroethane	µg/L	11	10	3.4	9.7
	1,1-Dichloroethene	µg/L	1.8	2.7	0.59 J	2.2
	Acetone	µg/L	1.9 U	1.9 U	2.6 J	1.9 U
	cis-1,2-Dichloroethene	µg/L	2	2.1	0.51 J	2.1
	Trichloroethene	µg/L	1.9	2.9	1.5	2
	Vinyl chloride	µg/L	0.24 J	0.7 J	0.12 J	0.32 J

Table 4.4. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X230K-14G	cis-1,2-Dichloroethene	µg/L			0.3 J	
	Trichloroethene	µg/L			4.1	
X230K-15G	cis-1,2-Dichloroethene	µg/L			0.15 J	
	Trichloroethene	µg/L			1	
X231A-01G	1,1-Dichloroethane	µg/L			1.5	
	Benzene	µg/L			0.21 JQ	
	cis-1,2-Dichloroethene	µg/L			0.46 J	
	Trichloroethene	µg/L			2.3 Q	
X231A-02G	1,1,1-Trichloroethane	µg/L			3.6	
	1,1,2-Trichloroethane	µg/L			0.6 J	
	1,1-Dichloroethane	µg/L			6	
	1,1-Dichloroethene	µg/L			73 D	
	Benzene	µg/L			0.19 J	
	Chloroform	µg/L			1.4	
	cis-1,2-Dichloroethene	µg/L			11	
	Tetrachloroethene	µg/L			0.43 J	
	trans-1,2-Dichloroethene	µg/L			0.25 J	
	Trichloroethene	µg/L			230 DJ	
	Trichlorofluoromethane	µg/L			0.34 J	
X231A-04G	1,1,1-Trichloroethane	µg/L			0.16 J	
	1,1-Dichloroethene	µg/L			0.6 J	
	Chloroform	µg/L			0.25 J	
	cis-1,2-Dichloroethene	µg/L			6.4	
	Trichloroethene	µg/L			47	
	Trichlorofluoromethane	µg/L			1.3 J	
X231B-02G	1,1-Dichloroethene	µg/L	1.2 J		2.6 D	
	Chloroform	µg/L	1 J		0.73 DJ	
	cis-1,2-Dichloroethene	µg/L	35		20 D	
	Methylene chloride	µg/L	1.8 BJ		0.64 U	
	trans-1,2-Dichloroethene	µg/L	0.92 J		0.89 DJ	
	Trichloroethene	µg/L	630		270 D	
X231B-03G	1,1,1-Trichloroethane	µg/L	1.4		1.3	
	1,1,2-Trichloroethane	µg/L	0.71 J		0.57 J	
	1,1-Dichloroethane	µg/L	1.9		1.6	
	1,1-Dichloroethene	µg/L	95 D		74 D	
	1,2-Dichloroethane	µg/L	0.4 J		0.13 U	
	Benzene	µg/L	0.18 J		0.16 J	
	Chloroform	µg/L	0.35 J		0.23 J	
	cis-1,2-Dichloroethene	µg/L			4.5 J	
	Tetrachloroethene	µg/L	0.25 J		0.22 JQ	
	trans-1,2-Dichloroethene	µg/L	0.35 J		0.15 U	
	Trichloroethene	µg/L	110 D		100 D	
X231B-06G	1,1,1-Trichloroethane	µg/L	25		14	
	1,1,2-Trichloroethane	µg/L	0.37 J		0.48 J	
	1,1-Dichloroethane	µg/L	28		23	
	1,1-Dichloroethene	µg/L	66 DJ		52	
	1,2-Dichloroethane	µg/L	0.59 J		0.13 U	
	Chloroform	µg/L	0.45 J		0.66 J	
	cis-1,2-Dichloroethene	µg/L			2.6	
	Tetrachloroethene	µg/L	0.4 J		0.36 J	

Table 4.4. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231B-06G	Trichloroethene	µg/L	64 D		52	
	Trichlorofluoromethane	µg/L	0.29 U		0.7 J	
X231B-07G	Chloroform	µg/L	1.7			
	cis-1,2-Dichloroethene	µg/L	7.2			
	Trichloroethene	µg/L	57			
X231B-11G	1,1,1-Trichloroethane	µg/L	0.97 J			
	1,1-Dichloroethene	µg/L	3.3			
	Trichloroethene	µg/L	0.71 J			
X231B-12G	1,1,1-Trichloroethane	µg/L			1.1	
	1,1-Dichloroethane	µg/L			0.18 J	
	1,1-Dichloroethene	µg/L			5.3	
	Trichloroethene	µg/L			2.5	
X231B-14G	1,1,1-Trichloroethane	µg/L			0.68 J	
	1,1-Dichloroethane	µg/L			0.82 J	
	1,1-Dichloroethene	µg/L			14 J	
	Chloroform	µg/L			0.55 J	
	cis-1,2-Dichloroethene	µg/L			3.9	
	Trichloroethene	µg/L			69 D	
X231B-15G	1,1-Dichloroethene	µg/L			0.24 J	
	Chloroform	µg/L			0.61 J	
	cis-1,2-Dichloroethene	µg/L			0.17 J	
	Trichloroethene	µg/L			0.67 J	
X231B-16G	1,1,1-Trichloroethane	µg/L			0.38 J	
	1,1-Dichloroethene	µg/L			2	
	Chloroform	µg/L			4.3	
	Trichloroethene	µg/L			0.26 J	
X231B-20G	1,1,1-Trichloroethane	µg/L			0.21 J	
	1,1-Dichloroethene	µg/L			8.8	
	Chloroform	µg/L			0.93 J	
	cis-1,2-Dichloroethene	µg/L			0.28 J	
	Trichloroethene	µg/L			34	
	Trichlorofluoromethane	µg/L			0.53 J	
X231B-23G	1,1,1-Trichloroethane	µg/L			0.18 J	
	1,1-Dichloroethene	µg/L			1.1	
	Trichloroethene	µg/L			1.3	
X231B-24B	Methylene chloride	µg/L	0.32 BJ			
X231B-29G	cis-1,2-Dichloroethene	µg/L	0.26 J			
	Trichloroethene	µg/L	4.5			
X231B-32B	1,2-Dimethylbenzene	µg/L			0.2 J	
	m,p-Xylenes	µg/L			0.44 J	
	Toluene	µg/L			0.37 J	
	Trichloroethene	µg/L			0.53 J	
X231B-36G	Chloroform	µg/L			0.95 DJ	
	cis-1,2-Dichloroethene	µg/L			0.84 DJ	
	Trichloroethene	µg/L			540 D	
X231B-37G	1,1-Dichloroethane	µg/L			1.4	
	1,1-Dichloroethene	µg/L			1.5	
	Benzene	µg/L			0.17 J	
	cis-1,2-Dichloroethene	µg/L			7.3	
	trans-1,2-Dichloroethene	µg/L			0.92 J	

Table 4.4. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231B-37G	Trichloroethene	µg/L			12	
	Vinyl chloride	µg/L			0.49 J	
X231B-38G	1,1,1-Trichloroethane	µg/L	0.39 J			
	1,1-Dichloroethane	µg/L	0.25 J			
	1,1-Dichloroethene	µg/L	0.62 J			
	1,2-Dichlorobenzene	µg/L	0.26 J			
	Trichloroethene	µg/L	0.17 J			
X326-09G	1,1-Dichloroethene	µg/L	280 D		180 D	
	Bromodichloromethane	µg/L	34 U		32 DJ	
	Chloroform	µg/L	290 D		670 D	
	cis-1,2-Dichloroethene	µg/L	180 DJ		560 D	
	Methylene chloride	µg/L	88 DJ		13 U	
	Trichloroethene	µg/L	27000 D		71000 DJ	
	Vinyl chloride	µg/L	20 U		27 DJ	
X326-10G	1,1-Dichloroethene	µg/L			8.6	
	cis-1,2-Dichloroethene	µg/L			0.81 J	
	Trichloroethene	µg/L			9.3	
X622-PZ01G	1,1-Dichloroethene	µg/L			0.24 J	
	Benzene	µg/L			0.17 J	
	cis-1,2-Dichloroethene	µg/L			11	
	trans-1,2-Dichloroethene	µg/L			0.72 J	
	Trichloroethene	µg/L			2.8	
	Vinyl chloride	µg/L			0.23 J	
X622-PZ02G	1,1,1-Trichloroethane	µg/L			1.1	
	1,1-Dichloroethane	µg/L			1.2	
	1,1-Dichloroethene	µg/L			15	
	Chloroform	µg/L			0.75 J	
	cis-1,2-Dichloroethene	µg/L			8	
	Trichloroethene	µg/L			140 D	
	Trichlorofluoromethane	µg/L			1.5 J	
X622-PZ03G	1,1,1-Trichloroethane	µg/L			0.71 DJ	
	1,1-Dichloroethane	µg/L			0.97 DJ	
	1,1-Dichloroethene	µg/L			2.8 D	
	cis-1,2-Dichloroethene	µg/L			6.1 D	
	Trichloroethene	µg/L			270 D	
	Trichlorofluoromethane	µg/L			6.7 D	
X626-07G	1,1,1-Trichloroethane	µg/L	5.7 D		5.4 D	
	1,1,2-Trichloroethane	µg/L	3.5 DJ		4.5 D	
	1,1-Dichloroethane	µg/L	3.1 DJ		3.4 D	
	1,1-Dichloroethene	µg/L	410 D		430 D	
	Benzene	µg/L	1.1 DJ		1.3 DJ	
	Chloroform	µg/L	0.96 DJ		0.85 DJ	
	cis-1,2-Dichloroethene	µg/L	1.5 DJ		1.7 DJ	
	Methylene chloride	µg/L	1.5 DJ		0.64 U	
	Trichloroethene	µg/L	680 D		620 D	
X710-01G	cis-1,2-Dichloroethene	µg/L	0.45 J			
	Trichloroethene	µg/L	22			
X760-02G	Trichloroethene	µg/L	0.39 J			
X760-03G	Chloroform	µg/L			0.24 J	
	cis-1,2-Dichloroethene	µg/L			1.1	

Table 4.4. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X760-03G	Trichloroethene	µg/L			150 D	
X760-07G	1,1-Dichloroethene	µg/L			0.42 J	
	Chloroform	µg/L			0.29 J	
	cis-1,2-Dichloroethene	µg/L			12	
	Trichloroethene	µg/L			400 D	
	Vinyl chloride	µg/L			0.35 J	
X770-17GA	cis-1,2-Dichloroethene	µg/L	1 DJ		1.2	
	Methylene chloride	µg/L	0.65 DJ		0.32 U	
	Trichloroethene	µg/L	370 D		400 D	

Table 4.5. Results for radionuclides at the Quadrant I Groundwater Investigative (5-Unit) Area – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231A-01G	Technetium-99	pCi/L			21.4	
	Uranium	µg/L			20.8	
	Uranium-233/234	pCi/L			23.3	
	Uranium-235/236	pCi/L			1.21	
	Uranium-238	pCi/L			6.79	
X231A-02G	Technetium-99	pCi/L			9.52	
	Uranium	µg/L			0.0836 U	
	Uranium-233/234	pCi/L			0.0774 JU	
	Uranium-235/236	pCi/L			-0.00602 U	
	Uranium-238	pCi/L			0.029 U	
X231A-04G	Technetium-99	pCi/L			3.28 U	
	Uranium	µg/L			0.343 J	
	Uranium-233/234	pCi/L			0.126 J	
	Uranium-235/236	pCi/L			0.0241 U	
	Uranium-238	pCi/L			0.112 J	
X231B-02G	Technetium-99	pCi/L			52.6	
	Uranium	µg/L			0.234 JU	
	Uranium-233/234	pCi/L			0.0617 JU	
	Uranium-235/236	pCi/L			0.0177 U	
	Uranium-238	pCi/L			0.076 JU	
X231B-03G	Americium-241	pCi/L			0.0387 UJ	
	Neptunium-237	pCi/L			0 U	
	Plutonium-238	pCi/L			-0.00537 U	
	Plutonium-239/240	pCi/L			0.0107 U	
	Technetium-99	pCi/L			11	
	Uranium	µg/L			0.364 J	
	Uranium-233/234	pCi/L			0.112 J	
	Uranium-235/236	pCi/L			0.0058 U	
	Uranium-238	pCi/L			0.121 J	
X231B-06G	Americium-241	pCi/L			0.0153 U	
	Neptunium-237	pCi/L			0.0099 U	
	Plutonium-238	pCi/L			-0.00525 U	
	Plutonium-239/240	pCi/L			0.0105 U	
	Technetium-99	pCi/L			28.5	
	Uranium	µg/L			2.4	
	Uranium-233/234	pCi/L			3.44	
	Uranium-235/236	pCi/L			0.226	
	Uranium-238	pCi/L			0.773	
X326-09G	Technetium-99	pCi/L			1.95 U	
	Uranium	µg/L			0.214 UJ	
	Uranium-233/234	pCi/L			0.0791 UJ	
	Uranium-235/236	pCi/L			0.0109 U	
	Uranium-238	pCi/L			0.0703 UJ	
X626-07G	Technetium-99	pCi/L			3.29 U	
	Uranium	µg/L			0.282 J	
	Uranium-233/234	pCi/L			0.0759 U	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.0949 J	

