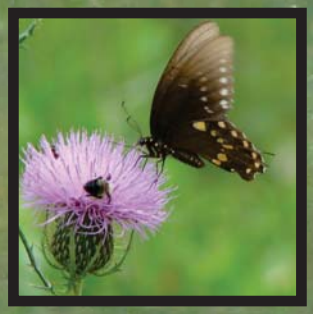
U.S. Department of Energy

Portsmouth Gaseous Diffusion Plant



Annual Site Environmental Report – 2014

March 2016

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Report – 2014
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0688&D1

March 2016

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

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This document has been approved for public release:

Samuel Eldridge (signature on file)	03/10/2016
Classification Office	Date

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FIGURES

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ACRONYMS AND ABBREVIATIONS

ACP	American Centrifuge Plant
Bq	becquerel
BSFR	bulk survey for release
BWCS	BWXT Conversion Services, LLC[1]
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
Ci	curie
CMS	corrective measures study
D&D	decontamination and decommissioning
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
EAB	enhanced anaerobic bioremediation
EMS	Environmental Management System
FBP	Fluor-BWXT Portsmouth LLC[2]
Gy	gray
IRM	interim remedial measure
kg	kilogram
lbs	pounds
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
mg	milligram
mg/L	milligram per liter (equivalent to part per million)
mL	milliliter
mrem	millirem
mSv	millisievert
NCRP	National Council on Radiation Protection
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
Ohio EPA	Ohio Environmental Protection Agency
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
PK	Peter Kiewit

[1] B&W Conversion Services, LLC became BWXT Conversion Services, LLC in 2015. The new name is used in this document.
[2] Fluor-B&W Portsmouth LLC became Fluor-BWXT Portsmouth LLC in 2015. The new name is used in this document.

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
RFI	RCRA facility investigation
RI/FS	remedial investigation/feasibility study
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
WEMS	Wastren-EnergX Mission Support, LLC

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.

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

decontamination and decommissioning – 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 is in or adjacent to current production and operational areas such that remedial activities would interrupt operations, or an area that could 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. The unit of absorbed dose is the rad, equal to 0.01 joule per kilogram in any medium.

- **absorbed dose** – The quantity of ionizing radiation energy absorbed by an organ divided by the organ's mass. Absorbed dose is expressed in units of rad (or gray) (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. Radon is the major contributor to the annual dose for internal radionuclides.

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 – A risk-based screening level often used in human health risk assessment at sites where remediation may be required due to contaminants present in the environment at

concentrations that could be harmful to human health. Contaminants with maximum soil or groundwater concentrations that are less than the corresponding screening level (or preliminary remediation goal) can often be excluded from further risk assessment.

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 (CERCLA) 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. 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 International Agency for Research on Cancer considers TCE a probable human carcinogen.

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 activities, primarily environmental monitoring, at the U.S. Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant (PORTS) for calendar year 2014. 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 28,256 residents (U.S. Census Bureau 2016).

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)[1], Wastren-EnergX Mission Support, LLC (WEMS), and BWXT Conversion Services, LLC (BWCS)[2] managed DOE programs at PORTS in 2014.

FBP was responsible for the following activities: 1) D&D of the former gaseous diffusion process buildings and associated facilities; 2) environmental restoration of contaminated areas; 3) monitoring and reporting on environmental compliance; 4) disposition of legacy radioactive waste; 5) uranium management; and 6) operation of the site's waste storage facilities.

WEMS provided facility support services including the following: 1) maintenance of facilities, grounds, and roadways; 2) janitorial services; 3) security access for DOE facilities; 4) training; 5) records and fleet management; and 6) information technology/network support for DOE operations.

BWCS was responsible for operations associated with 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., has been developing a gaseous centrifuge uranium enrichment plant at PORTS. The Centrus Lead Cascade, which is a small-scale demonstration centrifuge for uranium enrichment, has been operating since 2006 for demonstration and testing purposes. The commercial scale American Centrifuge Plant (ACP) is not operating and is under development. Both of these facilities (the Lead Cascade and the ACP) are housed in existing buildings at PORTS that are leased from DOE.

[1] Fluor-B&W Portsmouth LLC became Fluor-BWXT Portsmouth LLC in 2015. The new name is used in this document.
[2] B&W Conversion Services, LLC became BWXT Conversion Services, LLC in 2015. The new name is used in this document.

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 COMPLIANCE

DOE and/or the responsible DOE contractor (FBP or BWCS) 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 BWCS are responsible for preparing a number of reports for compliance with environmental regulations. These reports include: 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 National Pollutant Discharge Elimination System (NPDES) monitoring data; a quarterly radiological discharge monitoring report for NPDES outfalls; an annual hazardous chemical inventory; and an annual toxic chemical release inventory.

Centrus is responsible for compliance activities directly associated with the ACP and Lead Cascade including air emission permits associated with the gaseous centrifuge uranium enrichment operations (the proposed ACP and Lead Cascade), NPDES outfalls, and management of wastes generated by their current operations.

DOE/FBP received four Notices of Violation from inspections or reports conducted in 2014 as described in the following paragraphs.

DOE/FBP received a Notice of Violation on June 5, 2014, from the inspection conducted by the Ohio Environmental Protection Agency (Ohio EPA) on May 21, 2014. The Notice of Violation was for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The hazardous waste report was revised to include the waste in question. Ohio EPA stated in a letter received on June 19, 2014, that the violation had been abated.

FBP received a Notice of Violation on June 13, 2014, from the exceedance of the NPDES Permit limitation for chlorine at Outfall 003 reported in the May 2014 Discharge Monitoring Report. FBP reported the violation to Ohio EPA as required by the NPDES permit. Ohio EPA acknowledged receipt of the violation notification and the actions taken to resolve the exceedance. No further activities were required by Ohio EPA.

DOE/FBP received a Notice of Violation concerning underground storage tank regulations on July 17, 2014, from the inspection conducted by the United States Environmental Protection Agency (U.S. EPA) on March 24-26, 2014. The Notice of Violation was for failing to maintain records of the monitoring required to ensure that underground storage tanks were not leaking. Regulations require that underground storage tanks be monitored every 30 days for releases. Records of this monitoring between March 2013 and August 2013 were not available. Leak monitoring records after August 2013 were provided to the inspector. No further action was required.

DOE/FBP received a Notice of Violation concerning hazardous waste regulations on September 19, 2014, from the inspection conducted by U.S. EPA and Ohio EPA on March 24-26, 2014. The Notice of Violation from U.S. EPA was for eight allegedly incomplete hazardous waste manifests (a shipping document for hazardous waste) and for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The hazardous waste report

was revised to include the waste in question (Ohio EPA issued a Notice of Violation for this same issue). DOE and FBP disagreed with U.S. EPA that FBP was responsible for filling in the incomplete portions of the manifests cited in the violation. The incomplete portion of the manifests (a code that designates the type of treatment/disposal) is completed by the facility that treats or disposes of the waste, and then the completed manifest is returned to FBP. At the time of the inspection, the completed manifests had not yet been returned to FBP. The manifests were completed and returned to FBP after the inspection. No further actions were required.

Three unplanned releases from DOE activities at PORTS occurred in 2014. Each of the releases was contained on site and did not impact the public. Additional information about the releases is provided below:

- Piping insulation containing approximately 6 lbs of friable asbestos was discovered outside the X-333 Process Building on April 1, 2014. This release required reporting to the National Response Center and Ohio EPA because the reportable quantity for friable asbestos is 1 lb. The released material was recovered and the affected area was cleaned.

- An oil sheen on Little Beaver Creek was discovered on October 16, 2014, and reported to the National Response Center and Ohio EPA in accordance with the Clean Water Act. After investigation, it was determined that a small amount of oil from an air compressor at the X-330 Process Building had entered the storm sewer and subsequently discharged to the X-230J7 Holding Pond and then to Little Beaver Creek. A maximum of 0.5 gallon of oil was estimated to have been released to Little Beaver Creek. The oil sheen on the creek was contained by the use of absorbents and removed from the creek on the day of discovery. The air compressor was shut down until repairs were completed.

- Groundwater contaminated with trichloroethene (TCE), a hazardous waste, was released on-site at PORTS on November 9, 2014, when a pipe containing the groundwater was struck during excavation activities. The release required notification to the National Response Center and Ohio EPA. Contaminated soil was excavated and managed as containing hazardous waste. The affected portion of the piping was isolated to prevent any further release and repaired.

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.

The primary components of the D&D DFF&O are a remedial investigation/feasibility study (RI/FS) and record of decision for 1) process buildings and complex facilities, which also includes most other structures/facilities at PORTS, and 2) site-wide waste disposition. Major planning documents that direct the D&D process are the RI/FS work plan, RI/FS report, proposed plan, and record of decision.

The RI/FS work plan details the tasks to be completed to characterize site conditions, determine the nature of wastes to be generated, assess the potential risk to human health and the environment, and evaluate potential remedial alternatives. The RI/FS report provides the results of the RI/FS work plan. The proposed plan identifies proposed remedial actions for public comment, and the record of decision finalizes the remedial actions selected by DOE and Ohio EPA.

Revised RI/FS reports for the process buildings and waste disposition decisions were submitted to Ohio EPA in June and February of 2014, respectively. The Process Buildings RI/FS report evaluated the controlled removal of stored waste and materials, demolition of the buildings or structures, and characterization of materials for disposal or disposition (DOE 2014g). The waste disposition RI/FS report evaluated a combination of on-site and off-site disposal and complete off-site disposal for waste generated by D&D (DOE 2014h). Ohio EPA provided final concurrence on the reports in July and October 2014, respectively.

Proposed plans for the process buildings and waste disposition were submitted to Ohio EPA in July and June 2014, respectively. The proposed plans recommended controlled removal of the process buildings and other facilities and a combination of on-site and off-site waste disposal (DOE 2014e, DOE 2014f). Ohio EPA concurred with the proposed plans in October 2014. The notice of availability for public comment on the proposed plans was published on October 29, 2014. A public meeting was held on November 17, 2014, and the public comment period ran from November 12, 2014, through March 11, 2015.

Environmental Restoration Program

The Environmental Restoration Program was established by DOE in 1989 to identify, control, and remediate environmental contamination at PORTS. The 1989 Ohio Consent Decree and the 1989 U.S. EPA Administrative Order by Consent (as amended in 1994 and 1997) require investigation and cleanup of environmental media at PORTS in accordance with the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. The site was divided into quadrants to facilitate the investigation and cleanup. The initial assessment and investigation of PORTS under the RCRA corrective action process was completed in the 1990s. Corrective actions, also called remedial actions, are underway in each quadrant.

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.

DOE submitted the *Deferred Units RCRA Facility Investigation/Corrective Measures Study Work Plan for Solid Waste Management Units* to Ohio EPA in April 2014 (DOE 2014a). DOE and Ohio EPA met throughout the remainder of 2014 to further discuss Ohio EPA concerns and issues with the work plan.

The Environmental Restoration Program monitors and maintains five closed landfills at PORTS in accordance with Ohio EPA regulations. Samples are collected periodically (most often semiannually) from groundwater monitoring wells around the landfills. The samples are analyzed for chemicals and radionuclides that could be released from the materials that were disposed in the landfills.

Four groundwater treatment facilities are operated by the Environmental Restoration Program to treat contaminated groundwater from the on-site groundwater plumes that are contaminated with industrial solvents, including TCE. These facilities are part of the systems at PORTS that collect contaminated groundwater. The groundwater treatment facilities remove TCE from the water so it can be safely discharged to Little Beaver Creek or the Scioto River in accordance with NPDES permits issued by Ohio EPA.

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 2014, FBP shipped approximately 8900 tons of waste or other materials to off-site facilities for treatment, disposal, recycling, or reuse.

Waste management activities are conducted in compliance with applicable DOE Orders, Ohio EPA regulations, and U.S. EPA regulations. Waste management requirements are varied and often complex because of the variety of wastes generated by DOE activities at PORTS. The types of waste managed by DOE at PORTS include:

- *Low-level radioactive waste* (LLW) – radioactive waste not classified as high level or transuranic waste.

- *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.

- *PCB wastes* – waste containing PCBs, a class of synthetic organic chemicals. Disposal of PCB-contaminated materials is regulated under the Toxic Substances Control Act.

- *Solid wastes* – Waste that includes construction and demolition debris, industrial waste, and sanitary waste, as defined by Ohio regulations.

Many of the wastes generated by DOE activities at PORTS are a combination of the first three waste types listed above; for example, some wastes are both RCRA hazardous waste and LLW (called mixed waste).

In addition to complying with DOE Orders and Ohio EPA/U.S. EPA regulations, DOE has also implemented supplemental policies for management of DOE waste at PORTS including: minimizing waste generation; characterizing and certifying wastes before they are stored, processed, treated, or disposed; pursuing volume reduction (such as blending and bulking); 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 2014, SODI received approximately 1270 tons of materials from PORTS, primarily recyclable metals.

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@wems-llc.com. Additional information is provided by the DOE Site Office (740-897-5010) and the Office of Public Affairs (740-897-3933). This Annual Site Environmental Report and other information can also be obtained from the DOE web site for PORTS at www.energy.gov/pppo or the FBP web site at www.fbportsmouth.com.

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. Additional information about the board can be obtained at www.ports-ssab.energy.gov 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.

With the beginning of D&D at PORTS, DOE is working 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 (www.portsvirtualmuseum.org) is intended to preserve photos, video, oral histories, and other information associated with operation of PORTS.

ENVIRONMENTAL MONITORING

Extensive environmental monitoring is completed at PORTS to comply with environmental regulations, permit requirements, and DOE Orders, and to address public concerns about plant operations. The *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2013a) 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 2013b, DOE 2014d). This monitoring is discussed in Chapter 6, Groundwater Programs.

Environmental monitoring includes the collection of samples of air, water, soil, vegetation, and biota (animals and crops) on a regular basis that ranges from weekly (ambient air) to annually (sediment, soil, vegetation, and biota). In 2014, 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).

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 1000 samples from these programs are collected on an annual basis.

Data collected for these programs in 2014 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 next section, Radiological Dose, provides more information about the potential impacts to human health from radionuclides released by PORTS.

RADIOLOGICAL DOSE

Potential impacts on human health from radionuclides released by PORTS operations are calculated based on environmental monitoring data. This impact, commonly called 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. U.S. EPA sets a 10 millirem (mrem)/year limit for the dose from radionuclides released to the air in Title 40 of the Code of Federal Regulations, 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). DOE sets a 100 mrem/year limit for the dose from radionuclides from all potential pathways (air, water, and external radiation) 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). Figure 1 provides a comparison of the doses from various common radiation sources.

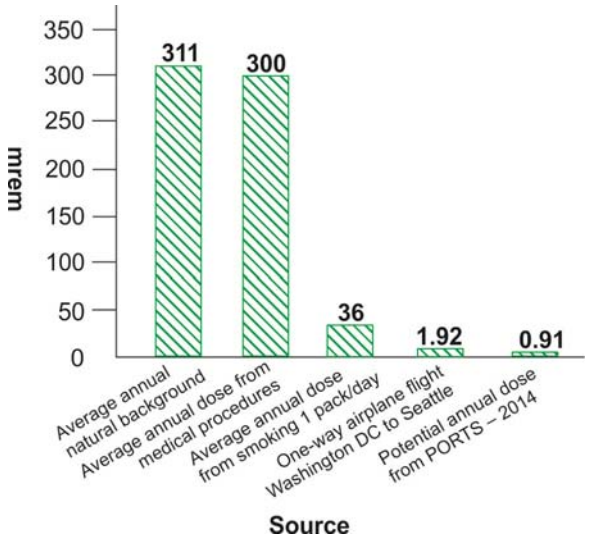

Figure 1. Comparison of dose from various common radiation sources (NCRP 2009).

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. The maximum dose that a member of the public could receive from radiation released by PORTS in 2014 is 0.91 mrem, based on a maximum dose of 0.017 mrem from radionuclides released to the Scioto River, 0.81 mrem from external radiation at station A29, and 0.077 mrem based on exposure to radionuclides detected at off-site monitoring locations in 2014. This summary of the dose calculations assumes that the same individual, or representative person, works at a private company located on the west side of the PORTS reservation and lives in the immediate vicinity of PORTS. The representative person is assumed to be exposed to the maximum dose

calculated from each pathway. This dose (0.91 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 (0.017 mrem) is also significantly less than the 10 mrem/year standard set by U.S. EPA in NESHAP (40 CFR Part 61 Subpart H).

GROUNDWATER PROGRAMS

Groundwater monitoring at PORTS is performed at RCRA hazardous waste units, solid waste disposal units, and RCRA Corrective Action Program units. The *Integrated Groundwater Monitoring Plan* (DOE 2013b, DOE 2014d) describes the groundwater monitoring program for PORTS, which has been reviewed and approved by Ohio EPA. In general, samples are collected from wells in the groundwater monitoring areas and from surface water locations that are part of the groundwater monitoring program. Samples are analyzed for metals, volatile organic compounds (VOCs), and/or radiological constituents. Constituents detected in the groundwater are then evaluated to assess the potential for each constituent to affect human health and the environment.

Some groundwater monitoring is conducted in order to meet DOE Order requirements. Exit pathway monitoring assesses the effect of PORTS on regional groundwater quality.

Five groundwater contamination plumes have been identified on site at PORTS in the following areas: X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility (Quadrant I), Quadrant I Groundwater Investigative (5-Unit) Area, Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Former Holding Pond (Quadrant II), and X-740 Former Waste Oil Handling Facility (Quadrant III). The primary groundwater contaminant is TCE. Other monitoring areas may have groundwater contaminated with metals or may be monitored to comply with regulatory requirements for closed landfills. Remediation of groundwater is being conducted primarily under Ohio EPA's RCRA Corrective Action Program.

The X-749/X-120 groundwater plume is near the southern boundary of PORTS. In 2014, 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 micrograms per liter (µg/L) or parts per billion. Data collected in 2014 indicate that the groundwater extraction wells installed in the X-749/X-120 groundwater plume in 2010 are succeeding in reducing TCE concentrations within the plume.

In general, concentrations of contaminants detected within the groundwater plumes at PORTS were stable or decreasing in 2014.

The *Integrated Groundwater Monitoring Plan* (DOE 2013b, DOE 2014d) also addresses monitoring of residential water supplies near PORTS 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.

QUALITY ASSURANCE AND QUALITY CONTROL

Data reliability is of the utmost importance for monitoring releases and measuring radiation in the environment. To demonstrate that the monitoring and measurement results are accurate, DOE contractors have implemented a quality assurance and quality control program based on guidelines from U.S. EPA, the American Society for Testing and Materials, and other federal and state agencies. DOE and DOE contractors administer numerous quality control activities to verify reliability of the data on a day-to-day basis. DOE and DOE contractors also participate actively in quality control programs administered by agencies outside the site such as U.S. EPA.

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)[1] is the DOE contractor responsible for D&D of PORTS, which includes the three gaseous diffusion process buildings and other associated facilities. BWXT Conversion Services, LLC (BWCS)[2] is responsible for operations associated with the Depleted Uranium Hexafluoride (DUF_6) Conversion Facility.

The United States Enrichment Corporation (USEC) operated the gaseous diffusion uranium enrichment facilities at PORTS until 2001. USEC, Inc. (the parent company of USEC) became Centrus Energy Corp. (Centrus) in 2014 after a financial restructuring. Centrus leases facilities at PORTS for the development and planned operation of its gaseous centrifuge uranium enrichment facility – the American Centrifuge Plant (ACP).

In general, activities conducted by Centrus are not covered by this document because their operations are not subject to DOE Orders. However, some Centrus environmental compliance information is provided in Chapter 2 and radiological and non-radiological environmental monitoring program information is discussed in Chapters 4 and 5, respectively. Centrus data are included in these chapters to provide a more complete picture of the programs in place at PORTS to detect and assess potential impacts to human health and the environment resulting from PORTS activities.

Figure 1.1 The Portsmouth Gaseous Diffusion Plant.

[1] Fluor-B&W Portsmouth LLC became Fluor-BWXT Portsmouth LLC in 2015. The new name is used in this document.
[2] B&W Conversion Services, LLC became BWXT Conversion Services, LLC in 2015. The new name is used in this document.

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 USEC, which was established by the Energy Policy Act of 1992.

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, Wastren-EnergX Mission Support, LLC (WEMS), and BWCS managed DOE programs at PORTS in 2014.

FBP was responsible for the following activities: 1) D&D of the former gaseous diffusion process building and associated facilities; 2) environmental restoration of contaminated areas; 3) monitoring and reporting on environmental compliance; 4) disposition of legacy radioactive waste; 5) uranium management; and 6) operation of the site's waste storage facilities.

WEMS provided facility support services including the following: 1) maintenance of facilities, grounds, and roadways; 2) janitorial services; 3) security access for DOE facilities; 4) training; 5) records and fleet management; and 6) information technology/network support for DOE operations.

BWCS was responsible for operations associated with 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.

Centrus is developing a gaseous centrifuge uranium enrichment plant at PORTS. The gaseous centrifuge uranium enrichment process requires much less electricity than the gaseous diffusion process. Gas centrifuge uranium enrichment uses a rotor that spins at a high speed within a casing to separate uranium-235 from uranium-238 (resulting in enriched uranium). Gaseous diffusion uranium enrichment uses a porous barrier to separate uranium-235 molecules from uranium-238 molecules.

The Centrus Lead Cascade, which is a small-scale demonstration centrifuge for uranium enrichment, has been operating since 2006 for demonstration and testing purposes. The commercial scale ACP is not operating and is under development. Both of these facilities (the Lead Cascade and the ACP) are housed in existing buildings at PORTS that were constructed for DOE's Gaseous Centrifuge Enrichment Plant, which was cancelled in 1985.

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 environmental restoration and waste management, are presented in other documents that have been prepared in accordance with applicable laws and regulations. These data are presented in other reports, such as the *2014 Groundwater Monitoring Report* (DOE 2015a), 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.

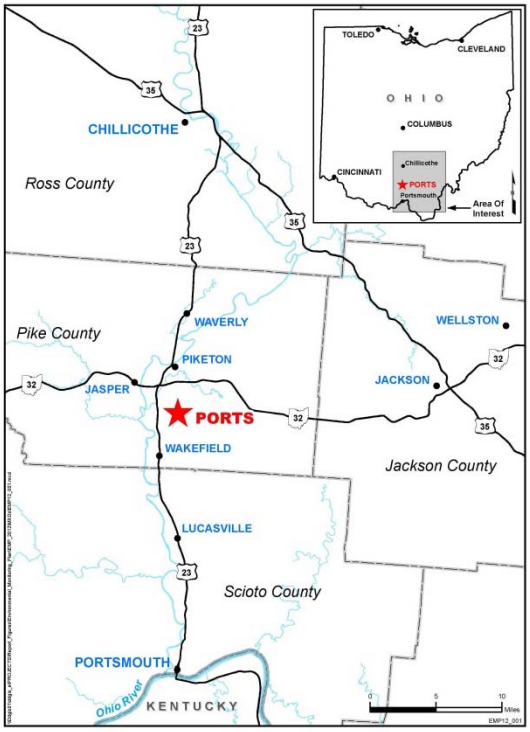

Figure 1.2. Location of PORTS.

Pike County has approximately 28,256 residents (U.S. Census Bureau 2016). 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 4,300 residents (U.S. Census Bureau 2016). The nearest residential center in this area is Piketon, which is about 5 miles north of the plant on U.S. Route 23 with a population of about 2,100 (U.S. Census Bureau 2016). Several residences are adjacent to the southern half of the eastern boundary and along Wakefield Mound Road (old U.S. 23), directly west of the plant.

Additional cities within 50 miles of the plant are Portsmouth (population 20,326), 22 miles south; Chillicothe (population 21,738), 27 miles north; and Jackson (population 6,284), 18 miles east (U.S. Census Bureau 2016). The total population within 50 miles of the plant is approximately 677,000 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 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 2014, DOE and/or the responsible DOE contractor (FBP or BWCS) 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. BWCS is responsible for activities associated with the DUF_6 Conversion Facility.

FBP and BWCS are responsible for preparing a number of reports for compliance with various applicable environmental regulations. These reports include 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, a quarterly radiological discharge monitoring report for NPDES outfalls, 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. DOE/FBP received four Notices of Violation from inspections or reports conducted in 2014 as described in the following paragraphs.

DOE/FBP received a Notice of Violation on June 5, 2014, from the Resource Conservation and Recovery Act (RCRA) inspection conducted by the Ohio Environmental Protection Agency (Ohio EPA) on May 21, 2014. The Notice of Violation was for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The hazardous waste report was revised to include the waste in question. Ohio EPA stated in a letter received on June 19, 2014, that the violation had been abated.

FBP received a Notice of Violation on June 13, 2014, from the exceedance of the NPDES Permit limitation for chlorine at Outfall 003 reported in the May 2014 Discharge Monitoring Report. FBP reported the violation to Ohio EPA as required by the NPDES permit. Ohio EPA acknowledged receipt of the violation notification and the actions taken to resolve the exceedance. No further activities were required by Ohio EPA.

DOE/FBP received a Notice of Violation concerning underground storage tank regulations on July 17, 2014, from the inspection conducted by the U.S. Environmental Protection Agency (U.S. EPA) on March 24-26, 2014. The Notice of Violation was for failing to maintain records of the monitoring required to ensure that underground storage tanks were not leaking. Regulations require that underground storage tanks be monitored every 30 days for releases. Records of this monitoring between March 2013 and August 2013 were not available. Leak monitoring records after August 2013 were provided to the inspector. No further action was required.

DOE/FBP received a Notice of Violation concerning RCRA hazardous waste regulations on September 19, 2014, from the inspection conducted by U.S. EPA and Ohio EPA on March 24-26, 2014. The Notice of Violation from U.S. EPA was for eight allegedly incomplete hazardous waste manifests (a shipping document for hazardous waste) and for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The hazardous waste report was revised to include the waste in question (Ohio EPA issued a Notice of Violation for this same issue). DOE and FBP disagreed with U.S. EPA that FBP was responsible for filling in the incomplete portions of

the manifests cited in the violation. The incomplete portion of the manifests (a code that designates the type of treatment/disposal) is completed by the facility that treats or disposes of the waste, and then the completed manifest is returned to FBP. At the time of the inspection, the completed manifests had not yet been returned to FBP. The manifests were completed and returned to FBP after the inspection. No further actions were required.

Three unplanned releases from DOE activities at PORTS occurred in 2014. Each of the releases was contained on site and did not impact the public. Additional information about the releases is provided below:

- Piping insulation containing approximately 6 pounds (lbs) of friable asbestos was discovered outside the X-333 Process Building on April 1, 2014. This release required reporting to the National Response Center and Ohio EPA because the reportable quantity for friable asbestos is 1 lb. The released material was recovered and the affected area was cleaned.

- An oil sheen on Little Beaver Creek was discovered on October 16, 2014, and reported to the National Response Center and Ohio EPA in accordance with the Clean Water Act. After investigation, it was determined that a small amount of oil from an air compressor at the X-330 Process Building had entered the storm sewer and subsequently discharged to the X-230J7 Holding Pond and then to Little Beaver Creek. A maximum of 0.5 gallon of oil was estimated to have been released to Little Beaver Creek. The oil sheen on the creek was contained by the use of absorbents and removed from the creek on the day of discovery. The air compressor was shut down until repairs were completed.

- Groundwater contaminated with trichloroethene (TCE), a hazardous waste, was released on-site at PORTS on November 9, 2014, when a pipe containing the groundwater was struck during excavation activities. The release required notification to the National Response Center and Ohio EPA. Contaminated soil was excavated and managed as containing hazardous waste. The affected portion of the piping was isolated to prevent any further release and repaired.

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. BWCS is responsible for activities associated with the DUF_6 Conversion Facility.

Centrus is responsible for compliance activities directly associated with the ACP and Lead Cascade including air emission permits associated with the gaseous centrifuge uranium enrichment operations (the proposed ACP and the Lead Cascade), NPDES outfalls, and management of wastes generated by their current operations.

DOE and/or DOE contractors (FBP or BWCS) held two NPDES permits for discharge of water to surface streams, numerous air emission permits, and a 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 BWCS) at the end of 2014.

Several federal, state, and local agencies are responsible for enforcing environmental regulations at PORTS. Primary regulatory agencies include U.S. EPA and Ohio 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 U.S. EPA and Ohio 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 requiring priority cleanup. However, D&D of PORTS is proceeding in accordance with the D&D DFF&O and CERCLA. The D&D DFF&O describes the 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, is conducted in accordance with the U.S. EPA Administrative Order by Consent, issued on September 29, 1989 (amended in 1994 and 1997), and Consent Decree with the State of Ohio, issued on August 29, 1989. U.S. EPA and Ohio EPA oversee 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 2014, FBP had one reportable quantity release of hazardous substances subject to Section 103 notification requirements. On April 1, 2014, loose and fallen piping insulation was discovered on the west side of the X-333 Process Building. The piping insulation contained friable asbestos. A release of more than 1 lb of friable asbestos to the environment requires notification to the National Response Center. Based on analysis of the piping insulation, approximately 6 lbs of friable asbestos was released. The National Response Center and Ohio EPA were notified of the release. The piping insulation was recovered and the affected area was cleaned. No additional actions were necessary.

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 2014, FBP and BWCS 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. The PORTS site, which included DOE contractors or lessees (FBP, WEMS, BWCS, and the Ohio Army National Guard) and Centrus reported the following chemicals for 2014: 1,2-propanediol, aluminum oxide, aluminum oxide hydrate, argon, asbestos, calcium chloride, calcium hydroxide, carbon dioxide, chlorine, citric acid, dichlorotetrafluoroethane (CFC-114), diesel fuel #2 (ultralow sulfur), ethylene glycol, fluorotrichloromethane (CFC-11), full range straight run middle distillate, gasoline, hydrogen fluoride, kerosene, lime calcium oxide, limestone, lubricating oils, methanol, mineral oils, nitric acid, nitrogen, PCBs, perfluoro-1,3-dimethylcyclohexane, petroleum distillates, potassium hydroxide, sodium chloride, sodium hydroxide, sodium fluoride, sodium polyacrylate, sulfuric acid, sulfur dioxide, tripotassium phosphate, triuranium octaoxide, uranium dioxide, uranium hexafluoride, uranium metal, uranium tetrafluoride, and uranium trioxide.

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 2014, DOE contractors reported the permitted release and/or off-site treatment of three chemicals:

- chlorine: used for water treatment;
- hydrogen fluoride: approximately 70 lbs released to the air from the DUF_6 Conversion Facility; and
- nitrate compounds: approximately 32,700 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. In 2014, DOE and FBP held a permit to store hazardous waste within seven designated areas of the X-326 building (38,105 square feet or 0.9 acre). 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.

In accordance with the terms and conditions of the RCRA Part B Permit, DOE and FBP are required to report to Ohio EPA any self-identified activities that are not in compliance with the Part B permit. In August 2014, FBP notified Ohio EPA of a permit non-compliance. FBP is required contractually to dispose of some wastes generated by USEC during its previous operation of the gaseous diffusion plant. FBP determined that some waste containers identified by USEC as low-level radioactive waste (LLW) should also be identified as RCRA hazardous waste. These wastes were not stored in a permitted hazardous waste storage area. FBP immediately took action to secure these containers and transfer the containers to a permitted storage area. FBP also reviewed waste characterization data for remaining

wastes generated by USEC to ensure compliance with hazardous waste regulations. No threats to human health or the environment were identified as a result of this non-compliance.

On November 9, 2014, DOE and FBP implemented the RCRA Contingency Plan (an emergency response plan required by the hazardous waste storage permit) in response to a release of groundwater contaminated with TCE. The release occurred when excavation to install an anchor for a newly installed utility pole struck a force main that transfers TCE-contaminated groundwater to the X-622 Groundwater Treatment Facility. The affected portion of the groundwater transfer system was immediately isolated to prevent any additional release. Approximately 375 gallons of groundwater containing an estimated 0.00313 lb of TCE was released. The contaminated groundwater was retained within the release area, pumped to a portable tank, and transferred to the X-622 Groundwater Treatment Facility. Contaminated soil was excavated and managed as containing hazardous waste. Ohio EPA and the National Response Center were notified of the release. No hazards to human health were identified. The release was contained on site and no significant impacts to the environment were identified.

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 2013 to Ohio EPA in February 2014. 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. Ohio EPA and U.S. EPA issued Notices of Violation to FBP/DOE in 2014 for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The report was revised in June 2014 to include the additional waste. 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 2014.

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 2013b, DOE 2014d). 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 2015a). Chapter 6 discusses these monitoring results for 2014.

BWCS is regulated as a small quantity hazardous waste generator. Small quantity hazardous waste generators are subject to fewer requirements for generation and accumulation of hazardous waste due to the smaller quantity of hazardous waste handled. 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 2013b, DOE 2014d). Chapter 6 discusses the groundwater monitoring results for these units in 2014.