Table 4.6 VOCs detected at the X-749A Classified Materials Disposal Facility – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749A-12G	1,1-Dichloroethane	µg/L		0.22 J		
	cis-1,2-Dichloroethene	µg/L		5.1		
	Trichloroethene	µg/L		4		
X749A-16G	Acetone	µg/L		2.7 J		
X749A-18G	cis-1,2-Dichloroethene	µg/L		0.21 J		
	Trichloroethene	µg/L		4.2		
X749A-19G	cis-1,2-Dichloroethene	µg/L		3.2		
	Trichloroethene	µg/L		14		

Table 4.7 Results for radionuclides at the X-749A Classified Materials Disposal Facility – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749A-02G	Technetium-99	pCi/L		-0.566 U		
	Uranium	µg/L		0.131 U		
	Uranium-233/234	pCi/L		0.132 J		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.044 UJ		
X749A-03G	Technetium-99	pCi/L		0.411 U		
	Uranium	µg/L		0.306 J		
	Uranium-233/234	pCi/L		0.13 J		
	Uranium-235/236	pCi/L		0.00577 U		
	Uranium-238	pCi/L		0.102 J		
X749A-04G	Technetium-99	pCi/L		-2.83 U		
	Uranium	µg/L		0.0546 U		
	Uranium-233/234	pCi/L		0.0642 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0183 U		
X749A-07G	Technetium-99	pCi/L		-2.65 U		
	Uranium	µg/L		6.93		
	Uranium-233/234	pCi/L		2.7		
	Uranium-235/236	pCi/L		0.151 J		
	Uranium-238	pCi/L		2.3		
X749A-12G	Technetium-99	pCi/L		-1.76 U		
	Uranium	µg/L		0.234 UJ		
	Uranium-233/234	pCi/L		0.0961 J		
	Uranium-235/236	pCi/L		0.012 U		
	Uranium-238	pCi/L		0.0769 UJ		
X749A-14G	Technetium-99	pCi/L		-1.43 U		
	Uranium	µg/L		0.194 UJ		
	Uranium-233/234	pCi/L		0.045 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.065 UJ		
X749A-16G	Technetium-99	pCi/L		2.67 U		
	Uranium	µg/L		0.151 UJ		
	Uranium-233/234	pCi/L		0.0329 U		
	Uranium-235/236	pCi/L		-0.0058 U		
	Uranium-238	pCi/L		0.0516 UJ		
X749A-17G	Technetium-99	pCi/L		-3.19 U		
	Uranium	µg/L		0.218 UJ		
	Uranium-233/234	pCi/L		0.0498 UJ		
	Uranium-235/236	pCi/L		0.00563 U		
	Uranium-238	pCi/L		0.0724 UJ		
X749A-18G	Technetium-99	pCi/L		-0.872 U		
	Uranium	µg/L		0.105 U		
	Uranium-233/234	pCi/L		0.0271 U		
	Uranium-235/236	pCi/L		0.0225 U		
	Uranium-238	pCi/L		0.0316 U		
X749A-19G	Technetium-99	pCi/L		-0.387 U		
	Uranium	µg/L		0.134 UJ		
	Uranium-233/234	pCi/L		0.0846 UJ		
	Uranium-235/236	pCi/L		0.0175 U		
	Uranium-238	pCi/L		0.0423 UJ		

Table 4.8. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X700-02G	1,1,1-Trichloroethane	µg/L	5.2 J			
	1,1-Dichloroethane	µg/L	14			
	1,1-Dichloroethene	µg/L	130			
	Chloroethane	µg/L	4.7 J			
	Chloroform	µg/L	1.6 J			
	cis-1,2-Dichloroethene	µg/L	1800			
	trans-1,2-Dichloroethene	µg/L	4.6 J			
	Trichloroethene	µg/L	4400			
	Vinyl chloride	µg/L	160			
X700-04G	1,1-Dichloroethane	µg/L	4.7 J			
	1,1-Dichloroethene	µg/L	21			
	Chloroethane	µg/L	41			
	cis-1,2-Dichloroethene	µg/L	2800			
	trans-1,2-Dichloroethene	µg/L	21			
	Trichloroethene	µg/L	950			
	Vinyl chloride	µg/L	5200			
X700-05G	1,1,2-Trichloroethane	µg/L	67 J			
	1,1-Dichloroethene	µg/L	100 J			
	Chloroform	µg/L	32 J			
	cis-1,2-Dichloroethene	µg/L	44000			
	Trichloroethene	µg/L	89000			
	Vinyl chloride	µg/L	1200			
X700-06G	1,1,2-Trichloroethane	µg/L	950 J			
	Chloroform	µg/L	530 J			
	cis-1,2-Dichloroethene	µg/L	2100			
	Trichloroethene	µg/L	1100000			
X701-26G	1,1-Dichloroethene	µg/L	0.23 U		0.93 J	
	Chloroform	µg/L	0.31 J		0.32 J	
	Methylene chloride	µg/L	0.32 BJ		0.32 U	
	Tetrachloroethene	µg/L	1.4		1.6	
	Trichloroethene	µg/L	0.58 J		0.4 J	
X701-27G	1,1,1-Trichloroethane	µg/L	0.68 J		0.79 J	
	1,1-Dichloroethane	µg/L	0.51 J		0.51 J	
	1,1-Dichloroethene	µg/L	1		1.4	
	cis-1,2-Dichloroethene	µg/L	3.8		6.2	
	trans-1,2-Dichloroethene	µg/L	0.15 U		0.2 J	
	Trichloroethene	µg/L	9.7		19	
X701-45G	cis-1,2-Dichloroethene	µg/L	0.7 J			
	Trichloroethene	µg/L	11			
X701-68G	1,1,1-Trichloroethane	µg/L	0.35 J			
	1,1-Dichloroethane	µg/L	0.28 J			
	1,1-Dichloroethene	µg/L	1.5			
	Chloroform	µg/L	0.19 J			
	cis-1,2-Dichloroethene	µg/L	15			
	trans-1,2-Dichloroethene	µg/L	0.23 J			
	Trichloroethene	µg/L	56			
	Trichlorofluoromethane	µg/L	0.82 J			
X701-69G	cis-1,2-Dichloroethene	µg/L	210			
	Methylene chloride	µg/L	2.4 BJ			
	trans-1,2-Dichloroethene	µg/L	4.8			

Table 4.8. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-69G	Trichloroethene	µg/L	750			
	Vinyl chloride	µg/L	0.52 J			
X701-70G	cis-1,2-Dichloroethene	µg/L	250			
	Methylene chloride	µg/L	8.3 BJ			
	Trichloroethene	µg/L	1400			
	Vinyl chloride	µg/L	1.1 J			
X701-117GA	1,1-Dichloroethene	µg/L	1.5 J			
	cis-1,2-Dichloroethene	µg/L	190			
	Methylene chloride	µg/L	2.7 BJ			
	trans-1,2-Dichloroethene	µg/L	0.65 J			
	Trichloroethene	µg/L	920			
X705-01GA	Carbon tetrachloride	µg/L	0.25 J			
	Chloroform	µg/L	13			
	Methylene chloride	µg/L	0.35 BJ			
	Tetrachloroethene	µg/L	0.37 J			
	Trichloroethene	µg/L	40			
X705-02G	1,1-Dichloroethene	µg/L	0.3 J			
	cis-1,2-Dichloroethene	µg/L	0.51 J			
	Trichloroethene	µg/L	33			
X705-03G	1,1-Dichloroethane	µg/L	1.3			
	1,1-Dichloroethene	µg/L	9.8			
	cis-1,2-Dichloroethene	µg/L	8			
	Tetrachloroethene	µg/L	0.62 J			
	trans-1,2-Dichloroethene	µg/L	0.29 J			
	Trichloroethene	µg/L	90			
X705-04G	1,1-Dichloroethene	µg/L	0.34 J			
	Carbon tetrachloride	µg/L	8.7			
	Chloroform	µg/L	190			
	Tetrachloroethene	µg/L	1.4			
	Trichloroethene	µg/L	18			
X705-06G	Chloroform	µg/L	1.2			
	cis-1,2-Dichloroethene	µg/L	0.6 J			
	Tetrachloroethene	µg/L	3.7			
	Trichloroethene	µg/L	10			
X705-07G	Bromodichloromethane	µg/L	0.17 J			
	Chloroform	µg/L	1.3			
	Chloromethane	µg/L	0.42 J			
	cis-1,2-Dichloroethene	µg/L	0.19 J			
	Trichloroethene	µg/L	7.1			
X705-08G	1,1-Dichloroethene	µg/L	27			
	Trichlorofluoromethane	µg/L	14			
X720-01G	1,1,1-Trichloroethane	µg/L	8.1 DJ			
	1,1-Dichloroethene	µg/L	57 D			
	Trichloroethene	µg/L	6500 D			
	Vinyl chloride	µg/L	85 D			
X720-08G	1,1-Dichloroethene	µg/L	93			
	cis-1,2-Dichloroethene	µg/L	27 J			
	Methylene chloride	µg/L	14 J			
	Tetrachloroethene	µg/L	24 J			
	Trichloroethene	µg/L	10000			

Table 4.8. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X720-09G	1,1,1-Trichloroethane	µg/L	2800			
	1,1,2-Trichloroethane	µg/L	72 J			
	1,1-Dichloroethane	µg/L	170			
	1,1-Dichloroethene	µg/L	7500 J			
	1,2-Dichloroethane	µg/L	88 J			
	1,2-Dimethylbenzene	µg/L	220			
	Acetone	µg/L	1300			
	Chloroform	µg/L	65 J			
	cis-1,2-Dichloroethene	µg/L	2400			
	Ethylbenzene	µg/L	150			
	m,p-Xylenes	µg/L	400			
	Methylene chloride	µg/L	52 J			
	Tetrachloroethene	µg/L	620			
	Toluene	µg/L	770			
	Trichloroethene	µg/L	330000			
	Vinyl chloride	µg/L	100			

Table 4.9. Results for radionuclides at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X700-02G	Technetium-99	pCi/L	21.8			
	Uranium	µg/L	2.44 J			
	Uranium-233/234	pCi/L	0.668			
	Uranium-235/236	pCi/L	0.0364 UJ			
	Uranium-238	pCi/L	0.815			
X700-04G	Technetium-99	pCi/L	29.6			
	Uranium	µg/L	9.86 J			
	Uranium-233/234	pCi/L	4.39			
	Uranium-235/236	pCi/L	0.202 J			
	Uranium-238	pCi/L	3.28			
X700-05G	Technetium-99	pCi/L	2.12 U			
	Uranium	µg/L	1.87 J			
	Uranium-233/234	pCi/L	0.983			
	Uranium-235/236	pCi/L	0.031 UJ			
	Uranium-238	pCi/L	0.624			
X700-06G	Technetium-99	pCi/L	21.9			
	Uranium	µg/L	12.2 J			
	Uranium-233/234	pCi/L	5.89			
	Uranium-235/236	pCi/L	0.193 J			
	Uranium-238	pCi/L	4.05			
X701-26G	Technetium-99	pCi/L	27			
	Uranium	µg/L	4.4 J			
	Uranium-233/234	pCi/L	2.41			
	Uranium-235/236	pCi/L	0.0777 UJ			
	Uranium-238	pCi/L	1.47			
X701-68G	Technetium-99	pCi/L	21.1			
	Uranium	µg/L	4.06 J			
	Uranium-233/234	pCi/L	1.6			
	Uranium-235/236	pCi/L	0.0534 UJ			
	Uranium-238	pCi/L	1.35			
X701-69G	Technetium-99	pCi/L	0 U			
	Uranium	µg/L	5.74 J			
	Uranium-233/234	pCi/L	2.77			
	Uranium-235/236	pCi/L	0.0793 UJ			
	Uranium-238	pCi/L	1.92			
X701-70G	Technetium-99	pCi/L	13.7			
	Uranium	µg/L	2.04 J			
	Uranium-233/234	pCi/L	1			
	Uranium-235/236	pCi/L	0.056 UJ			
	Uranium-238	pCi/L	0.676			
X705-01GA	Americium-241	pCi/L	0.0315 U			
	Neptunium-237	pCi/L	0.00476 U			
	Plutonium-238	pCi/L	0.017 U			
	Plutonium-239/240	pCi/L	0.0284 U			
	Technetium-99	pCi/L	154			
	Uranium	µg/L	0.826 J			
	Uranium-233/234	pCi/L	0.461			
	Uranium-235/236	pCi/L	0.0174 U			
	Uranium-238	pCi/L	0.275			
X705-02G	Technetium-99	pCi/L	1.8 U			

Table 4.9. Results for radionuclides at the Quadrant II Groundwater Investigative (7-Unit) Area – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X705-02G	Uranium	µg/L	4.53 J			
	Uranium-233/234	pCi/L	1.38			
	Uranium-235/236	pCi/L	0.0834 UJ			
	Uranium-238	pCi/L	1.51			
X705-07G	Technetium-99	pCi/L	74.7			
	Uranium	µg/L	1.19 J			
	Uranium-233/234	pCi/L	0.424 J			
	Uranium-235/236	pCi/L	0.0543 UJ			
	Uranium-238	pCi/L	0.393 J			
X720-01G	Technetium-99	pCi/L	1.99 U			
	Uranium	µg/L	26			
	Uranium-233/234	pCi/L	8.3			
	Uranium-235/236	pCi/L	0.476			
	Uranium-238	pCi/L	8.65			
X720-08G	Technetium-99	pCi/L	191			
	Uranium	µg/L	3.58 J			
	Uranium-233/234	pCi/L	2.62			
	Uranium-235/236	pCi/L	0.114 J			
	Uranium-238	pCi/L	1.19			
X720-09G	Technetium-99	pCi/L	1.22 U			
	Uranium	µg/L	9.02			
	Uranium-233/234	pCi/L	7.63			
	Uranium-235/236	pCi/L	0.429			
	Uranium-238	pCi/L	2.96			

Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ03G	1,1-Dichloroethene	µg/L	0.23 U		0.2 J	
	cis-1,2-Dichloroethene	µg/L	110		110 D	
	trans-1,2-Dichloroethene	µg/L	0.85 J		1.4	
	Trichloroethene	µg/L	26 J		52	
	Vinyl chloride	µg/L	0.1 U		0.53 J	
LBC-PZ07G	Acetone	µg/L			1.9 JQ	
X230J7-01GA	1,1-Dichloroethene	µg/L	0.46 U		0.21 J	
	Chloroform	µg/L	0.32 U		0.18 J	
	cis-1,2-Dichloroethene	µg/L	0.86 J		0.94 J	
	Trichloroethene	µg/L	360		340 D	
X230J7-02GA	Chloroform	µg/L	0.32 U		0.2 J	
	cis-1,2-Dichloroethene	µg/L	8.7		10	
	Tetrachloroethene	µg/L	0.4 U		0.31 J	
	Trichloroethene	µg/L	370		340 DQ	
	Vinyl chloride	µg/L	0.2 U		0.52 J	
X230J7-03GA	1,1,2-Trichloroethane	µg/L	1.1 DJ		1.6 U	
	cis-1,2-Dichloroethene	µg/L	130 D		200 D	
	Tetrachloroethene	µg/L	1.3 DJ		1.1 DJ	
	trans-1,2-Dichloroethene	µg/L	2.5 DJ		4.9 DJ	
	Trichloroethene	µg/L	1200 D		1300 D	
	Vinyl chloride	µg/L	1.8 DJ		8 D	
X237-EPW	cis-1,2-Dichloroethene	µg/L			1900 DJ	
	Tetrachloroethene	µg/L			8 DJ	
	trans-1,2-Dichloroethene	µg/L			11 DJ	
	Trichloroethene	µg/L			5800 D	
X237-WPW	1,1,1-Trichloroethane	µg/L			8.7 DJ	
	1,1,2,2-Tetrachloroethane	µg/L			75 D	
	1,1,2-Trichloroethane	µg/L			46 D	
	1,1-Dichloroethene	µg/L			16 DJ	
	Chloroform	µg/L			4.8 DJ	
	cis-1,2-Dichloroethene	µg/L			3500 D	
	Tetrachloroethene	µg/L			67 D	
	trans-1,2-Dichloroethene	µg/L			48 D	
	Trichloroethene	µg/L			38000 D	
	Vinyl chloride	µg/L			240 D	
X701-01G	1,1-Dichloroethene	µg/L	0.62 J		1.8	
	cis-1,2-Dichloroethene	µg/L	15		40 J	
	trans-1,2-Dichloroethene	µg/L	0.5 J		1.6	
	Trichloroethene	µg/L	83 D		190 D	
	Vinyl chloride	µg/L	0.19 J		0.75 J	
X701-02G	1,1-Dichloroethene	µg/L	0.23 U		0.21 J	
	cis-1,2-Dichloroethene	µg/L	2.8		2.7	
	Trichloroethene	µg/L	9.1		9.5	
X701-06G	1,1-Dichloroethane	µg/L	0.23 J		0.8 J	
	1,1-Dichloroethene	µg/L	2.2		5.9	
	Chloroform	µg/L	0.16 U		0.33 J	
	cis-1,2-Dichloroethene	µg/L	16		22	
	trans-1,2-Dichloroethene	µg/L	0.26 J		0.6 J	
	Trichloroethene	µg/L	97 D		180 D	
	Vinyl chloride	µg/L	0.34 J		0.74 J	

Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-15G	1,1-Dichloroethene	µg/L	0.23 U		0.85 DJ	
	cis-1,2-Dichloroethene	µg/L	190		780 D	
	trans-1,2-Dichloroethene	µg/L	3.6		8.4 D	
	Trichloroethene	µg/L	3		8.4 D	
	Vinyl chloride	µg/L	0.1 U		2.2 DJ	
X701-16G	Trichloroethene	µg/L	0.16 U		0.17 J	
X701-20G	1,1,2,2-Tetrachloroethane	µg/L	150 DJ		160 D	
	1,1,2-Trichloroethane	µg/L	140 U		65 DJ	
	cis-1,2-Dichloroethene	µg/L	1200 D		1000 D	
	Methylene chloride	µg/L	180 DJ		32 U	
	Tetrachloroethene	µg/L	120 DJ		130 D	
	trans-1,2-Dichloroethene	µg/L	75 U		67 DJ	
	Trichloroethene	µg/L	60000 D		51000 D	
X701-21G	1,1,2,2-Tetrachloroethane	µg/L	0.21 U		0.52 J	
	1,1-Dichloroethane	µg/L	0.22 U		0.23 J	
	1,1-Dichloroethene	µg/L	0.23 U		0.35 J	
	1,2-Dichlorobenzene	µg/L	0.29 J		0.31 J	
	Chloroform	µg/L	0.16 U		0.18 J	
	cis-1,2-Dichloroethene	µg/L	38		54	
	Tetrachloroethene	µg/L	0.2 U		0.34 J	
	trans-1,2-Dichloroethene	µg/L	0.3 J		1.2	
	Trichloroethene	µg/L	30		120 D	
	Vinyl chloride	µg/L	2		3.7	
X701-23G	cis-1,2-Dichloroethene	µg/L			0.41 J	
	Trichloroethene	µg/L			5.6	
X701-24G	1,1,2-Trichloroethane	µg/L	4.1 DJ		16 U	
	1,1-Dichloroethene	µg/L	2.3 U		9.8 DJ	
	cis-1,2-Dichloroethene	µg/L	340 D		1400 D	
	Methylene chloride	µg/L	3.4 DJ		16 U	
	trans-1,2-Dichloroethene	µg/L	4 DJ		32 DJ	
	Trichloroethene	µg/L	3600 D		15000 D	
	Vinyl chloride	µg/L	6.2 DJ		61 D	
X701-30G	cis-1,2-Dichloroethene	µg/L	0.18 J		0.16 J	
	Trichloroethene	µg/L	4.4		4.5	
	Trichlorofluoromethane	µg/L	0.67 J		0.9 J	
X701-31G	Trichloroethene	µg/L			0.18 J	
X701-38G	Acetone	µg/L			2.2 J	
X701-42G	1,2-Dichlorobenzene	µg/L			0.3 J	
	cis-1,2-Dichloroethene	µg/L			31	
	Trichloroethene	µg/L			7.2	
	Vinyl chloride	µg/L			1.9	
X701-61B	1,2-Dimethylbenzene	µg/L			0.21 J	
	Acetone	µg/L			200 J	
	m,p-Xylenes	µg/L			2.7	
X701-66G	1,1-Dichloroethene	µg/L	2.4 DJ		3 DJ	
	Chloroform	µg/L	4 DJ		4.1 DJ	
	cis-1,2-Dichloroethene	µg/L	180 D			
	Tetrachloroethene	µg/L	4.9 DJ		6.2 DJ	
	trans-1,2-Dichloroethene	µg/L	1.6 DJ		2.7 DJ	
	Trichloroethene	µg/L	3300 D		4700 D	

Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-66G	Vinyl chloride	µg/L	5.5 DJ		11 UJ	
X701-77G	1,1,1-Trichloroethane	µg/L			1.6 DJ	
	1,1-Dichloroethene	µg/L			2.6 DJ	
	Chloroform	µg/L			1.7 DJ	
	cis-1,2-Dichloroethene	µg/L			46 D	
	Methylene chloride	µg/L			4 DJ	
	Tetrachloroethene	µg/L			9 DJ	
	trans-1,2-Dichloroethene	µg/L			2 DJ	
	Trichloroethene	µg/L			2400 D	
X701-79G	1,1-Dichloroethene	µg/L			0.19 J	
	cis-1,2-Dichloroethene	µg/L			4.7	
	Trichloroethene	µg/L			230 D	
X701-127G	1,1,2,2-Tetrachloroethane	µg/L	42 DJ		80 DJ	
	1,1,2-Trichloroethane	µg/L	58 DJ		67 DJ	
	cis-1,2-Dichloroethene	µg/L	850 D		1000 D	
	Methylene chloride	µg/L	79 DJ		64 U	
	Tetrachloroethene	µg/L	40 U		51 DJ	
	trans-1,2-Dichloroethene	µg/L	30 U		39 DJ	
	Trichloroethene	µg/L	36000 D		52000 D	
X701-128G	1,1,2-Trichloroethane	µg/L	29 DJ		32 U	
	cis-1,2-Dichloroethene	µg/L	440 D		340 D	
	Methylene chloride	µg/L	34 DJ		32 U	
	Tetrachloroethene	µg/L	40 DJ		41 DJ	
	Trichloroethene	µg/L	32000 D		26000 D	
X701-130G	Chloroform	µg/L			170 DJ	
	cis-1,2-Dichloroethene	µg/L			690 DJ	
	Tetrachloroethene	µg/L			220 DJ	
	Trichloroethene	µg/L			150000 D	
X701-141G	1,1-Dichloroethene	µg/L			0.22 J	
	cis-1,2-Dichloroethene	µg/L			2.7	
	Tetrachloroethene	µg/L			0.21 J	
	Trichloroethene	µg/L			220 D	
X701-142G	1,1,2-Trichloroethane	µg/L	15 DJ		15 DJ	
	1,1-Dichloroethene	µg/L	11 DJ		7.7 DJ	
	cis-1,2-Dichloroethene	µg/L	4100 D		3500 D	
	Methylene chloride	µg/L	13 U		19 DJ	
	trans-1,2-Dichloroethene	µg/L	45 D		37 DJ	
	Trichloroethene	µg/L	4500 D		5400 D	
	Vinyl chloride	µg/L	19 DJ		91 D	
X701-143G	1,1-Dichloroethene	µg/L	0.46 U		1.6 DJ	
	1,2-Dichloroethane	µg/L	0.26 U		1.1 DJ	
	cis-1,2-Dichloroethene	µg/L	260 D		890 D	
	Methylene chloride	µg/L	0.64 U		1.6 DJ	
	trans-1,2-Dichloroethene	µg/L	3.9 D		7 D	
	Trichloroethene	µg/L	69 D		29 D	
	Vinyl chloride	µg/L	2.5 D		260 D	
X701-144G	cis-1,2-Dichloroethene	µg/L	88 D			
	trans-1,2-Dichloroethene	µg/L	0.95 J			
	Trichloroethene	µg/L	0.28 J			
	Vinyl chloride	µg/L	42			

Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-BW2G	1,1-Dichloroethene	µg/L			79 DJ	
	Chloroform	µg/L			240 D	
	cis-1,2-Dichloroethene	µg/L			480 D	
	Methylene chloride	µg/L			91 DJ	
	Tetrachloroethene	µg/L			47 DJ	
	Trichloroethene	µg/L			53000 D	
X701-BW3G	1,1-Dichloroethane	µg/L			0.34 J	
	1,1-Dichloroethene	µg/L			0.85 J	
	cis-1,2-Dichloroethene	µg/L			61 D	
	Tetrachloroethene	µg/L			0.2 J	
	trans-1,2-Dichloroethene	µg/L			0.28 J	
	Trichloroethene	µg/L			62 D	
	Vinyl chloride	µg/L			10	
X701-BW4G	cis-1,2-Dichloroethene	µg/L	5.6		7.9	
	trans-1,2-Dichloroethene	µg/L	0.41 J		0.45 J	
	Trichloroethene	µg/L	1.3		2.3	
	Vinyl chloride	µg/L	0.1 U		0.5 JQ	
X701-EW121G	1,1,2,2-Tetrachloroethane	µg/L	220 DJ		160 DJ	
	cis-1,2-Dichloroethene	µg/L	760 D		670 D	
	Methylene chloride	µg/L	160 DJ		260 DJ	
	Tetrachloroethene	µg/L	120 DJ		130 DJ	
	trans-1,2-Dichloroethene	µg/L	76 DJ		70 DJ	
	Trichloroethene	µg/L	81000 D		76000 D	
X701-EW122G	1,1,2,2-Tetrachloroethane	µg/L	110 D		78 DJ	
	1,1,2-Trichloroethane	µg/L	33 DJ		64 U	
	cis-1,2-Dichloroethene	µg/L	320 D		320 D	
	Methylene chloride	µg/L	47 DJ		130 DJ	
	Tetrachloroethene	µg/L	110 D		77 DJ	
	trans-1,2-Dichloroethene	µg/L	37 DJ		30 U	
	Trichloroethene	µg/L	27000 D		42000 D	
X701-IRMPZ03G	1,1,2-Trichloroethane	µg/L	2.3 DJ		1.6 U	
	1,1-Dichloroethene	µg/L	0.92 U		1.7 DJ	
	cis-1,2-Dichloroethene	µg/L	220 D		610 D	
	Methylene chloride	µg/L	1.3 U		2.3 DJ	
	trans-1,2-Dichloroethene	µg/L	4.4 D		6 D	
	Trichloroethene	µg/L	470 D		1100 D	
	Vinyl chloride	µg/L	0.4 U		1.9 DJ	
X701-IRMPZ05G	cis-1,2-Dichloroethene	µg/L	370 D			
	trans-1,2-Dichloroethene	µg/L	5.1 DJ			
	Trichloroethene	µg/L	1000 D			
	Vinyl chloride	µg/L	5.4 DJ			
X701-IRMPZ06G	1,1-Dichloroethene	µg/L			0.36 DJ	
	Benzene	µg/L			0.36 DJ	
	cis-1,2-Dichloroethene	µg/L			440 D	
	trans-1,2-Dichloroethene	µg/L			16 D	
	Trichloroethene	µg/L			14 D	
	Vinyl chloride	µg/L			30 D	
X701-IRMPZ07G	cis-1,2-Dichloroethene	µg/L	5400 D			
	Tetrachloroethene	µg/L	98 DJ			
	trans-1,2-Dichloroethene	µg/L	79 DJ			

Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-IRMPZ07G	Trichloroethene	µg/L	56000 D			
	Vinyl chloride	µg/L	410 D			
X701-IRMPZ08G	cis-1,2-Dichloroethene	µg/L	23		37	
	trans-1,2-Dichloroethene	µg/L	0.28 J		0.43 J	
	Trichloroethene	µg/L	21		46	
X701-TC01G	1,1,1-Trichloroethane	µg/L	2.3 DJ		67 D	
	1,1,2,2-Tetrachloroethane	µg/L	1 DJ		19 DJ	
	1,1-Dichloroethane	µg/L	0.88 U		8.1 DJ	
	1,1-Dichloroethene	µg/L	0.92 U		26 DJ	
	Chloromethane	µg/L	1.2 U		41 DJ	
	cis-1,2-Dichloroethene	µg/L	90 DJ		5400 D	
	Tetrachloroethene	µg/L	2.9 DJ		26 DJ	
	trans-1,2-Dichloroethene	µg/L	3 DJ		190 D	
	Trichloroethene	µg/L	630 D		11000 D	
	Vinyl chloride	µg/L	2.1 DJ		83 D	
X701-TC03G	1,1,1-Trichloroethane	µg/L	120 DJ		86 DJ	
	1,1,2,2-Tetrachloroethane	µg/L	230 D		120 DJ	
	Chloromethane	µg/L	60 U		99 DJ	
	cis-1,2-Dichloroethene	µg/L	6700 D		6400 D	
	Tetrachloroethene	µg/L	89 DJ		56 DJ	
	trans-1,2-Dichloroethene	µg/L	710 D		610 D	
	Trichloroethene	µg/L	60000 D		29000 D	
	Vinyl chloride	µg/L	95 DJ		43 DJ	
X701-TC05G	1,1,1-Trichloroethane	µg/L	91 DJ		79 DJ	
	1,1,2,2-Tetrachloroethane	µg/L	180 D		130 D	
	Acetone	µg/L	190 U		200 DJ	
	Chloromethane	µg/L	65 DJ		98 DJ	
	cis-1,2-Dichloroethene	µg/L	2900 D		2200 D	
	Tetrachloroethene	µg/L	52 DJ		29 DJ	
	trans-1,2-Dichloroethene	µg/L	460 D		350 D	
	Trichloroethene	µg/L	24000 D		10000 D	
X701-TC10G	1,1,1-Trichloroethane	µg/L	20 DJ		12 DJ	
	1,1-Dichloroethene	µg/L	23 U		12 DJ	
	cis-1,2-Dichloroethene	µg/L	1500 D		1400 DJ	
	Tetrachloroethene	µg/L	25 DJ		20 DJ	
	trans-1,2-Dichloroethene	µg/L	79 DJ		47 D	
	Trichloroethene	µg/L	11000 D		9800 D	
	Vinyl chloride	µg/L	50 DJ		44 DJ	
X701-TC17G	1,1,1-Trichloroethane	µg/L	26 DJQ		14 DJ	
	1,1,2,2-Tetrachloroethane	µg/L	21 QU		18 DJQ	
	Acetone	µg/L	190 QU		600 D	
	Chloroform	µg/L	16 QU		13 DJ	
	Chloromethane	µg/L	96 DJQ		88 D	
	cis-1,2-Dichloroethene	µg/L	190 DQJ		73 D	
	Tetrachloroethene	µg/L	53 DJ		21 DJQ	
	trans-1,2-Dichloroethene	µg/L	15 QU		7.4 DJ	
	Trichloroethene	µg/L	14000 D		6100 D	
X701-TC22G	1,1,1-Trichloroethane	µg/L	29 DJ		64 U	
	1,1,2,2-Tetrachloroethane	µg/L	49 DJ		80 U	
	cis-1,2-Dichloroethene	µg/L	1300 D		830 D	

Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC22G	Tetrachloroethene	µg/L	94 DJ		180 DJ	
	trans-1,2-Dichloroethene	µg/L	180 D		100 DJ	
	Trichloroethene	µg/L	33000 D		57000 D	
	Vinyl chloride	µg/L	40 DJ		40 U	
X701-TC28G	1,1,1-Trichloroethane	µg/L	180 DJ		160 U	
	1,1,2,2-Tetrachloroethane	µg/L	160 DJ		200 QU	
	cis-1,2-Dichloroethene	µg/L	530 D			
	Tetrachloroethene	µg/L	1100 D		800 DJQ	
	Trichloroethene	µg/L	170000 D		190000 DJ	
X701-TC48G	1,1,1-Trichloroethane	µg/L	4.8 DJ		2.6 DJ	
	1,1,2,2-Tetrachloroethane	µg/L	14 D		11 D	
	1,1,2-Trichloroethane	µg/L	17 D		14 D	
	2-Butanone	µg/L	100 D		69 D	
	Acetone	µg/L	720 D		750 D	
	Benzene	µg/L	2.9 DJ		2.5 DJ	
	Bromomethane	µg/L	5.2 DJ		3.3 DJ	
	Chloroform	µg/L	5.4 DJ		4.5 DJ	
	Chloromethane	µg/L	95 D		48 D	
	cis-1,2-Dichloroethene	µg/L	50 D		34 D	
	Tetrachloroethene	µg/L	22 DJ		8.9 DJQ	
	trans-1,2-Dichloroethene	µg/L	7.5 DJ		4.4 DJ	
	Trichloroethene	µg/L	2900 D		1200 D	
X701-TC54G	1,1,2,2-Tetrachloroethane	µg/L	890 D		770 DJ	
	1,1,2-Trichloroethane	µg/L	85 DJ		320 U	
	Acetone	µg/L	260 DJ		1900 U	
	Chloroform	µg/L	17 DJ		160 U	
	Chloromethane	µg/L	34 DJ		300 U	
	cis-1,2-Dichloroethene	µg/L	410 D		320 DJ	
	Methylene chloride	µg/L	49 DJ		320 U	
	Tetrachloroethene	µg/L	600 D		440 DJ	
	trans-1,2-Dichloroethene	µg/L	46 DJ		150 U	
	Trichloroethene	µg/L	340000 DJ		140000 D	
X701-TC61G	1,1,1-Trichloroethane	µg/L	120 D		160 U	
	1,1,2,2-Tetrachloroethane	µg/L	700 D		710 DJ	
	1,1,2-Trichloroethane	µg/L	87 DJ		320 U	
	Acetone	µg/L	320 DJ		1900 U	
	cis-1,2-Dichloroethene	µg/L	890 D		900 DJ	
	Methylene chloride	µg/L	44 DJ		320 U	
	Tetrachloroethene	µg/L	470 D		470 DJ	
	trans-1,2-Dichloroethene	µg/L	130 D		150 U	
	Trichloroethene	µg/L	160000 D		150000 D	
X701-TC67G	1,1,1-Trichloroethane	µg/L	11 DJ		16 U	
	1,1,2,2-Tetrachloroethane	µg/L	22 DJ		20 U	
	cis-1,2-Dichloroethene	µg/L	190 D		180 D	
	Methylene chloride	µg/L	23 DJ		32 U	
	Tetrachloroethene	µg/L	49 DJ		52 DJ	
	trans-1,2-Dichloroethene	µg/L	10 DJ		15 U	
	Trichloroethene	µg/L	15000 D		14000 D	
X744G-01G	Trichloroethene	µg/L	0.16 J		0.16 U	
X744G-02G	cis-1,2-Dichloroethene	µg/L	1.6		2	

Table 4.10. VOCs detected at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X744G-02G	Trichloroethene	µg/L	24		31	
	Trichlorofluoromethane	µg/L	4.1		5.4	
X744G-03G	cis-1,2-Dichloroethene	µg/L	0.62 J		0.66 J	
	Trichloroethene	µg/L	7		8.2	

Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ03G	Technetium-99	pCi/L	-0.764 U			
	Uranium	µg/L	0.0695 U			
	Uranium-233/234	pCi/L	0.045 UJ			
	Uranium-235/236	pCi/L	0.00559 U			
	Uranium-238	pCi/L	0.0225 U			
LBC-PZ06G	Technetium-99	pCi/L	0.61 U			
	Uranium	µg/L	0.225 UJ			
	Uranium-233/234	pCi/L	0.0897 UJ			
	Uranium-235/236	pCi/L	0.0062 U			
	Uranium-238	pCi/L	0.0747 UJ			
X230J7-01GA	Technetium-99	pCi/L	9.16			
	Uranium	µg/L	0.232 UJ			
	Uranium-233/234	pCi/L	0.059 UJ			
	Uranium-235/236	pCi/L	0.00564 U			
	Uranium-238	pCi/L	0.0771 UJ			
X230J7-02GA	Technetium-99	pCi/L	131			
	Uranium	µg/L	0.198 UJ			
	Uranium-233/234	pCi/L	0.0411 UJ			
	Uranium-235/236	pCi/L	0.0171 U			
	Uranium-238	pCi/L	0.064 UJ			
X230J7-03GA	Americium-241	pCi/L	0.0345 U			
	Neptunium-237	pCi/L	0.00432 U			
	Plutonium-238	pCi/L	0.0184 U			
	Plutonium-239/240	pCi/L	0.049 U			
	Technetium-99	pCi/L	90			
	Uranium	µg/L	0.4 J			
	Uranium-233/234	pCi/L	0.142 J			
	Uranium-235/236	pCi/L	0.0122 U			
	Uranium-238	pCi/L	0.132 J			
X230J7-04GA	Technetium-99	pCi/L			3.44 U	
	Uranium	µg/L			0.192 U	
	Uranium-233/234	pCi/L			0.0689 U	
	Uranium-235/236	pCi/L			0.00659 U	
	Uranium-238	pCi/L			0.0636 U	
X701-01G	Technetium-99	pCi/L	-1.96 U			
	Uranium	µg/L	2.84 J			
	Uranium-233/234	pCi/L	1.27			
	Uranium-235/236	pCi/L	0.0709 UJ			
	Uranium-238	pCi/L	0.945			
X701-02G	Technetium-99	pCi/L	-0.366 U			
	Uranium	µg/L	0.713 J			
	Uranium-233/234	pCi/L	0.648			
	Uranium-235/236	pCi/L	0.0167 U			
	Uranium-238	pCi/L	0.237 J			
X701-06G	Technetium-99	pCi/L	26.2			
	Uranium	µg/L	8.45			
	Uranium-233/234	pCi/L	5.79			
	Uranium-235/236	pCi/L	0.345			
	Uranium-238	pCi/L	2.79			
X701-15G	Technetium-99	pCi/L	0.943 U			

Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-15G	Uranium	µg/L	0.088 U			
	Uranium-233/234	pCi/L	0.0371 UJ			
	Uranium-235/236	pCi/L	0.0115 U			
	Uranium-238	pCi/L	0.0278 U			
X701-16G	Technetium-99	pCi/L	1.29 U			
	Uranium	µg/L	0.182 UJ			
	Uranium-233/234	pCi/L	0.0464 UJ			
	Uranium-235/236	pCi/L	0.00577 U			
	Uranium-238	pCi/L	0.0603 UJ			
X701-18G	Technetium-99	pCi/L			3.22 U	
	Uranium	µg/L			0.0749 U	
	Uranium-233/234	pCi/L			0.0302 U	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.0252 U	
X701-19G	Technetium-99	pCi/L	3.56 U			
	Uranium	µg/L	0.0303 U			
	Uranium-233/234	pCi/L	0.0186 U			
	Uranium-235/236	pCi/L	0.00578 U			
	Uranium-238	pCi/L	0.0093 U			
X701-20G	Americium-241	pCi/L	0.0155 U		0.0157 U	
	Neptunium-237	pCi/L	0.00483 U		0.00951 U	
	Plutonium-238	pCi/L	0.0107 U		0 U	
	Plutonium-239/240	pCi/L	0.0107 U		0.0107 U	
	Technetium-99	pCi/L	228		244	
	Uranium	µg/L	0.34 J		0.377 J	
	Uranium-233/234	pCi/L	0.0759 UJ		0.189 J	
	Uranium-235/236	pCi/L	0.0189 UJ		0.00602 U	
	Uranium-238	pCi/L	0.111 J		0.126 J	
X701-21G	Technetium-99	pCi/L	431			
	Uranium	µg/L	0.225 UJ			
	Uranium-233/234	pCi/L	0.0462 UJ			
	Uranium-235/236	pCi/L	0.0115 UJ			
	Uranium-238	pCi/L	0.0739 U			
X701-23G	Technetium-99	pCi/L			22	
	Uranium	µg/L			0.0612 U	
	Uranium-233/234	pCi/L			0.00981 U	
	Uranium-235/236	pCi/L			0.0061 U	
	Uranium-238	pCi/L			0.0196 U	
X701-24G	Americium-241	pCi/L	0.00482 U			
	Neptunium-237	pCi/L	-0.00471 U			
	Plutonium-238	pCi/L	0.00546 U			
	Plutonium-239/240	pCi/L	0.0437 UJ			
	Technetium-99	pCi/L	5.52 UJ			
	Uranium	µg/L	0.398 J			
	Uranium-233/234	pCi/L	0.11 J			
	Uranium-235/236	pCi/L	0.0057 U			
	Uranium-238	pCi/L	0.133 J			
X701-25G	Technetium-99	pCi/L	0.85 U			
	Uranium	µg/L	0.0326 U			
	Uranium-233/234	pCi/L	0.00918 U			

Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-25G	Uranium-235/236	pCi/L	0.0114 U			
	Uranium-238	pCi/L	0.00918 U			
X701-30G	Technetium-99	pCi/L	2.51 U			
	Uranium	µg/L	0.308 J			
	Uranium-233/234	pCi/L	0.124 J			
	Uranium-235/236	pCi/L	0.011 UJ			
	Uranium-238	pCi/L	0.102 J			
X701-31G	Technetium-99	pCi/L			0.264 U	
	Uranium	µg/L			0.14 JU	
	Uranium-233/234	pCi/L			0.08 JU	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.047 JU	
X701-38G	Technetium-99	pCi/L			-0.331 U	
	Uranium	µg/L			0.0157 U	
	Uranium-233/234	pCi/L			0.0133 U	
	Uranium-235/236	pCi/L			0.00551 U	
	Uranium-238	pCi/L			0.00443 U	
X701-42G	Technetium-99	pCi/L			422	
	Uranium	µg/L			0.126 U	
	Uranium-233/234	pCi/L			0.0519 JU	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.0425 JU	
X701-48G	Americium-241	pCi/L			0 U	
	Neptunium-237	pCi/L			-0.00506 U	
	Plutonium-238	pCi/L			0.00576 U	
	Plutonium-239/240	pCi/L			0.0173 U	
	Technetium-99	pCi/L			0.954 U	
	Uranium	µg/L			0.0959 U	
	Uranium-233/234	pCi/L			0.0143 U	
	Uranium-235/236	pCi/L			0.0237 U	
	Uranium-238	pCi/L			0.0286 U	
X701-58B	Technetium-99	pCi/L			3.18 U	
	Uranium	µg/L			0.155	
	Uranium-233/234	pCi/L			0.164	
	Uranium-235/236	pCi/L			0.024 U	
	Uranium-238	pCi/L			0.0483 U	
X701-61B	Technetium-99	pCi/L			2 U	
	Uranium	µg/L			0.2 U	
	Uranium-233/234	pCi/L			0.106	
	Uranium-235/236	pCi/L			0.0599 U	
	Uranium-238	pCi/L			0.0578	
X701-66G	Americium-241	pCi/L	0.0342 U		0.0319 U	
	Neptunium-237	pCi/L	0.00429 U		0 U	
	Plutonium-238	pCi/L	0 U		0 U	
	Plutonium-239/240	pCi/L	0.0434 U		-0.0121 U	
	Technetium-99	pCi/L	316		360	
	Uranium	µg/L	0.303 J		0.379	
	Uranium-233/234	pCi/L	0.0832 UJ		0.171	
	Uranium-235/236	pCi/L	0.0194 U		0.0125 U	
	Uranium-238	pCi/L	0.0988 J		0.125	

Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-77G	Technetium-99	pCi/L			37.5	
	Uranium	µg/L			0.171 JU	
	Uranium-233/234	pCi/L			0.0926 J	
	Uranium-235/236	pCi/L			0.0115 U	
	Uranium-238	pCi/L			0.0555 JU	
X701-79G	Technetium-99	pCi/L			53.5	
	Uranium	µg/L			0.0527 U	
	Uranium-233/234	pCi/L			0.0198 U	
	Uranium-235/236	pCi/L			0.0185 U	
	Uranium-238	pCi/L			0.0148 U	
X701-127G	Americium-241	pCi/L	0.0103 U		0.00492 U	
	Neptunium-237	pCi/L	-0.00447 U		0 U	
	Plutonium-238	pCi/L	0.0171 U		-0.00601 U	
	Plutonium-239/240	pCi/L	0.0114 U		0.0542 U	
	Technetium-99	pCi/L	92.9		134	
	Uranium	µg/L	0.302 J		0.174 U	
	Uranium-233/234	pCi/L	0.0936 J		0.0496 U	
	Uranium-235/236	pCi/L	0.0184 UJ		-0.00618 U	
	Uranium-238	pCi/L	0.0985 J		0.0596 U	
X701-128G	Americium-241	pCi/L	-0.0155 U			
	Neptunium-237	pCi/L	0.0091 U			
	Plutonium-238	pCi/L	-0.00571 U			
	Plutonium-239/240	pCi/L	0.0114 U			
	Technetium-99	pCi/L	40.8			
	Uranium	µg/L	0.23 UJ			
	Uranium-233/234	pCi/L	0.101 J			
	Uranium-235/236	pCi/L	0.0164 UJ			
	Uranium-238	pCi/L	0.0748 U			
X701-130G	Technetium-99	pCi/L			1150	
	Uranium	µg/L			5.26	
	Uranium-233/234	pCi/L			8.24	
	Uranium-235/236	pCi/L			0.372	
	Uranium-238	pCi/L			1.71	
X701-BW1G	Technetium-99	pCi/L			6.69 UJ	
	Uranium	µg/L			0.0555 U	
	Uranium-233/234	pCi/L			0.0534 UJ	
	Uranium-235/236	pCi/L			0.00553 U	
	Uranium-238	pCi/L			0.0178 U	
X701-BW2G	Technetium-99	pCi/L			1260	
	Uranium	µg/L			0.156 JU	
	Uranium-233/234	pCi/L			0.0428 JU	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.0523 JU	
X701-BW3G	Technetium-99	pCi/L			108	
	Uranium	µg/L			0.0516 U	
	Uranium-233/234	pCi/L			0.0194 U	
	Uranium-235/236	pCi/L			0.0181 U	
	Uranium-238	pCi/L			0.0145 U	
X701-BW4G	Technetium-99	pCi/L	81.6			
	Uranium	µg/L	0.0333 U			

Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-BW4G	Uranium-233/234	pCi/L	0.0217 U			
	Uranium-235/236	pCi/L	0.0162 UJ			
	Uranium-238	pCi/L	0.00867 U			
X701-EW121G	Technetium-99	pCi/L	174		160	
	Uranium	µg/L	0.291 UJ		0.155	
	Uranium-233/234	pCi/L	0.153 J		0.125	
	Uranium-235/236	pCi/L	0 U		0 U	
	Uranium-238	pCi/L	0.0978 UJ		0.0522	
X701-EW122G	Technetium-99	pCi/L	323		272	
	Uranium	µg/L	0.712 J		0.622	
	Uranium-233/234	pCi/L	0.208 J		0.171	
	Uranium-235/236	pCi/L	0.0123 UJ		0.0343 U	
	Uranium-238	pCi/L	0.237 J		0.204	
X701-TC01G	Americium-241	pCi/L	0.0442 U		0.00542 U	
	Neptunium-237	pCi/L	0.00906 U		0.0152 U	
	Plutonium-238	pCi/L	0.01 U		-0.0117 U	
	Plutonium-239/240	pCi/L	0.0301 U		0.0117 U	
	Technetium-99	pCi/L	41.5		280	
	Uranium	µg/L	20.1 J		8.3	
	Uranium-233/234	pCi/L	13.7		4.52	
	Uranium-235/236	pCi/L	0.811 J		0.237	
	Uranium-238	pCi/L	6.63		2.75	
X701-TC03G	Americium-241	pCi/L	0.0105 U		0.0207 U	
	Neptunium-237	pCi/L	0.00503 U		0 U	
	Plutonium-238	pCi/L	-0.016 U		0.0116 U	
	Plutonium-239/240	pCi/L	0.00534 U		0.0407 U	
	Technetium-99	pCi/L	887		634	
	Uranium	µg/L	4.87 J		5.07	
	Uranium-233/234	pCi/L	1.53		2.07	
	Uranium-235/236	pCi/L	0.0854 UJ		0.114	
	Uranium-238	pCi/L	1.62		1.68	
X701-TC05G	Americium-241	pCi/L	0.0157 U		0.0205 U	
	Neptunium-237	pCi/L	0 U		0.00968 U	
	Plutonium-238	pCi/L	0.0048 U		0.00557 U	
	Plutonium-239/240	pCi/L	0.0144 U		0.0223 U	
	Technetium-99	pCi/L	887		731	
	Uranium	µg/L	13.2 J		17.5	
	Uranium-233/234	pCi/L	5.5		6.68	
	Uranium-235/236	pCi/L	0.296 J		0.373	
	Uranium-238	pCi/L	4.4		5.83	
X701-TC10G	Americium-241	pCi/L	0.0305 U		0.0227 U	
	Neptunium-237	pCi/L	0 U		0.00535 U	
	Plutonium-238	pCi/L	-0.0106 U		-0.00627 U	
	Plutonium-239/240	pCi/L	0.0213 U		0.00627 U	
	Technetium-99	pCi/L	232		168	
	Uranium	µg/L	6.81 J		11.2	
	Uranium-233/234	pCi/L	2.51		4.12	
	Uranium-235/236	pCi/L	0.0895 UJ		0.244	
	Uranium-238	pCi/L	2.27		3.74	
X701-TC17G	Americium-241	pCi/L	0.0319 U		-0.0218 U	

Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC17G	Neptunium-237	pCi/L	0.00449 U		-0.0156 U	
	Plutonium-238	pCi/L	0.0101 U		0.0117 U	
	Plutonium-239/240	pCi/L	0.0203 U		0.0234 U	
	Technetium-99	pCi/L	339		334	
	Uranium	µg/L	31.7 J		45.5	
	Uranium-233/234	pCi/L	11.9		17.9	
	Uranium-235/236	pCi/L	0.773 J		1.04	
	Uranium-238	pCi/L	10.5		15.1	
X701-TC22G	Americium-241	pCi/L	0.037 U		0.026 U	
	Neptunium-237	pCi/L	0.00447 U		-0.00485 U	
	Plutonium-238	pCi/L	-0.00481 U		-0.0122 U	
	Plutonium-239/240	pCi/L	0.0144 U		0.00612 U	
	Technetium-99	pCi/L	393		316	
	Uranium	µg/L	1.11 J		1.11	
	Uranium-233/234	pCi/L	0.328		0.381	
	Uranium-235/236	pCi/L	0.03 UJ		0.0241 U	
	Uranium-238	pCi/L	0.367		0.368	
X701-TC28G	Americium-241	pCi/L	-0.0105 U		0.0106 U	
	Neptunium-237	pCi/L	-0.00473 U		0 U	
	Plutonium-238	pCi/L	0.00509 U		0.00619 U	
	Plutonium-239/240	pCi/L	0.0255 U		0.0124 U	
	Technetium-99	pCi/L	364		339	
	Uranium	µg/L	17.2 J		20.6	
	Uranium-233/234	pCi/L	6.97		7.46	
	Uranium-235/236	pCi/L	0.316 J		0.394	
	Uranium-238	pCi/L	5.73		6.85	
X701-TC48G	Americium-241	pCi/L	0.0446 U		0.00495 U	
	Neptunium-237	pCi/L	0.00474 U		0.0135 U	
	Plutonium-238	pCi/L	0.00478 U		0.00559 U	
	Plutonium-239/240	pCi/L	0.0143 U		0.0168 U	
	Technetium-99	pCi/L	284		271	
	Uranium	µg/L	68.7 J		90.5	
	Uranium-233/234	pCi/L	24.7 J		31.7	
	Uranium-235/236	pCi/L	1.07 J		1.63	
	Uranium-238	pCi/L	22.9 J		30.1	
X701-TC54G	Americium-241	pCi/L	0.0147 U		0.027 U	
	Neptunium-237	pCi/L	-0.00447 U		-0.00496 U	
	Plutonium-238	pCi/L	-0.00989 U		0.0194 U	
	Plutonium-239/240	pCi/L	0.0099 U		0.0324 U	
	Technetium-99	pCi/L	466		435	
	Uranium	µg/L	2.04 J		2.64	
	Uranium-233/234	pCi/L	0.527		0.792	
	Uranium-235/236	pCi/L	0.0321 UJ		0.0242 U	
	Uranium-238	pCi/L	0.682		0.882	
X701-TC61G	Americium-241	pCi/L	0.0401 U		0 U	
	Neptunium-237	pCi/L	-0.00529 U		-0.00468 U	
	Plutonium-238	pCi/L	-0.0157 U		0 U	
	Plutonium-239/240	pCi/L	0.00524 U		0.0227 U	
	Technetium-99	pCi/L	523		458	
	Uranium	µg/L	2.11 J		1.58	

Table 4.11. Results for radionuclides at the X-701B Former Holding Pond – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC61G	Uranium-233/234	pCi/L	0.547		0.546	
	Uranium-235/236	pCi/L	0.0851 UJ		0.021 U	
	Uranium-238	pCi/L	0.694		0.529	
X701-TC67G	Americium-241	pCi/L	0.025 U		0.0103 U	
	Neptunium-237	pCi/L	0.00471 U		-0.0142 U	
	Plutonium-238	pCi/L	0.00511 U		-0.0114 U	
	Plutonium-239/240	pCi/L	0.00511 U		0.0342 U	
	Technetium-99	pCi/L	125		112	
	Uranium	µg/L	0.62 J		1.32	
	Uranium-233/234	pCi/L	0.143 J		0.323	
	Uranium-235/236	pCi/L	0.0237 UJ		0.0175 U	
	Uranium-238	pCi/L	0.205 J		0.44	

Table 4.12. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X633-07G	Chromium	µg/L		1400 J		1300 J
X633-PZ04G	Chromium	µg/L		48		46

Table 4.13. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-02G	1,1-Dichloroethene	µg/L	0.25 J			
	Trichloroethene	µg/L	0.35 J			
X616-09G	1,1,1-Trichloroethane	µg/L	2.7		4	
	1,1-Dichloroethane	µg/L	2.9		4	
	1,1-Dichloroethene	µg/L	25		40	
	cis-1,2-Dichloroethene	µg/L	3.3		2.9	
	Trichloroethene	µg/L	23		29	
	Trichlorofluoromethane	µg/L	0.3 J		0.84 J	
X616-13G	1,1,1-Trichloroethane	µg/L	3.4		3.8	
	1,1-Dichloroethane	µg/L	0.98 J		1.1	
	1,1-Dichloroethene	µg/L	25		28 J	
	cis-1,2-Dichloroethene	µg/L	0.52 J		0.59 J	
	Trichloroethene	µg/L	14		18 J	
	Trichlorofluoromethane	µg/L	8.3		8.6 J	
X616-14G	1,1,1-Trichloroethane	µg/L	1.4		1.7	
	1,1-Dichloroethane	µg/L	0.35 J		0.4 J	
	1,1-Dichloroethene	µg/L	8.5		11 J	
	Trichloroethene	µg/L	2.7		3.7 J	
	Trichlorofluoromethane	µg/L	0.93 J		1.3 J	
X616-16G	cis-1,2-Dichloroethene	µg/L	0.94 J			
	Trichloroethene	µg/L	0.69 J			
X616-20B	1,1,1-Trichloroethane	µg/L	0.35 JQ		0.3 J	
	1,1-Dichloroethane	µg/L	0.58 J		0.44 J	
	1,1-Dichloroethene	µg/L	5.3 QJ		4.6	
	cis-1,2-Dichloroethene	µg/L	0.55 J		0.44 J	
	Trichloroethene	µg/L	16		11	
X616-25G	1,1-Dichloroethane	µg/L	0.22 U		0.19 J	
	cis-1,2-Dichloroethene	µg/L	0.61 J		0.54 J	
	Trichloroethene	µg/L	2.9		1.3	
X616-28B	1,1,1-Trichloroethane	µg/L	0.79 JQ			
	1,1-Dichloroethene	µg/L	0.64 JQ			
	Trichloroethene	µg/L	0.48 J			

Table 4.14. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-02G	Chromium	µg/L	0.51 J			
X616-05G	Chromium	µg/L	530 J			
X616-09G	Chromium	µg/L	6.3			
X616-10G	Chromium	µg/L	0.5 U			
X616-13G	Chromium	µg/L	0.5 U			
X616-14G	Chromium	µg/L	1.6 J			
X616-16G	Chromium	µg/L	0.5 U			
X616-17G	Chromium	µg/L	14 J			
X616-19B	Chromium	µg/L	17			
X616-20B	Chromium	µg/L	2.4			
X616-21G	Chromium	µg/L	1.4 J			
X616-22G	Chromium	µg/L	0.58 J			
X616-24B	Chromium	µg/L	5.3			
X616-25G	Chromium	µg/L	3.2			
X616-26G	Chromium	µg/L	7.7			
X616-28B	Chromium	µg/L	0.56 J			

Table 4.15. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-02G	1,1,1-Trichloroethane	µg/L		1.7		
	1,1-Dichloroethane	µg/L		2		
	1,1-Dichloroethene	µg/L		3		
	Trichloroethene	µg/L		4.4		
X740-03G	1,1-Dichloroethane	µg/L		2.6 D		
	1,1-Dichloroethene	µg/L		52 D		
	1,2-Dichloroethane	µg/L		6.5 D		
	Chloroethane	µg/L		6.8 D		
	trans-1,2-Dichloroethene	µg/L		0.76 DJ		
	Trichloroethene	µg/L		4.8 D		
	Vinyl chloride	µg/L		9.1 D		
X740-04G	1,1-Dichloroethene	µg/L		0.25 J		
	Trichloroethene	µg/L		2.6		
X740-08G	1,1,1-Trichloroethane	µg/L		1.1		
	1,1-Dichloroethane	µg/L		13		
	1,1-Dichloroethene	µg/L		1.7		
	cis-1,2-Dichloroethene	µg/L		14		
	trans-1,2-Dichloroethene	µg/L		3.7		
	Trichloroethene	µg/L		7.4		
X740-09B	1,1,1-Trichloroethane	µg/L		7.6 D		
	1,1-Dichloroethane	µg/L		25 D		
	1,1-Dichloroethene	µg/L		240 D		
	1,2-Dichloroethane	µg/L		68 D		
	Chloroform	µg/L		1.3 DJ		
	cis-1,2-Dichloroethene	µg/L		1600 D		
	Methylene chloride	µg/L		2.2 DJ		
	Tetrachloroethene	µg/L		8.1 D		
	trans-1,2-Dichloroethene	µg/L		1.9 DJ		
	Trichloroethene	µg/L		490 D		
	Vinyl chloride	µg/L		4.3 DJ		
X740-10G	1,1,1-Trichloroethane	µg/L		0.29 J		
	1,1-Dichloroethane	µg/L		2		
	1,1-Dichloroethene	µg/L		9.3		
	1,2-Dichloroethane	µg/L		3.2		
	cis-1,2-Dichloroethene	µg/L		57		
	Tetrachloroethene	µg/L		0.77 J		
	Trichloroethene	µg/L		41		
X740-11G	1,1,1-Trichloroethane	µg/L		0.9 J		
	1,1-Dichloroethane	µg/L		0.49 J		
	1,1-Dichloroethene	µg/L		7.1 J		
	1,2-Dichloroethane	µg/L		2.1		
	Chloroform	µg/L		0.23 J		
	Trichloroethene	µg/L		28 J		
X740-13G	Acetone	µg/L		3.9 J		
X740-14B	Trichloroethene	µg/L		1.6		
X740-18G	1,1-Dichloroethene	µg/L		1.8		
	2-Butanone	µg/L		120		
	Acetone	µg/L		280 D		
	Chloroethane	µg/L		1.3 J		
	cis-1,2-Dichloroethene	µg/L		17		

Table 4.15. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-18G	trans-1,2-Dichloroethene	µg/L		0.33 J		
	Trichloroethene	µg/L		0.23 J		
	Vinyl chloride	µg/L		4.9		
X740-19G	1,1-Dichloroethane	µg/L		0.29 J		
	1,1-Dichloroethene	µg/L		1.6		
	1,2-Dichloroethane	µg/L		0.66 J		
	cis-1,2-Dichloroethene	µg/L		11		
	Tetrachloroethene	µg/L		0.44 J		
	Trichloroethene	µg/L		7.6		
X740-20G	cis-1,2-Dichloroethene	µg/L		1.8		
	Trichloroethene	µg/L		2.3		
X740-21G	1,1-Dichloroethene	µg/L		0.24 J		
	cis-1,2-Dichloroethene	µg/L		0.79 J		
	Trichloroethene	µg/L		5		
X740-22G	1,1,1-Trichloroethane	µg/L		1		
	1,1-Dichloroethane	µg/L		0.89 J		
	1,1-Dichloroethene	µg/L		9.5		
	1,2-Dichloroethane	µg/L		3.1 Q		
	Chloroform	µg/L		0.19 J		
	cis-1,2-Dichloroethene	µg/L		11		
	Tetrachloroethene	µg/L		1.5		
	Trichloroethene	µg/L		77 DJ		
X740-PZ04M	Acetone	µg/L		1.9 J		
X740-PZ10G	1,1,1-Trichloroethane	µg/L		0.19 J		
	1,1-Dichloroethane	µg/L		0.17 J		
	1,1-Dichloroethene	µg/L		0.28 J		
	Tetrachloroethene	µg/L		0.22 J		
	Trichloroethene	µg/L		7.2		
X740-PZ12G	1,1,1-Trichloroethane	µg/L		1.3		
	1,1-Dichloroethane	µg/L		0.58 J		
	1,1-Dichloroethene	µg/L		4.1		
	1,2-Dichloroethane	µg/L		3 Q		
	Chloroform	µg/L		0.31 J		
	cis-1,2-Dichloroethene	µg/L		0.15 J		
	Tetrachloroethene	µg/L		0.73 J		
	Trichloroethene	µg/L		56		
X740-PZ14G	1,1,1-Trichloroethane	µg/L		1.2		
	1,1-Dichloroethane	µg/L		0.75 J		
	1,1-Dichloroethene	µg/L		11		
	1,2-Dichloroethane	µg/L		3.8		
	Chloroform	µg/L		0.36 J		
	cis-1,2-Dichloroethene	µg/L		0.98 J		
	Tetrachloroethene	µg/L		1.1		
	Trichloroethene	µg/L		82 DJ		
X740-PZ17G	1,1,1-Trichloroethane	µg/L		0.7 J		
	1,1-Dichloroethane	µg/L		0.27 J		
	1,1-Dichloroethene	µg/L		3.1		
	1,2-Dichloroethane	µg/L		1.7		
	Acetone	µg/L		2.4 J		
	Chloroform	µg/L		0.16 J		

Table 4.15. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-PZ17G	Trichloroethene	µg/L		20		

Table 4.16. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-07G	Beryllium	µg/L	0.11 J		1.7	
	Chromium	µg/L	4.6		14	
F-08B	Beryllium	µg/L	0.08 U		0.08 U	
	Chromium	µg/L	0.5 U		0.5 U	
X611-01B	Beryllium	µg/L	0.08 U		0.08 U	
	Chromium	µg/L	0.5 U		1.9 J	
X611-02BA	Beryllium	µg/L	0.08 U		0.08 U	
	Chromium	µg/L	0.55 J		0.54 J	
X611-03G	Beryllium	µg/L	0.08 U		0.08 U	
	Chromium	µg/L	0.5 U		4.7	
X611-04BA	Beryllium	µg/L	0.23 J		0.75 J	
	Chromium	µg/L	0.5 U		0.5 U	

Table 4.17. VOCs detected at the X-735 Landfills – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-01GA	Methylene chloride	µg/L		0.49 J		
X735-02GA	1,1-Dichloroethane	µg/L		0.33 J		
X735-03G	Methylene chloride	µg/L		0.6 J		
	Trichloroethene	µg/L		0.28 J		
X735-03GA	Methylene chloride	µg/L		0.62 J		

Table 4.18. Results for radionuclides at the X-735 Landfills – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-01GA	Technetium-99	pCi/L		-2.31 U		
	Uranium	µg/L		0.0825 U		
	Uranium-233/234	pCi/L		0.0248 U		
	Uranium-235/236	pCi/L		0.0185 U		
	Uranium-238	pCi/L		0.0248 U		
X735-02GA	Technetium-99	pCi/L		-1.66 U		
	Uranium	µg/L		0.0366 U		
	Uranium-233/234	pCi/L		0.0177 U		
	Uranium-235/236	pCi/L		0.022 U		
	Uranium-238	pCi/L		0.00886 U		
X735-03G	Technetium-99	pCi/L		-1.21 U		
	Uranium	µg/L		0.426 J		
	Uranium-233/234	pCi/L		0.177 J		
	Uranium-235/236	pCi/L		0.011 U		
	Uranium-238	pCi/L		0.141 J		
X735-03GA	Technetium-99	pCi/L		-0.83 U		
	Uranium	µg/L		0.038 U		
	Uranium-233/234	pCi/L		0.0273 U		
	Uranium-235/236	pCi/L		-0.0057 U		
	Uranium-238	pCi/L		0.0137 U		
X735-04G	Technetium-99	pCi/L		-0.763 U		
	Uranium	µg/L		0.0326 U		
	Uranium-233/234	pCi/L		0.0183 U		
	Uranium-235/236	pCi/L		0.0114 U		
	Uranium-238	pCi/L		0.00917 U		
X735-04GA	Technetium-99	pCi/L		-0.344 U		
	Uranium	µg/L		0.131 UJ		
	Uranium-233/234	pCi/L		0.014 U		
	Uranium-235/236	pCi/L		0.0116 U		
	Uranium-238	pCi/L		0.0421 UJ		
X735-05G	Technetium-99	pCi/L		-2.64 U		
	Uranium	µg/L		0.325 J		
	Uranium-233/234	pCi/L		0.0982 J		
	Uranium-235/236	pCi/L		0.0116 U		
	Uranium-238	pCi/L		0.108 J		
X735-05GA	Technetium-99	pCi/L		-1.32 U		
	Uranium	µg/L		0.125 UJ		
	Uranium-233/234	pCi/L		0.0881 J		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0419 UJ		
X735-06GAA	Technetium-99	pCi/L		-1.22 U		
	Uranium	µg/L		0.0304 U		
	Uranium-233/234	pCi/L		0.0186 U		
	Uranium-235/236	pCi/L		0.00579 U		
	Uranium-238	pCi/L		0.00932 U		
X735-12G	Technetium-99	pCi/L		-2.11 U		
	Uranium	µg/L		0.186 UJ		
	Uranium-233/234	pCi/L		0.0625 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0625 UJ		