2.3.1.4 Federal Facility Compliance Act

Waste that is a mixture of RCRA hazardous waste and 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 2014 was submitted to Ohio EPA in December 2014.

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. Five PCB transformers were in service at PORTS in 2014: one in the X-530 Switchyard and four pole-mounted transformers within the 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 2014. The *2014 PCB Document Log for the Portsmouth Gaseous Diffusion Plant* was prepared in June 2015. Approximately 10 tons of PCB waste (over 9100 kilograms [kg] gross weight) was generated in 2014. Two tons of PCB waste (gross weight) was shipped for disposal in 2014. Waste contaminated with PCBs was generated during 2014 through activities in the X-330 and X-333 Process Buildings and other areas.

A TSCA Federal Facilities Compliance Agreement between DOE and U.S. EPA became effective in 1992 to resolve several PCB compliance issues. These issues included the use of PCBs in systems that are not totally enclosed, storage of wastes containing both PCBs and radionuclides in accordance with nuclear criticality safety requirements, and storage of wastes containing both PCBs and radionuclides for longer than one year. The agreement required installation of troughs under motor exhaust duct gaskets located in the former gaseous diffusion facilities to collect PCB oil leaks. When leaks or spills of PCBs occur, they are managed in accordance with the Federal Facilities Compliance Agreement.

Annual reports of progress made toward milestones specified in the Federal Facilities Compliance Agreement are submitted to U.S. EPA. DOE was in compliance with the requirements and milestones of this Federal Facilities Compliance Agreement during 2014.

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 2014.

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*

DOE Order 458.1 provides guidance and establishes radiation protection standards and control practices designed to protect the public and the environment from undue potential radiological risk from operations of DOE and DOE contractors. DOE Order 458.1 requires that off-site radiation doses do not exceed 100 millirem (mrem)/year above background for all exposure pathways. In addition, DOE Order 458.1 sets dose limits to protect biota (aquatic and/or terrestrial plants and animals) and limits for discharges of radioactive materials to natural waterways. 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 radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment. LLW is generated and stored in accordance with DOE Order 435.1 and its implementing procedures. Chapter 3, Section 3.4 provides additional information about the DOE Waste Management Program at PORTS.

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*, Part 70. Ohio EPA issued the final Title V Air Permit to FBP in April 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 2014, 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 2014.

BWCS is responsible for four permitted sources associated with the DUF_6 Conversion Facility. In 2014, the Annual Permit Evaluation Report for the BWCS 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 BWCS in 2014.

Appendix B lists the FBP and BWCS 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

As part of the Stratospheric Ozone Protection Plan, 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 is stored in pressurized tanks within the X-333 Process Building.

2.3.3.3 National Emission Standards for Hazardous Air Pollutants

Title 40 of the Code of Federal Regulations, 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) requires DOE to submit an annual report for radiological emissions from DOE air emission sources. DOE contractors FBP and BWCS are both responsible for radiological air emission sources. Chapter 4, Section 4.3.3, provides the radiological dose calculations from these emissions.

FBP sources. In 2014, FBP was responsible for numerous air emission sources including 1) continuously monitored vents in the X-326 and X-330 Process Buildings and the X-344A Uranium Hexafluoride Sampling Building; 2) room ventilation exhausts and/or pressure relief vents associated with the X-700 Chemical Cleaning Facility, X-710 Technical Services Building, X-705 Decontamination Facility, the X-326 L-Cage Glove Box, and the XT-847 Glove Box; and 3) the X-622, X-623, X-624, X-627 Groundwater Treatment Facilities.

Radiological emissions from the vents in the X-326 and X-330 Process Buildings and the X-344A Uranium Hexafluoride Sampling Building were measured by continuous monitoring. 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 conservatively estimated based on quarterly influent/effluent sampling and quarterly throughput. Total radiological airborne emissions from FBP sources in 2014 were 0.00987 curie (Ci) (9.87E-03 Ci).

BWCS sources. In 2014, BWCS 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 2014 were 0.0000405Ci (4.05E-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 BWCS held NPDES permits during 2014 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.

FBP submitted an NPDES permit renewal application to Ohio EPA in June 2012 to replace the FBP NPDES permit that was issued in 2011 and expired at the end of April 2013. FBP continued to monitor the FBP NPDES outfalls in accordance with the current permit throughout 2014 because Ohio EPA had not yet issued a new permit.

The BWCS NPDES permit allows the discharge of process wastewaters from the DUF_6 Conversion Facility. The NPDES permit in effect from January 1, 2014 through May 31, 2014 included one outfall (BWCS NPDES Outfall 001). No process wastewater was discharged through the BWCS Outfall 001; however, only precipitation runoff was discharged from the BWCS Outfall 001. Process wastewater from the DUF_6 Conversion Facility was discharged through the sanitary sewer system to the X-6619 Sewage Treatment Plant for treatment prior to discharge through FBP NPDES Outfall 003. The current BWCS NPDES permit, effective June 1, 2014, provides monitoring requirements for BWCS Outfall 001 that are only effective when process wastewater is being discharged through the outfall. The permit also includes a new outfall (BWCS Outfall 602), which monitors the discharge of BWCS process wastewater to the sanitary sewer system that flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003). Chapter 4, Section 4.3.5, and Chapter 5, Section 5.4.1.2, provide additional information on the BWCS 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). Four permit limitations associated with the FBP NPDES permit were exceeded during 2014 (see Chapter 5, Section 5.4.1.1). The overall FBP NPDES compliance rate for 2014 was 99%. BWCS had five exceedances of NPDES permit effluent limitations in 2014, all prior to implementation of the new BWCS permit in June 2014 (see Chapter 5, Section 5.4.1.2). The overall BWCS NPDES compliance rate for 2014 was 99%.

A quarterly discharge monitoring report that provides radiological monitoring data for the FBP NPDES outfalls is also submitted to Ohio EPA (see Chapter 4, Section 4.3.5). The BWCS 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. A Stormwater Pollution Prevention Plan is prepared for construction activities covered by the NPDES Construction Stormwater General Permit. The Stormwater Pollution Prevention Plan includes a detailed description of the construction activity and the controls to be used to minimize impacts to stormwater runoff.

The final end state and future use of the PORTS site has not yet been determined. 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 2014, 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.

2.3.5 Other Environmental Statutes

This section discusses the DOE compliance status with other U.S. EPA and Ohio EPA regulations, including underground storage tank regulations, the Endangered Species Act, and others.

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 (FBP is responsible for five tanks and Centrus is responsible for two tanks). 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 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 451.1, *National Environmental Policy Act Compliance Program*. Restoration actions, waste management, enrichment facilities maintenance, and other activities are evaluated to determine the appropriate level of evaluation and documentation. No environmental impact statements or environmental assessments were completed during 2014.

Routine operation and maintenance activities are also evaluated to assess potential environmental impacts. Most DOE activities at PORTS qualify for a categorical exclusion 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 Title 10 of the *Code of Federal Regulations* Part 1021, Appendix B to Subpart D. Categorical exclusions for PORTS are posted on the DOE Portsmouth/Paducah Project Office website (www.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*), which is proposed for federal listing as endangered, in the northeastern area of PORTS that is the planned location for the on-site disposal facility (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 proposed for federal listing as endangered.

2.3.5.4 National Historic Preservation Act

The National Historic Preservation Act of 1966 is the primary law governing the protection of cultural resources (archaeological and historical properties). Cultural resource reviews are conducted on a case-by-case basis, and consultations with the State Historic Preservation Office and other stakeholders are made as required by Sections 106 and 110 of the Act. The cultural resources of three broad 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 (the period of occupation by DOE – 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 is located in the northeast corner of PORTS in the support area for the planned on-site disposal facility. In 2014, 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 can be recovered from the area (approximately 1 acre) prior to construction activities for the on-site disposal facility.

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, were the only historic era sites determined to be eligible for inclusion on the National Register of Historic Places.

With the beginning of D&D at PORTS, DOE is working 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. Requirements of the National Historic Preservation Act are being included in the CERCLA process. The PORTS Virtual Museum (www.portsvirtualmuseum.org) is intended to preserve photos, video, oral histories, and other information associated with operation of PORTS. Additional assessment and/or mitigation activities may be performed, as necessary, in the future.

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; a questionnaire that provides information for PORTS is completed annually by DOE.

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, WEMS, and BWCS have developed the following EMS criteria, as applicable: site EMS policy statement, EMS implementation training, identification of significant environmental aspects of site operations, establishment of measurable environmental objectives and targets, EMS awareness training (initial and ongoing), and establishment of EMS procedures.

Independent surveillances of the FBP and WEMS EMS programs were completed in the spring of 2014. The review team identified four findings within the FBP EMS program that required corrective actions plans. The findings involved inclusion of site tenants in the EMS program, training (two findings), and the review process for the National Environmental Policy Act. No findings were identified for the WEMS EMS program.

FBP serves as the coordinating contractor for EMS implementation among the DOE site contractors (FBP, WEMS, and BWCS). FBP and WEMS prepare annual EMS reports to document progress, performance, and successes in implementing the EMS at PORTS. The highest priority aspects identified in the fiscal year 2014 FBP EMS report were waste management, discharges to surface water, and chemical use. The FBP EMS report stated that 50-79% of the established EMS objectives, targets, and programs were on schedule to be met. The highest priority aspects identified in the WEMS EMS report were air emissions, release of liquid effluents, and generation of solid waste. The WEMS report stated that 80% of the established EMS objectives and targets were on schedule to be met.

BWCS has declared readiness for its EMS program, which indicates the program is ready to be audited for conformance to applicable standards.

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

2.3.7 Executive Orders

An Executive Order is issued by a member of the executive branch of the government. Most 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 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*

Executive Order 13514 established management requirements for greenhouse gas emissions and expanded previous energy reduction and other environmental sustainability goals. Chapter 3, Section 3.5, provides a summary of the DOE Environmental Sustainability Program at PORTS and associated activities for 2014, which includes goals related to this executive order.

2.3.7.2 Executive Order 11988, *Floodplain Management,* and Executive Order 11990, *Protection of Wetlands*

Part 1022 of Title 10 of the Code of Federal Regulations 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. The1996 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 planned on-site disposal facility is located. DOE is developing mitigation strategies for wetlands and streams that will be impacted by the construction of the on-site disposal facility in accordance with CERCLA applicable or relevant and appropriate requirements.

2.3.7.3 Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*

Executive Order 13653 established a framework to improve the nation's preparedness and resilience for climate change. Existing activities included in 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.

2.4 OTHER MAJOR ENVIRONMENTAL ISSUES AND ACTIONS

This section summarizes environmental inspections of DOE activities at PORTS during 2014 and the results of these inspections.

2.4.1 Environmental Program Inspections

During 2014, 18 inspections of DOE activities at PORTS were conducted by federal, state, or local agencies. Table 2.1 lists these inspections.

2.4.2 Notices of Violation

DOE and/or FBP received the following Notices of Violation from inspections or reports completed in 2014.

DOE/FBP received a Notice of Violation on June 5, 2014 from the RCRA inspection conducted by Ohio EPA on May 21, 2014. The Notice of Violation was for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The hazardous waste report was revised to include the waste in question. Ohio EPA stated in a letter received on June 19, 2014 that the violation had been abated.

FBP received a Notice of Violation on June 13, 2014 from the exceedance of the NPDES Permit limitation for chlorine at Outfall 003 reported in the May 2014 Discharge Monitoring Report. FBP reported the violation to Ohio EPA as required by the NPDES permit. Ohio EPA acknowledged receipt of the violation notification and the actions taken to resolve the exceedance. No further activities were required by Ohio EPA.

DOE/FBP received a Notice of Violation concerning underground storage tank regulations on July 17, 2014, from the inspection conducted by U.S. EPA on March 24-26, 2014. The Notice of Violation was for failing to maintain records of the monitoring required to ensure that underground storage tanks were not leaking. Regulations require that underground storage tanks be monitored every 30 days for releases. Records of this monitoring between March 2013 and August 2013 were not available. Leak monitoring records after August 2013 were provided to the inspector. No further action was required.

DOE/FBP received a Notice of Violation concerning RCRA hazardous waste regulations on September 19, 2014, from the inspection conducted by U.S. EPA and Ohio EPA on March 24-26, 2014. The Notice of Violation from U.S. EPA was for eight allegedly incomplete hazardous waste manifests (a shipping document for hazardous waste) and for failing to include corrosive hazardous waste generated and neutralized in the X-710 Laboratory in the biennial hazardous waste report. The hazardous waste report was revised to include the waste in question (Ohio EPA issued a Notice of Violation for this same issue). DOE and FBP disagreed with U.S. EPA that FBP was responsible for filling in the incomplete portions of the manifests cited in the violation. The incomplete portion of the manifests (a code that designates the type of treatment/disposal) is completed by the facility that treats or disposes of the waste, and then the completed manifest is returned to FBP. At the time of the inspection, the completed manifests had not yet been returned to FBP. The manifests were completed and returned to FBP after the inspection. No further actions were required.

Table 2.1. Environmental inspections of DOE activities at PORTS for 2014

Date	DOE contractor	Agency	Type	Notices of Violation
March 24-26	FBP	U.S. EPA & Ohio EPA	Multi-media compliance	See Section 2.4.2
March 24-26	BWCS	U.S. EPA & Ohio EPA	Multi-media compliance	None
Spring 2014 (June 23 letter date)	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-230J5, X-230J6, X-230J7, X-230K, X-230L Holding Ponds)	None
May 21	FBP	Ohio EPA	RCRA Hazardous Waste Permit compliance	See Section 2.4.2
May 21	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-734 Landfills, X-231A/B Oil Degradation Plots, X-749A Landfill)	None
May 29 (letter date)	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-700 and X-705 Basement Sumps – information review)	None
June 10	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-720 Neutralization Pit, X-701A Limehouse, X-701C Neutralization Pit, X-616, X-705A/B Soils Area, 5-Unit Area extraction wells)	None
June 18	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-622, X-623, X-624, X-627 Groundwater Treatment Facilities, X-701B soil cover)	None
June 24	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749 Landfill, X-533 Switchyard – former control room pad and switchgear houses)	None
August 20	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-705A/B Soils Area, X-231A/B Oil Degradation Plots, X-749A Landfill)	None
August 20	FBP	Ohio EPA	RCRA Hazardous Waste Permit compliance	None
September 2	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (PK Landfill, X-735 Landfills)	None
September 16	FBP	Ohio EPA	Clean Air Act compliance	None
November 12	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-734 Landfills)	None
November 12	FBP	Ohio EPA	RCRA Hazardous Waste Permit compliance	None
November 25	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-611A Prairie)	None

Table 2.1. Environmental inspections of DOE activities at PORTS for 2014 (continued)

Date	DOE contractor	Agency	Type	Notices of Violation
December 3	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-735 Landfills)	None
December 9	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-231A/B Oil Degradation Plots)	None

2.5 UNPLANNED RELEASES

The following unplanned releases from DOE activities at PORTS occurred in 2014.

Piping insulation containing approximately 6 lbs of friable asbestos was discovered outside the X-333 Process Building on April 1, 2014. This release required reporting to the National Response Center and Ohio EPA because the reportable quantity for friable asbestos is 1 lb. Section 2.3.1.1 provides more information about this release.

An oil sheen on Little Beaver Creek was discovered on October 16, 2014 and reported to the National Response Center and Ohio EPA in accordance with the Clean Water Act. After investigation, it was determined that a small amount of oil from an air compressor at the X-330 Process Building had entered the storm sewer and subsequently discharged to the X-230J7 Holding Pond and then to Little Beaver Creek. A maximum of 0.5 gallon of oil was estimated to have been released to Little Beaver Creek. The oil sheen on the creek was contained by the use of absorbents and removed from the creek on the day of discovery. The area of the sheen was located on site and did not impact the public.

Groundwater contaminated with TCE (a RCRA hazardous waste) was released on-site at PORTS on November 9, 2014, when a pipe containing the groundwater was struck during excavation activities. The release activated the RCRA Contingency Plan and required notification of the National Response Center and Ohio EPA. The release was contained on site. Section 2.3.1.3 provides more information about this release.

2.6 SUMMARY OF PERMITS

Appendix B lists the permits held by DOE and/or DOE contractors in 2014.

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3. ENVIRONMENTAL PROGRAM INFORMATION

3.1 SUMMARY

Revised Remedial Investigation/Feasibility Study (RI/FS) reports for the process buildings and waste disposition decisions were submitted to Ohio EPA in June and February of 2014, respectively. The Process Buildings RI/FS report evaluated the controlled removal of stored waste and materials, demolition of the buildings or structures, and characterization of materials for disposal or disposition (DOE 2014g). The waste disposition RI/FS report evaluated a combination of on-site and off-site disposal and complete off-site disposal for waste generated by D&D (DOE 2014h). Ohio EPA provided final concurrence on the reports in July and October 2014, respectively.

Proposed plans for the process buildings and waste disposition were submitted to Ohio EPA in July and June 2014, respectively. The proposed plans recommended controlled removal of the process buildings and other facilities and a combination of on-site and off-site waste disposal (DOE 2014e, DOE 2014f). Ohio EPA concurred with the proposed plans in October 2014. The notice of availability for public comment on the proposed plans was published on October 29, 2014. A public meeting was held on November 17, 2014, and the public comment period ran from November 12, 2014 through March 11, 2015.

DOE submitted the *Deferred Units RCRA Facility Investigation/Corrective Measures Study Work Plan for Solid Waste Management Units* to Ohio EPA in April 2014 (DOE 2014a). 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. DOE and Ohio EPA met throughout the remainder of 2014 to further discuss Ohio EPA concerns and issues with the work plan.

In 2014, FBP shipped approximately 8900 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 and to allow these structures to be addressed under one of two processes (see Sections 3.2.1 and 3.2.3 below) with the agreement of DOE and Ohio EPA. 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, 3.2.2, and 3.2.3. The PORTS Community Relations Plan (DOE 2010a, DOE 2012a) 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.

The primary components of the D&D DFF&O are: 1) an RI/FS and record of decision for process buildings and complex facilities; 2) an RI/FS and record of decision for evaluation and selection of alternatives for site-wide waste disposition; and 3) engineering evaluations/cost analyses and action memoranda for less complex facilities (non-time critical removal actions). The following sections discuss each component of the D&D DFF&O and the activities completed during 2014 for each component of the D&D DFF&O.

3.2.1 Process Buildings and Complex Facilities

D&D of seven of the most complex facilities at PORTS, including the three gaseous diffusion process buildings, is following the RI/FS process. In addition, over 250 other facilities or structures (including but not limited to groundwater treatment facilities, warehouses, concrete pads, trailers, storage yards, etc.) are included in the RI/FS process.

The D&D process began with a pre-investigation evaluation report, which includes site history, a summary of existing data, and identification of problems to be addressed in the RI/FS work plan. The pre-investigation evaluation report was completed in 2011 (DOE 2011c). Ohio EPA comments on the report were addressed in the RI/FS work plan.

The process buildings RI/FS work plan detailed the tasks to be completed to characterize site conditions, determine the nature of wastes to be generated, assess the potential risk to human health and the environment, and evaluate potential remedial alternatives. Specific activities included identifying contaminants within the buildings (PCBs, radionuclides, and other chemicals), determining the quantity of wastes to be generated by D&D of the buildings, and identifying alternatives for handling and disposing of wastes (reusing various materials, landfill disposal, etc.). Ohio EPA concurred with the RI/FS work plan in 2011 (DOE 2011d).

The process buildings RI/FS report provides the results of the RI/FS work plan. The initial RI/FS report was submitted to Ohio EPA in January 2013. The RI/FS report evaluated two alternatives on how to conduct D&D of the process building and other facilities. Alternative 1 was no action, which provided a basis for comparison, but the risk to human health and the environment made Alternative 1 unacceptable. DOE's preferred alternative — Alternative 2 — included the controlled removal of stored waste, materials, hazards, process gas equipment, and process piping. It also included:

- 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.

DOE and Ohio EPA worked throughout 2013 and the beginning of 2014 to address comments and finalize the report. A revised RI/FS report was submitted to Ohio EPA in June 2014. Ohio EPA concurred with the RI/FS report (DOE 2014g) in July 2014.

A proposed plan that identifies the proposed remedial action is then prepared and made available for public comment. DOE submitted the process buildings proposed plan to Ohio EPA in July 2014, which presented Alternative 2 as the preferred alternative for D&D of the process buildings and other facilities.

Based on Ohio EPA comments, a revised plan was submitted to Ohio EPA in October 2014, and Ohio EPA concurred with the revised proposed plan in October 2014 (DOE 2014e).

The notice of availability for public comment on the proposed plan was published on October 29, 2014. A public meeting was held on November 17, 2014, and the public comment period ran from November 12, 2014 through March 11, 2015.

The record of decision finalizes the remedial action selected by DOE in the proposed plan with concurrence from Ohio EPA. Implementation of the remedial action begins after the record of decision. Ohio EPA concurred with the process buildings record of decision in 2015 (DOE 2015b).

3.2.2 Site-wide Waste Disposition

This portion of D&D evaluates off-site and on-site waste disposal alternatives for waste generated by D&D. The on-site disposal alternative to be evaluated involves construction of an on-site waste disposal facility. The waste disposition project follows a similar process as described for D&D of the process buildings and complex facilities, including the pre-investigation evaluation report (DOE 2010b) and RI/FS work plan (DOE 2012c).

The initial waste disposition RI/FS report was submitted to Ohio EPA in February 2013. The RI/FS report evaluated the required no-action alternative (Alternative 1) and two action alternatives (Alternatives 2 and 3). Alternative 2 considers a combination of on-site and off-site disposal. Alternative 3 considers complete off-site disposal. DOE and Ohio EPA worked throughout 2013 and the beginning of 2014 to address comments and finalize the report. A revised RI/FS report was submitted to Ohio EPA in February 2014. Ohio EPA provided conditional concurrence with the RI/FS report and the preliminary waste acceptance criteria for the proposed on-site waste disposal facility in April 2014 and final concurrence in October 2014 (DOE 2014h).

DOE submitted the proposed plan for waste disposition to Ohio EPA in June 2014, which recommended Alternative 2, a combination of on-site and off-site disposal. Based on Ohio EPA comments, a revised plan was submitted to Ohio EPA in October 2014, and Ohio EPA concurred with the revised proposed plan in October 2014 (DOE 2014f). The notice of availability for public comment on the proposed plan was published on October 29, 2014. A public meeting was held on November 17, 2014, and the public comment period ran from November 12, 2014, through March 11, 2015.

The record of decision finalizes the remedial action selected by DOE in the proposed plan with concurrence from Ohio EPA. Implementation of the remedial action begins after the record of decision. Ohio EPA concurred with the waste disposition record of decision in 2015 (DOE 2015c).

3.2.3 Non-time Critical Removal Actions

Selected smaller and less complex buildings at PORTS have undergone D&D using the process for non-time critical removal actions. In general, this process includes a removal site evaluation, sampling and analysis plan, engineering evaluation/cost analysis, and removal action completion report. Ohio EPA reviews and concurs with each of these documents, and the public is given an opportunity to comment on the engineering evaluation/cost analysis, prior to D&D.

The following activities took place in 2014 for facilities that were demolished in 2013:

- Ohio EPA provided concurrence on the removal action completion report for the X-744S Warehouse and X-624-1 Decontamination Pad in January 2014 (DOE 2013d).

- A removal action completion report for the X-600 Steam Plant Complex was submitted to Ohio EPA in May 2014. Ohio EPA provided concurrence on the report in May 2014 (DOE 2014j).

- A removal action completion report for the X-102 Cafeteria and X-106 Tactical Response Building was submitted to Ohio EPA in January 2014. Ohio EPA provided concurrence on the report in April 2014 (DOE 2014i).

3.3 ENVIRONMENTAL RESTORATION PROGRAM

DOE established the Environmental Restoration Program in 1989 to identify, control, and remediate environmental contamination at PORTS. Environmental restoration is conducted in accordance with the RCRA corrective action process, under U.S. EPA Administrative Order by Consent, issued on September 29, 1989 (amended in 1994 and 1997), and Consent Decree with the State of Ohio, issued on August 29, 1989. 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 U.S. EPA Administrative Order by Consent and 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 contaminants 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 [RFI]), and

3) a study to identify and evaluate remedial alternatives to address contamination (the cleanup alternatives study/corrective measures study [CMS]).

Following the approval of the final cleanup alternative study/corrective measure study, Ohio EPA selects the remedial alternatives that will undergo further review to determine the final remedial actions (the preferred plan). Upon concurrence from U.S. EPA and completion of the public review and comment period, U.S. EPA and Ohio EPA select 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” 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 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 RFI/CMS Work Plan for Solid Waste Management Units*, revised to respond to Ohio EPA comments received in August 2013, was submitted to Ohio EPA in April 2014 (DOE 2014a). DOE and Ohio EPA met in July, August, and October of 2014 to further discuss Ohio EPA concerns and issues with the work plan. DOE submitted a revised work plan in 2015, which was approved by Ohio EPA.

As part of the investigation of the deferred units, and to support the overall D&D of PORTS, DOE is developing a soil background study. This background study will be used to determine the concentrations of metals, radionuclides, and other constituents in soil to 1) assess the extent of possible soil contamination that can be attributed to PORTS operations, 2) support development of risk-based soil preliminary remediation goals, and 3) support real property transfer under CERCLA. The *Preliminary Soil Background Study Sampling and Analysis Report* was submitted to Ohio EPA in November 2012 (DOE 2012b). DOE and Ohio EPA conducted additional discussions throughout 2014 concerning the specific methods to be used to establish the soil background levels. The final report was submitted to Ohio EPA in 2015.

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

3.3.1 Quadrant I

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

Remedial actions required for the X-749B Peter Kiewit Landfill (PK Landfill) were provided in separate Decision Documents issued by Ohio EPA in 1996 (Ohio EPA 1996a) and U.S. EPA in 1997 (U.S. EPA 1997). The following sections discuss the remedial actions required for the X-749/X-120 groundwater plume, PK Landfill, and the Quadrant I Groundwater Investigative (5-Unit) Area. Chapter 6 provides 2014 groundwater monitoring results for the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, (Section 6.4.1.3 and Figure 6.2), PK Landfill (Section 6.4.2.1 and Figure 6.2) and Quadrant I Groundwater Investigative (5-Unit) Area (Section 6.4.3.1 and Figure 6.3).

3.3.1.1 X-749/X-120 groundwater plume

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

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

Table 3.1. Remedial actions at PORTS in groundwater monitoring areas

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

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

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

The *First Five-Year Review for the X-749/X-120 Groundwater Plume*, submitted to Ohio EPA in January 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 next review of the remedial actions implemented for the X-749/X-120 groundwater plume will be submitted to Ohio EPA in 2016.

Based on the results of the *First Five-Year Review for the X-749/X-120 Groundwater Plume*, DOE initiated an 18-month evaluation period (through September 2012) to determine whether additional groundwater extraction wells are necessary for remediation of the X-749/X-120 plume. A report on the results of the 18-month evaluation entitled *Technical Memorandum for the X-749/X-120 Groundwater Optimization Project* was approved by Ohio EPA in 2013 (DOE 2013g). The report evaluated installation of one or more groundwater extraction wells and up to five new groundwater monitoring wells. The report also evaluated continued operation of the existing groundwater extraction wells. DOE and Ohio EPA will discuss the path forward for the X-749/X-120 groundwater plume prior to any changes in the current remedy.

During development of the *Deferred Units RCRA RFI/CMS Work Plan for Solid Waste Management Units*, a previously unknown potential source area to the X-749/X-120 groundwater plume was identified north of the X-749 Landfill. DOE and Ohio EPA have agreed to include investigation of this area in the *Deferred Units RCRA RFI/CMS Work Plan for Solid Waste Management Units* (DOE 2014a).

Chapter 6, Section 6.4.1.3 and Figure 6.2, provide additional information about the 2014 groundwater monitoring results for the X-749/X-120 groundwater plume.

3.3.1.2 PK Landfill

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

The second five-year review for the PK Landfill found that the remedial actions implemented at the PK Landfill (the groundwater collection systems and landfill cap) were achieving remedial action objectives by eliminating exposure pathways and reducing the potential for contaminant transport (DOE 2008d). Concentrations of many of the contaminants detected in the PK Landfill wells, sumps, and manholes had decreased significantly from 1999 to 2007. Contaminants detected in the PK Landfill wells, sumps, and manholes were not detected in surface water samples collected from Big Run Creek adjacent to or downstream from PK Landfill. Based on these data, construction of a barrier wall on the upgradient sides of the PK Landfill did not appear to be necessary.

The third five-year review for the PK Landfill found that the corrective actions implemented at the PK Landfill (the groundwater collection systems, landfill cap, and institutional controls) were continuing to achieve corrective action objectives by eliminating exposure pathways and reducing the potential for contaminant transport (DOE 2013i). 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 2014 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.

A five-year review of both the groundwater extraction system for the Quadrant I Groundwater Investigative (5-Unit) Area and the multi-layered caps for the X-231A and X-231B Oil Biodegradation Plots was completed in 2008 (DOE 2008a). This report found that the remedial actions had eliminated potential exposure pathways to contaminants and reduced concentrations of TCE in the groundwater, although more slowly than expected.

The second five-year review of 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 submitted to Ohio EPA in 2013 (DOE 2013e). This report 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 2014.

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 2014 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 2014b). Overall, the results indicated that appropriate conditions can 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 further development of remedial alternatives for the Quadrant II Groundwater Investigative (7-Unit) Area will be incorporated into the *Deferred Units RCRA RFI/CMS Work Plan for Solid Waste Management Units* (DOE 2014a).

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 2014.

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 2014.

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. A background study was underway in 2014 to provide additional information about the concentrations of naturally-occurring metals in soil within the varying geologic formations at PORTS (see Section 3.3).

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 *2014 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides the data for this monitoring (DOE 2015a).

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. Collection of groundwater samples to monitor the pilot study is continuing through 2015. 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).

Chapter 6 provides 2014 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 2014 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 2013h) 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 2013f). 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. A background study was underway in 2014 to provide additional information about the concentrations of naturally-occurring metals in soil within the varying geologic formations at PORTS (see Section 3.3).

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 *2014 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides the data for this monitoring (DOE 2015a).

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 (Studsvik in 2014) 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 2014, SODI received approximately 1270 tons of materials from PORTS, primarily recyclable metals.

In 2014, FBP shipped approximately 8900 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 2014:

- aluminum cans: 2256 lbs
- batteries: 31,702 lbs
- electronic materials (computer equipment, etc.): 23,398 lbs
- light bulbs: 8826 lbs
- mercury-containing thermostats/thermometers: 37 lbs
- scrap metal (including SODI): 2,544,906 lbs
- paper/cardboard: 89,786 lbs
- plastic bottles: 6496 lbs
- toner cartridges: 476 lbs
- wooden pallets: 13,680 lbs
- used oil: 11,201 lbs.

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 2015 Site Sustainability Plan* describes the Environmental Sustainability Program and integrates the tenets of an EMS (see Chapter 2, Section 2.3.6) (DOE 2014c). 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 2014

Waste type	Waste stream	Quantity (lbs[a])	Treatment or disposal, facility
RCRA	Aerosol cans and other liquids or solids classified as hazardous waste	5764	Environmental Quality Co.
LLW	Uranium materials, scrap metal, sludge, and other debris.	437,511	EnergySolutions Clive, UT
LLW	Uranium materials, scrap metal, and other solids	12,978,715	Nevada National Security Site
LLW/BSFR	Assorted solids (wood, metal, plastic, etc.)	117,520	Studsvik, Inc.
RCRA/LLW	Lab wastes and other materials contaminated with radionuclides and classified as RCRA hazardous waste	8459	Diversified Scientific Solutions
RCRA/LLW	D&D waste, sludge, alumina, and other materials classified as hazardous waste	94,812	EnergySolutions Clive, UT
RCRA/LLW	Alumina trap waste, sludge, and other materials classified as hazardous waste	11,883	Materials & Energy Corp.
RCRA/LLW	Solids contaminated with RCRA metals	608	EnergySolutions Bear Creek, TN
LLW/PCB	Oil/water mixture from X-333 and X-330 Buildings	2360	Diversified Scientific Solutions
RCRA/LLW/ PCB	Solid lab wastes and other materials contaminated with metals, solvents, etc.	58	EnergySolutions Clive, UT
RCRA/LLW/ PCB	Lab wastes contaminated with metals, solvents, etc.	178	Materials & Energy Corp.
RCRA/LLW/ PCB	Corrosive liquids and liquids contaminated with RCRA metals	202	Diversified Scientific Solutions
Solid waste	D&D waste, concrete, asphalt, metal, and other materials	877,720	Rumpke/Pike Sanitation Landfill
Solid waste	Non-hazardous liquids (antifreeze)	80	Environmental Quality Co.
Solid waste	Non-hazardous liquids (non-recyclable oil)	478,200	Clean Harbors
-	Recyclable aluminum cans, batteries, electronic materials, plastic, batteries, metal, light bulbs, etc. (see Section 3.4)	196,078	Various (not including SODI)
-	Recyclable metals transferred to SODI (see Section 3.4)	2,536,686[b]	-

[a]Lbs in net weight (waste only).
[b]8220 lbs of recyclable metals were not managed by SODI and are included in the previous entry in this table.