Table 4.18. Results for radionuclides at the X-735 Landfills – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-13GA	Technetium-99	pCi/L		-0.729 U		
	Uranium	µg/L		0.191 UJ		
	Uranium-233/234	pCi/L		0.0596 UJ		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0642 UJ		
X735-16B	Technetium-99	pCi/L		-1.61 U		
	Uranium	µg/L		0.0631 U		
	Uranium-233/234	pCi/L		0.0145 U		
	Uranium-235/236	pCi/L		0.012 U		
	Uranium-238	pCi/L		0.0193 U		
X735-17B	Technetium-99	pCi/L		-2.85 U		
	Uranium	µg/L		0.0835 U		
	Uranium-233/234	pCi/L		0.0996 J		
	Uranium-235/236	pCi/L		0.00563 U		
	Uranium-238	pCi/L		0.0272 U		
X735-18B	Technetium-99	pCi/L		-0.829 U		
	Uranium	µg/L		2.1E-06 U		
	Uranium-233/234	pCi/L		0.0132 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0 U		
X735-19G	Technetium-99	pCi/L		-1.14 U		
	Uranium	µg/L		0.102 U		
	Uranium-233/234	pCi/L		0.0333 U		
	Uranium-235/236	pCi/L		0.00591 U		
	Uranium-238	pCi/L		0.0333 U		
X735-20B	Technetium-99	pCi/L		0.705 U		
	Uranium	µg/L		0.011 U		
	Uranium-233/234	pCi/L		0.0239 U		
	Uranium-235/236	pCi/L		0.0238 U		
	Uranium-238	pCi/L		0 U		
X735-21G	Technetium-99	pCi/L		-1.39 U		
	Uranium	µg/L		0.531 J		
	Uranium-233/234	pCi/L		0.197 J		
	Uranium-235/236	pCi/L		0.0292 U		
	Uranium-238	pCi/L		0.174 J		
X737-05B	Technetium-99	pCi/L		-0.683 U		
	Uranium	µg/L		0.00776 U		
	Uranium-233/234	pCi/L		0.00899 U		
	Uranium-235/236	pCi/L		0.0168 U		
	Uranium-238	pCi/L		0 U		
X737-06G	Technetium-99	pCi/L		0.97 U		
	Uranium	µg/L		0.0276 U		
	Uranium-233/234	pCi/L		0.0278 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.00926 U		
X737-07B	Technetium-99	pCi/L		-2.02 U		
	Uranium	µg/L		-0.0026 U		
	Uranium-233/234	pCi/L		0.00451 U		
	Uranium-235/236	pCi/L		-0.0056 U		
	Uranium-238	pCi/L		0 U		

Table 4.18. Results for radionuclides at the X-735 Landfills – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X737-09G	Technetium-99	pCi/L		-0.997 U		
	Uranium	µg/L		0.0814 U		
	Uranium-233/234	pCi/L		0.0309 U		
	Uranium-235/236	pCi/L		0.00549 U		
	Uranium-238	pCi/L		0.0265 U		

Table 4.19. VOCs detected at the X-734 Landfills – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
RSY-02B	Methylene chloride	µg/L		0.32 U		0.36 J
X734-01G	Methylene chloride	µg/L		0.32 U		0.33 J
X734-02B	Methylene chloride	µg/L		0.32 U		0.35 J
X734-03G	Methylene chloride	µg/L		0.32 U		0.35 J
X734-04G	Methylene chloride	µg/L		0.32 U		0.32 J
X734-05B	1,2-Dimethylbenzene	µg/L		0.26 J		0.19 U
	Benzene	µg/L		0.66 J		1.8
	Ethylbenzene	µg/L		0.42 J		0.21 J
	Methylene chloride	µg/L		0.32 U		0.62 BJ
	Toluene	µg/L		0.35 J		0.69 J
X734-06G	Methylene chloride	µg/L		0.32 U		0.55 BJ
X734-10G	Methylene chloride	µg/L		0.32 U		0.66 BJ
X734-14G	Methylene chloride	µg/L		0.32 U		1 BJ
X734-15G	Methylene chloride	µg/L		0.32 U		0.83 BJ
X734-16G	Acetone	µg/L		5.7 JQ		18
X734-23G	cis-1,2-Dichloroethene	µg/L		7.1		5.5
	trans-1,2-Dichloroethene	µg/L		0.37 J		0.28 J
	Vinyl chloride	µg/L		1.9		1.5

Table 4.20. Results for radionuclides at the X-734 Landfills – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
RSY-02B	Americium-241	pCi/L		0.0255 U		
	Neptunium-237	pCi/L		0.0089 U		
	Plutonium-238	pCi/L		-0.005 U		
	Plutonium-239/240	pCi/L		0.0198 U		
	Technetium-99	pCi/L		-0.783 U		
	Uranium	µg/L		0.112 U		
	Uranium-233/234	pCi/L		0.0561 U		
	Uranium-235/236	pCi/L		0.0127 U		
	Uranium-238	pCi/L		0.0357 U		
X734-01G	Americium-241	pCi/L		0.0257 U		
	Neptunium-237	pCi/L		0.00462 U		
	Plutonium-238	pCi/L		-0.0052 U		
	Plutonium-239/240	pCi/L		0.0367 U		
	Technetium-99	pCi/L		1.1 U		
	Uranium	µg/L		0.211 U		
	Uranium-233/234	pCi/L		0.0681 U		
	Uranium-235/236	pCi/L		0.0181 U		
	Uranium-238	pCi/L		0.0681 U		
X734-02B	Americium-241	pCi/L		0.0195 U		
	Neptunium-237	pCi/L		-0.0142 U		
	Plutonium-238	pCi/L		0.01 U		
	Plutonium-239/240	pCi/L		0.0301 U		
	Technetium-99	pCi/L		-1.11 U		
	Uranium	µg/L		0.0164 U		
	Uranium-233/234	pCi/L		0.0324 U		
	Uranium-235/236	pCi/L		0.00575 U		
	Uranium-238	pCi/L		0.00463 U		
X734-03G	Americium-241	pCi/L		0.0334 U		
	Neptunium-237	pCi/L		0.0095 U		
	Plutonium-238	pCi/L		-0.0239 U		
	Plutonium-239/240	pCi/L		0.0299 U		
	Technetium-99	pCi/L		-1.18 U		
	Uranium	µg/L		2.85		
	Uranium-233/234	pCi/L		1.59		
	Uranium-235/236	pCi/L		0.11		
	Uranium-238	pCi/L		0.94		
X734-04G	Americium-241	pCi/L		0 U		
	Neptunium-237	pCi/L		0.00473 U		
	Plutonium-238	pCi/L		0.0227 U		
	Plutonium-239/240	pCi/L		0.034 U		
	Technetium-99	pCi/L		-2.06 U		
	Uranium	µg/L		1.96		
	Uranium-233/234	pCi/L		0.847		
	Uranium-235/236	pCi/L		0.037 U		
	Uranium-238	pCi/L		0.654		
X734-05B	Americium-241	pCi/L		0.0199 U		
	Neptunium-237	pCi/L		0.02 U		
	Plutonium-238	pCi/L		0.0128 U		
	Plutonium-239/240	pCi/L		0.0256 U		
	Technetium-99	pCi/L		-0.807 U		

Table 4.20. Results for radionuclides at the X-734 Landfills – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X734-05B	Uranium	µg/L		0.361		
	Uranium-233/234	pCi/L		0.308		
	Uranium-235/236	pCi/L		0.00599 U		
	Uranium-238	pCi/L		0.12		
X734-06G	Americium-241	pCi/L		0.0317 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.0055 U		
	Plutonium-239/240	pCi/L		0.0275 U		
	Technetium-99	pCi/L		-0.716 U		
	Uranium	µg/L		0.0114 U		
	Uranium-233/234	pCi/L		0.019 U		
	Uranium-235/236	pCi/L		-0.0059 U		
	Uranium-238	pCi/L		0.00475 U		
X734-10G	Americium-241	pCi/L		0 U		
	Neptunium-237	pCi/L		0.00498 U		
	Plutonium-238	pCi/L		-0.0125 U		
	Plutonium-239/240	pCi/L		0.0188 U		
	Technetium-99	pCi/L		-0.231 U		
	Uranium	µg/L		0.336		
	Uranium-233/234	pCi/L		0.105		
	Uranium-235/236	pCi/L		0.0179 U		
	Uranium-238	pCi/L		0.11		
X734-14G	Americium-241	pCi/L		0.0151 U		
	Neptunium-237	pCi/L		0.0149 U		
	Plutonium-238	pCi/L		0.0115 U		
	Plutonium-239/240	pCi/L		0.0287 U		
	Technetium-99	pCi/L		-1.95 U		
	Uranium	µg/L		0.987		
	Uranium-233/234	pCi/L		0.436		
	Uranium-235/236	pCi/L		0.0233 U		
	Uranium-238	pCi/L		0.328		
X734-15G	Americium-241	pCi/L		0.0432 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		-0.0053 U		
	Plutonium-239/240	pCi/L		0.016 U		
	Technetium-99	pCi/L		-1.9 U		
	Uranium	µg/L		0.101 U		
	Uranium-233/234	pCi/L		0.0339 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0339 U		
X734-16G	Americium-241	pCi/L		-0.0127 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		-0.0118 U		
	Plutonium-239/240	pCi/L		0.00592 U		
	Technetium-99	pCi/L		-1.03 U		
	Uranium	µg/L		3.6		
	Uranium-233/234	pCi/L		1.89		
	Uranium-235/236	pCi/L		0.11 U		
	Uranium-238	pCi/L		1.19		
X734-18G	Americium-241	pCi/L		-0.0108 U		

Table 4.20. Results for radionuclides at the X-734 Landfills – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X734-18G	Neptunium-237	pCi/L		-0.01 U		
	Plutonium-238	pCi/L		-0.017 U		
	Plutonium-239/240	pCi/L		0.017 U		
	Technetium-99	pCi/L		-1.49 U		
	Uranium	µg/L		1.76		
	Uranium-233/234	pCi/L		1.06		
	Uranium-235/236	pCi/L		0.0293 U		
	Uranium-238	pCi/L		0.588		
X734-20G	Americium-241	pCi/L		0.0152 U		
	Neptunium-237	pCi/L		-0.014 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.0566 U		
	Technetium-99	pCi/L		-1.29 U		
	Uranium	µg/L		0.00275 U		
	Uranium-233/234	pCi/L		0.0477 U		
	Uranium-235/236	pCi/L		0.00593 U		
	Uranium-238	pCi/L		0 U		
X734-22G	Americium-241	pCi/L		0.0213 U		
	Neptunium-237	pCi/L		0.00475 U		
	Plutonium-238	pCi/L		-0.0059 U		
	Plutonium-239/240	pCi/L		0.00585 U		
	Technetium-99	pCi/L		-2.57 U		
	Uranium	µg/L		0.918		
	Uranium-233/234	pCi/L		0.493		
	Uranium-235/236	pCi/L		0.0184 U		
	Uranium-238	pCi/L		0.306		
X734-23G	Americium-241	pCi/L		0.0222 U		
	Neptunium-237	pCi/L		0.00968 U		
	Plutonium-238	pCi/L		-0.0066 U		
	Plutonium-239/240	pCi/L		0.0198 U		
	Technetium-99	pCi/L		-1.51 U		
	Uranium	µg/L		0.0258 U		
	Uranium-233/234	pCi/L		0.0164 U		
	Uranium-235/236	pCi/L		0.0205 U		
	Uranium-238	pCi/L		0.00548 U		

Table 4.21. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-03G	Cadmium	µg/L		47		60
	Nickel	µg/L		430		680
TCP-01G	Cadmium	µg/L		9.7		0.27 U
	Nickel	µg/L		130		0.67 J
X533-03G	Cadmium	µg/L		28		36
	Nickel	µg/L		360 J		490 J

Table 4.22. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X344C-01G	cis-1,2-Dichloroethene	µg/L	1.9			
	trans-1,2-Dichloroethene	µg/L	0.27 J			
	Trichloroethene	µg/L	0.54 J			
	Vinyl chloride	µg/L	0.23 J			