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 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* and Executive Order 13423, *Strengthening Federal Environmental, Energy, and Transportation Management.* Executive Order 13514 introduced management requirements for greenhouse gas emissions and expanded previous energy reduction and other environmental sustainability goals.

In support of these Executive Orders, the *Fiscal Year 2015 Site Sustainability Plan for the Portsmouth Gaseous Diffusion Plant* provides goals and progress through fiscal year 2014 for reductions in greenhouse gas emissions, water consumption, recycling/waste diversion, electronic stewardship, and other areas (DOE 2014c). The following accomplishments were listed for fiscal year 2014:

- a decrease of 35.5% in greenhouse gas emissions (primarily associated for electricity consumption) versus the fiscal year 2008 baseline emissions.
- 11.8% of electricity consumption from renewable energy sources, which exceeds the goal of 7.5%.
- an increase in alternative fuel (E-85) consumption of 26% versus fiscal year 2013.
- a reduction of 5.2% in paper and printer usage versus fiscal year 2013.

PORTS also received a Silver Level GreenBuy Award from DOE for fiscal year 2014 for buying products that save energy, conserve water, and reduce health and environmental impacts.

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. Additional information about the PORTS Site Specific Advisory Board can be obtained at www.ports-ssab.energy.gov 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. The email address is portseic@wems-llc.com. 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). Other information, including this Annual Site Environmental Report, can also be obtained from the DOE Portsmouth/Paducah Project Office web site at www.energy.gov/pppo or the FBP web site at www.fbportsmouth.com.

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.

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 Office of Public Affairs (740-897-3933) also provides information on the program.

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 2014, environmental monitoring information was collected by DOE contractors (FBP and BWCS) and Centrus. This chapter includes information on air emissions and 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 100 mrem/year limit 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 2014 or detected by environmental monitoring programs in 2014 is 0.91 mrem/year. This summary of the dose calculations assumes that the same individual, or representative person, works at a private company located on the west side of the PORTS reservation 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 2014

Source of dose	Dose (mrem/year)
Airborne radionuclides (off-site individual)	0.017[a]
Radionuclides released to the Scioto River	0.0015
External radiation at station A29	0.81
Radionuclides detected by environmental monitoring programs	0.077
Total	0.91[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.

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 2013a). 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 2014, environmental monitoring data were collected by DOE contractors (FBP and BWCS) and Centrus. This chapter provides information on the Centrus NPDES monitoring program and air emissions of radionuclides from Centrus sources. 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
- vegetation
- 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 an annual dose limit of 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.

Small quantities of radionuclides were released to the environment from PORTS operations during 2014. 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 2014 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 2014, 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 2014 as part of the DOE environmental monitoring programs for sediment, soil, residential drinking water (well water – excluding naturally-occurring detections of uranium isotopes) and 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 2014, doses are estimated for exposure to radionuclides detected by the monitoring programs for sediment, soil, and vegetation. Radionuclides were not detected in 2014 in samples of residential drinking water, deer, 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 but may be included as a conservative measure in the calculations used to determine the potential dose received from PORTS operations. Technetium-99 and transuranic radionuclides (americium-241, 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. Absorbed dose is measured in units of rad or gray (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 2014, FBP was responsible for air emission sources associated with the former gaseous diffusion plant operations, including continuously monitored vents in the X-326 and X-330 Process Buildings, and the X-344A Uranium Hexafluoride Sampling Building. The vents in the X-326 were in use to support *in-situ* deposit removal and other activities necessary before equipment is removed as part of D&D. The X-344A vents were in use for ongoing sampling activities of uranium product. Vents in the X-330 and X-333 Process Buildings and X-343 Feed Vaporization and Sampling Building that were continuously monitored when the gaseous diffusion plant was operating were inactive during 2014.

Other radionuclide air emission sources included room ventilation exhausts and/or pressure relief vents associated with the X-700 Chemical Cleaning Facility (inactive), 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 DOE/FBP airborne sources in 2014 were calculated to be 0.00987 Ci (9.87E-03 Ci).

BWCS 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 DOE/BWCS airborne sources in 2014 were calculated to be 0.0000405 Ci (4.05E-05 Ci).

Total emissions from all DOE airborne sources in 2014 were calculated to be 0.00991 Ci (9.91E-03 Ci). Centrus reported total emissions of 0.0000127 Ci (1.27E-05 Ci) from airborne sources that are part of the Lead Cascade.

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 2014 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 677,000 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 DOE air emission sources at PORTS in 2014 was 0.017 mrem/year. The combined dose from Centrus (the Lead Cascade) and DOE sources is also 0.017 mrem/year. The dose from the Centrus sources is negligible compared to DOE sources. 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 2014, the population dose from PORTS emissions was 0.151 person-rem/year, (0.151 person-rem/year from DOE sources and 0.000068 person-rem/year from Centrus). 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 and Centrus 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 2014 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 0.0003 mrem/year at station A8, which is on-site near the northwestern PORTS property boundary (see Figure 4.1).

The highest net dose measured at the ambient air monitoring stations (0.0003 mrem/year at station A8) is 2% of the dose calculated from the combined DOE and Centrus point source emissions (0.017 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, BWCS, and Centrus were responsible for NPDES outfalls at PORTS during 2014. The BWCS 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 2014 are included in this section. Quarterly reports that provide radiological monitoring data for the NPDES outfalls are submitted to Ohio EPA by FBP and Centrus for their respective outfalls.

4.3.5.1 FBP outfalls

In 2014, 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 ditch that flows to Little Beaver Creek.

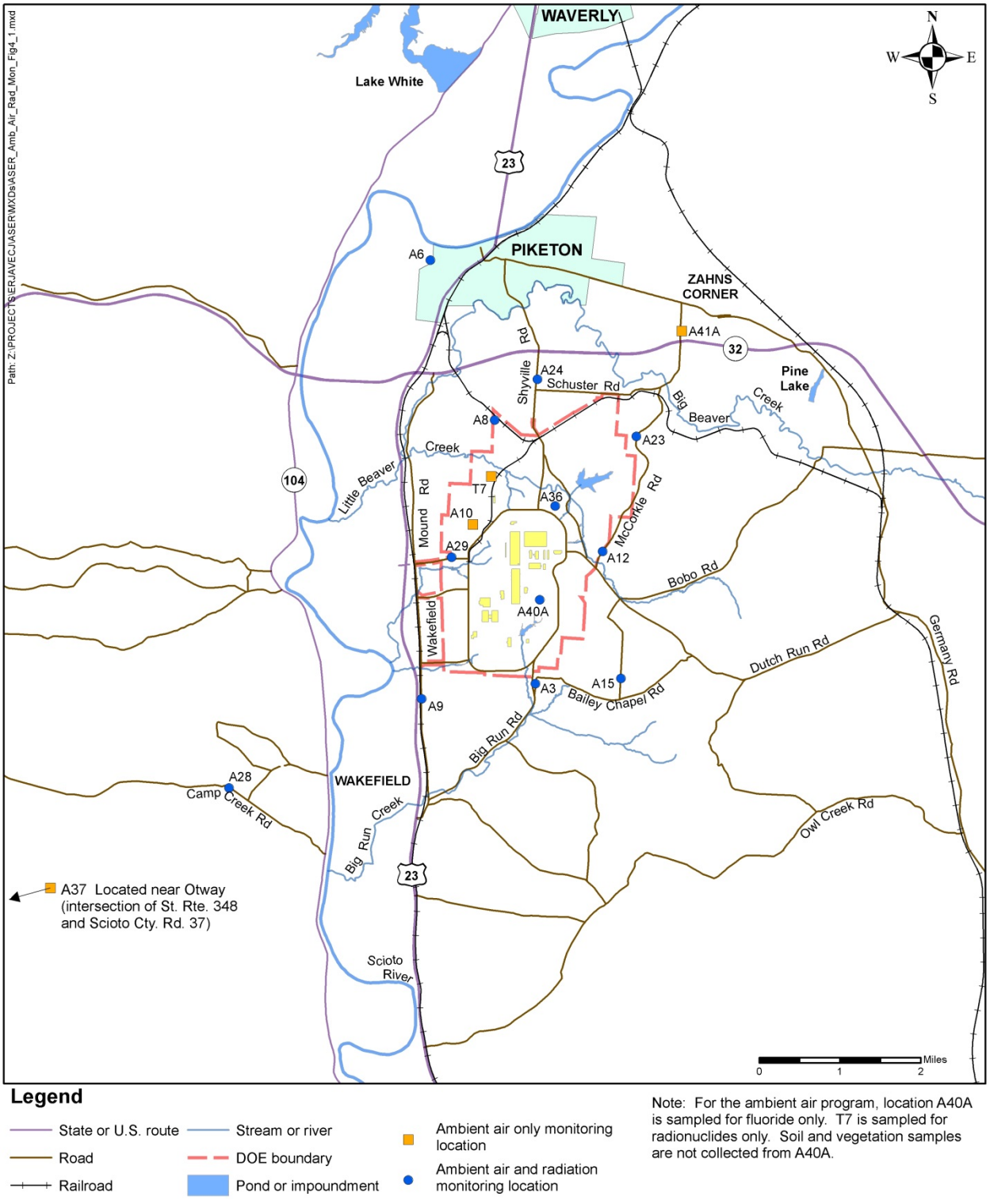


Figure 4.1. DOE ambient air and radiation monitoring locations.

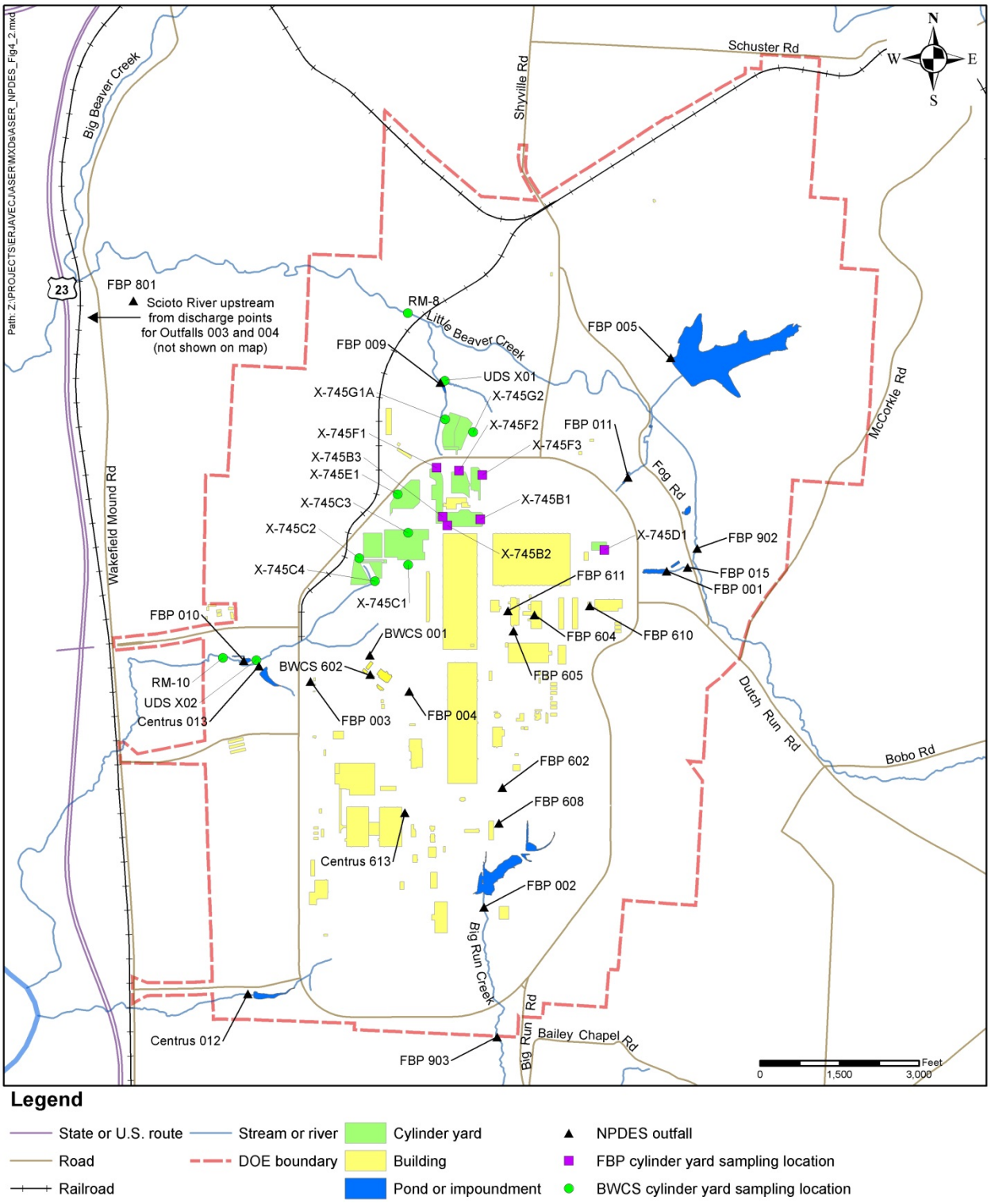


Figure 4.2. PORTS NPDES outfalls/monitoring points and cylinder storage yards sampling locations.

FBP NPDES Outfall 002 (X-230K South Holding Pond) – The X-230K South Holding Pond receives non-contact cooling water, 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 of Pike County sewage, and process wastewater from BWCS 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 chlorination 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 two 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 rainfall.

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 an unnamed stream 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 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 an unnamed stream 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 ditch 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 2014, uranium discharges from the FBP external outfalls (Outfalls 001, 002, 003, 004, 005, 009, 010, 011, and 015) were estimated at 14 kg. Total radioactivity (technetium-99 and isotopic uranium) released from the same outfalls was estimated at 0.070 Ci.

Discharges of radionuclides were calculated using monthly or weekly 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 2014.

4.3.5.2 Centrus outfalls

In 2014, 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 southern 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 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 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 2014. Plutonium-238 (0.018 pCi/L) and plutonium-239/240 (0.024 pCi/L) were detected in the first quarter sample collected at Outfall 012. The *First Quarter Calendar Year 2014 Radiological Discharge Monitoring Report for the American Centrifuge Program* that reports these data to Ohio EPA states that these results are believed to be false positives due to the very low detection limits associated with the samples. No other transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) were detected in any of the samples collected from Centrus NPDES outfalls in 2014.

Uranium discharges in 2014 from external Centrus NPDES outfalls (Outfalls 012 and 013) were estimated at 0.568 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. As a conservative measure, 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 2013c) were also used when available. Environmental pathways considered were ingestion of water, ingestion of fish, swimming, boating, and shoreline activities. This exposure scenario is very conservative 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 2014 (0.0015 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 2013a). 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 conservatively 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 2014, the average annual dose (8736 hours) recorded at the cylinder yards near Perimeter Road was 784 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 0.78 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 2013a). The total annual dose measured in 2014 at station A29, near the Ohio Valley Electric Corporation (OVEC), was 92 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 85 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 7 mrem/year difference between the average off-site background dose (85 mrem/year) and the dose at station A29 (92 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 0.81 mrem.

The average annual dose to a person in the United States from all radiation sources (natural and manmade) is approximately 620 mrem (NCRP 2009). The higher potential estimated dose from external radiation to a member of the public (0.81 mrem/year to a worker near station A29 versus 0.78 mrem/year to a delivery person on Perimeter Road) is approximately 0.1 percent of the average yearly 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 Information Reporting 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 2014 Radiation Exposure Information Reporting System report indicated that no visitors received a measurable dose (1 mrem or more).

More than 2400 DOE employees and DOE contractors were monitored throughout 2014. These workers received an average dose of 4.4 mrem. Less than 4% of the monitored workers, primarily workers handling DUF_6 cylinders, received a measurable dose (1 mrem total effective dose or more). No administrative guidelines or regulatory dose limits were exceeded in 2014.

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 of 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 2014, dose calculations were completed for public exposure to radionuclides detected in sediment, soil, and vegetation. Radionuclides were not detected in 2014 in samples of residential drinking water, deer, 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 1997) 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 2013c) were used when available. This document integrates the results of technical meetings between U.S. EPA, 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 2014 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 2014

Source of dose	Dose (mrem/year)[a]
Sediment	0.028
Soil	0.045
Vegetation	0.0044
Total	0.077

[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 2014 from monitoring location RM-5, an off-site sampling location on Big Beaver Creek (see Section 4.6.5 and Figure 4.4):

- neptunium-237: 0.0176 picocuries per gram (pCi/g)
- technetium-99: 4.5 pCi/g
- uranium-233/234: 3.26 pCi/g
- uranium-235/236: 0.163 pCi/g
- uranium-238: 1.29 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 2013c), and exposure factors in U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997), the dose that could be received by an individual from sediment contaminated at these levels is 0.028 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 A6 in Piketon (see Section 4.6.7 and Figure 4.1):

- uranium-233/234: 1.14 pCi/g
- uranium-235/236: 0.0613 pCi/g
- uranium-238: 1.19 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 2013c), and exposure factors in U.S. EPA's *Exposure Factors Handbook* (U.S. EPA 1997), the dose that could be received by an individual from soil contaminated at these levels is 0.045 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 A9 (south of PORTS on old U.S. Route 23 – see Section 4.6.8.1 and Figure 4.1):

<u>Vegetation</u>
- uranium-233/234: 0.0593 pCi/g
- uranium-238: 0.0636 pCi/g

<u>Soil (duplicate sample)</u>
- uranium-233/234: 0.787 pCi/g
- uranium-235/236: 0.0444 pCi/g
- uranium-238: 0.829 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 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 2013c) and U.S.

EPA's *Exposure Factors Handbook* (U.S. EPA 1997), the dose that could be received by an individual eating beef from cattle that grazed on vegetation and soil contaminated at these levels is 0.0044 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 2014 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 2014. 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 (duplicate sample)
Technetium-99	18.3 pCi/L	0.461 pCi/g
Uranium-233/234	5.63 pCi/L	1.27 pCi/g
Uranium-235/236	0.237 pCi/L	0.0605 pCi/g
Uranium-238	0.989 pCi/L	0.453 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 2014, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations EDD-SW01 (surface water) and RM-11 (sediment) was 0.0339, 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 2014 from the northern side of the PORTS reservation [surface water sampling location NHP-SW01 (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 2014. 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 or technetium-99 were detected in 2014 from samples collected NHP-SW01 (surface water) and A8 (soil – regular sample). The maximum levels of uranium isotopes were as follows:

Radionuclide	NHP-SW01	A8
Uranium-233/234	2.97 pCi/L	1.33 pCi/g
Uranium-235/236	0.225 pCi/L	0.0713 pCi/g
Uranium-238	1.92 pCi/L	1.31 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 2014, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations NHP-SW01 (surface water) and A8 (soil) was 0.00113, 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 2014.

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 and Centrus 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 2014, 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. Station A41A, which replaced Station A41 in Zahns Corner due to road construction, began operating in April 2014.

No transuranic radionuclides were detected at the ambient air monitoring stations in 2014. Technetium-99 was detected at each of the 15 ambient air stations. The maximum activity of technetium-99 in ambient air was 0.030 picocurie per cubic meter (pCi/m^3) at station A24 (north of the plant on Shyville Road), which is 0.003% of the DOE derived concentration standard of 920 pCi/m^3 (DOE 2011a).

Uranium-233/234 and uranium-238 were detected at each of the monitoring stations. The maximum activity of uranium-233/234 in ambient air (0.00026 pCi/m^3) was detected at station A36 (on site at the X-611 Water Treatment Plant). The maximum activity of uranium-238 in ambient air (0.00010 pCi/m^3) was detected at station A24 (north of the plant on Shyville Road). These activities are 0.02% and 0.008% respectively, of the DOE derived concentration standards for uranium-233/234 (1.1 pCi/m^3) and uranium-238 (1.3 pCi/m^3) (DOE 2011a).

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 off-site ambient air stations (0.0002 mrem/year) was at station A6, which is in Piketon. 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 784 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 (0.78 mrem/year) is significantly less than DOE's 100 mrem/year dose limit to the public for radionuclides from all potential pathways.

In 2014, the average annual dose measured at eight off-site or background locations (A3, A6, A9, A12, A15, A23, A24, and A28) was 85 mrem. Three locations within PORTS measured levels of radiation at least 50% higher than the average off-site radiation (85 mrem): location #874 (641 mrem) near the X-745C Cylinder Storage Yard; location #862 (129 mrem) south of the cylinder yards and west of the X-530A Switchyards; and location #933 (162 mrem) east of the X-744G building in the X-701B Holding Pond groundwater monitoring area. Five other on-site locations (A8, A29, A36, A40A, and X-230J2) measured radiation at levels slightly higher than the average background (ranging from 2 mrem to 11 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 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 (0.81 mrem/year) is significantly less than the DOE Order 458.1 100 mrem/year dose limit to the public for radionuclides from all potential pathways.

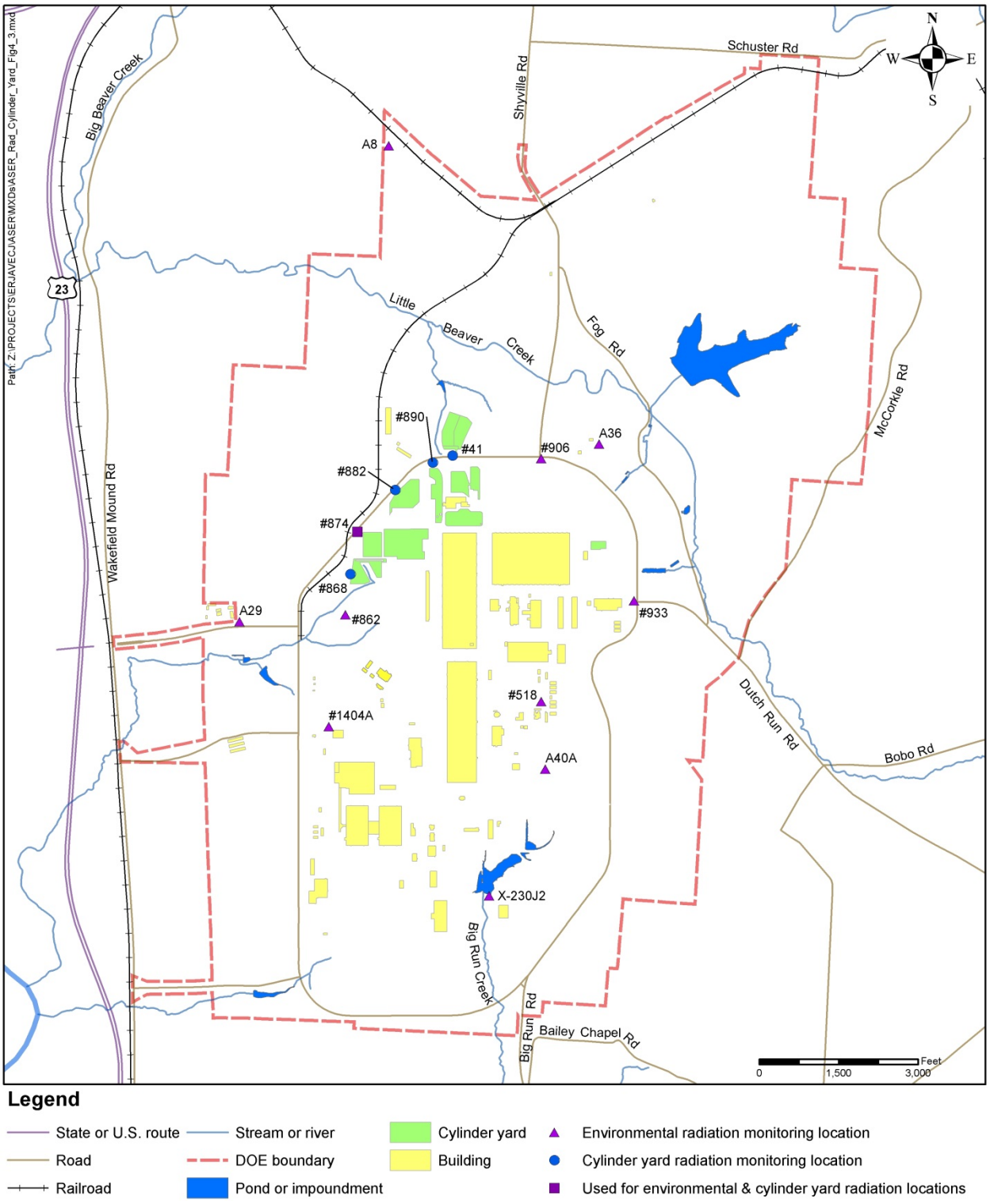


Figure 4.3. On-site radiation and cylinder yard dose monitoring locations.

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 2014.

4.6.3 Surface Water from Cylinder Storage Yards

In 2014, FBP collected surface water samples from the X-745B, X-745D, and X-745F Cylinder Storage Yards. BWCS 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 2014 by FBP and BWCS, respectively.

4.6.3.1 FBP cylinder storage yards

In 2014, 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 (711 pCi/L) and beta activity (794 pCi/L) were detected in the samples collected in January 2014 from X-745B Cylinder Storage Yard (location X-745B3). The maximum concentration of uranium (62.1 µg/L) was detected in the August 2014 sample collected from X-745B Cylinder Storage Yard (location X-745B2). 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 2014 (0.0015 mrem) is significantly less than the DOE Order 458.1 100 mrem/year limit for all radiological releases from a facility.

4.6.3.2 BWCS 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 (X-745C1, X-745C2, X-745C3, X-745C4, X-745E1, X-745G1A, and X-745G2). Figure 4.2 shows the sampling locations. Samples were analyzed for alpha activity, beta activity, and uranium.

Maximum levels of alpha activity (17 pCi/L), beta activity, (22 pCi/L), and uranium (38 µg/L) were detected in the sample collected from X-745C1 in October 2014. 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 2014 (0.0015 mrem) is significantly less than the DOE Order 458.1 100 mrem/year limit for all radiological releases from a facility.

4.6.4 Local Surface Water

In 2014, local surface water samples were 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 2013a).

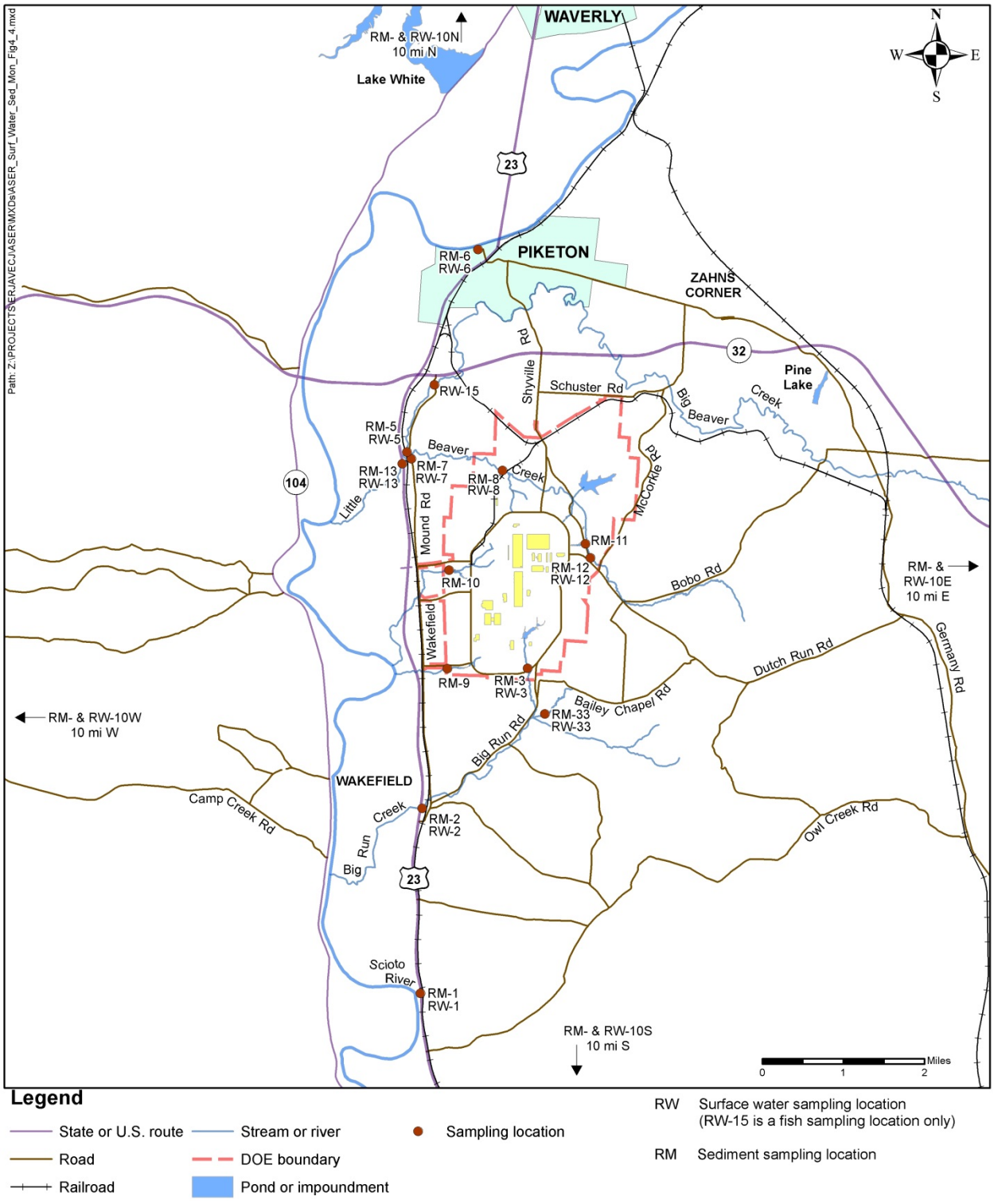


Figure 4.4. Local surface water and sediment monitoring locations.

No transuranic radionuclides were detected in the local surface water samples collected during 2014. Technetium-99 was detected at 8.55 pCi/L in the sample collected from Big Run Creek near the PORTS property boundary (RW-3), which is 0.02% of the DOE derived concentration standard of 44,000 pCi/L (DOE 2011a).

Maximum detections of uranium and uranium isotopes in local surface water samples were detected at the following locations. Uranium was detected at 2.24 µg/L at RW-6 (the upstream location on the Scioto River in Piketon) and RW-8 (a downstream location on Little Beaver Creek). Uranium-233/234 was detected at 2.62 pCi/L at RW-8, uranium-235/236 was detected at 0.164 pCi/L at RW-5 (Big Beaver Creek), and uranium-238 was detected at 0.742 pCi/L at RW-6. Detections of uranium isotopes in local surface water samples in 2014 were well below 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).

4.6.5 Sediment

Sediment samples are collected from the same locations upstream and downstream from PORTS where local surface water samples are collected and at the NPDES outfalls on the east and west sides of PORTS (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 2013a).

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 off-site sampling location RM-5 on Big Beaver Creek and on-site sampling location RM-9 (discharge from the X-2230M Southwest Holding Pond). Uranium was detected at 6.3 micrograms per gram (µg/g) (RM-9), uranium-233/234 was detected at 3.26 pCi/g (RM-5), uranium-235/236 was detected at 0.163 pCi/g (RM-5), and uranium-238 was detected at 2.1 pCi/g (RM-9). Uranium and uranium isotopes detected in the 2014 samples have been detected at similar levels in previous sampling events from 2002 through 2013.

Technetium-99 is often detected in sediment samples collected at locations downstream from PORTS. In 2014, technetium-99 was detected in the sample collected from sampling locations on Big Beaver Creek (RM-5 and RM-13), downstream locations on Big Run Creek (RM-2 and RM-3), the location downstream from NPDES outfalls 010 and 013 (RM-10), and downstream locations on Little Beaver Creek (RM-11, RM-7, and RM-8). The highest detection (4.5 pCi/g) was at location RM-5 (Big Beaver Creek). These detections of technetium-99 are consistent with data from previous sampling events (2002 through 2013).

Neptunium-237 was detected at 0.0176 pCi/g at Big Beaver Creek sampling location RM-5 and at 0.0864 pCi/g at Big Run Creek sampling location RM-2.

Section 4.3.9.1 provides a dose assessment to a member of the public based on detections of radionuclides at sampling location RM-5 on Big Beaver Creek. This off-site sampling location had the following levels of radionuclides detected in 2014 that would cause the highest dose to a member of the public: 0.0176 pCi/g of neptunium-237, 4.5 pCi/g of technetium-99, 3.26 pCi/g of uranium-233/234, 0.163 pCi/g of uranium-235/236, and 1.29 pCi/g of uranium-238. The total potential dose to a member of the public resulting from PORTS operations (0.91 mrem/year), which includes this dose calculation (0.028 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-emitting radionuclides.

When a low concentration of settleable solids is detected in a water sample, accurate measurement of the alpha and beta 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 activity). In 2014, 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 ranged from 4.4 to 12.5 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 2013a).

No transuranics or technetium-99 were detected in any of the soil samples collected during 2014. 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 (1.14 pCi/g), uranium-235/236 (0.0613 pCi/g), and uranium-238 (1.19 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 A6 in Piketon). The total potential dose to a member of the public resulting from PORTS operations (0.91 mrem/year), which includes this dose calculation (0.045 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 2013a) requires biological monitoring to assess the uptake of radionuclides into selected local biota (vegetation, deer, fish, crops, milk, and eggs).

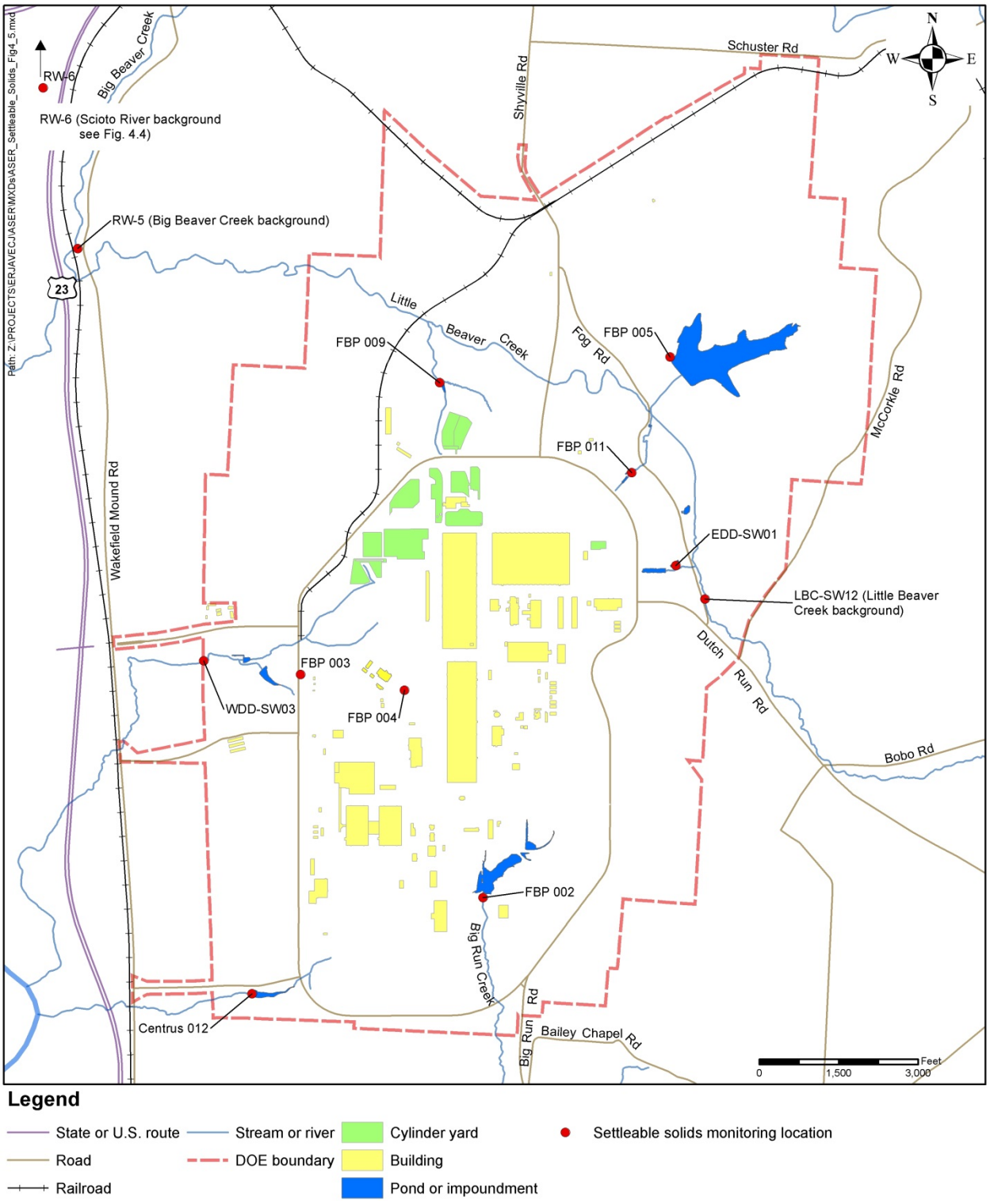


Figure 4.5. DOE settleable solids monitoring locations.

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) in accordance with the DOE *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2013a).

Uranium, uranium-233/234, and uranium-238 were detected in vegetation samples collected in 2014. 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. The total potential dose to a member of the public resulting from PORTS operations (0.91 mrem/year), which includes this dose calculation (0.0044 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 January, November, and December of 2014. No radionuclides were detected in any of the deer samples collected in 2014.

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-1 and RW-6) as shown on Figure 4.4. In 2014, fish were caught at Little Beaver Creek (RW-8) and the upstream location on the Scioto River (RW-6). 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 2014.

4.6.8.4 Crops

In 2014, crop samples, including peppers, 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 2014.

4.6.8.5 Milk and eggs

Samples were collected in 2014 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 2014.

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 2014. Sections 4.7.1 and 4.7.2 provide information about personal property released from FBP and BWCS, 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 2014, FBP authorized 1891 release requests for materials/items of personal property. Table 4.3 summarizes the items/materials released through these release requests.

Table 4.3 Summary of FBP personal property releases in 2014

Items/materials	Number of release requests	Items/materials	Number of release requests
Waste/recycling/reuse		*Equipment/other materials*	
Trash	96	Vehicles	223
Construction waste	38	Equipment	327
Light bulbs	47	Hand equipment	137
Aerosol cans	18	Samples	53
Fuel	3	Chemicals	3
Batteries	24	Personal protective equipment	273
Recyclables	34	Records	285
Oil	46	Electronics	59
Cylinders	42	Dosimeters	22
Water bottles	31		
Office furniture	29	Miscellaneous/uncategorized	100
Pipe	1		

4.7.2 BWCS releases

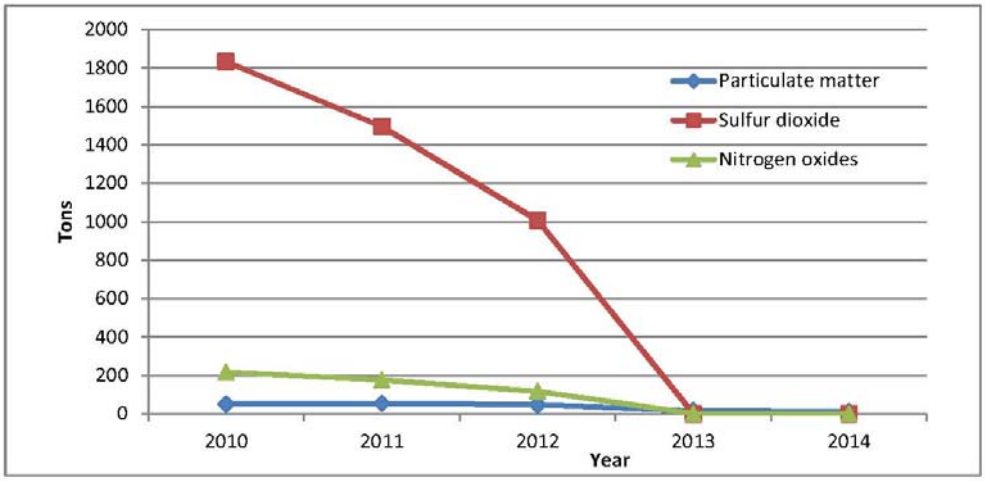
In 2014, BWCS continued off-site shipment of aqueous hydrogen fluoride produced by the DUF_6 Conversion Facility, which converts DUF_6 into uranium oxide and aqueous hydrogen fluoride. Each shipment must meet the release limit of less than 3 picocuries/milliliter (pCi/mL) of total uranium activity. Just over 1,469,500 gallons of aqueous hydrogen fluoride were shipped off site during 2014. The average total uranium activity of all the shipments was 0.008 pCi/mL.

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.

Discharges of non-radiological air pollutants from PORTS permitted emission sources have decreased over the last five years due to the demolition of the X-600 Steam Plant Complex in 2013. Figure 5.1 illustrates the decreases in some of the air pollutants (particulate matter, sulfur dioxide, and nitrogen oxides). Other non-radiological data collected in 2014 are similar to data collected in previous years.



Pollutant (tons)	2010	2011	2012	2013	2014
Particulate matter	51.2	54.6	47.5	15.75	12.2
Sulfur dioxide	1833	1495	1007	0.001	0
Nitrogen oxides	217	176	117	1.59	0.595

Figure 5.1. Emissions of selected non-radiological air pollutants 2010 – 2014.

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 2013a) 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, BWCS, 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 DOE 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 DOE to become a major source of air pollutants as defined in Title 40 of the *Code of Federal Regulations,* 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 2014: 12.18 tons of particulate matter, 2.96 tons of organic compounds, and 0.595 ton of nitrogen oxides. Emissions for 2014 are associated with the X-627 Groundwater Treatment Facility, X-333 Coolant System, X-326 Dry Air Plant Emergency Generator, 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. A report was not required in 2014. BWCS reported less than 10 tons/year of specified non-radiological air pollutants for 2013 (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). BWCS reported 70 lbs of hydrogen fluoride emitted to the air in the Toxic Chemical Release Inventory for 2014 (see Chapter 2, Section 2.3.1.2).

U.S. EPA also requires annual reporting of greenhouse gas emissions (carbon dioxide, methane, and nitrous oxide). In 2014, FBP reported emissions of 15,958 metric tons of carbon dioxide, 0.3 metric ton of methane, and 0.03 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 2014, no asbestos-containing materials 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 2014, samples for fluoride were collected weekly from 14 or 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. The ambient air station in Zahns Corner had not operated recently because it had to be relocated due to road construction. The replacement station (A41A) began operating in April 2014.

In 2014, fluoride was not detected in 95 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 0.017 microgram per cubic meter ($\mu g/m^3$). Average ambient concentrations of fluoride measured at the stations around PORTS ranged from 0.014 $\mu g/m^3$ at station A36 (on site at the X-611 Water Filtration Plant) to 0.021 $\mu g/m^3$ at off-site stations A3 and A12 (south and east of PORTS, respectively). 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, BWCS, 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 2014, DOE contractors (FBP and BWCS) were responsible for 20 NPDES discharge points (outfalls) or sampling points at PORTS. Centrus was responsible for three outfalls. This section describes non-radiological discharges from these outfalls during 2014.

5.4.1.1 FBP NPDES outfalls

In 2014, 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 are as follows:

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

- FBP NPDES Outfall 002 (X-230K South Holding Pond) – cadmium, fluoride, mercury, oil and grease, pH, 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, fecal coliform (May-October only), mercury, nitrite + nitrate, oil and grease, pH, silver, 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) – pH and suspended solids.

- FBP NPDES Outfall 009 (X-230L North Holding Pond) – cadmium, fluoride, oil and grease, pH, suspended solids, and zinc.

- FBP NPDES Outfall 010 (X-230J5 Northwest Holding Pond) – cadmium, mercury, oil and grease, pH, suspended solids, and zinc.

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

- FBP NPDES Outfall 015 (X-624 Groundwater Treatment Facility) – total PCBs, pH, 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, iron, 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 2014, discharge limitations at the FBP NPDES monitoring locations were exceeded on four occasions.

The maximum daily concentration limit for chlorine (0.05 mg/L) was exceeded once at Outfall 004 (Cooling Tower Blowdown) and twice at Outfall 003 (X-6619 Sewage Treatment Plant) in 2014. Chlorine was detected at 0.14 mg/L in a January 2014 sample collected from Outfall 004 and at 0.63 and 0.12 mg/L in samples collected at Outfall 003 during May and June 2014. The exceedances were caused by operational issues and were corrected on the day of the exceedance.

In June 2014, the maximum 24-hour temperature limit (29.4 °C) was exceeded at Outfall 902 (a monitoring location on Little Beaver Creek downstream from FBP Outfall 001) with a result of 30.3°C. The exceedance was due to the hot and dry weather conditions when the sample was collected (June 23-24, 2014).

In 2014, the overall FBP NPDES compliance rate with the NPDES permit was 99%.

5.4.1.2 BWCS NPDES outfalls

BWCS is responsible for the NPDES permit for the discharge of process wastewaters from the DUF_6 Conversion Facility. The NPDES permit in effect from January 1, 2014 through May 31, 2014 included one outfall (BWCS NPDES Outfall 001) that discharges to the West Ditch, which flows to the X-230J5 Northwest Holding Pond (FBP NPDES Outfall 010) and then to the Scioto River. However, only precipitation runoff has been discharged through BWCS NPDES Outfall 001; process wastewater from the DUF_6 Conversion Facility has been discharged to the sanitary sewer system that flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003) since 2008.

The current BWCS NPDES permit, effective June 1, 2014, provides monitoring requirements for BWCS Outfall 001 that are only effective when process wastewater is being discharged through the outfall. The current permit also includes a new outfall (BWCS Outfall 602), which monitors the discharge of BWCS process wastewater to the sanitary sewer. Chapter 4, Figure 4.2 shows the location of the BWCS NPDES outfalls.

From January 1, 2014 through May 31, 2014, water discharged from BWCS Outfall 001 (precipitation runoff) was monitored for total flow, temperature, biochemical oxygen demand, pH, suspended solids, oil and grease, ammonia-nitrogen, phosphorus, chlorine, and dissolved solids. Beginning on June 1, 2014, monitoring requirements for precipitation runoff at BWCS NPDES Outfall 001 ceased, and process wastewater discharged from BWCS Outfall 602 was monitored for pH and total flow.

The monitoring data collected in accordance with the BWCS permit are submitted to Ohio EPA in a monthly discharge monitoring report. BWCS had five exceedances of NPDES permit effluent limitations in 2014, all prior to implementation of the new BWCS permit in June 2014. The discharge limitation for total suspended solids (daily loading limit) was exceeded once in 2014, and discharge limitations for dissolved solids (daily concentration and daily loading) were exceeded four times during 2014. The exceedances were due to precipitation. The permit loading limits were based on an estimated process flow of water through the outfall. When precipitation increased the flow above the assumed amount, exceedances of the loading limits could sometimes occur. The overall BWCS NPDES compliance rate in 2014 was 99%.

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 USEC, Inc. outfall are as follows:

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

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

- 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 2014; therefore, the overall Centrus compliance rate with the NPDES permit was 100%.

5.4.2 Surface Water Monitoring Associated with BWCS Cylinder Storage Yards

Surface water samples (filtered and unfiltered) are collected quarterly from four locations in the drainage basins downstream from the BWCS 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 2014. Section 5.5.2 presents the results for sediment samples collected as part of this program.

5.5 SEDIMENT

In 2014, sediment monitoring at PORTS included local streams and the Scioto River upstream and downstream from PORTS and drainage basins downstream from the BWCS 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 and at the NPDES outfalls on the east and west sides of PORTS (see Chapter 4, Figure 4.4). In 2014, samples were analyzed for 20 metals and PCBs, in addition to the radiological parameters discussed in Chapter 4.

PCBs (PCB-1248 and PCB-1254) were detected in the sample collected from the Scioto River upstream from PORTS at Piketon (RM-6). PCBs (PCB-1260 and PCB-1254) were also detected in sediment samples collected downstream from PORTS. PCBs were detected in samples collected from Little Beaver Creek at the confluence from the X-230L North Holding Pond (RM-8), Little Beaver Creek at the discharge point from the X-230J7 Pond (RM-11), Big Beaver Creek (RM-5 and RM-13), Big Run Creek near the PORTS property boundary (RM-3), downstream Big Run Creek at Wakefield (RM-2), downstream from Centrus NPDES Outfall 012 (RM-9), and the West Drainage Ditch near FBP NPDES Outfall 010 and Centrus NPDES Outfall 013 (RM-10).

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 2015). The highest detection of PCBs (152 µg/kg) was in the West Drainage Ditch near FBP NPDES Outfall 010 and Centrus NPDES Outfall 013 (RM-10).

Investigation and remediation of PCBs in soil and sediment at PORTS will be addressed as part of the environmental remediation of PORTS.

The results of metals sampling conducted in 2014 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 BWCS Cylinder Storage Yards

Sediment samples are collected quarterly from four locations in the drainage basins downstream from the BWCS 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.

In 2014, PCBs were detected in at least one of the sediment samples collected at each location. The maximum concentration of PCBs (440 µg/kg) was detected at sampling location UDS X01. The concentrations of PCBs detected in 2014 are below the 1 ppm (1000 ppb) 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. One sample 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 2015).

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-1 and RW-6). In 2014, fish were collected from upstream and downstream locations on the Scioto River (RW-6 and RW-1) as well as the downstream sampling location on Little Beaver Creek (RW-8). 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. Fish samples collected from the upstream Scioto River sampling location (RW-6) consisted of freshwater drum. The fish sample collected from the downstream Scioto River sampling location (RW-1) was catfish. The sample collected from Little Beaver Creek (RW-8) was blue gill.

PCBs (PCB-1260) were detected in fish collected from the Scioto River at concentrations ranging from 24.4 to 47.6 µg/kg. PCBs were detected in the bluegill sample from Little Beaver Creek at 235 µg/kg. 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 2008). 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 samples collected from the Scioto River (24.4 to 47.6 µg/kg) are less than the unrestricted limit (50 µg/kg). The concentration of PCBs detected in the bluegill caught on site in Little Beaver Creek (RW-8) was 235 µg/kg, which is above the 1/week maximum limit (220 µg/kg) and below the 1/month maximum limit (1000 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.

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 U.S. EPA, and DOE Orders. More than 400 monitoring wells are used to track the flow of groundwater and to identify and measure groundwater contaminants. Groundwater programs also include on-site surface water monitoring and water supply monitoring.

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 2014.

The groundwater plume at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility is near the southern boundary of PORTS. In 2014, 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 2014 indicate that the groundwater extraction wells installed in the X-749/X-120 groundwater plume in 2010 are succeeding in reducing TCE concentrations within the plume.

The *2014 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 2015a). 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 2014. The following sections provide an overview of the PORTS groundwater monitoring program followed by a review of the history and 2014 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 2014 was completed in accordance with the *Integrated Groundwater Monitoring Plan* dated May 2013 (DOE 2013b). In June 2014, a revision to the *Integrated Groundwater Monitoring Plan* dated May 2014 was approved by Ohio EPA that incorporated the following minor revisions to the groundwater monitoring program (DOE 2014d):

- Separating the X-749/X-120/PK Landfill Area into two monitoring areas: 1) X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, and 2) PK Landfill;

- Separating the Quadrant I Groundwater Investigative (5-Unit) Area/X-749A Classified Materials Disposal Facility into two monitoring areas: 1) Quadrant I Groundwater Investigative (5-Unit) Area, and 2) X-749A Classified Materials Disposal Facility;

- Returning the X-740 Former Waste Oil Handling Facility to the routine IGWMP monitoring program (the area was monitored under a pilot study between 2009 and 2013); and

- Making minor changes to the monitoring programs for the Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Former Holding Pond, and X-616 Former Chromium Sludge Surface Impoundments.

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 2013b, DOE 2014d). These areas (see Figure 6.1) are:

- Quadrant I
  - X-749 Contaminated Materials Disposal Facility /X-120 Former Training Facility,
  - PK Landfill,
  - Quadrant I Groundwater Investigative (5-Unit) Area,
  - X-749A Classified Materials Disposal Facility,
- Quadrant II
  - Quadrant II Groundwater Investigative (7-Unit) Area,
  - X-701B Former Holding Pond,
  - X-633 Former Recirculating Cooling Water Complex,
- Quadrant III
  - X-616 Former Chromium Sludge Surface Impoundments,
  - X-740 Former Waste Oil Handling Facility,
- 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 2013b, DOE 2014d).

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 risk-based screening levels often used in human health risk assessment at sites where remediation may be required due to contaminants present in the environment at concentrations that could be harmful to human health. Contaminants with maximum concentrations that are less than the corresponding preliminary remediation goal can often be excluded from further risk assessment.

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 2014.

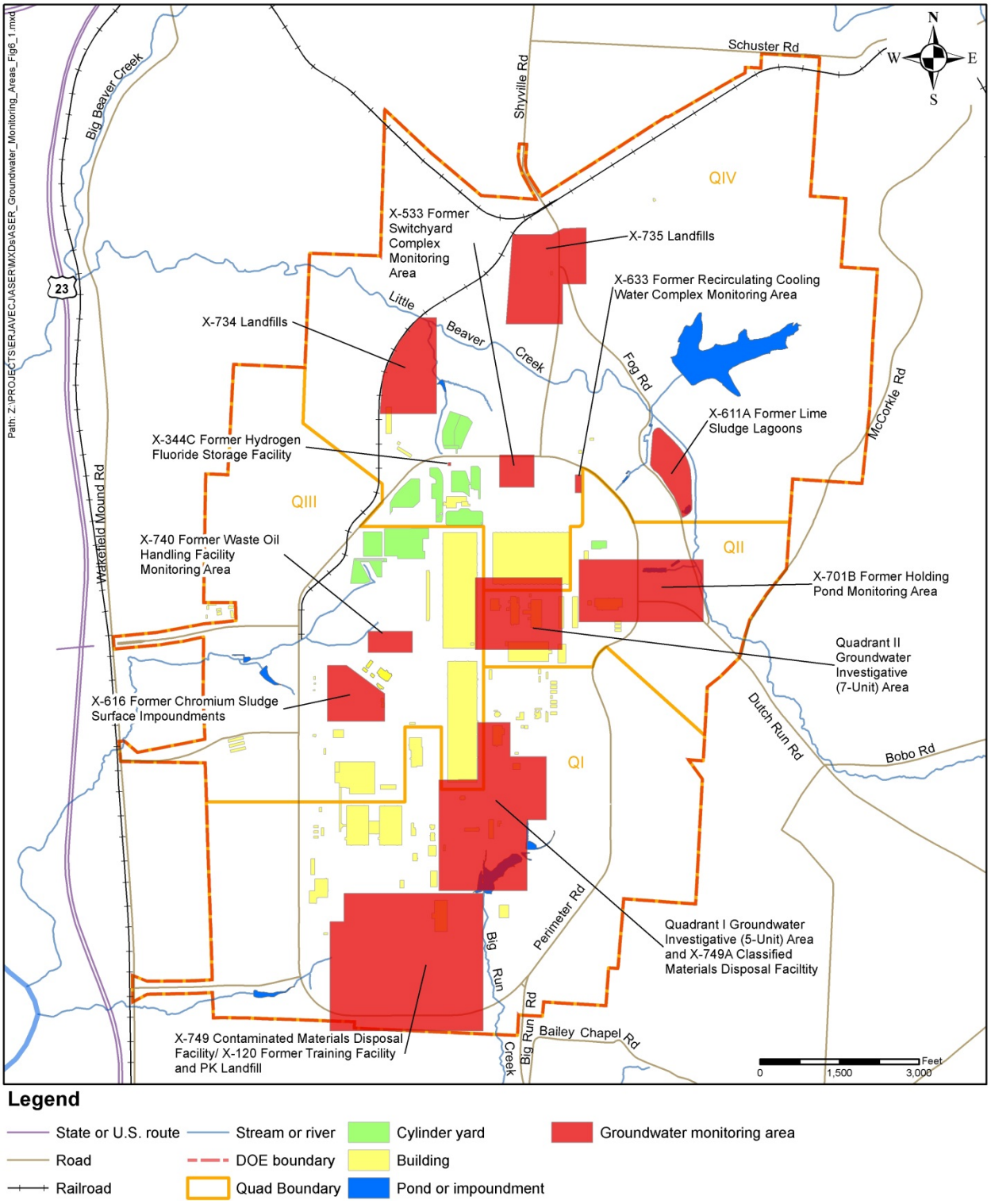


Figure 6.1. Groundwater monitoring areas at PORTS.

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2014

Monitoring Area or Program	Analytes	
X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility[a,b]	VOCs[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d] total metals[d]: Be, Cd, Cr, Mn, Ni
PK Landfill[b]	VOCs[c]	total metals[d]: Be, Cd, Cr, Mn, Ni
Quadrant I Groundwater Investigative (5-Unit) Area[a,b]	VOCs[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d] total metals[d]: Be, Cd, Cr, Mn, Ni
X-749A Classified Materials Disposal Facility	VOC[e] technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[c] alkalinity chloride sulfate chemical oxygen demand total dissolved solids	total metals[d]: 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[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d] total metals[d]: Be, Cd, Cr, Mn, Ni
X-701B Former Holding Pond[a,b]	VOCs[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d]	alkalinity chloride sulfate total dissolved solids total metals[d]: Be, Cd, Cr, Mn, Ni
X-633 Former Recirculating Cooling Water Complex	total metals[d]: Cr	
X-616 Former Chromium Sludge Surface Impoundments	VOCs[c]	total metals[d]: Be, Cd, Cr, Mn, Ni
X-740 Former Waste Oil Handling Facility[a,b]	VOCs[c] EAB/GC[f]	
X-611A Former Lime Sludge Lagoons	total metals[d]: Be, Cr	
X-735 Landfills	VOC[e] technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d] alkalinity chloride sulfate chemical oxygen demand total dissolved solids	total metals[d]: 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 – 2014 (continued)

Monitoring Area or Program	Analytes	
X-734 Landfills	VOCs[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d] alkalinity chloride	total metals[d]: Be, Cd, Cr, Mn, Ni, Na ammonia chemical oxygen demand nitrate/nitrite sulfate total dissolved solids
X-533 Former Switchyard Complex	total metals[d]: Cd, Ni	
X-344C Former Hydrogen Fluoride Storage Building	VOCs[c]	
Surface Water	VOCs[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d]
Water Supply	VOCs[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d] alpha activity
Exit Pathway	VOCs[c] transuranics[d]: ^{241}Am, ^{237}Np, ^{238}Pu, $^{239/240}$Pu	technetium-99 U, $^{233/234}$U, $^{235/236}$U, ^{238}U[d]

[a]Selected well(s) in this area are sampled once every two years for a comprehensive list of more than 200 potential contaminants (Title 40, Code of Federal Regulations, 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.
[c]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).
[d]Appendix C lists the symbols for metals and transuranic radionuclides.
[e]VOCs listed in footnote c plus: acrylonitrile, bromochloromethane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, trans-1,4-dichloro-2-butene, 1,2-dichloropropane, cis-1,3-dichloropropene, trans-1,3-dichloropropene, 2-hexanone (methyl butyl ketone), dibromomethane, iodomethane, styrene, 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane, and vinyl acetate.
[f]Enhanced anaerobic bioremediation (EAB) parameters and gene copies of EAB bacteria: Chloride, nitrate, sulfate, nitrate/nitrite as nitrogen, chemical oxygen demand, ethane, ethylene, methane, alkalinity, dehalococcoides spp, functional gene RDase BAV1, functional gene RDase VS, and reductase-encoding tceA gene.

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

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

6.4.1.1 X-749 Contaminated Materials Disposal Facility

The X-749 Contaminated Materials Disposal Facility is a landfill located in the south-central section of the facility in Quadrant I. The landfill covers approximately 11.5 acres and was built in an area of highest elevation within the southern half of PORTS. The landfill operated from 1955 to 1990, during which time buried wastes were generally contained in metal drums or other containers compatible with the waste.

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

The initial closure of the X-749 Landfill in 1992 included installation of 1) a multimedia cap; 2) a barrier wall along the north side and northwest corner of X-749 Landfill; and 3) subsurface groundwater drains on the northern half of the east side and the southwest corner of the landfill, including one sump within each of the groundwater drains. The barrier wall and subsurface drains extended down to bedrock. An additional barrier wall on the south and east sides of the X-749 Landfill was constructed in 2002. The groundwater drain and sump on the east side of the landfill were removed for construction of this barrier wall. Groundwater from the remaining subsurface drain is treated at the X-622 Groundwater Treatment Facility and discharged through FBP NPDES Outfall 608, which flows to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

In 2002 and 2003, hybrid poplar trees were planted in several areas of the X-749/X-120 groundwater plume. The trees are used in a process called phytoremediation to degrade or contain contaminants in soil and/or groundwater. Chapter 3, Section 3.3.1.1, provides additional information about the remedial actions implemented to address the X-749/X-120 groundwater plume.

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).

Eighty-four wells and one sump/extraction well were sampled during 2014 to monitor the X-749/X-120 area. Table 6.1 lists the analytical parameters for the wells and sump in this area.

6.4.1.2 X-120 Former Training Facility

The X-120 Former Training Facility (originally called the Goodyear Training Facility and also called the X-120 Old Training Facility), which is west and north of the X-749 Contaminated Materials Disposal Facility, covered an area of approximately 11.5 acres west of the present-day XT-847 building. The X-120 Former Training Facility included a machine shop, metal shop, paint shop, and several warehouses used during the construction of PORTS in the 1950s.

Groundwater in the vicinity of this facility is contaminated with VOCs, primarily TCE. In 1996, a horizontal well was installed along the approximate axis of the X-120 plume. Contaminated groundwater flowed from this well to the X-625 Groundwater Treatment Facility. In 2003, operation of the X-625 Groundwater Treatment Facility and horizontal well ceased with the approval of Ohio EPA due to the limited amount of groundwater collected by the well. A groundwater extraction well was installed in 2010 in the area west of the X-120 Former Training Facility to remediate the higher concentrations of TCE in groundwater in this area. Chapter 3, Section 3.3.1.1, provides additional information about the remedial actions implemented to address the X-749/X-120 groundwater plume.

Eighty-four wells and one sump/extraction well were sampled during 2014 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 2014

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 are 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 became smaller in 2014 compared to 2013 based on the increase in TCE detected in well X749-29G. The concentration of TCE detected in well X749-29G in the last four years has fluctuated above and below 5 µg/L (see Figure 6.2). Concentrations of TCE remained less than 5 µg/L in 2014 in the other three wells that define the area (X120-05G, X749-PZ07G, and X749-36G).

The area of the plume with higher TCE concentrations (100 µg/L to 1000 µg/L) to the south and west of the X-749 Landfill remained separated from the higher TCE concentrations within or just outside of the X-749 Landfill. In other words, wells with TCE concentrations higher than 5 µg/L (the definition of the plume perimeter) but less than 100 µg/L are between the landfill and the higher TCE concentrations west and south of the landfill. These results indicate that the extraction wells in the groundwater collection system at the southwest side of the X-749 Landfill are functioning as intended to prevent migration of TCE from the X-749 Landfill.

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. Concentrations of TCE remained stable or continued to decrease within the eastern portion of the plume (wells X749-PZ10G, X749-20G, and X749-35G). TCE increased to 6 µg/L in well X749-21G, which is at the boundary of the plume. Concentrations of TCE detected in this well fluctuate above and below 5 µg/L (see Figure 6.2).