Table 4.23. VOCs detected at surface water monitoring locations – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Acetone	µg/L	100	4.3 J	2.8 J	33
	Bromodichloromethane	µg/L	0.17 U	0.9 J	0.79 J	0.45 J
	Chloroform	µg/L	0.16 U	1.5	0.93 J	0.52 J
	Dibromochloromethane	µg/L	0.17 U	0.64 J	0.59 J	0.51 J
	Methylene chloride	µg/L	0.4 J	0.32 U	0.32 U	0.32 U
BRC-SW05	Acetone	µg/L	7.9 J	1.9 U	1.9 U	1.9 U
EDD-SW01	Bromodichloromethane	µg/L	0.82 J	1	1	0.62 J
	Bromoform	µg/L	1	0.19 U	0.19 U	0.19 U
	Chloroform	µg/L	0.49 J	2.2	1.4	0.92 J
	cis-1,2-Dichloroethene	µg/L	0.47 J	0.49 J	0.31 J	1.1
	Dibromochloromethane	µg/L	1.2	0.5 J	0.85 J	0.56 J
	Toluene	µg/L	0.17 U	0.24 J	0.17 U	0.17 U
	Trichloroethene	µg/L	0.94 J	1	0.61 J	1.5
LBC-SW01	Bromodichloromethane	µg/L	0.38 J	0.17 U	0.17 U	0.17 U
	Chloroform	µg/L	0.21 J	0.16 U	0.16 U	0.16 U
	cis-1,2-Dichloroethene	µg/L	0.41 J	0.15 U	0.15 U	0.15 U
	Dibromochloromethane	µg/L	0.7 J	0.17 U	0.17 U	0.17 U
	Trichloroethene	µg/L	0.55 J	0.16 U	0.16 U	0.16 U
LBC-SW02	Bromodichloromethane	µg/L	0.22 J	0.26 J	0.17 J	0.17 U
	Chloroform	µg/L	0.16 U	0.49 J	0.28 J	0.22 J
	cis-1,2-Dichloroethene	µg/L	0.2 J	0.17 J	0.15 U	0.23 J
	Dibromochloromethane	µg/L	0.51 J	0.17 U	0.2 J	0.17 U
	Trichloroethene	µg/L	0.26 J	0.26 J	0.16 J	0.37 J
NHP-SW01	Chloroform	µg/L	0.16 U	0.28 J	0.16 U	0.16 U
UND-SW01	1,1-Dichloroethane	µg/L	0.22 U	0.16 U	0.17 J	0.16 U
	1,1-Dichloroethene	µg/L	0.26 J	0.18 J	0.29 J	0.14 U
	cis-1,2-Dichloroethene	µg/L	0.23 J	0.3 J	0.45 J	0.15 U
	Trichloroethene	µg/L	2.8	4.3	4.4 J	1
UND-SW02	Methylene chloride	µg/L	0.36 J	0.32 U	0.32 U	0.32 U
WDD-SW01	Bromoform	µg/L	0.19 U	0.19 U	0.87 J	0.19 U
	Chloroform	µg/L	0.16 U	0.16 U	0.16 U	0.25 J
	Dibromochloromethane	µg/L	0.17 U	0.17 U	0.43 J	0.17 U
WDD-SW03	Bromodichloromethane	µg/L	0.19 J	0.17 U	0.17 U	0.17 U
	Bromoform	µg/L	0.5 J	0.19 U	0.19 U	0.19 U
	Dibromochloromethane	µg/L	0.44 J	0.2 J	0.17 U	0.17 U

Table 4.24. Results for radionuclides at surface water monitoring locations – 2017

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Americium-241	pCi/L		0 U		-0.00528 U
	Neptunium-237	pCi/L		-0.0235 U		0.00539 U
	Plutonium-238	pCi/L		-0.0109 U		0.00617 U
	Plutonium-239/240	pCi/L		0.0109 U		0.0247 U
	Technetium-99	pCi/L	2.62 U	0.488 U	1.65 U	2.91 U
	Uranium	µg/L	2.65 J	0.351 J	1.01	0.6 J
	Uranium-233/234	pCi/L	1.5	0.34	0.653	1.95
	Uranium-235/236	pCi/L	0.0726 UJ	0.0179 U	0.0235 U	0.117 J
	Uranium-238	pCi/L	0.88	0.115 J	0.336	0.183 J
BRC-SW02	Americium-241	pCi/L		0.0158 U		0.00955 U
	Neptunium-237	pCi/L		0 U		0.00975 U
	Plutonium-238	pCi/L		0.00516 U		0.00554 U
	Plutonium-239/240	pCi/L		0.00516 U		0.0111 U
	Technetium-99	pCi/L	3.16 U	0.488 U	4.59 U	3.71 U
	Uranium	µg/L	1.33 J	0.693 J	0.403	0.494 J
	Uranium-233/234	pCi/L	0.912	0.631	0.491	0.456
	Uranium-235/236	pCi/L	0.0491 UJ	0.042 U	0.0252 U	0.0296 U
	Uranium-238	pCi/L	0.438	0.226 J	0.132	0.162 J
BRC-SW05	Americium-241	pCi/L		0.021 U		0.0525 U
	Neptunium-237	pCi/L		0.00513 U		-0.00503 U
	Plutonium-238	pCi/L		-0.0053 U		0.00567 U
	Plutonium-239/240	pCi/L		0.0105 U		0.0227 U
	Technetium-99	pCi/L	0.716 U	-1.06 U	1.4 U	1 U
	Uranium	µg/L	1.62 J	1.18 J	0.607	0.571 J
	Uranium-233/234	pCi/L	1.15	0.841	0.61	0.54
	Uranium-235/236	pCi/L	0.0952 UJ	0.0902 UJ	0.037 U	0.0654 UJ
	Uranium-238	pCi/L	0.531	0.382	0.198	0.182 J
EDD-SW01	Americium-241	pCi/L		0.00998 U		0.0566 UJ
	Neptunium-237	pCi/L		0 U		-0.0049 U
	Plutonium-238	pCi/L		0.0239 U		-0.00634 U
	Plutonium-239/240	pCi/L		0.0179 U		0.00635 U
	Technetium-99	pCi/L	35.3	2.99 U	5.13 UJ	4.25 U
	Uranium	µg/L	1.44 J	0.686 J	1.21 J	0.51 J
	Uranium-233/234	pCi/L	2.89	1.42	1.84	0.886
	Uranium-235/236	pCi/L	0.153 J	0.0824 UJ	0.0925 JU	0.041 U
	Uranium-238	pCi/L	0.46	0.218 J	0.392	0.165 J
LBC-SW01	Americium-241	pCi/L		0.00484 U		0.00951 U
	Neptunium-237	pCi/L		0.0047 U		0 U
	Plutonium-238	pCi/L		0.00553 U		0 U
	Plutonium-239/240	pCi/L		0.0387 U		0.00572 U
	Technetium-99	pCi/L	21.9	-1.81 U	0.507 U	3.58 U
	Uranium	µg/L	0.817 J	0.0801 U	0.0882 U	0.188 UJ
	Uranium-233/234	pCi/L	1.91	0.0278 U	0.079 JU	0.0932 J
	Uranium-235/236	pCi/L	0.112 J	-0.0058 U	0 U	0.0174 U
	Uranium-238	pCi/L	0.257	0.0278 U	0.0296 U	0.0606 UJ
LBC-SW02	Americium-241	pCi/L		-0.0052 U		0 U
	Neptunium-237	pCi/L		0 U		0.0044 U
	Plutonium-238	pCi/L		0 U		-0.0179 U
	Plutonium-239/240	pCi/L		0.00605 U		0.0357 U
	Technetium-99	pCi/L	19.5	4.33 U	7.75	5.94 UJ

Table 4.24. Results for radionuclides at surface water monitoring locations – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-SW02	Uranium	µg/L	0.856 J	0.526 J	1.59 J	0.499 J
	Uranium-233/234	pCi/L	1.58	1.08	2.62	0.75
	Uranium-235/236	pCi/L	0.0644 UJ	0.0297 U	0.119 J	0.029 U
	Uranium-238	pCi/L	0.278	0.172 J	0.515	0.163 J
LBC-SW03	Americium-241	pCi/L		0.0488 UJ		0.00548 U
	Neptunium-237	pCi/L		0.0135 U		0 U
	Plutonium-238	pCi/L		0.00541 U		-0.00604 U
	Plutonium-239/240	pCi/L		0.0108 U		0.00604 U
	Technetium-99	pCi/L	18.6	2.54 U	8.27	5.65 UJ
	Uranium	µg/L	0.964 J	0.668 J	1.67 J	0.745 J
	Uranium-233/234	pCi/L	1.65	0.955	2.51	1.06
	Uranium-235/236	pCi/L	0.066 UJ	0.0582 UJ	0.133 J	0.0542 U
	Uranium-238	pCi/L	0.314	0.215 J	0.54	0.242
LBC-SW04	Americium-241	pCi/L		0.0292 U		0.0145 U
	Neptunium-237	pCi/L		0 U		0.00506 U
	Plutonium-238	pCi/L		0 U		0.023 U
	Plutonium-239/240	pCi/L		0.0358 U		0.0115 U
	Technetium-99	pCi/L	16.1	2.27 U	4.08 U	7.59
	Uranium	µg/L	1.32 J	1.08 J	1.94 J	1.12 J
	Uranium-233/234	pCi/L	1.69	1.49	2.29	1.56
	Uranium-235/236	pCi/L	0.113 J	0.0517 UJ	0.113 JU	0.087 UJ
	Uranium-238	pCi/L	0.425	0.356	0.634	0.364
NHP-SW01	Americium-241	pCi/L		0.0155 U		0.0152 U
	Neptunium-237	pCi/L		0.00464 U		0 U
	Plutonium-238	pCi/L		0.0169 U		0 U
	Plutonium-239/240	pCi/L		0 U		0.0115 U
	Technetium-99	pCi/L	-0.0993 U	0.62 U	0.509 U	2.9 U
	Uranium	µg/L	5.05 J	3.65 J	4.83 J	2.42
	Uranium-233/234	pCi/L	2.51	1.35	1.94	0.838
	Uranium-235/236	pCi/L	0.0988 UJ	0.0807 UJ	0.148 J	0.0291 U
	Uranium-238	pCi/L	1.68	1.21	1.6	0.81
UND-SW01	Americium-241	pCi/L		0.0251 U		0.00984 U
	Neptunium-237	pCi/L		0.019 U		0.00949 U
	Plutonium-238	pCi/L		0.0057 U		0 U
	Plutonium-239/240	pCi/L		0.0228 U		-0.00544 U
	Technetium-99	pCi/L	-0.143 U	0.243 U	-0.11 U	0.52 U
	Uranium	µg/L	2.49	2.25	1.93	1.34
	Uranium-233/234	pCi/L	1.07	0.809	0.941	0.585
	Uranium-235/236	pCi/L	0.0353 U	0.0394 U	0.023 U	0.0172 U
	Uranium-238	pCi/L	0.832	0.75	0.646	0.447
UND-SW02	Americium-241	pCi/L		0.0344 U		0.021 U
	Neptunium-237	pCi/L		0.00996 U		-0.00534 U
	Plutonium-238	pCi/L		0 U		0.00585 U
	Plutonium-239/240	pCi/L		0.023 U		0.0117 U
	Technetium-99	pCi/L	-0.895 U	-1.56 U	1.32 U	1.14 U
	Uranium	µg/L	1.98	1.54	1.25	1.26
	Uranium-233/234	pCi/L	0.876	0.643	0.492	0.488
	Uranium-235/236	pCi/L	0.0391 U	0.0118 U	0.042 U	0.0303 U
	Uranium-238	pCi/L	0.661	0.515	0.415	0.42
WDD-SW01	Americium-241	pCi/L		-0.005 U		0.0406 UJ

Table 4.24. Results for radionuclides at surface water monitoring locations – 2017 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
WDD-SW01	Neptunium-237	pCi/L		0 U		0.0215 U
	Plutonium-238	pCi/L		0.011 U		-0.0218 U
	Plutonium-239/240	pCi/L		0.011 U		0.00546 U
	Technetium-99	pCi/L	1.75 U	-3.4 U	4.18 U	3.1 U
	Uranium	µg/L	2.77	1.42	2.37	2.18 J
	Uranium-233/234	pCi/L	1.68	0.823	0.916	0.895
	Uranium-235/236	pCi/L	0.0391 U	0.0463 U	0.0674 JU	0.0655 UJ
	Uranium-238	pCi/L	0.924	0.47	0.786	0.722
WDD-SW02	Americium-241	pCi/L		0.0165 U		0 U
	Neptunium-237	pCi/L		0 U		0.00471 U
	Plutonium-238	pCi/L		-0.0054 U		0 U
	Plutonium-239/240	pCi/L		0.00544 U		0.00657 U
	Technetium-99	pCi/L	1.03 U	-0.133 U	2.53 U	4.5 UJ
	Uranium	µg/L	3.07 J	2.97 J	2.01	1.33
	Uranium-233/234	pCi/L	1.96	2.05	1.05	1.16
	Uranium-235/236	pCi/L	0.139 J	0.0874 UJ	0.0407 U	0.0405 U
	Uranium-238	pCi/L	1.01	0.984	0.668	0.442
WDD-SW03	Americium-241	pCi/L		0.0205 U		0.021 U
	Neptunium-237	pCi/L		0 U		0 U
	Plutonium-238	pCi/L		-0.0103 U		-0.011 U
	Plutonium-239/240	pCi/L		0.00517 U		0.0219 U
	Technetium-99	pCi/L	-0.055 U	-0.954 U	4 U	1.4 U
	Uranium	µg/L	2.96 J	1.39 J	2.1	1.19
	Uranium-233/234	pCi/L	1.49	0.608	1.12	0.647
	Uranium-235/236	pCi/L	0.0686 UJ	0.0504 UJ	0.0282 U	0.0175 U
	Uranium-238	pCi/L	0.985	0.46	0.702	0.399

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5. REFERENCES

DOE 2015. *Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0032&D8, U.S. Department of Energy, Piketon, OH, July.

DOE 2017. *Integrated Groundwater Monitoring Plan for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0032&D10, U.S. Department of Energy, Piketon, OH, August.

DOE 2018a. *2017 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio,* DOE/PPPO/03-0847&D1, U.S. Department of Energy, Piketon, OH, March.

DOE 2018b. *U.S. Department of Energy Portsmouth Gaseous Diffusion Plant Annual Site Environmental Report – 2017, Piketon, Ohio,* DOE/PPPO/03-0862&D1, U.S. Department of Energy, Piketon, OH, December.

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