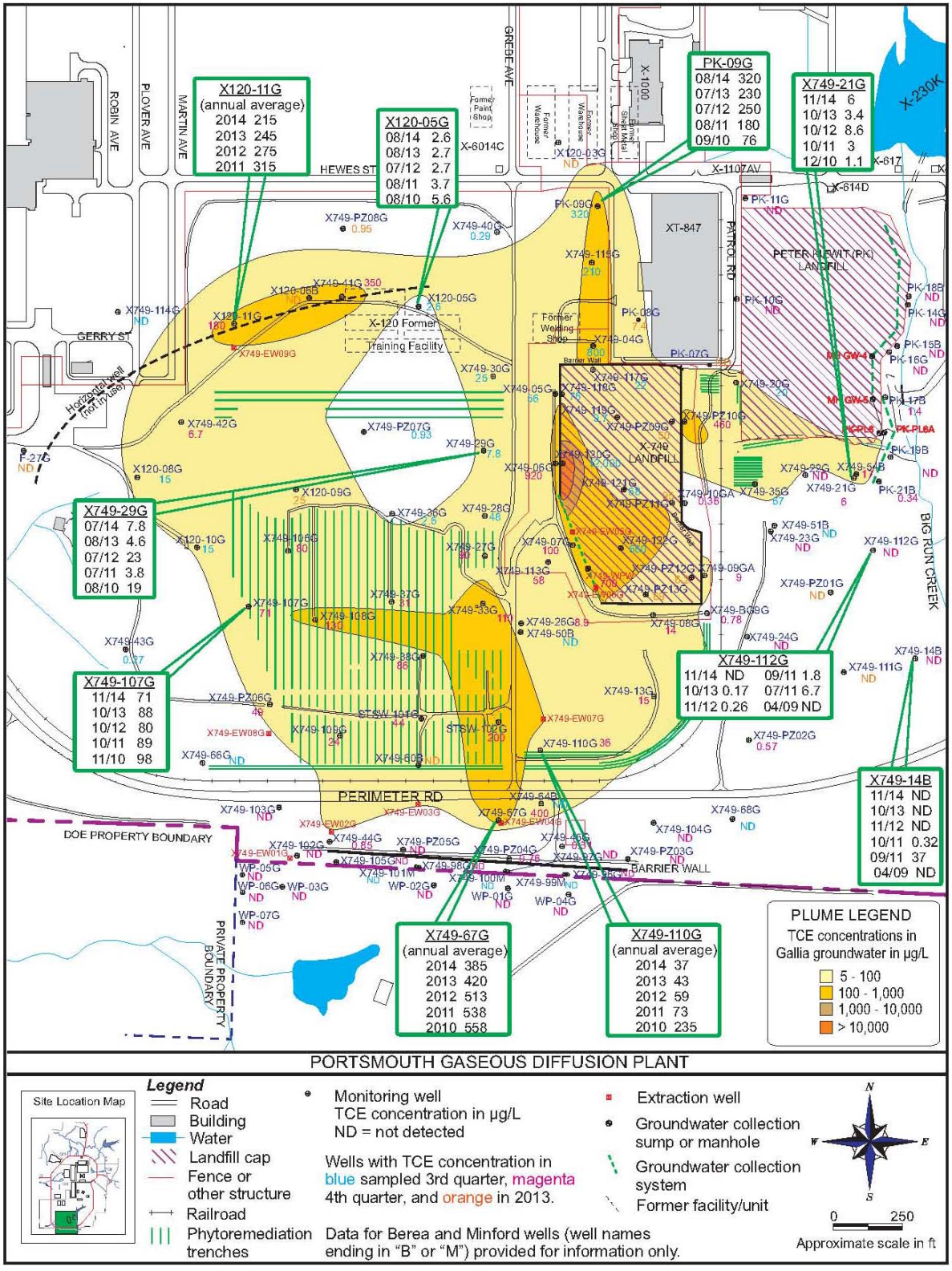


Figure 6.2. TCE-contaminated Gallia groundwater plume at the X-749 Contaminated Materials Disposal Facility/X-120 Old Training Facility – 2014.

Extraction well X749-EW09G is located in the northern portion of the X-749/X-120 groundwater plume and is intended to remediate higher concentrations of TCE associated with the former X-120 facility. Well X120-11G, which is immediately north of X749-EW09G, monitors the performance of extraction well X749-EW09G. The average concentration of TCE detected in 2014 in well X120-11G (215 µg/L) has decreased from the average annual concentrations detected in 2011–2013 (see Figure 6.2). Therefore, X749-EW09G is extracting contaminated groundwater from this area of higher TCE concentrations associated with the former X-120 facility and reducing concentrations of TCE in this area.

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 (approximately 350 ft south of extraction well X749-EW07G) and X749-110G (approximately 125 ft south of X749-EW07G) monitor the performance of extraction well X749-EW07G. The average concentration of TCE detected in 2014 in well X749-67G (385 µg/L) has decreased from the average annual concentrations detected in 2010–2013 (see Figure 6.2). The average concentration of TCE detected in 2014 in well X749-110G (37 µg/L) has decreased from the average annual concentrations detected in 2010–2013 (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.

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 2010, with the exception of well X749-67G (discussed in the previous paragraph). No VOCs were detected in any of the seven off-site monitoring wells.

Samples were collected semiannually in 2014 from wells X749-112G and X749-14B because TCE was detected at concentrations up to 37 µg/L in well X749-14B and 6.7 µg/L in well X749-112G in 2011. These wells, located on the east side of the X-749 Landfill, are typically not within the X-749/X-120 groundwater plume. VOCs, including TCE, were not detected in any of the samples collected from wells X749-14B and X749-112G in 2014.

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 2014, nine wells and two sumps were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells and sumps in this area.

6.4.2.1 Monitoring results for the PK Landfill in 2014

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 2014, vinyl chloride was detected in samples collected from wells PK-17B and PK-21B at concentrations ranging from 12 to 18 µg/L, which exceed the preliminary remediation goal of 2 µg/L. Vinyl chloride is typically detected in these wells at concentrations above the preliminary remediation goal. No other VOCs were detected in the PK Landfill monitoring wells at concentrations that exceeded the preliminary remediation goals.

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

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

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

Twenty-seven wells were sampled in 2014 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 2014

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.

In general, no significant changes in TCE concentrations were identified in wells that monitor the Quadrant I Groundwater Investigative (5-Unit) Area in 2014. The eastern edge of the groundwater plume at the Quadrant I Groundwater Investigative Area expanded in 2014 based on the detection of TCE at 14 µg/L in well X749A-18G (a well that also monitors the X-749A Landfill). TCE has been detected above and below 5 µg/L in well X749A-18G; however, the last detection greater than 5 µg/L occurred in 2011 at 7 µg/L (see Figure 6.3).

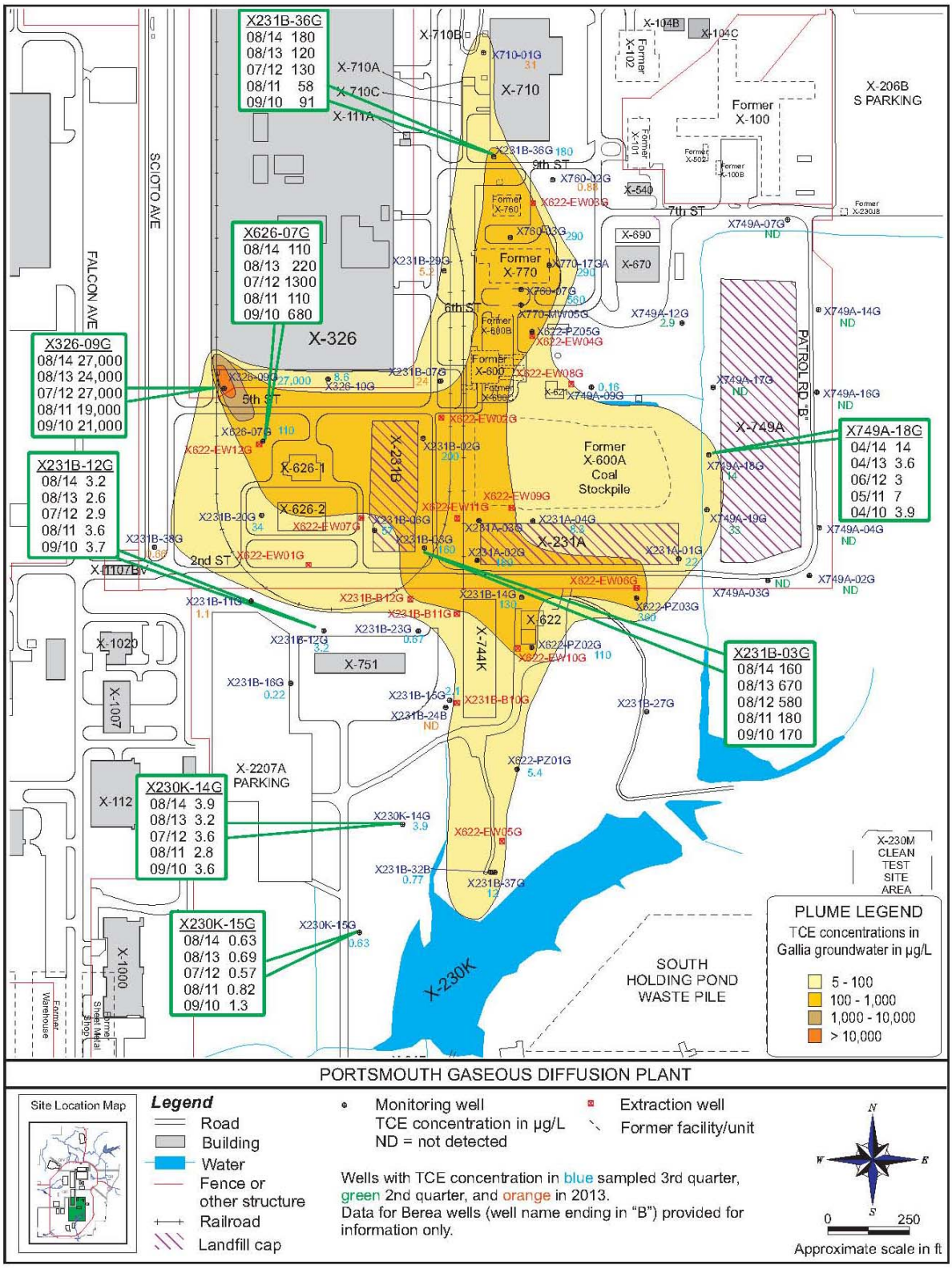


Figure 6.3. TCE-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative (5-Unit) Area – 2014.

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. Potential contaminants include PCBs, asbestos, radionuclides, and industrial waste. Closure of the landfill, completed in 1994, included the construction of a multilayer cap and the installation of a drainage system to collect surface water runoff. The drainage system discharges via the X-230K South Holding Pond (FBP NPDES Outfall 002). Although the X-749A Classified Materials Disposal Facility is located at the eastern edge of the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume, the X-749A Landfill is not the source of the VOCs detected in some of the X-749A monitoring wells at the eastern edge of the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume.

Ten wells associated with the landfill were sampled in 2014. 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 2014

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.

One of the statistical control limits, the Shewhart control limit, for iron was exceeded in well X749A-17G in the second and fourth quarter samples collected from the well. In accordance with landfill regulations, Ohio EPA was notified of these exceedances in December 2014, and additional sampling was completed in December 2014 and January 2015. Based on the results of this additional sampling, DOE determined that the X-749A Landfill had not impacted groundwater quality, and requested a return to the detection monitoring program. Ohio EPA approved this request.

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). Eighteen 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 2014

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 in 2014 were similar to or less than TCE concentrations detected in previous years (see Figure 6.4). Wells at the eastern or southeastern boundary of the monitoring area, X700-03G, X701-26G, and X701-27G, were sampled semiannually to monitor movement of the east side of the Quadrant II Groundwater Investigative (7-Unit) Area plume towards the X-701B Former Holding Pond Area. TCE was not detected in any of the samples collected from well X700-03G. Concentrations of TCE detected in wells X701-26G and X701-27G were similar to TCE concentrations detected in 2013.

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.

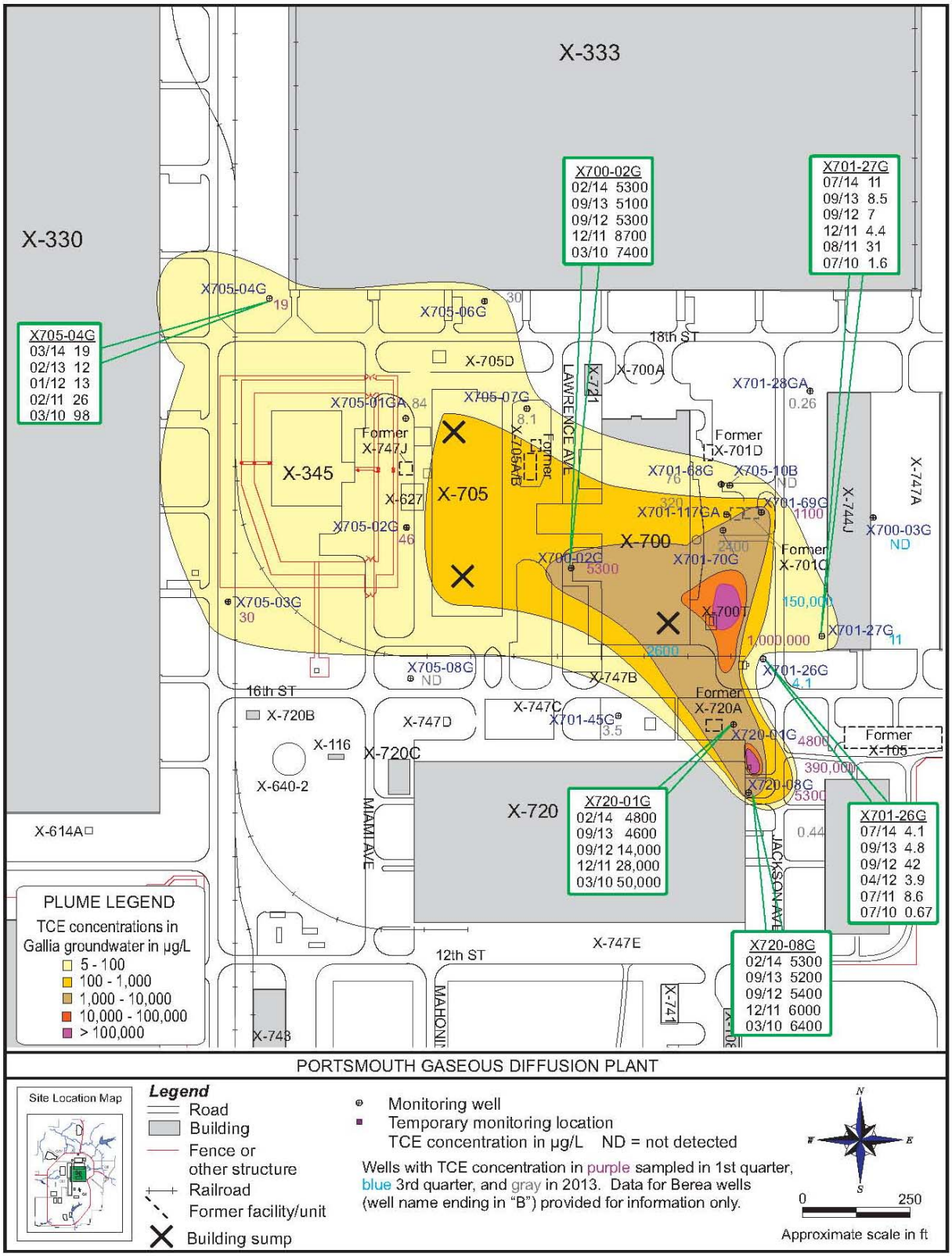


Figure 6.4. TCE-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative (7-Unit) Area – 2014.

Sixty-three wells that monitor the X-701B Former Holding Pond area were sampled in 2014. Table 6.1 lists the analytical parameters for the wells that are part of the *Integrated Groundwater Monitoring Plan* (DOE 2014d).

Additional monitoring wells and surface water locations were sampled in 2014 to monitor the area near the X-237 Groundwater Collection System and Little Beaver Creek. The *2014 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* includes the supplemental monitoring data collected to evaluate the X-237 Groundwater Collection System and Little Beaver Creek (DOE 2015a).

6.4.6.1 Monitoring results for the X-701B Former Holding Pond in 2014

In general, concentrations of TCE detected in wells within the X-701B plume in 2014 were similar to previous years. However, concentrations of TCE continued to increase in wells X701-BW2G and X701-130G that monitor the western portion of the plume, west of the IRM treatment area (see Figure 6.5).

The northern perimeter of the plume expanded in 2014 based on the detection of TCE at 8.2 µg/L in well X701-42G. Previous concentrations of TCE detected in this well, which was added to the IGWMP in 2012, were less than 4 µg/L (see Figure 6.5).

In the first quarter of 2014, TCE was detected at an elevated concentration of 2200 µg/L in well X701-IRMPZ08G that monitors the northeast corner of the monitoring area east of the X-237 Groundwater Collection System and west of Little Beaver Creek. Elevated concentrations of TCE in this well are used as an indication of operational issues with the X-237 Groundwater Collection System. TCE was also detected at slightly elevated concentrations up to 3.7 µg/L in surface water samples collected from Little Beaver Creek.

Additional activities were immediately initiated including sampling of surface water and groundwater near the X-237 Groundwater Collection System, and collection of groundwater elevation measurements in the vicinity of the X-237 Groundwater Collection System. The X-237 north and south pumping wells (X237-NPW and X237-SPW) were cleaned in April 2014. The concentration of TCE detected in well X701-IRMPZ08G decreased to 1400 µg/L in July 2014 (see Figure 6.5).

In the third quarter, TCE was detected at 170 µg/L in well X701-01G in the southwestern portion of the monitoring area. The TCE concentrations in the wells that define this area of the plume have rebounded since the completion of the IRM in 2011, which ended the dewatering of the IRM area (see Figure 6.5). TCE has not been detected at concentrations over 100 µg/L in well X701-01G in sampling conducted since 1999.

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 ten 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.

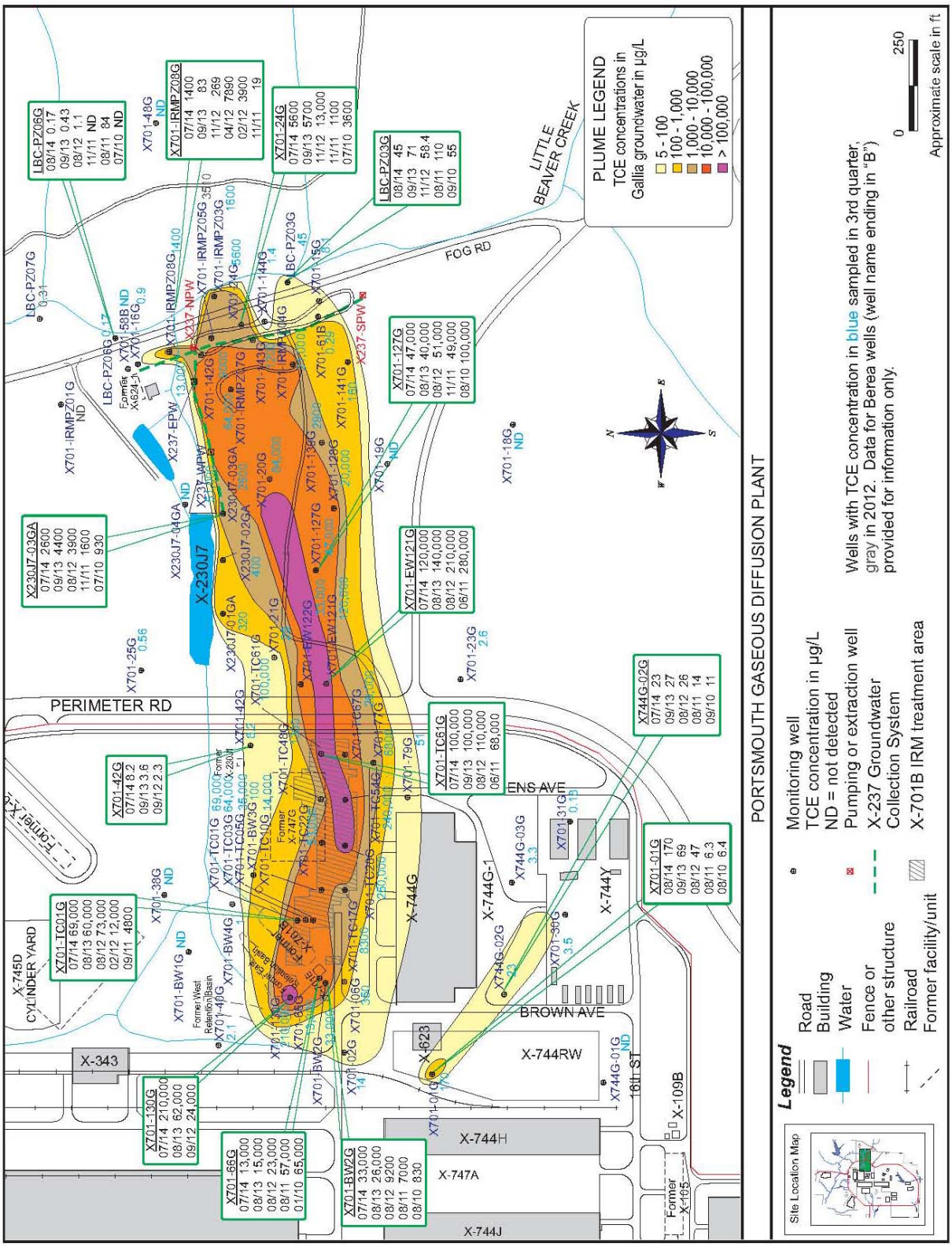


Figure 6.5. TCE-contaminated Gallia groundwater plume at the X-701B Former Holding Pond – 2014.

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 above the preliminary remediation goal in samples collected from well X701-127G, which monitors the center of the plume downgradient from the IRM treatment area and the area in which oxidant was injected from 2006 through 2008. This area is likely affected by the oxidant used in the X-701B IRM and the oxidant injections conducted in 2006 through 2008.

6.4.7 X-633 Former Recirculating Cooling Water Complex

The X-633 Former Recirculating Cooling Water Complex in Quadrant II consisted of a recirculating water pumphouse and four cooling towers with associated basins. Chromium-based corrosion inhibitors were added to the cooling water until the early 1990s, when the system was converted to a phosphate-based inhibitor. D&D of the facilities was completed in 2010. Chapter 3, Section 3.3.2.3 provides additional information about the RCRA investigation of soils and groundwater in this area.

The X-633 Former Recirculating Cooling Water Complex was identified as an area of concern for potential metals contamination in 1996 based on historical analytical data for groundwater wells in this area. Samples from wells in this area were collected in 1998 and 1999 to assess the area for metals contamination. Based on detections of chromium above the preliminary remediation goal, this area was added to the PORTS groundwater monitoring program. Two wells are sampled semiannually for chromium as part of the monitoring program for this area.

6.4.7.1 Monitoring results for the X-633 Former Recirculating Cooling Water Complex in 2014

Chromium was detected in both of the X-633 monitoring wells in 2014. Samples collected from well X633-07G contained chromium at concentrations above the preliminary remediation goal of 100 µg/L: 950 µg/L (second quarter) and 270 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 2014

Chromium is of special concern at X-616 because of the previous use of the area. In 2014, 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.

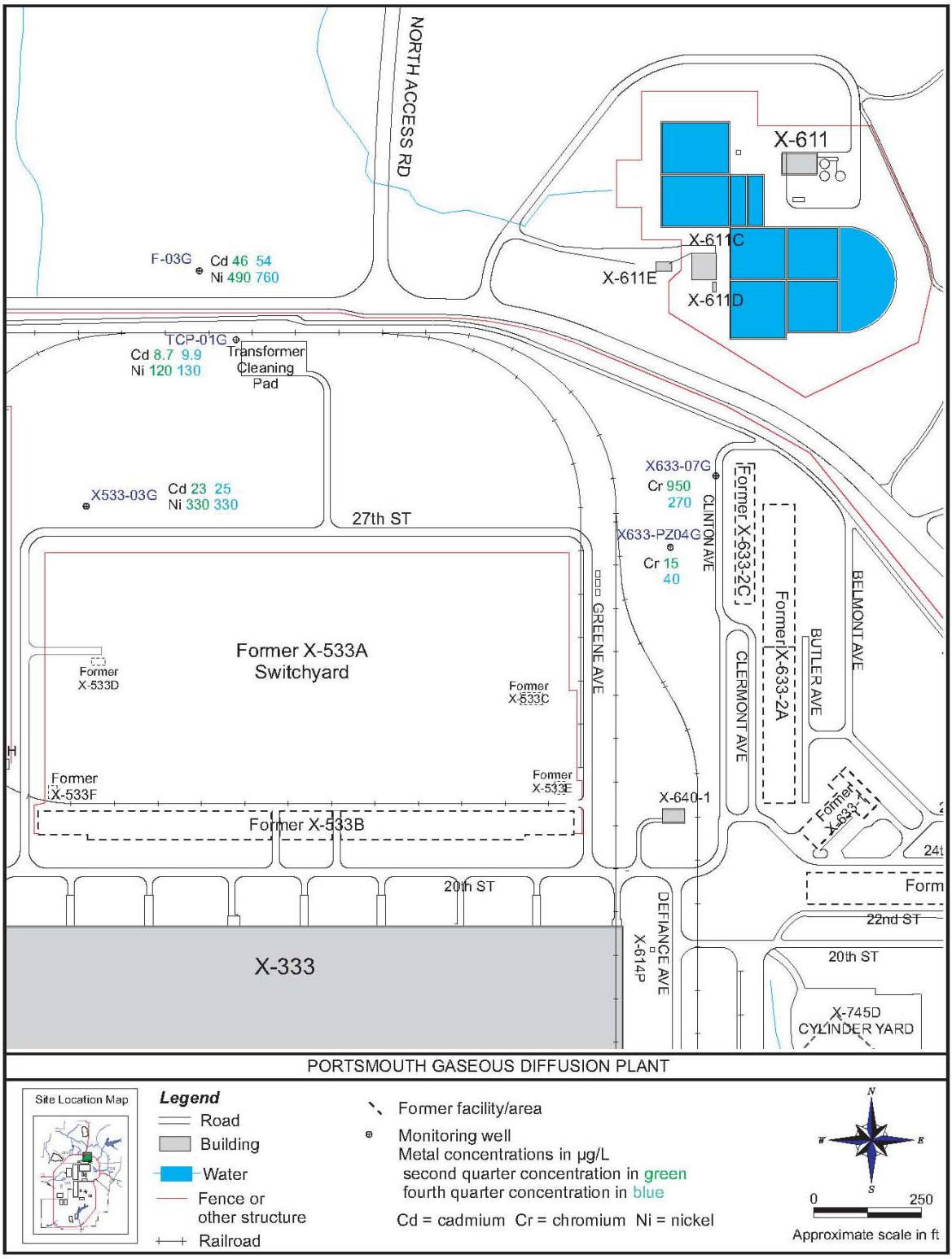


Figure 6.6. Metal concentrations in groundwater at the X-633 Former Recirculating Cooling Water Complex and X-533 Former Switchyard Complex – 2014.

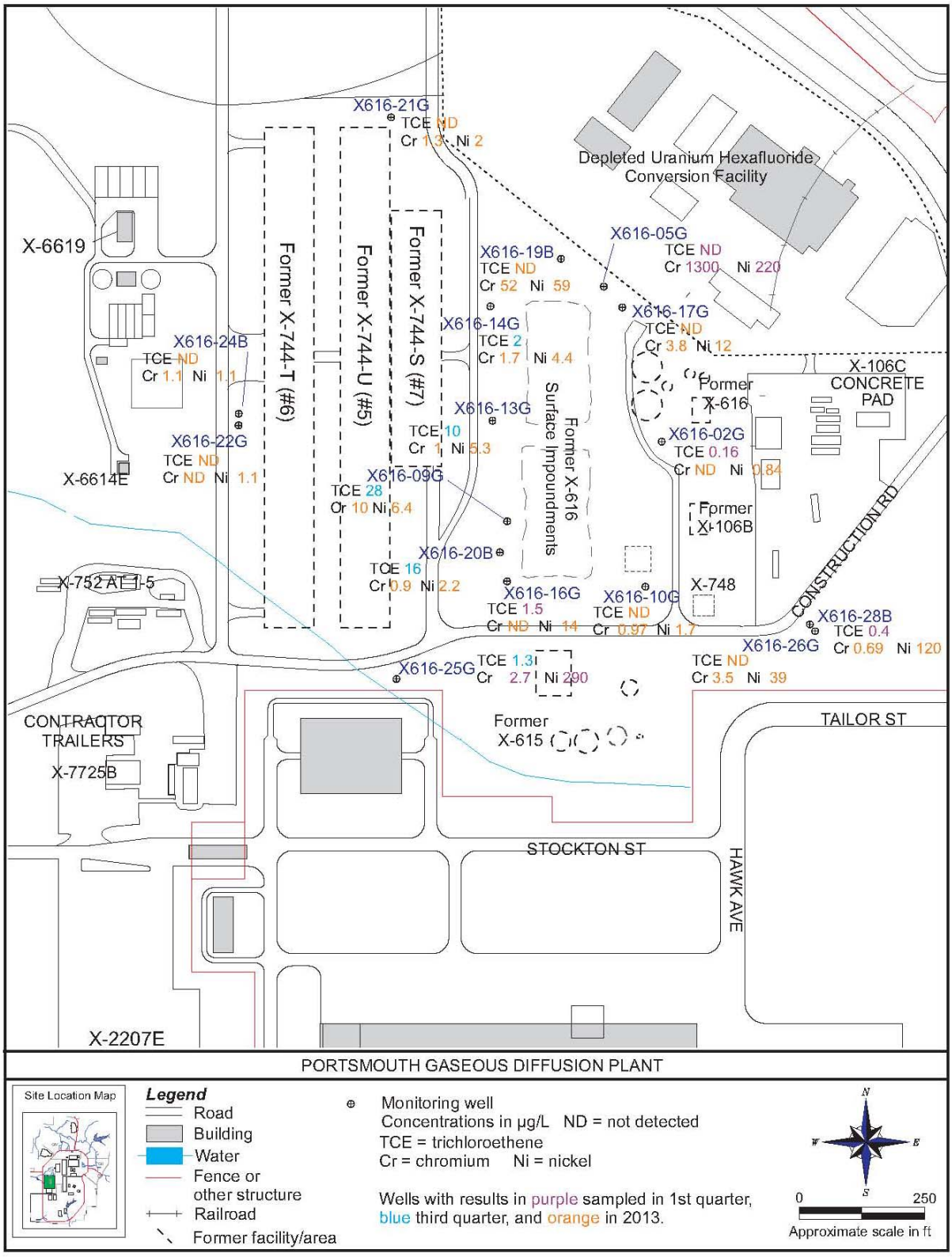


Figure 6.7. TCE and metal concentrations in groundwater at the X-616 Former Chromium Sludge Surface Impoundments – 2014.

TCE was detected above the preliminary remediation goal of 5 µg/L in wells X616-09G, X616-13G, and X616-20B, which is typical for these wells. 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 2013 or 2014.

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 (EAB) began in 2010. Chapter 3, Section 3.3.3, provides additional information about the remedial activities for the X-740 area.

At the request of Ohio EPA, routine monitoring at the X-740 Former Waste Oil Handling Facility under the *Integrated Groundwater Monitoring Plan* was discontinued in 2009. However, monitoring of the area continued in support of the EAB pilot study underway in this area. Routine monitoring of the X-740 area was returned to the *Integrated Groundwater Monitoring Plan* beginning with the second quarter of 2014, which includes continued monitoring of the EAB pilot study (DOE 2014d). Nineteen wells that monitor the X-740 Former Waste Oil Handling Facility were sampled during 2014.

6.4.9.1 Monitoring results for the X-740 Former Waste Oil Handling Facility in 2014

A contaminated groundwater plume consisting primarily of TCE is located near the X-740 Former Waste Oil Handling Facility in Quadrant III. Figure 6.8 shows the TCE groundwater plume in 2014 for the X-740 area. The perimeter of the X-740 groundwater plume did not change in 2014. However, concentrations of TCE are decreasing in Gallia wells that monitor the EAB pilot study (X740-18G, X740-19G, X740-20G, X740-21G, and X740-22G–see Figure 6.8). Additionally, TCE has decreased in well X740-03G from over 1000 µg/L (prior to the EAB pilot study) to an average of 20 µg/L in 2014. Well X740-03G typically had the highest concentrations of TCE detected in the X-740 monitoring area before the EAB pilot study.

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.

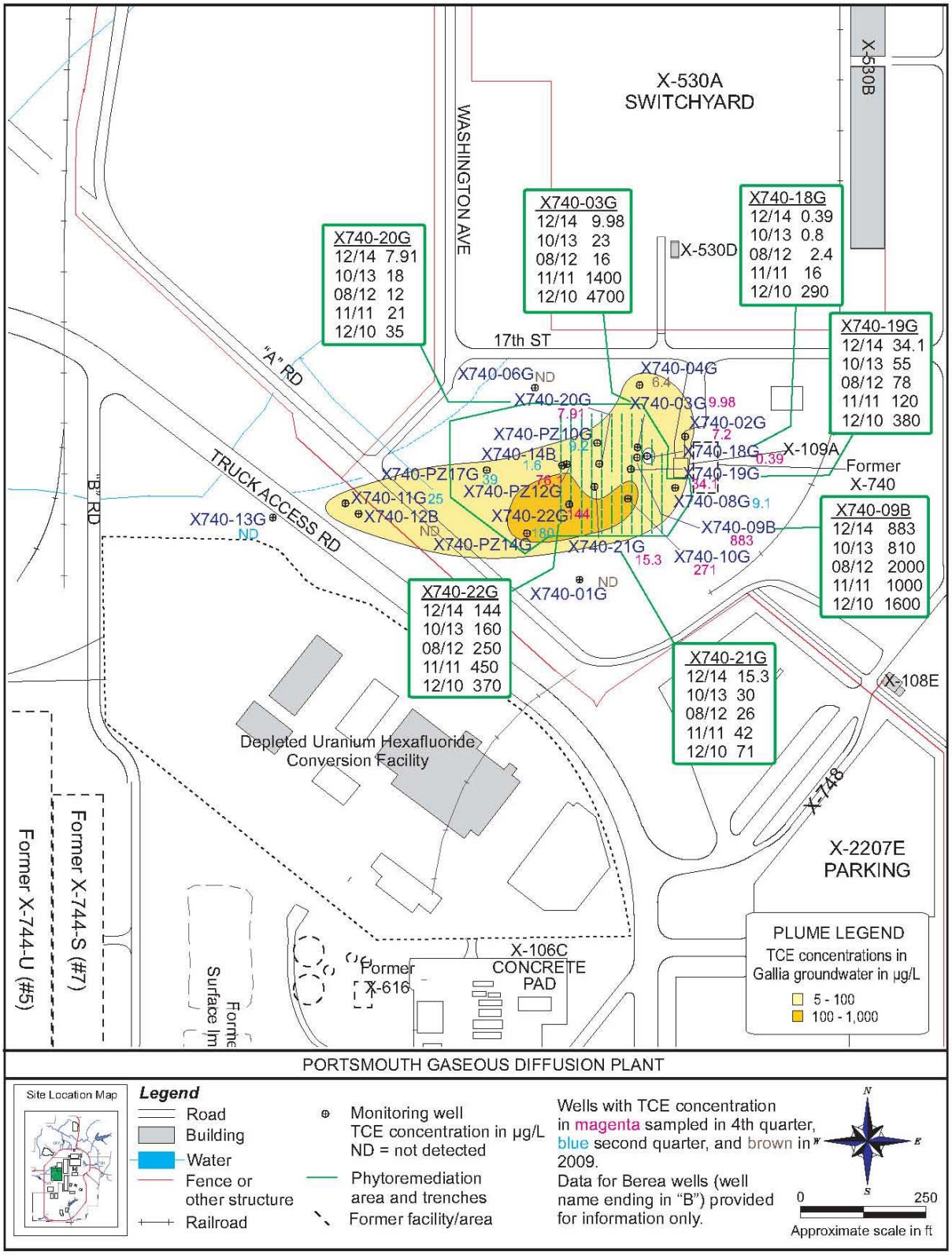


Figure 6.8. TCE-contaminated Gallia groundwater plume near the X-740 Former Waste Oil Handling Facility – 2014.

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 2014

The six monitoring wells at X-611A are sampled and analyzed for beryllium and chromium. In 2014, chromium was detected in the samples collected from three of the six wells in this area at concentrations between 0.53 and 6.4 µg/L, which are below the preliminary remediation goal (100 µg/L).

In 2014, beryllium was detected in two of the six wells in this area at concentrations of 2.6 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 2014.

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.

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 2013b, DOE 2014d). 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-two wells were sampled in 2014 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.

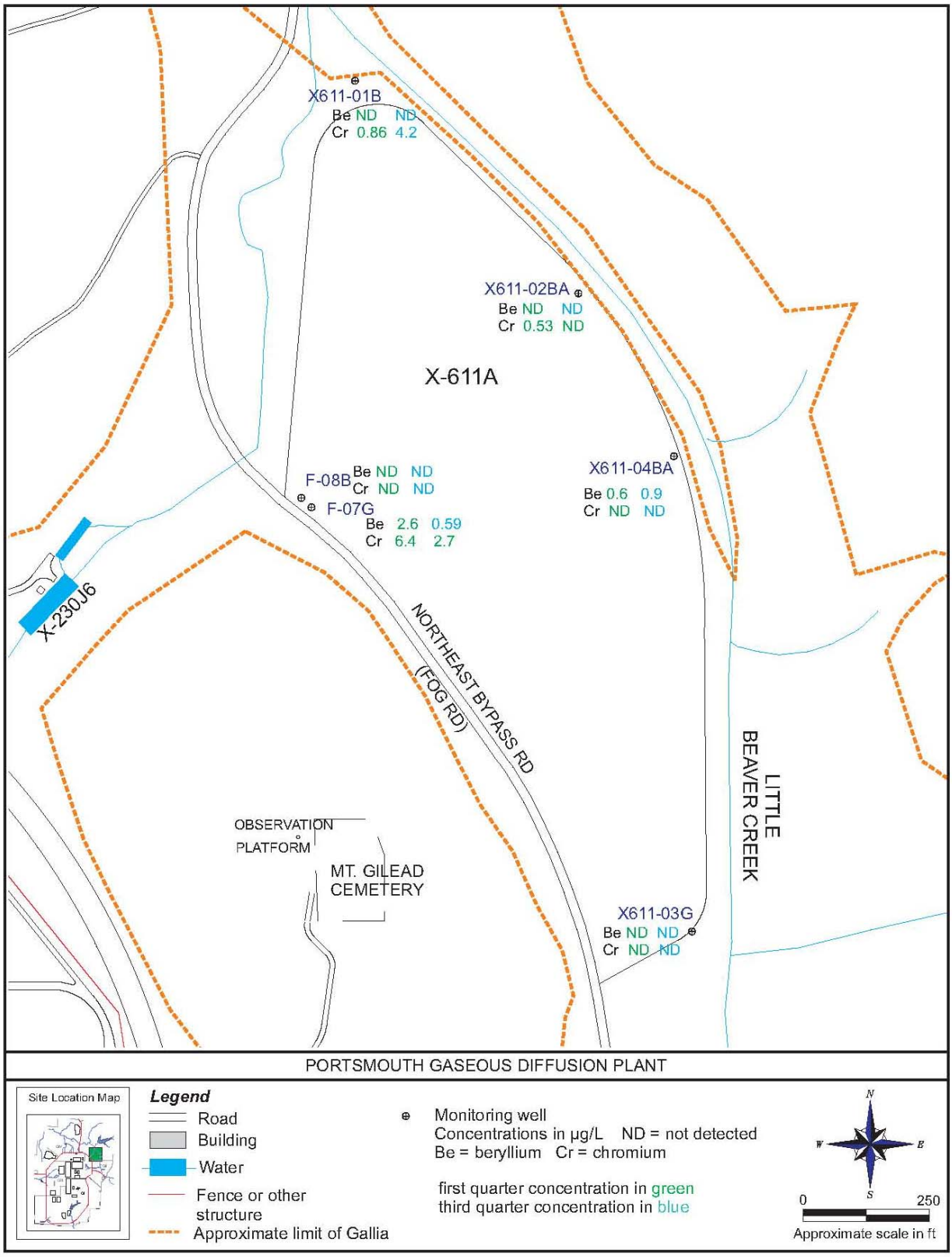


Figure 6.9. Metal concentrations in groundwater at the X-611A Former Lime Sludge Lagoons – 2014.

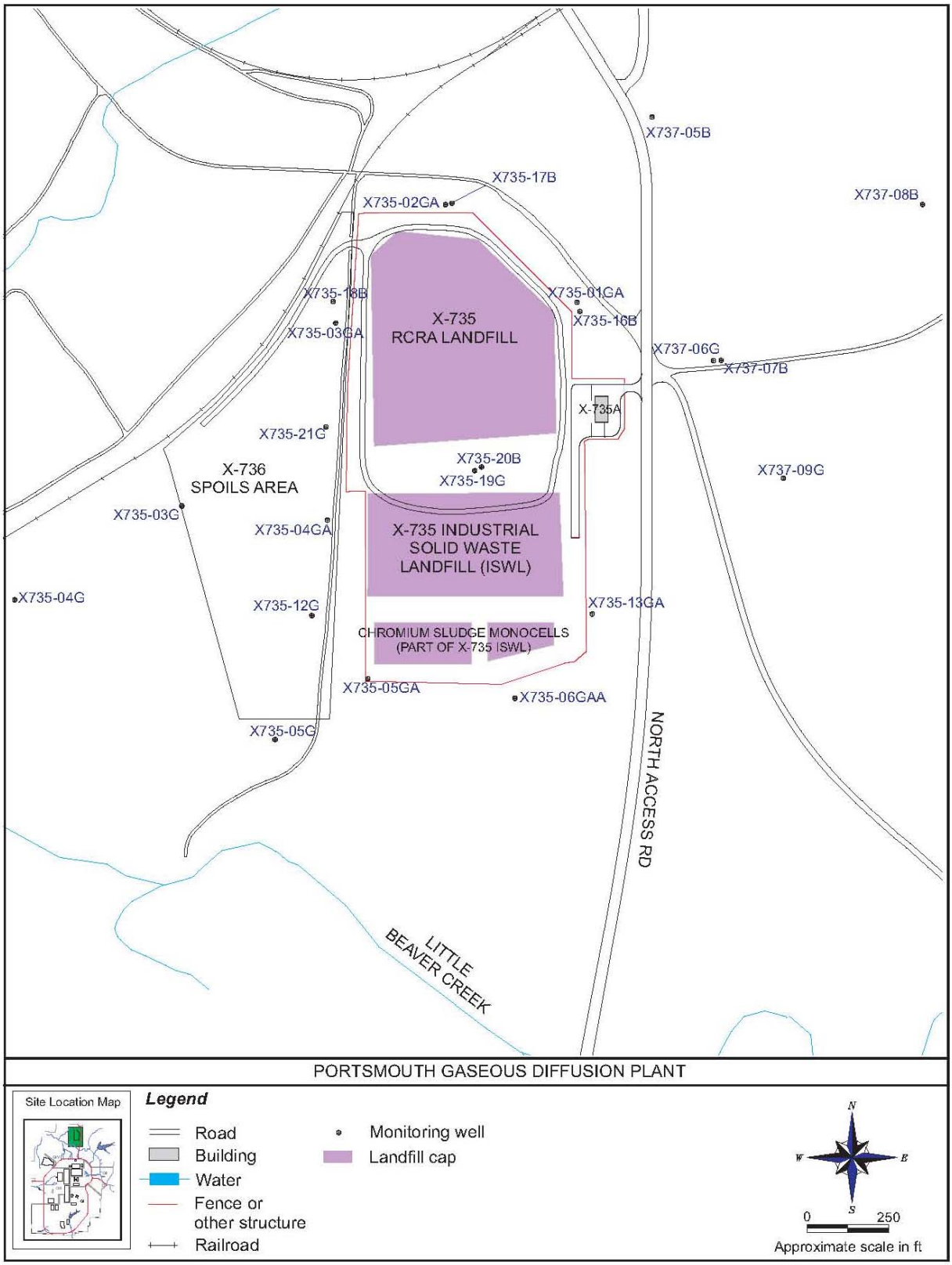


Figure 6.10. Monitoring wells at the X-735 Landfills.

6.4.11.1 Monitoring results for the X-735 Landfills in 2014

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 2014.

The detection monitoring program for X-735 Berea wells continued in 2014. 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 2014.

Samples from four X-735 monitoring wells were also analyzed for radionuclides (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).

6.4.12 X-734 Landfills

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

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

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

6.4.12.1 Monitoring results for the X-734 Landfills in 2014

VOCs are routinely detected in a number of the wells that monitor the X-734 Landfills, but generally at concentrations below or just above preliminary remediation goals. In 2014, no VOCs were detected at concentrations above the preliminary remediation goals in the samples collected from the X-734 monitoring wells.

Samples from 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.

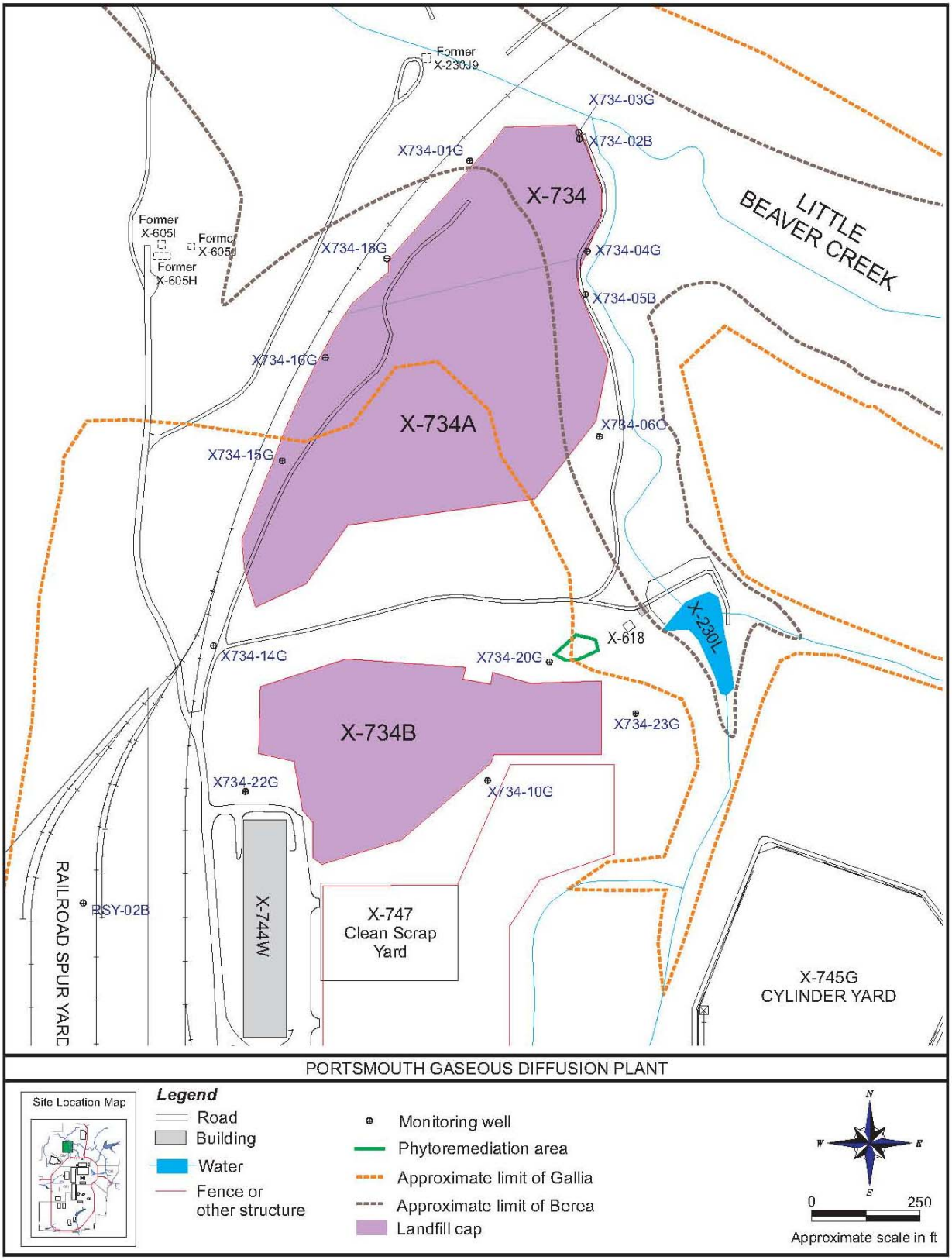


Figure 6.11. Monitoring wells at the X-734 Landfills.

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 2014

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 2014 and analyzed for cadmium and nickel. Each of the well samples contained these metals at concentrations above the preliminary remediation goals (6.5 µg/L for cadmium and 100 µg/L for nickel). Concentrations of cadmium detected in the wells ranged from 8.7 to 54 µg/L, and concentrations of nickel detected in the wells ranged from 120 to 760 µg/L. Figure 6.6 shows the concentrations of metals detected in the X-533 wells in 2014.

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).

6.4.14.1 Monitoring results for the X-344C Former Hydrogen Fluoride Storage Building in 2014

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 2014 at low concentrations less than 2 µg/L, which are less than the preliminary remediation goals. These detections are consistent with the data collected at this well in 2009 through 2013.

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:

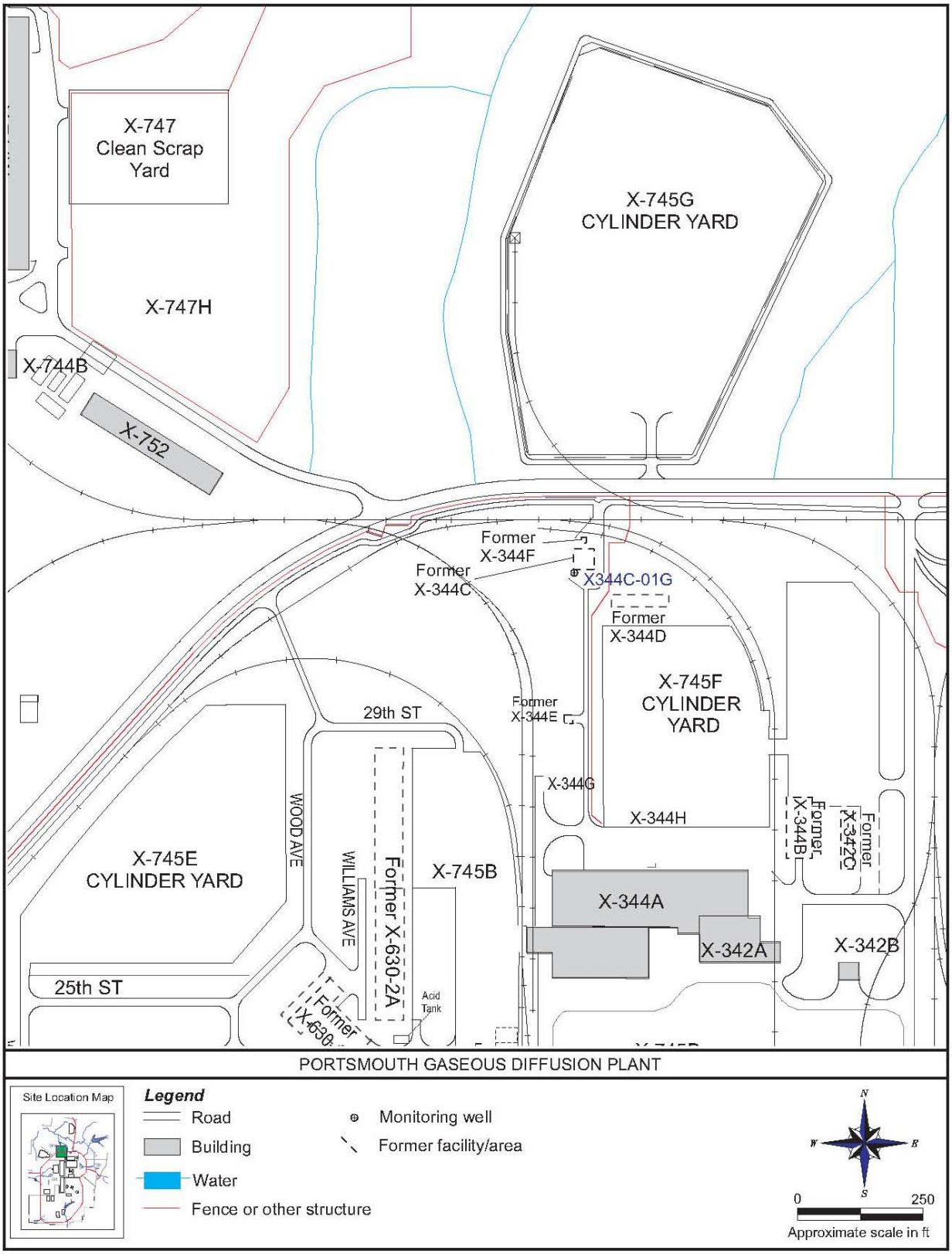


Figure 6.12. Monitoring well at the X-344C Former Hydrogen Fluoride Storage Building.

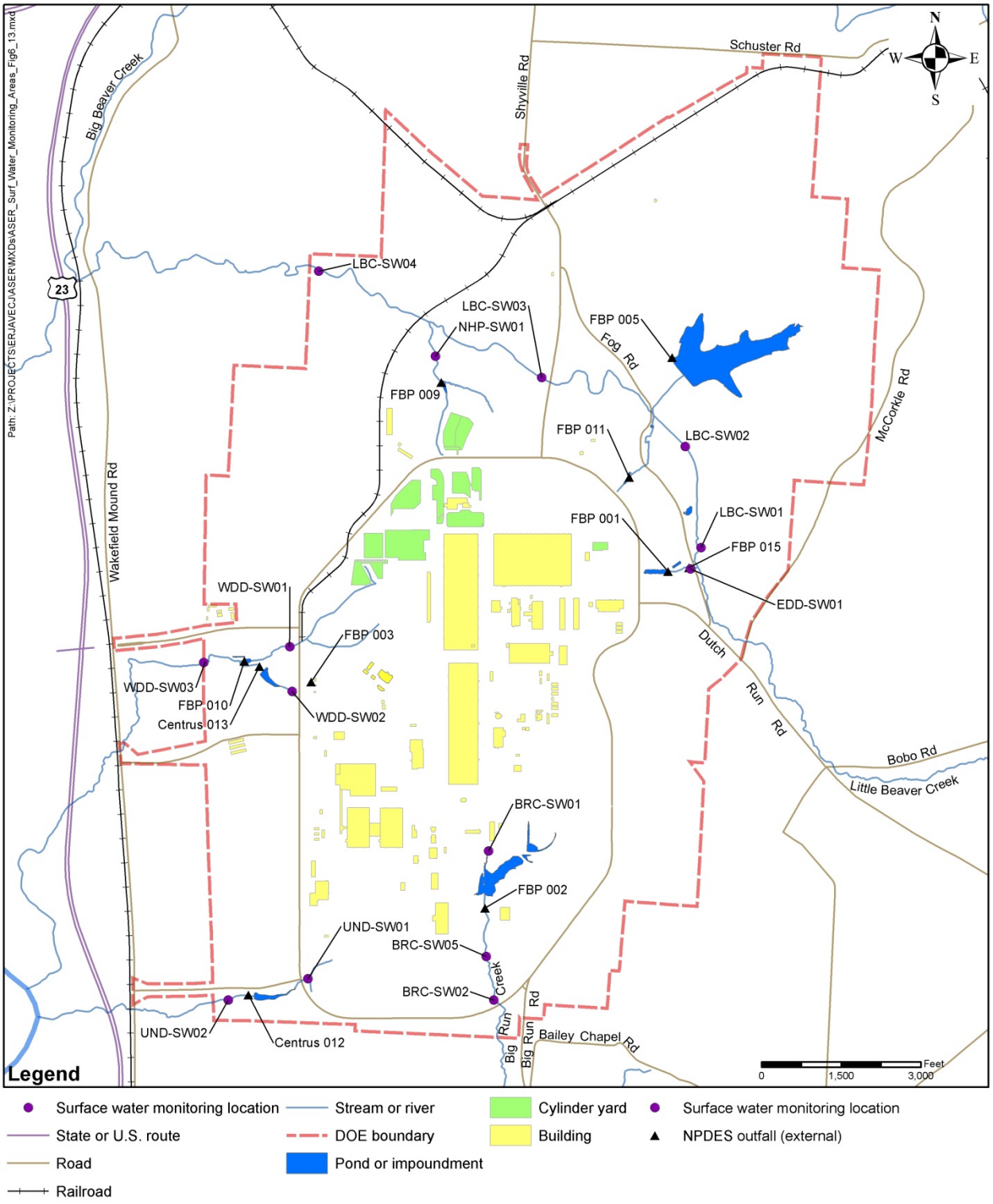


Figure 6.13. Surface water monitoring locations.

- 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 2014

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).

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 2014, TCE was detected at 0.2 to 4.3 µg/L in each of the four samples collected from the Southwestern Drainage Ditch at UND-SW01. *Cis*-1,2-dichloroethene was also detected at an estimated concentration of 0.27 µg/L in the second quarter sample collected at UND-SW01. VOCs, including TCE and *cis*-1,2-dichloroethene, 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 was detected at elevated concentrations up to 43 µg/L in samples collected in the first and second quarters of 2014 from the East Drainage Ditch and Little Beaver Creek. Additional activities were immediately initiated near the X-237 Groundwater Collection System including sampling of surface water and groundwater and collection of groundwater elevation measurements in the vicinity of the X-237

Groundwater Collection System. The X-237 north and south pumping wells (X237-NPW and X237-SPW) were cleaned in April 2014. After cleaning, concentrations of TCE detected in East Drainage Ditch and Little Beaver Creek returned to typical levels. 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 2014 were analyzed for selected transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). Plutonium-239/240 was detected at 0.128 pCi/L in the second quarter sample collected at Little Beaver Creek sampling location LBC-SW03, which is 0.09% of the derived concentration standard for plutonium-239/240 in water (140 pCi/L – DOE 2011a). No other transuranics were detected in the surface water samples collected during 2014.

Technetium-99 was detected at levels up to 18.3 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). Technetium-99 is occasionally detected in samples collected from the East Drainage Ditch and Little Beaver Creek. These detections are within the historical range of technetium-99 detected in Little Beaver Creek, and are 0.04% or less of derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011a).

Technetium-99 was detected in the second quarter samples collected from Big Run Creek: BRC-SW01 (8.63 pCi/L), BRC-SW02 (60.2 pCi/L), and BRC-SW05 (76.5 pCi/L). Technetium-99 was also detected in the first and second quarter samples collected from West Drainage Ditch sampling locations WDD-SW01 and WDD-SW03 at a maximum activity of 11.6 pCi/L. The technetium-99 detections in Big Run Creek and West Drainage Ditch are 0.2% or less of derived concentration standard for technetium-99 in water (44,000 pCi/L – DOE 2011a).

Uranium was routinely detected in the 2014 surface water samples at levels similar to those detected in previous years. Detections of uranium were well below the Ohio EPA drinking water standard for uranium (30 µg/L). Because uranium occurs naturally in rocks and soil, some or all of the uranium detected in these samples may be due to naturally-occurring uranium.

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 2013b, DOE 2014d).

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).

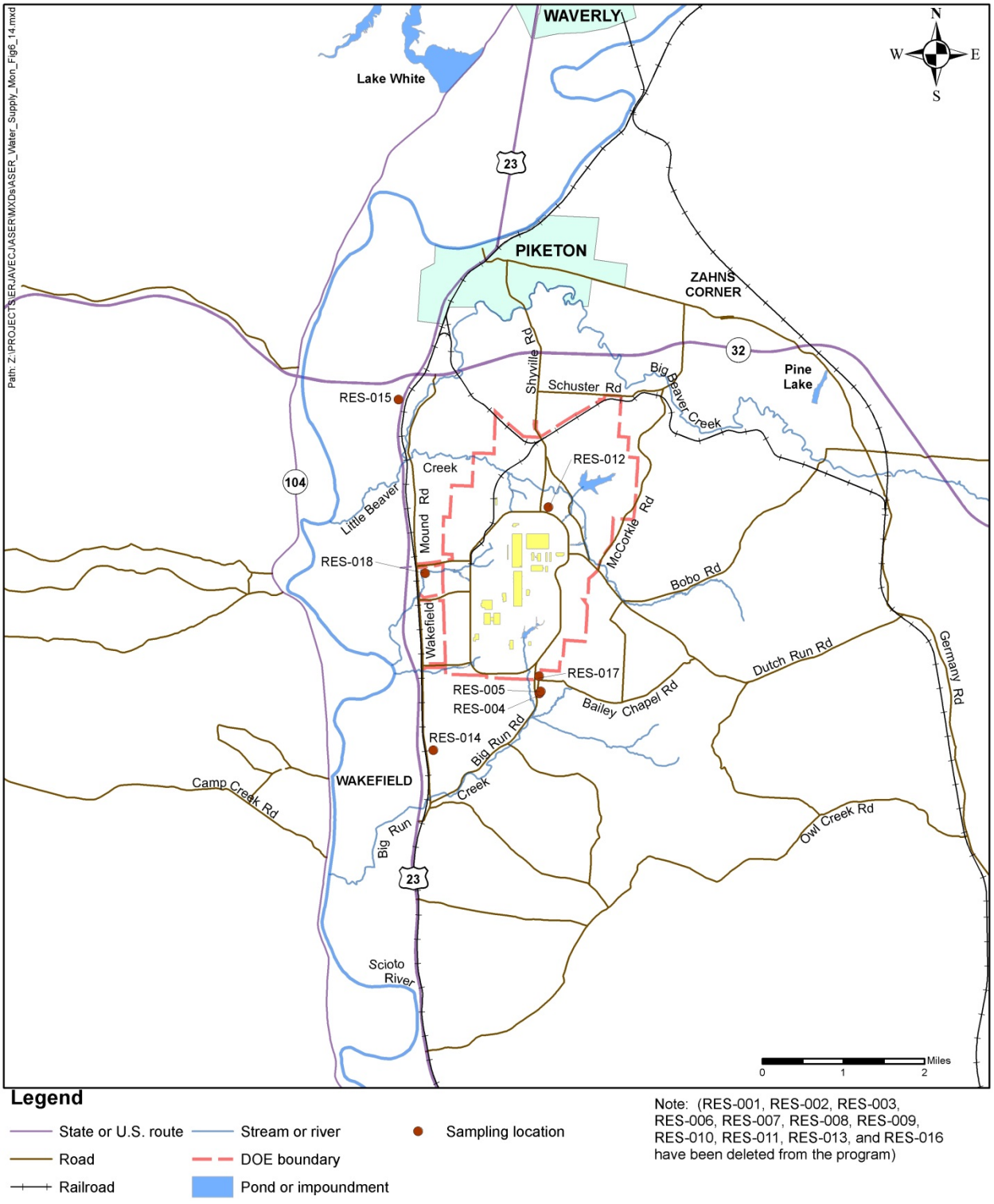


Figure 6.14. Water supply monitoring locations.

Four residential drinking water sources participated in the program in 2014. 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 2014 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 2014. 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.

In the first and third quarters of 2014, TCE was detected at estimated concentrations of 0.18 µg/L and 0.64 µg/L, respectively, 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 and in the third quarter sample collected from sampling location RES-018. 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 2014. 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) — see Figure 6.13 — are part of the exit pathway monitoring program. TCE was detected at 1.9 µg/L in the first quarter sample collected from Little Beaver Creek at LBC-SW04 (see Section 6.4.15.1). This detection was 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.

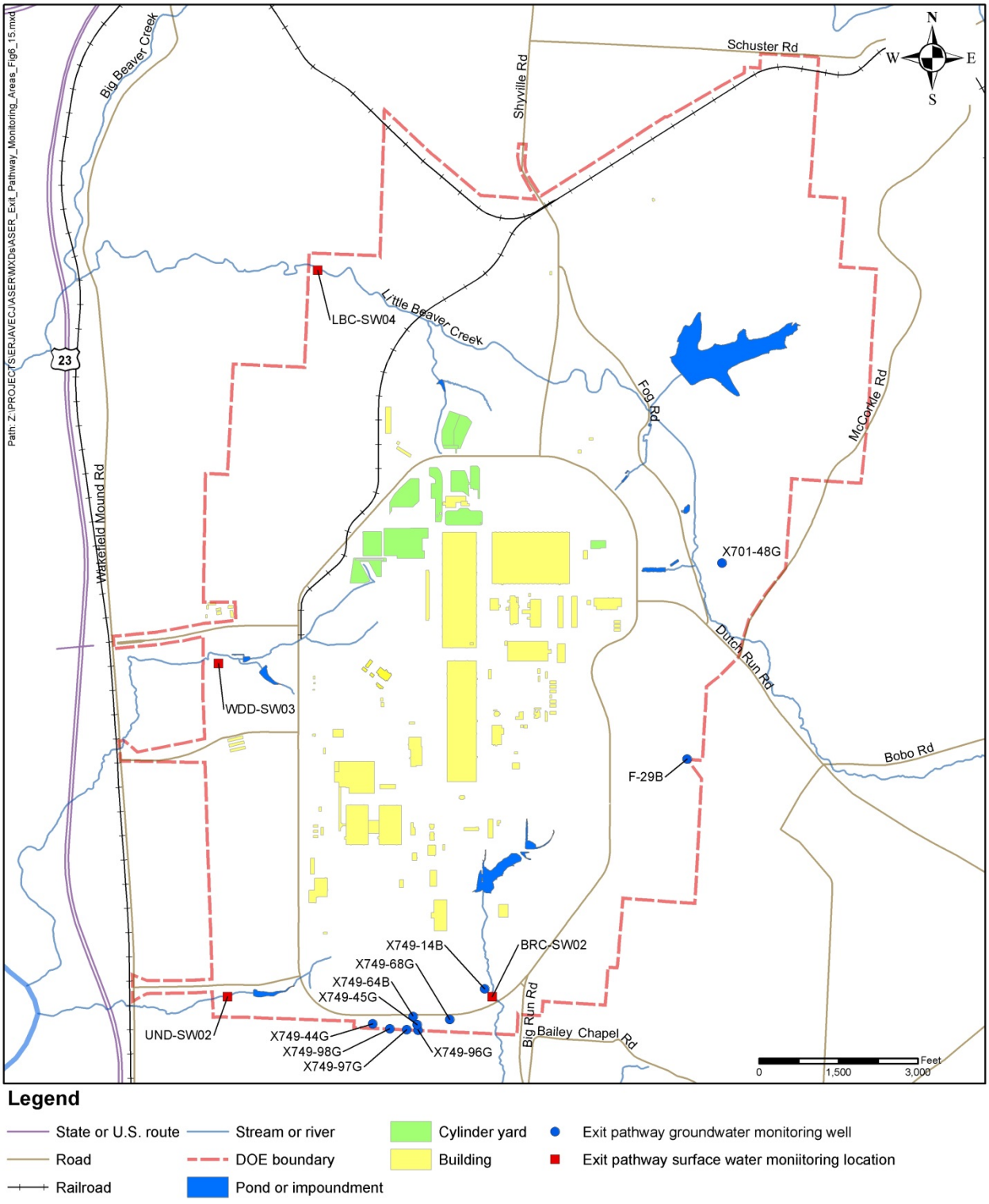


Figure 6.15. Exit pathway monitoring locations.

Trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in chlorinated drinking water, were detected in samples collected from the Western Drainage Ditch and Little Beaver Creek 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 levels up to 60.2 pCi/L in the first and/or second quarter samples collected at the surface water exit pathway monitoring locations on Little Beaver Creek, Big Run Creek, and Western Drainage Ditch. These detections were 0.1% or less of 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 at 6.2 µg/L in the first quarter sample collected from well X749-45G, but TCE decreased to less than 5 µg/L in the second, third, and fourth quarter samples collected from the well. The other detections of TCE in the exit pathway monitoring wells were below the Ohio EPA drinking water standard for TCE (5 µg/L).

Only groundwater monitoring well X701-48G was sampled for radionuclides in 2014 (most exit pathway monitoring wells are sampled for radionuclides every two years in odd-numbered years). No radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238) were detected in well X701-48G in 2014.

6.6 GROUNDWATER TREATMENT FACILITIES

In 2014, a combined total of approximately 30.4 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 31 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 2014[a]

Facility	Gallons of water treated	Gallons of TCE removed
X-622	17,191,400	2
X-623	21,880	0.01
X-624	2,320,100	7
X-627	10,877,360	22

[a]Source: *2014 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2015a)

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 17 million gallons of groundwater during 2014, thereby removing approximately 2 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 2014.

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 2014, 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, April, June, August, September, and October of 2014.

The facility treated approximately 22,000 gallons of water during 2014, thereby removing approximately 0.01 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 2014.

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 2.3 million gallons of water in 2014, thereby removing approximately 7 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 2014.

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 million gallons of groundwater were processed during 2014, thereby removing 22 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 2014.

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 2014 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 BWCS during 2014 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 2014, samples collected for DOE environmental monitoring programs at PORTS such as NPDES monitoring, groundwater monitoring required by the *Integrated Groundwater Monitoring Plan* (DOE 2013b, DOE 2014d), and environmental monitoring required by the *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2013a), 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.

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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.

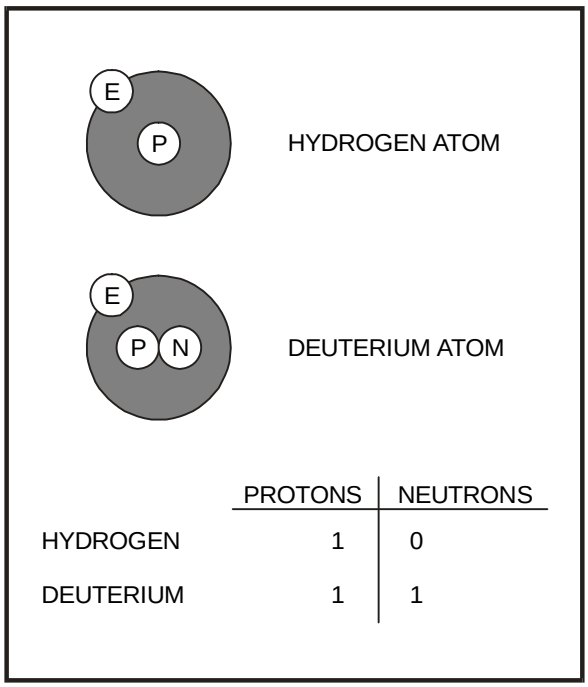

Figure A.1. Isotopes of the element hydrogen

Another example is the element uranium, which has 92 protons; all isotopes of uranium, therefore, have 92 protons. However, each uranium isotope has a different number of neutrons. Uranium-238 (also denoted ^{238}U) has 92 protons and 146 neutrons; uranium-235 has 92 protons and 143 neutrons; uranium-234 has 92 protons and 142 neutrons.

Some isotopes are stable, or nonradioactive; some are radioactive. 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.

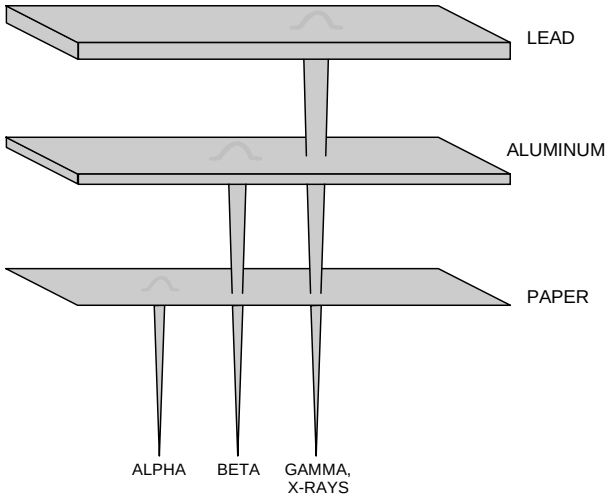

Figure A.2. Penetrating power of radiation.

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.

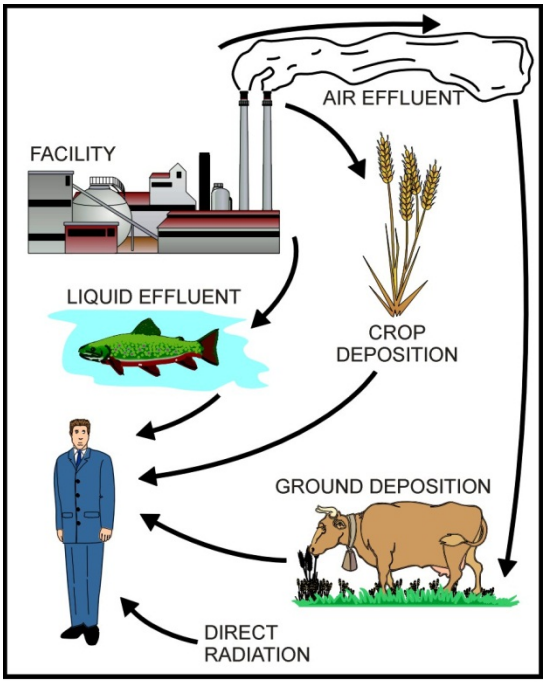

Figure A.3. Possible radiation pathways.

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
BWCS – 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*LD	7/23/2015	8/31/2020	Active
Safe Drinking Water Act – License to Operate a Public Water System	OH6632414	1/1/2014	1/30/2015	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	1/919/1996	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
BWCS – 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	87.75
Plutonium-239	^{239}Pu	24,100
Plutonium-240	^{240}Pu	6,569
Technetium-99	^{99}Tc	213,000
Uranium-233	^{233}U	159,200
Uranium-234	^{234}U	244,500
Uranium-235	^{235}U	703,800,000
Uranium-236	^{236}U	23,415,000
Uranium-238	^{238}U	4,468,000,000

Source: *Radioactive Decay Tables: A Handbook of Decay Data for Application to Radioactive Dosimetry and Radiological Assessments (*DOE/TIC-11026), as reported in the *Oak Ridge Reservation Annual Site Environmental Report for 2005* (DOE/ORO-2218).

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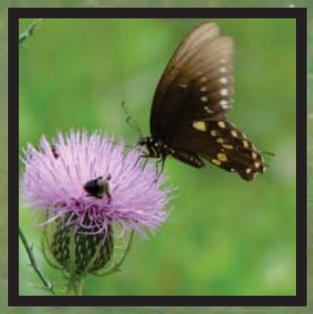

Annual Site Environmental Data – 2014

March 2016

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Data – 2014
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0689&D1

March 2016

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

FBP-ER-RCRA-WD-RPT-0201, Revision 1

This document has been approved for public release:

Samuel Eldridge (signature on file)	03/10/2016
Classification Office	Date

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CONTENTS

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TABLES

ACRONYMS AND ABBREVIATIONS

#/100 mL	number per 100 mL
ACP	American Centrifuge Plant
BWCS	BWXT Conversion Services, LLC[1]
°C	degrees Celsius
Ci	curie
cm	centimeter
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
FBP	Fluor-BWXT Portsmouth LLC[2]
°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
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

[1] B&W Conversion Services, LLC became BWXT Conversion Services, LLC in 2015. The new name is used in this document.
[2] Fluor-B&W Portsmouth LLC became Fluor-BWXT Portsmouth LLC in 2015. The new name is used in this document.

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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 2014 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 – 2014* (DOE 2016).

Radiological monitoring data presented in this Data Report and discussed in the *Annual Site Environmental Report for 2014* indicate that the maximum dose a member of the public could receive from radionuclides released by PORTS in 2014 or detected by environmental monitoring programs in 2014 is 0.91 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 – 2014* provides more information about non-radiological chemicals released from PORTS or detected by PORTS monitoring programs during 2014.

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2. ENVIRONMENTAL MONITORING

This section provides environmental monitoring data collected in 2014 by DOE contractors Fluor-BWXT Portsmouth LLC (FBP) and BWXT Conversion Services, LLC (BWCS). Data collected by Centrus for NPDES outfalls associated with the American Centrifuge Plant (ACP) and Lead Cascade 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 – 2014
- Table 2.2. FBP and BWCS NPDES permit summaries – 2014
- Table 2.3. FBP NPDES discharge and compliance rates – 2014
- Table 2.4. BWCS NPDES discharge and compliance rates – 2014
- Table 2.5. Centrus NPDES discharge monitoring results – 2014
- Table 2.6. Radionuclides in surface water runoff samples from FBP and BWCS cylinder storage yards – 2014
- Table 2.7. Drainage basin monitoring of surface water and sediment for BWCS cylinder storage yards – 2014
- Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2014
- Table 2.9. External radiation monitoring program (mrem) – 2014
- Table 2.10. External radiation monitoring (mrem) at locations near cylinder storage yards – 2014
- Table 2.11. Settleable solids monitoring results – 2014
- Table 2.12. Local surface water monitoring program results – 2014
- Table 2.13. Sediment monitoring program results – 2014
- Table 2.14. Soil and vegetation monitoring at ambient air monitoring stations – 2014
- Table 2.15. Biota (fish) monitoring program results – 2014
- Table 2.16. Biota (crops) monitoring program results – 2014
- Table 2.17. Biota (deer) monitoring program results – 2014
- Table 2.18. Off-site dairy monitoring – 2014.

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2014

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
001	Americium-241	4(4)	0	< 0.034	
	Neptunium-237	4(4)	0	< 0.0299	
	Plutonium-238	4(4)	0	< 0.014	
	Plutonium-239/240	4(4)	< 0.00963	< 0.0344	
	Technetium-99	12(5)	0	47.8	
	Uranium	12(2)	< 0.197	3.25	
	Uranium-233/234	12(0)	0.509	6.35	2.57
	Uranium-235/236	12(6)	< 0.0072	0.404	
	Uranium-238	12(2)	< 0.057	1.04	
002	Americium-241	4(4)	0	< 0.0281	
	Neptunium-237	4(4)	0	< 0.0104	
	Plutonium-238	4(4)	0	< 0.00645	
	Plutonium-239/240	4(4)	< 0.0188	< 0.0417	
	Technetium-99	12(8)	0	94.5	
	Uranium	12(0)	0.5	1.36	0.811
	Uranium-233/234	12(0)	0.442	1.32	0.784
	Uranium-235/236	12(12)	< 0.0175	< 0.0892	
	Uranium-238	12(0)	0.16	0.444	0.265
003	Americium-241	4(4)	< 0.0177	< 0.0425	
	Neptunium-237	4(4)	< 0.0066	< 0.0233	
	Plutonium-238	4(4)	0	< 0.00609	
	Plutonium-239/240	4(4)	< 0.00581	< 0.0288	
	Technetium-99	12(0)	27.1	170	80.1
	Uranium	12(0)	1.09	7.62	2.82
	Uranium-233/234	12(0)	1.36	11.7	3.66
	Uranium-235/236	12(5)	< 0.0606	0.657	
	Uranium-238	12(0)	0.351	2.46	0.920
004	Americium-241	4(4)	< 0.00894	< 0.0255	
	Neptunium-237	4(4)	0	< 0.0218	
	Plutonium-238	4(4)	0	< 0.0142	
	Plutonium-239/240	4(4)	< 0.0137	< 0.0189	
	Technetium-99	12(12)	0	< 1.88	
	Uranium	12(7)	< 0.173	0.787	
	Uranium-233/234	12(1)	< 0.102	0.426	0.177
	Uranium-235/236	12(12)	0	< 0.0237	
	Uranium-238	12(7)	< 0.0546	0.261	
005	Technetium-99	2(2)	0	< 1.06	
	Uranium	2(2)	< 0.137	< 0.239	
	Uranium-233/234	2(1)	< 0.0871	0.108	
	Uranium-235/236	2(2)	< 0.0056	< 0.0181	
	Uranium-238	2(2)	< 0.045	< 0.0774	

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2014 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
009	Americium-241	4(4)	< 0.0104	< 0.036	
	Neptunium-237	4(4)	0	< 0.0431	
	Plutonium-238	4(4)	0	< 0.0626	
	Plutonium-239/240	4(4)	0	< 0.0749	
	Technetium-99	12(12)	0	< 0.975	
	Uranium	12(0)	1.8	7.25	4.62
	Uranium-233/234	12(0)	0.759	2.82	1.92
	Uranium-235/236	12(6)	< 0.0565	0.21	
	Uranium-238	12(0)	0.591	2.4	1.53
010	Americium-241	4(4)	< 0.0138	< 0.0218	
	Neptunium-237	4(4)	0	< 0.00899	
	Plutonium-238	4(4)	0	< 0.0154	
	Plutonium-239/240	4(4)	< 0.00621	< 0.0306	
	Technetium-99	12(10)	0	17.4	
	Uranium	12(0)	0.863	3.55	2.19
	Uranium-233/234	12(0)	0.382	1.79	1.13
	Uranium-235/236	12(11)	< 0.0153	0.133	
	Uranium-238	12(0)	< 0.282	1.18	0.73
011	Americium-241	4(4)	0	< 0.0509	
	Neptunium-237	4(4)	0	< 0.00515	
	Plutonium-238	4(4)	0	0	
	Plutonium-239/240	4(4)	0	< 0.0289	
	Technetium-99	12(12)	0	< 1.39	
	Uranium	12(0)	0.944	3.13	1.85
	Uranium-233/234	12(0)	0.354	1.33	0.85
	Uranium-235/236	12(12)	< 0.0144	< 0.0776	
	Uranium-238	12(0)	0.315	1.04	0.616
015	Americium-241	4(4)	< 0.00468	< 0.019	
	Neptunium-237	4(4)	0	< 0.0153	
	Plutonium-238	4(4)	0	< 0.0199	
	Plutonium-239/240	4(4)	0	< 0.0232	
	Technetium-99	12(7)	0	34.6	
	Uranium	12(0)	0.463	1.16	0.792
	Uranium-233/234	12(0)	0.34	1.27	0.637
	Uranium-235/236	12(12)	0	< 0.092	
	Uranium-238	12(0)	0.153	0.387	0.261
608	Americium-241	4(4)	< 0.0143	< 0.0317	
	Neptunium-237	4(4)	0	< 0.00831	
	Plutonium-238	4(4)	0	< 0.00502	
	Plutonium-239/240	4(4)	< 0.0182	< 0.0301	
	Technetium-99	12(0)	157	500	289
	Uranium	12(0)	0.485	1.97	1.00
	Uranium-233/234	12(0)	0.305	0.922	0.464
	Uranium-235/236	12(12)	< 0.0111	< 0.0675	
	Uranium-238	12(0)	0.161	0.651	0.329

Table 2.1. Radionuclide concentrations in FBP and Centrus NPDES outfall water samples – 2014 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
610	Americium-241	4(4)	0	< 0.0252	
	Neptunium-237	4(4)	0	0	
	Plutonium-238	4(4)	0	< 0.00549	
	Plutonium-239/240	4(4)	< 0.011	< 0.0392	
	Technetium-99	5(0)	13.7	455	151
	Uranium	5(0)	2.83	9.4	4.52
	Uranium-233/234	5(0)	3.31	11.4	5.69
	Uranium-235/236	5(0)	0.214	0.546	0.34
	Uranium-238	5(0)	0.919	3.07	1.46
611	Americium-241	4(4)	0	< 0.0316	
	Neptunium-237	5(2)	< 0.0143	0.259	
	Plutonium-238	4(4)	0	0	
	Plutonium-239/240	4(4)	< 0.0194	< 0.0238	
	Technetium-99	12(0)	43.5	1480	577
	Uranium	12(0)	4.76	42	19.2
	Uranium-233/234	12(0)	4.05	77.4	32.4
	Uranium-235/236	12(0)	0.265	3.72	1.68
	Uranium-238	12(0)	1.55	13.5	6.19
		Centrus Outfalls			
012	Americium-241	4(4)	< 0.059	< 0.081	
	Neptunium-237	4(4)	< 0.027	< 0.072	
	Plutonium-238	4(3)	0.018	< 0.141	
	Plutonium-239/240	4(3)	0.024	< 0.128	
	Technetium-99	52(52)	< 5.52	< 9.66	
	Uranium	52(0)	0.60	1.99	1.20
013	Americium-241	4(4)	< 0.064	< 0.072	
	Neptunium-237	4(4)	< 0.056	< 0.074	
	Plutonium-238	4(4)	< 0.0536	< 0.149	
	Plutonium-239/240	4(4)	< 0.04	< 0.077	
	Technetium-99	52(52)	< 5.51	< 10	
	Uranium	52(0)	0.27	2.41	1.09

[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 and BWCS NPDES permit summaries – 2014

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/month	24-hr composite		
Chlorine, total residual	mg/L	1/week	Grab		
Dissolved solids	mg/L	1/week	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/month	24-hr composite		
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/month	24-hr composite		
FBP Outfall 002 (X-230K South Holding Pond)					
Cadmium, total recoverable	µg/L	1/month	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/month	24-hr composite		
Mercury, total	ng/L	1/month	Grab	12 (0.000074)	1700 (0.0105)
pH	SU	1/week	Grab		6.5–9.0
Oil & grease	mg/L	1/week	Grab		10
Silver, total recoverable	µg/L	1/week	24-hr composite	1.3 (0.0080)	11 (0.068)
Thallium, total recoverable	µg/L	1/week	24-hr composite	6.3 (0.039)	79 (0.49)
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	1/2 months	24-hr composite		
Acute toxicity, *Pimephales promelas*	TUa	1/2 months	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/month	24-hr composite		
Fecal coliform[c]	#/100 mL	1/week	Grab	1000	2000
Flow rate	MGD	Daily	24-hr total		
Mercury, total	ng/L	1/month	Grab		
Nitrogen, ammonia (NH_3)	mg/L	1/2 weeks	24-hr composite		
Nitrite plus nitrate	mg/L	1/month	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/month	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/month	24-hr composite		

Table 2.2. FBP and BWCS NPDES permit summaries – 2014 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 004 (Cooling Tower Blowdown)					
Acute toxicity, *Ceriodaphnia dubia*	TUa	1/2 months	24-hr composite		1
Acute toxicity, *Pimephales promelas*	TUa	1/2 months	24-hr composite		1
Chlorine, total residual	mg/L	1/week	Grab		0.038
Copper, total recoverable	µg/L	1/month	24-hr composite		
Dissolved solids	mg/L	1/week	24-hr composite	3500 (14,784)	4000 (16,896)
Flow rate	MGD	Daily	24-hr total		
Mercury, total	ng/L	1/month	Grab		
Oil & grease	mg/L	1/month	Grab	15	20
pH	SU	1/2 weeks	Grab		6.5–9.0
Total suspended solids	mg/L	1/month	24-hr composite	18 (76)	27 (114)
Zinc, total recoverable	µg/L	1/month	24-hr composite		
FBP Outfall 005 (X-611B Lime Sludge Lagoons)					
Flow rate	MGD	3/week	24-hr total (estimate)		
pH	SU	1/week	Grab		6.5–10.0
Total suspended solids[b]	mg/L	1/week	Grab	10	15
FBP Outfall 009 (X-230L North Holding Pond)					
Cadmium, total recoverable	µg/L	1/month	Grab		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/month	Grab		
Oil & grease	mg/L	1/month	Grab	10	15
pH	SU	1/week	Grab		6.5–9.0
Precipitation, total	in	Daily	24-hr total		
Total suspended solids[b]	mg/L	1/week	Grab	30	45
Zinc, total recoverable	µg/L	1/month	Grab		
FBP Outfall 010 (X-230J5 Northwest Holding Pond)					
Cadmium, total recoverable	µg/L	1/month	24-hr composite		
Flow rate	MGD	Daily	24-hr total		
Mercury, total	ng/L	1/month	Grab		
Oil & grease	mg/L	1/month	Grab	10	15
pH	SU	1/2 weeks	Grab		6.5–9.0
Precipitation, total	in	Daily	24-hr total		
Total suspended solids[b]	mg/L	1/2 weeks	24-hr composite	30	45
Zinc, total recoverable	µg/L	1/month	24-hr composite		

Table 2.2. FBP and BWCS NPDES permit summaries – 2014 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
FBP Outfall 011 (X-230J6 Northeast Holding Pond)					
Cadmium, total recoverable	µg/L	1/month	Grab		
Chlorine, total residual	mg/L	1/2 weeks	Grab		
Copper, total recoverable	µg/L	1/month	Grab		
Flow rate	MGD	Daily	24-hr total		
Fluoride, total	mg/L	1/month	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		
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)					
Flow rate	MGD	Daily	24-hr total		
PCBs	µg/L	1/quarter	Grab		*d*
pH	SU	1/2 weeks	Grab		6.5–9.0
Trichloroethene	µg/L	1/2 weeks	Grab	10	10
FBP Outfall 602 (X-621 Coal Pile Runoff Treatment Facility)					
Flow rate	MGD	Daily	24-hr total (estimate)		
Iron, total[b]	µg/L	1/2 weeks	Grab	3500	7000
Manganese, total[b]	µg/L	1/2 weeks	Grab	2000	4000
pH	SU	1/2 weeks	Grab		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		

Table 2.2. FBP and BWCS NPDES permit summaries – 2014 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
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		
Iron, total	µg/L	1/month	24-hr composite		
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		
1,2-*trans*-dichloroethene	µg/L	1/2 weeks	Grab	25	66
Trichloroethene	µg/L	1/2 weeks	Grab		10
FBP Outfall 610 (X-623 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2 weeks	Grab		
1,2-*trans*-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 902 (Downstream Far Field Monitoring)					
Water temperature	°C	2/week	24-hr maximum	*e*	*e*
FBP Monitoring Station 903 (Downstream Far Field Monitoring)					
Water temperature	°C	2/week	24-hr maximum	*e*	*e*
FBP Monitoring Station 801 (Upstream Monitoring)					
48-hr acute toxicity, *Ceriodaphnia dubia*	% affected	1/2 months	Grab		
96-hr acute toxicity, *Pimephales promelas*	% affected	1/2 months	Grab		

Table 2.2. FBP and BWCS NPDES permit summaries – 2014 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
BWCS Outfall 001 (through May 31, 2014)					
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 (45.4)
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	mg/L	1/week	24-hr composite	30 (0.9)	45 (1.4)
Water temperature	°F	Daily	Maximum	*e*	*e*
BWCS Outfall 001 (beginning on June 1, 2014)[f]					
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	*e*	*e*
BWCS Outfall 602 (beginning on June 1, 2014)					
Flow rate	GPD	Daily	24-hr total		
pH	SU	Daily	Grab		

[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.
[e]Maximum daily and monthly average limits vary according to month.
[f]These monitoring requirements and limits apply only when process water is not being discharged to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

Table 2.3. FBP NPDES discharge and compliance rates – 2014

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	-	12(3)	0.02	0.12		µg/L
Chlorine, total residual	-	48(8)	< 0.02	0.09		mg/L
Dissolved solids	-	48(0)	110	470	219	mg/L
Flow rate	-	365	0.067	2.976	0.536	MGD
Fluoride, total	-	12(0)	0.095	0.21	0.15	mg/L
Oil & grease	100	48(39)	0.9	5.3		mg/L
monthly average[d]	100	12	0	1.3		mg/L
pH	100	50	6.99	8.74	7.81	SU
Precipitation, total	-	365	0	1.56	0.11	in
Silver, total recoverable	-	12(10)	0.01	0.02		µg/L
Total suspended solids	100	48(8)	0.6	21.5		mg/L
monthly average[d]	100	12	0.6	14.3		mg/L
Zinc, total recoverable	-	12(0)	6.65	70	29	µg/L
Outfall 002 (X-230K South Holding Pond)						
Cadmium, total recoverable	-	12(6)	< 0.04	0.089		µg/L
Flow rate	-	365	0.00002	2.523	0.421	MGD
Fluoride, total	-	12(0)	0.09	0.21	0.16	mg/L
Mercury, total	100	12(0)	0.986	4.74	2.62	ng/L
monthly average[d]	100	12	0.986	4.74	2.62	ng/L
Mercury, total (loading)	100	12	5.33E-08	3.89E-05	8.69E-06	kg/day
monthly average[d]	100	12	3.99E-07	1.43E-05	4.68E-06	kg/day
Oil & grease	100	52(42)	0.875	2.4		mg/L
monthly average[d]	-	12	0	0.74		mg/L
pH	100	48	6.82	8.23	7.62	SU
Silver, total recoverable	100	48(35)	0.0115	0.0515		µg/L
monthly average[d]	100	12	0	0.024		µg/L
Silver, total recoverable (loading)	100	48	0	0.000051		kg/day
monthly average[d]	100	12	0	0.000037		kg/day
Thallium, total recoverable	100	48(36)	0.0485	0.44		µg/L
monthly average[d]	100	12	0	0.14		µg/L
Thallium, total recoverable (loading)	100	48	0	0.00065		kg/day
monthly average[d]	100	12	0	0.00030		kg/day
Total suspended solids	100	48(0)	1.8	21	7.4	mg/L
monthly average[d]	100	12	3.6	12	7.4	mg/L
Outfall 003 (X-6619 Sewage Treatment Plant)						
Acute toxicity, *Ceriodaphnia dubia*	-	6(6)	< 1	< 1		TUa
Acute toxicity, *Pimephales promelas*	-	6(6)	< 1	< 1		TUa
Carbonaceous biochemical oxygen demand, 5-day	100	48(48)	< 5	< 5		mg/L
monthly average[d]	100	12	0	0		mg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2014 (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)						
Carbonaceous biochemical oxygen demand, 5-day (loading)	100	48	0	0		kg/day
monthly average[d]	100	12	0	0		kg/day
Chlorine, total residual[b]	98	104(41)	0.01	0.63		mg/L
Copper, total recoverable	-	12(0)	1.0	3.7	2.2	µg/L
Fecal coliform[b]	100	24(0)	2	244	50	#/100 mL
monthly average[d]	100	6	13	102	50	#/100 mL
Flow rate	-	365	0.150	0.568	0.279	MGD
Mercury, total	-	12(0)	4.6	34.9	11.7	ng/L
Nitrogen, ammonia (NH_3)	-	24(7)	< 0.022	1.2		mg/L
Nitrite plus nitrate	-	12(0)	5.8	21.9	8.7	mg/L
Oil & grease	-	4(4)	< 1.7	< 2		mg/L
pH	100	206	6.68	8.01	7.22	SU
Silver, total recoverable	-	12(5)	< 0.02	0.044		µg/L
Total suspended solids	100	48(7)	< 1.1	14	2.0	mg/L
monthly average[d]	100	12	1.1	3.9	2.0	mg/L
Total suspended solids (loading)	100	48	0	15.6	2.3	kg/day
monthly average[d]	100	12	1.1	4.7	2.1	kg/day
Zinc, total recoverable	-	12(0)	14	38	22	µg/L
Outfall 004 (Cooling Tower Blowdown)						
Acute toxicity, *Ceriodaphnia dubia*	100	6(6)	< 1	< 1		TUa
Acute toxicity, *Pimephales promelas*	100	6(6)	< 1	< 1		TUa
Chlorine, total residual	98	48(29)	< 0.02	0.14		mg/L
Copper, total recoverable	-	12(0)	6.45	30	15	µg/L
Dissolved solids	100	12(0)	170	360	226	mg/L
monthly average[d]	100	12	170	360	226	mg/L
Dissolved solids (loading)	100	12	56	150	90	kg/day
monthly average[d]	100	12	68	150	92	kg/day
Flow rate	-	365	0.078	0.145	0.107	MGD
Mercury, total	-	12(0)	0.71	7.07	2.02	ng/L
Oil & grease	100	12(9)	< 1.7	2.5		mg/L
monthly average[d]	100	12	0	2.5		mg/L
pH	100	12	6.95	7.89	7.50	SU
Total suspended solids	100	12(3)	< 1	3.6		mg/L
monthly average[d]	100	12	0	3.6		mg/L
Total suspended solids (loading)	100	12	0	1.5		kg/day
monthly average[d]	100	12	0	1.5		kg/day
Zinc, total recoverable	-	12(0)	11.5	45	24	µg/L
Outfall 005 (X-611B Lime Sludge Lagoons)						
Flow rate	-	15	0.017	0.875	0.397	MGD
pH	100	4	7.45	8.06	7.88	SU
Total suspended solids	100	2(0)	1.2	3.6	2.4	mg/L
monthly average[d]	100	1	2.4			mg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2014 (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)						
Cadmium, total recoverable	-	12(7)	0.027	0.054		µg/L
Flow rate	-	365	0.511	3.503	1.572	MGD
Fluoride, total	-	12(0)	0.12	0.26	0.18	mg/L
Oil & grease	100	12(11)	< 1.7	2		mg/L
monthly average[d]	100	12	0	2		mg/L
pH	100	185	6.95	8.40	7.49	SU
Precipitation, total	-	365	0	1.56	0.11	in
Total suspended solids	100	45(0)	4.4	32	12	mg/L
monthly average[d]	100	12	6.0	23	13	mg/L
Zinc, total recoverable	-	12(0)	6.4	31	17	µg/L
Outfall 010 (X-230J5 Northwest Holding Pond)						
Cadmium, total recoverable	-	12(3)	< 0.04	0.13		µg/L
Flow rate	-	365	0.0795	0.880	0.313	MGD
Mercury, total	-	12(0)	0.5	7.05	2.98	ng/L
Oil & grease	100	18(18)	< 1.52	< 2		mg/L
monthly average[d]	100	12	0	0		mg/L
pH	100	24	6.70	8.10	7.46	SU
Precipitation, total	-	365	0	1.56	0.11	in
Total suspended solids	100	22(1)	< 1.1	22	7.3	mg/L
monthly average[d]	100	11	2	17	7.7	mg/L
Zinc, total recoverable	-	12(0)	7.6	56	26	µg/L
Outfall 011 (X-230J6 Northeast Holding Pond)						
Cadmium, total recoverable	-	12(3)	< 0.04	0.17		µg/L
Chlorine, total residual	-	24(7)	< 0.02	0.05		mg/L
Copper, total recoverable	-	12(0)	0.59	7.1	2.0	µg/L
Flow rate	-	365	0.001	0.345	0.055	MGD
Fluoride, total	-	12(0)	0.14	0.26	0.20	mg/L
Oil & grease	100	24(20)	< 1.6	1.9		mg/L
monthly average[d]	100	12	0	1.9		mg/L
pH	100	27	6.60	8.92	7.73	SU
Precipitation, total	-	365	0	1.56	0.11	in
Total suspended solids	100	24(1)	< 1.1	16	4.2	mg/L
monthly average[d]	100	12	1.3	11	4.4	mg/L
Zinc, total recoverable	-	12(0)	2	64	20	µg/L
Outfall 015 (X-624 Groundwater Treatment Facility)						
Flow rate	-	364	0.0009	0.0294	0.0064	MGD
pH	100	24	7.16	7.92	7.47	SU
Trichloroethene	100	24(1)	< 0.16	3.4	1.1	µg/L
monthly average[d]	100	12	0.518	3.3	1.1	µg/L
PCBs	-	4(4)	< 0.1	< 0.11		µg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2014 (continued)

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
Outfall 602 (X-621 Coal Pile Runoff Treatment Facility)						
Flow rate	-	34	0.001	0.165	0.073	MGD
Iron, total	100	12(0)	100	450	270	µg/L
monthly average[d]	100	8	100	390	260	µg/L
Manganese, total	100	12(0)	94	310	150	µg/L
monthly average[d]	100	8	97	240	150	µg/L
pH	100	12	7.38	9.51	8.02	SU
Precipitation, total	-	304	0	1.72	0.10	in
Total suspended solids	100	12(0)	7.6	16	12	mg/L
monthly average[d]	100	8	7.6	14	11	mg/L
Outfall 604 (X-700 Biodenitrification Facility)						
Copper, total	-	5(0)	1.3	3.5	2.3	µg/L
Iron, total	-	5(0)	140	430	230	µg/L
Flow rate	-	34	0.0005	0.0111	0.0104	MGD
Nickel, total	-	5(0)	0.31	1.2	0.86	µg/L
Nitrogen, nitrate	-	5(1)	< 0.1	28.6		mg/L
pH	100	4	7.17	8.09	7.55	SU
Zinc, total	-	5(0)	5.7	15	9.3	µg/L
Outfall 605 (X-705 Microfiltration Treatment System)						
Chromium, hexavalent	-	1(1)	< 0.01			µg/L
Chromium, total	-	1(1)	< 0.88			µg/L
Copper, total	-	1(0)	6.3			µg/L
Flow rate	-	3	0.0043	0.0112	0.0075	MGD
Iron, total	-	1(1)	< 22			µg/L
Nickel, total	-	1(0)	11			µg/L
Nitrogen, ammonia (NH_3)	-	1(0)	0.22			mg/L
Nitrogen, nitrate	-	1(0)	5.26			mg/L
Nitrogen, nitrite	-	1(1)	< 0.1			mg/L
Nitrogen, Kjeldahl	-	1(0)	0.45			mg/L
Oil & grease	-	1(1)	< 1.8			mg/L
pH	100	1	7.80			SU
Sulfate (SO_4)	-	1(0)	40			mg/L
Total suspended solids	100	1(1)	< 1.1			mg/L
monthly average[d]	100	1	0			mg/L
Trichloroethene	-	1(1)	< 0.16			µg/L
Zinc, total	-	1(0)	6.7			µg/L
Outfall 608 (X-622 Groundwater Treatment Facility)						
Flow rate	-	365	0.0193	0.0897	0.0471	MGD
pH	-	25	6.85	8.25	7.60	SU
Trichloroethene	100	24(0)	1.15	5.3	2.1	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	-	6	0.0011	0.0079	0.0036	MGD
pH	-	5	5.86	7.30	6.69	SU
Trichloroethene	100	5(2)	< 0.16	1.8		µg/L
monthly average[d]	100	5	0	1.8		µg/L
1,2-*trans*-dichloroethene	100	5(5)	< 0.15	< 0.15		µg/L
monthly average[d]	100	5	0	0		µg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2014 (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	0.0144	0.0620	0.0298	MGD
pH	-	24	7.25	8.23	7.77	SU
Trichloroethene	100	24(3)	< 0.16	10	2.2	µg/L
monthly average[d]	100	12	0	8.8	2.2	µg/L
Monitoring Station 801 (Upstream Monitoring)						
48-hr acute toxicity, *Ceriodaphnia dubia*	-	6(5)	0	5		% affected
96-hr acute toxicity, *Pimephales promelas*	-	6(5)	0	10		% affected
Monitoring Station 902 (Downstream Far Field Monitoring)						
Water temperature	99	98	0	30.3	16	°C
monthly average	100	12	2.5	27	16	°C
Monitoring Station 903 (Downstream Far Field Monitoring)						
Water temperature	100	96	-0.5	28.8	15	°C
monthly average	100	12	1.5	26	15	°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.
Some 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 2.4. BWCS NPDES discharge and compliance rates – 2014

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
Outfall 001 (January 1, 2015 – May 31, 2015)						
Biochemical oxygen demand	-	12(5)	< 1	3.93		mg/L
Chlorine, total residual	100	103(0)	0.01625	0.02125	0.019	mg/L
Dissolved solids	92	32(0)	376	4430	1062	mg/L
Dissolved solids (loading)	75	12	13.7	241	53.2	kg/day
Flow rate	-	151	500	228,820	6549	GPD
Nitrogen-ammonia	-	12(0)	0.0416	0.243	0.103	mg/L
Oil and grease	-	5(1)	< 1.11	1.88		mg/L
pH	100	103	6.51	7.30	6.74	SU
Phosphorus, total	-	12(3)	< 0.017	1.36		mg/L
Total suspended solids	100	12(0)	1.5	24.4	6.8	mg/L
monthly average[d]	100	5	4.2	13.1	7.4	mg/L
Total suspended solids (loading)	92	12	0.045	2.4	0.41	kg/day
monthly average[d]	100	5	0.07	0.33	0.14	kg/day
Temperature	100	103	37.9	66.0	49.1	°F
monthly average	100	5	41	61.5	48.9	°F
Outfall 602 (June 1, 2015 – December 31, 2015)						
Flow rate	-	214	1227	14,917	6699	GPD
pH	-	150	6.15	8.24	6.61	SU

[a]Compliance rates are provided only for those parameters with a limit specified in the NPDES permit (many parameters require monitoring only).
[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.

Table 2.5. Centrus NPDES discharge monitoring results – 2014

Parameter	Number of samples[a]	Concentration			Units
		Minimum	Maximum	Average[b]	
Outfall 012 (X-230M Southwest Holding Pond)					
Cadmium	12(0)	0.093	0.58	0.25	µg/L
Chlorine	24(2)	< 0.01	0.08	0.03	mg/L
Copper	12(0)	0.73	2.7	1.6	µg/L
Flow rate	365	0.0268	1.479	0.199	MGD
Iron	12(0)	170	1500	618	µg/L
Oil and grease	25(22)	< 1.6	3.8		mg/L
PCBs, total	1(1)	< 0.094			µg/L
pH	25	7.11	8.69	7.68	SU
Selenium	12(12)	< 1	< 1		µg/L
Silver	12(8)	< 0.02	0.035		µg/L
Suspended solids	25(1)	< 1.1	17	6.7	mg/L
Thallium	12(8)	< 0.066	0.23		µg/L
Trichloroethene	12(12)	< 0.016	< 0.16		µg/L
Outfall 013 (X-230N West Holding Pond)					
Antimony	12(0)	0.24	1.0	0.58	µg/L
Arsenic	12(2)	< 0.5	1.4		µg/L
Chlorine	24(0)	0.01	0.07	0.03	mg/L
Copper	12(0)	0.54	2.3	1.6	µg/L
Flow rate	365	0.0052	1.318	0.141	MGD
Oil and grease	24(20)	< 1.6	4.7		mg/L
PCBs, total	1(1)	< 0.1			µg/L
pH	24	7.14	8.48	7.83	SU
Suspended solids	24(4)	< 1.1	12		mg/L
Thallium	12(9)	< 0.066	0.27		µg/L
Zinc	12(0)	3.7	46	19	µg/L
Outfall 613 (X-6002 Particulate Separator)					
Chlorine	19(0)	0	1.06	0.11	mg/L
Flow rate	303	0	0.220	0.0010	MGD
Suspended solids	19(0)	2	28	8	mg/L

[a]Number in parentheses is the number of samples that were below the detection limit.
[b]Averages were not calculated for outfalls that had greater than 15% of the results below the detection limit. 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 2.6. Radionuclides in surface water runoff samples from FBP and BWCS cylinder storage yards – 2014

Sample location	Parameter	Units	Number of samples[a]	Minimum[b]	Maximum	Average[c]
			FBP cylinder storage yards			
X745-B1	Alpha activity	pCi/L	10(3)	< 0.712	77.1	`
	Beta activity	pCi/L	10(0)	3.72	110	23.0
	Uranium	µg/L	10(0)	0.24	2.4	0.77
X745-B2	Alpha activity	pCi/L	10(1)	< 1.82	108	26.9
	Beta activity	pCi/L	10(0)	5.43	111	25.5
	Uranium	µg/L	10(0)	6.17	62.1	25.9
X745-B3	Alpha activity	pCi/L	9(1)	< 0.86	711	104.8
	Beta activity	pCi/L	9(0)	6.51	794	125.5
	Uranium	µg/L	9(0)	0.15	48.8	7.2
X745-D1	Alpha activity	pCi/L	12(9)	0	9.7	
	Beta activity	pCi/L	12(2)	< 2.79	19	
	Uranium	µg/L	12(0)	0.48	7.85	2.23
X745-F1	Alpha activity	pCi/L	12(9)	< 0.504	32.3	
	Beta activity	pCi/L	12(2)	< 2.39	62	
	Uranium	µg/L	12(0)	0.21	3.78	1.65
X745-F2	Alpha activity	pCi/L	12(5)	< 1.73	23.2	
	Beta activity	pCi/L	12(1)	4.49	30.3	10.7
	Uranium	µg/L	12(0)	1.4	5.4	3.13
X745-F3	Alpha activity	pCi/L	12(4)	< 0.2	8.07	
	Beta activity	pCi/L	12(2)	2.6	18.9	
	Uranium	µg/L	12(0)	1.38	7.36	3.63
			BWCS cylinder storage yards			
X745-C1	Alpha activity	pCi/L	12(4)	< 0.106	17	
	Beta activity	pCi/L	12(1)	< 1.09	22	5.07
	Uranium	µg/L	12(0)	0.87	38	5.7
X745-C2	Alpha activity	pCi/L	11(5)	0	5.44	
	Beta activity	pCi/L	11(0)	1.32	6.25	3.07
	Uranium	µg/L	11(0)	0.73	14	4.0
X745-C3	Alpha activity	pCi/L	12(8)	0	2.74	
	Beta activity	pCi/L	12(0)	1.13	3.46	2.34
	Uranium	µg/L	12(2)	< 0.23	9.0	
X745-C4	Alpha activity	pCi/L	11(5)	< 0.652	5.72	
	Beta activity	pCi/L	11(0)	1.49	7.62	3.82
	Uranium	µg/L	11(0)	0.52	11	3.4
X745-E1	Alpha activity	pCi/L	11(7)	< 0.493	2.31	
	Beta activity	pCi/L	11(0)	2.01	6.92	4.93
	Uranium	µg/L	11(3)	< 0.23	1.8	

Table 2.6. Radionuclides in surface water runoff samples from FBP and BWCS cylinder storage yards – 2014

Sample location	Parameter	Units	Number of samples[a]	Minimum[b]	Maximum	Average[c]
BWCS cylinder storage yards (continued)						
X745-G1A	Alpha activity	pCi/L	11(8)	< 0.555	4.57	
	Beta activity	pCi/L	11(0)	2.49	14.9	5.50
	Uranium	µg/L	11(0)	0.90	3.3	2.2
X745-G2	Alpha activity	pCi/L	11(9)	< 0.221	2.36	
	Beta activity	pCi/L	11(0)	1.25	9.32	3.09
	Uranium	µg/L	11(1)	< 0.23	3.0	1.3

[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 2.7. Drainage basin monitoring of surface water and sediment for BWCS cylinder storage yards – 2014

Location	Parameter[a]	First quarter[b]			Second quarter[b]		
		SW-F	SW-UF	Sed	SW-F	SW-UF	Sed
UDS X01	PCB-1242	0.23U	0.23U	11U	0.23U	0.23U	13U
	PCB-1248	0.23U	0.23U	11U	0.23U	0.23U	13U
	PCB-1254	0.16U	0.16U	7.2U	0.16U	0.16U	8.2U
	PCB-1260	0.16U	0.16U	7.2U	0.16U	0.16U	8.2U
	PCB-1262	0.16U	0.16U	7.2U	0.16U	0.16U	8.2U
	PCB-1268	0.16U	0.16U	7.2U	0.16U	0.16U	8.2U
	Total PCB[c]	0.16U	0.16U	7.2U	0.16U	0.16U	8.2U
RM-8	PCB-1242	0.23U	0.23U	10U	0.23U	0.23U	13U
	PCB-1248	0.23U	0.23U	10U	0.23U	0.23U	13U
	PCB-1254	0.16U	0.16U	6.4U	0.16U	0.16U	8.3U
	PCB-1260	0.16U	0.16U	6.4U	0.16U	0.16U	30J
	PCB-1262	0.16U	0.16U	6.4U	0.16U	0.16U	8.3U
	PCB-1268	0.16U	0.16U	6.4U	0.16U	0.16U	8.3U
	Total PCB[c]	0.16U	0.16U	6.4U	0.16U	0.16U	30J
UDS X02	PCB-1242	0.23U	0.23U	11U	0.23U	0.24U	13U
	PCB-1248	0.23U	0.23U	11U	0.23U	0.24U	13U
	PCB-1254	0.16U	0.16U	7.1U	0.16U	0.16U	8.0U
	PCB-1260	0.16U	0.16U	120	0.16U	0.16U	49P
	PCB-1262	0.16U	0.16U	7.1U	0.16U	0.16U	8.0U
	PCB-1268	0.16U	0.16U	7.1U	0.16U	0.16U	8.0U
	Total PCB[c]	0.16U	0.16U	120	0.16U	0.16U	49P
RM-10	PCB-1242	0.24U	0.25U	11U	0.23U	0.23U	11U
	PCB-1248	0.24U	0.25U	11U	0.23U	0.23U	11U
	PCB-1254	0.16U	0.17U	7.2U	0.16U	0.16U	6.8U
	PCB-1260	0.16U	0.17U	7.2U	0.16U	0.16U	6.8U
	PCB-1262	0.16U	0.17U	7.2U	0.16U	0.16U	6.8U
	PCB-1268	0.16U	0.17U	7.2U	0.16U	0.16U	6.8U
	Total PCB[c]	0.16U	0.17U	7.2U	0.16U	0.16U	6.8U

Table 2.7. Drainage basin monitoring of surface water and sediment for BWCS cylinder storage yards – 2014 (continued)

Location	Parameter[a]	Third quarter[b]			Fourth quarter[b]		
		SW-F	SW-UF	Sed	SW-F	SW-UF	Sed
UDS X01	PCB-1242	0.23U	0.23U	12U	0.23U	0.23U	11U
	PCB-1248	0.23U	0.23U	12U	0.23U	0.23U	11U
	PCB-1254	0.16U	0.16U	10U	0.16U	0.16U	9.2U
	PCB-1260	0.16U	0.16U	10U	0.16U	0.16U	9.2U
	PCB-1262	0.16U	0.16U	15J	0.16U	0.16U	9.2U
	PCB-1268	0.16U	0.16U	10U	0.16U	0.16U	9.2U
	Total PCB[c]	0.16U	0.16U	15JP	0.16U	0.16U	9.2U
RM-8	PCB-1242	0.23U	0.23U	12U	0.23U	0.23U	16U
	PCB-1248	0.23U	0.23U	12U	0.23U	0.23U	16U
	PCB-1254	0.16U	0.16U	10U	0.16U	0.16U	14U
	PCB-1260	0.16U	0.16U	16J	0.16U	0.16U	14U
	PCB-1262	0.16U	0.16U	10U	0.16U	0.16U	14U
	PCB-1268	0.16U	0.16U	10U	0.16U	0.16U	14U
	Total PCB[c]	0.16U	0.16U	16J	0.16U	0.16U	14U
UDS X02	PCB-1242	0.23U	0.23U	12U	0.23U	0.23U	11U
	PCB-1248	0.23U	0.23U	12U	0.23U	0.23U	11U
	PCB-1254	0.16U	0.16U	10U	0.16U	0.16U	8.8U
	PCB-1260	0.16U	0.16U	440	0.16U	0.16U	21J
	PCB-1262	0.16U	0.16U	10U	0.16U	0.16U	8.8U
	PCB-1268	0.16U	0.16U	10U	0.16U	0.16U	8.8U
	Total PCB[c]	0.16U	0.16U	440	0.16U	0.16U	21J
RM-10	PCB-1242	0.23U	0.23U	12U	0.25U	0.25U	12U
	PCB-1248	0.23U	0.23U	12U	0.25U	0.25U	12U
	PCB-1254	0.16U	0.16U	10U	0.17U	0.17U	10U
	PCB-1260	0.16U	0.16U	10U	0.17U	0.17U	10U
	PCB-1262	0.16U	0.16U	10U	0.17U	0.17U	10U
	PCB-1268	0.16U	0.16U	10U	0.17U	0.17U	10U
	Total PCB[c]	0.16U	0.16U	10U	0.17U	0.17U	10U

[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 practical quantitation limit; P – the relative percent difference between the primary and confirmation column exceeded 40%. The lower value has been reported; U – undetected.
[c]Total PCBs are the sum of PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, PCB-1260, PCB-1262, and PCB-1268. PCB-1016, PCB-1221, and PCB-1232 were not detected in any of the samples.

Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2014

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c]	Average[c, e]
		On-site air samplers			
A8	Americium-241	4(4)	5.9E-07	4.5E-06	
	Fluoride	52(41)	1.0E-02	2.1E-02	
	Neptunium-237	4(4)	0	1.9E-06	
	Plutonium-238	4(4)	0	2.4E-06	
	Plutonium-239/240	4(4)	6.4E-07	4.2E-06	
	Technetium-99	12(0)	1.1E-03	2.7E-02	1.3E-02
	Uranium	12(2)	1.6E-05	6.9E-05	
	Uranium-233/234	12(1)	0	1.1E-04	3.5E-05
	Uranium-235/236	12(11)	1.1E-06	7.2E-06	
	Uranium-238	12(2)	5.1E-06	2.2E-05	
A10	Americium-241	4(4)	1.7E-06	4.4E-06	
	Fluoride	52(44)	1.2E-02	2.2E-02	
	Neptunium-237	4(4)	0	4.0E-06	
	Plutonium-238	4(4)	0	6.2E-07	
	Plutonium-239/240	4(4)	0	3.6E-06	
	Technetium-99	12(0)	2.9E-04	2.3E-02	9.4E-03
	Uranium	12(4)	2.2E-05	5.0E-05	
	Uranium-233/234	12(1)	4.8E-07	1.6E-04	4.6E-05
	Uranium-235/236	12(10)	0	1.8E-05	
	Uranium-238	12(4)	8.3E-06	3.4E-05	
A29	Americium-241	4(4)	5.6E-07	1.7E-06	
	Fluoride	53(39)	8.4E-03	7.0E-02	
	Neptunium-237	4(4)	0	6.9E-07	
	Plutonium-238	4(4)	0	9.4E-07	
	Plutonium-239/240	4(4)	5.8E-07	3.0E-06	
	Technetium-99	12(0)	1.7E-03	2.1E-02	1.5E-02
	Uranium	12(0)	1.8E-05	8.6E-05	5.1E-05
	Uranium-233/234	12(1)	1.5E-06	1.1E-04	3.8E-05
	Uranium-235/236	12(11)	0	1.3E-05	
	Uranium-238	12(0)	1.0E-05	4.0E-05	2.0E-05
A36	Americium-241	4(4)	1.4E-06	6.5E-06	
	Fluoride	51(41)	6.3E-03	2.7E-02	
	Neptunium-237	4(4)	0	6.5E-07	
	Plutonium-238	4(4)	0	6.1E-07	
	Plutonium-239/240	4(4)	6.2E-07	2.6E-06	
	Technetium-99	12(0)	1.4E-03	8.5E-03	5.3E-03
	Uranium	12(1)	2.9E-05	9.5E-05	4.8E-05
	Uranium-233/234	12(1)	3.4E-06	2.6E-04	7.8E-05
	Uranium-235/236	12(12)	0	1.1E-05	
	Uranium-238	12(1)	9.2E-06	3.0E-05	1.6E-05
A40A	Fluoride	46(36)	1.3E-02	4.2E-02	

Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2014 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c]	Average[c, e]
		On-site air samplers			
T7	Americium-241	4(4)	2.2E-06	4.1E-06	
	Neptunium-237	4(4)	0	7.0E-07	
	Plutonium-238	3(3)	0	1.2E-06	
	Plutonium-239/240	3(3)	1.1E-06	3.0E-06	
	Technetium-99	12(0)	8.0E-04	1.9E-02	6.9E-03
	Uranium	12(6)	9.9E-06	4.4E-05	
	Uranium-233/234	12(1)	2.9E-06	7.5E-05	2.5E-05
	Uranium-235/236	12(11)	0	7.3E-06	
	Uranium-238	12(6)	3.8E-06	2.3E-05	
		Off-site air samplers			
A3	Americium-241	4(4)	1.2E-06	6.7E-06	
	Fluoride	52(35)	1.2E-02	5.2E-02	
	Neptunium-237	4(4)	0	1.4E-06	
	Plutonium-238	4(4)	0	2.5E-06	
	Plutonium-239/240	4(4)	6.8E-07	3.5E-06	
	Technetium-99	12(0)	1.8E-03	2.3E-02	1.1E-02
	Uranium	12(0)	1.9E-05	5.7E-05	4.6E-05
	Uranium-233/234	12(1)	2.6E-06	8.3E-05	4.1E-05
	Uranium-235/236	12(11)	5.7E-07	1.1E-05	
	Uranium-238	12(0)	1.1E-05	3.4E-05	1.7E-05
A6	Americium-241	4(4)	3.8E-06	7.0E-06	
	Fluoride	53(44)	1.2E-02	2.4E-02	
	Neptunium-237	4(4)	0	2.1E-06	
	Plutonium-238	4(4)	0	1.4E-06	
	Plutonium-239/240	4(4)	1.3E-06	3.1E-06	
	Technetium-99	12(0)	4.1E-03	2.6E-02	1.1E-02
	Uranium	12(0)	1.3E-05	7.3E-05	4.5E-05
	Uranium-233/234	12(2)	2.0E-06	3.5E-05	
	Uranium-235/236	12(11)	0	1.6E-05	
	Uranium-238	12(0)	1.2E-05	4.9E-05	1.8E-05
A9	Americium-241	4(4)	5.5E-07	4.4E-06	
	Fluoride	44(36)	1.0E-02	6.3E-02	
	Neptunium-237	4(4)	0	7.6E-07	
	Plutonium-238	4(4)	0	1.2E-06	
	Plutonium-239/240	4(4)	0	3.6E-06	
	Technetium-99	12(2)	8.7E-05	2.5E-02	
	Uranium	12(0)	1.6E-05	1.2E-04	7.4E-05
	Uranium-233/234	12(1)	2.6E-06	6.4E-05	3.6E-05
	Uranium-235/236	12(11)	0	1.5E-05	
	Uranium-238	12(0)	1.9E-05	4.6E-05	2.8E-05

Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2014 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c]	Average[c, e]
A12	Americium-241	4(4)	0	3.4E-06	
	Fluoride	51(35)	1.1E-02	4.5E-02	
	Neptunium-237	4(4)	0	6.7E-07	
	Plutonium-238	4(4)	0	1.8E-06	
	Plutonium-239/240	4(4)	1.9E-06	5.3E-06	
	Technetium-99	12(0)	5.2E-03	2.1E-02	9.7E-03
	Uranium	12(0)	1.8E-05	7.4E-05	4.6E-05
	Uranium-233/234	12(1)	8.0E-07	1.1E-04	4.4E-05
	Uranium-235/236	12(11)	5.0E-07	8.6E-06	
	Uranium-238	12(0)	8.9E-06	2.4E-05	1.6E-05
A15	Americium-241	4(4)	1.9E-06	7.7E-06	
	Fluoride	50(46)	1.1E-02	1.9E-02	
	Neptunium-237	4(4)	0	5.5E-06	
	Plutonium-238	4(4)	0	1.3E-06	
	Plutonium-239/240	4(4)	1.2E-06	4.1E-06	
	Technetium-99	12(0)	1.9E-03	2.1E-02	8.5E-03
	Uranium	12(3)	1.4E-05	5.7E-05	
	Uranium-233/234	12(1)	5.4E-07	5.1E-05	2.8E-05
	Uranium-235/236	12(11)	0	9.5E-06	
	Uranium-238	12(3)	4.5E-06	2.9E-05	
A23	Americium-241	4(4)	1.2E-06	5.2E-06	
	Fluoride	51(43)	3.6E-03	2.9E-02	
	Neptunium-237	4(4)	0	1.5E-06	
	Plutonium-238	4(4)	0	1.2E-06	
	Plutonium-239/240	4(4)	2.1E-06	3.7E-06	
	Technetium-99	12(0)	1.9E-03	2.2E-02	1.0E-02
	Uranium	12(0)	3.8E-05	7.1E-05	5.0E-05
	Uranium-233/234	12(1)	0	1.1E-04	4.7E-05
	Uranium-235/236	12(11)	9.5E-07	1.5E-05	
	Uranium-238	12(0)	1.2E-05	4.5E-05	1.9E-05
A24	Americium-241	4(4)	1.7E-06	3.7E-06	
	Fluoride	49(34)	1.3E-02	3.0E-02	
	Neptunium-237	4(4)	0	1.4E-06	
	Plutonium-238	4(4)	0	1.2E-06	
	Plutonium-239/240	4(4)	1.2E-06	6.1E-06	
	Technetium-99	12(0)	9.3E-04	3.0E-02	1.4E-02
	Uranium	12(0)	3.0E-05	1.3E-04	6.3E-05
	Uranium-233/234	12(1)	1.5E-06	1.4E-04	5.2E-05
	Uranium-235/236	12(11)	5.0E-07	3.5E-05	
	Uranium-238	12(1)	9.9E-06	1.0E-04	2.8E-05

Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2014 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
A28	Americium-241	4(4)	1.8E-06	5.3E-06	
	Fluoride	53(40)	1.3E-02	2.3E-02	
	Neptunium-237	4(4)	0	2.5E-06	
	Plutonium-238	4(4)	0	2.0E-06	
	Plutonium-239/240	4(4)	1.7E-06	6.1E-06	
	Technetium-99	12(0)	1.8E-03	2.3E-02	1.2E-02
	Uranium	12(1)	9.5E-06	5.7E-05	4.0E-05
	Uranium-233/234	12(1)	1.6E-06	7.4E-05	1.9E-05
	Uranium-235/236	12(11)	0	8.2E-06	
	Uranium-238	12(1)	8.8E-06	2.5E-05	1.5E-05
A37 (background)	Americium-241	4(4)	0	4.5E-06	
	Fluoride	53(38)	1.3E-02	2.9E-02	
	Neptunium-237	4(4)	0	1.2E-06	
	Plutonium-238	4(4)	0	2.4E-06	
	Plutonium-239/240	4(4)	1.2E-06	4.0E-06	
	Technetium-99	12(0)	7.6E-04	2.4E-02	8.2E-03
	Uranium	12(3)	7.4E-06	4.6E-05	
	Uranium-233/234	12(2)	5.4E-07	1.9E-05	
	Uranium-235/236	12(12)	4.7E-07	7.0E-06	
	Uranium-238	12(3)	6.2E-06	2.1E-05	
A41A[f]	Americium-241	3(3)	5.6E-07	3.0E-06	
	Fluoride	37(21)	1.4E-02	3.0E-02	
	Neptunium-237	3(3)	0	6.9E-07	
	Plutonium-238	3(3)	0	4.1E-06	
	Plutonium-239/240	3(3)	1.1E-06	2.3E-06	
	Technetium-99	9(0)	1.1E-03	2.6E-02	1.4E-02
	Uranium	9(0)	1.6E-05	6.9E-05	4.7E-05
	Uranium-233/234	9(1)	9.6E-07	4.7E-05	2.3E-05
	Uranium-235/236	9(8)	0	1.3E-05	
	Uranium-238	9(0)	9.2E-06	3.8E-05	1.9E-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).
[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.
[f]Station A41A in Zahns Corner that replaced Station A41 began operation in April 2014.

Table 2.9. External radiation monitoring program (mrem) – 2014

Location	First quarter	Second quarter	Third quarter	Fourth quarter	Cumulative annual whole body dose[a]
#1404A	19	21	20	22	82
#518	19	20	21	23	83
#862	28	36	33	32	129
#874	122	192	142	185	641
#906	16	19	18	19	72
#933	45	35	40	42	162
A12	20	21	21	24	86
A15	20	23	22	25	90
A23	19	20	22	22	83
A24	21	21	23	25	90
A28	19	21	21	22	83
A29	21	23	24	24	92
A3	18	19	19	22	78
A36	22	21	20	24	87
A40A	20	nr[b]	22	25	89
A6	19	22	20	21	82
A8	22	24	24	26	96
A9	20	28	19	23	90
X-230J2	22	22	21	26	91
Control[c]	15	15	13	16	59
Trip blank[c]	16	18	16	19	69

[a]The annual occupational whole body dose limit set by Title 10 of the *Code of Federal Regulations* Part 20 is 5000 mrem.
[b]Not reported. The dosimeter was missing at the end of the quarter. The cumulative dose was calculated using the average dose for the remaining quarters for the missing measurement.
[c]The control dosimeter is sent from the laboratory at the beginning of the quarter, remains at PORTS throughout the quarter in a low background location, and is returned to the laboratory with the other dosimeters at the end of the quarter. The trip blank dosimeter is sent from the laboratory at the beginning of the quarter, accompanies the sample team to the field locations at the beginning and end of each quarter and is returned to the laboratory with the other dosimeters at the end of the quarter. The control and trip blank measurements are an indication of background radiation.

Table 2.10. External radiation monitoring (mrem) at locations near cylinder storage yards – 2014

Location	First quarter[a]			Second quarter[a]		
	Deep[b]	N[c]	Shallow[d]	Deep[b]	N[c]	Shallow[d]
#41	142	ND	142	148	ND	148
#868	279	ND	279	397	32	397
#874	125	ND	125	168	ND	168
#882	229	ND	229	261	ND	261
#890	64	ND	64	64	ND	64
Trip blank	15	ND	15	16	ND	16

Location	Third quarter[a]			Fourth quarter[a]			Annual (total)[a]		
	Deep[b]	N[c]	Shallow[d]	Deep[b]	N[c]	Shallow[d]	Deep[b]	N[c]	Shallow[d]
#41	145	ND	145	166	ND	166	601	ND	601
#868	319	ND	391	355	ND	355	1350	32	1350
#874	147	ND	147	175	ND	175	615	ND	615
#882	265	ND	265	316	26	316	1071	26	1071
#890	56	ND	56	97	33	97	281	33	281
Trip blank	15	ND	15	18	ND	18	64	ND	64

[a]ND – not detected above the minimum reportable dose.
[b]Deep dose (dose equivalent at a tissue depth of 1 centimeter [cm]) applies to external whole body exposure. Dose is reported for photon energies from approximately 10 kilo-electron volts (keV) to 6 mega-electron volts (MeV) and includes neutron dose (if present).
[c]Neutron component of deep dose.
[d]Shallow dose (dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 square cm) applies to exposure of the skin or an extremity. It includes the dose for beta particles and photons. Extremity doses are based on 662 keV photons. Neutron dose is included if present.

Table 2.11. Settleable solids monitoring results – 2014

Sampling location	Parameter[a]	Unit	Results[b] April	Results[b] November
Little Beaver Creek				
EDD-SW01 (FBP Outfalls 001& 015)	Settleable solids	mg/L	4.4	12.5
	Suspended solids	mg/L	4.4	12.5
FBP Outfall 005	Settleable solids	mg/L	6.7	ns
	Suspended solids	mg/L	12.4	ns
FBP Outfall 009	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	8.4	6.4
FBP Outfall 011	Settleable solids	mg/L	4U	5
	Suspended solids	mg/L	4U	5
Big Run Creek				
FBP Outfall 002	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	9.3	7.9
Scioto River				
ACP NPDES Outfall 012	Settleable solids	mg/L	4U 4U[c]	4U 4U[c]
	Suspended solids	mg/L	4.5 4U[c]	4U 4U[c]
WDD-SW03 (FBP Outfall 010 & ACP Outfall 013)	Settleable solids	mg/L	4.4	4U
	Suspended solids	mg/L	4.4	4U
FBP Outfall 003	Settleable solids	mg/L	9.7	4U
	Suspended solids	mg/L	14.2	4U
FBP Outfall 004	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	4U	6.2
Background locations				
RW-6 (Scioto River)	Settleable solids	mg/L	12.8	4U
	Suspended solids	mg/L	30	4U
RW-5 (Big Beaver Creek)	Settleable solids	mg/L	4U	4U
	Suspended solids	mg/L	4U	7.9
LBC-SW12 (Little Beaver Creek)	Settleable solids	mg/L	4U 4U[c]	7.5 4U[c]
	Suspended solids	mg/L	4U 4U[c]	7.5 4U[c]

[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: ns – not sampled (the outfall was not in use when samples were collected). U – undetected.
[c]This result is for the duplicate sample collected from this location. A duplicate sample is a sample collected from the same location at the same time and using the same sampling device (if possible) as the regular sample.

Table 2.12. Local surface water monitoring program results – 2014

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]	
Scioto River	Americium-241	0.0211U	0.0249U	
RW-1	Neptunium-237	0.0225U	0U	
(downstream)	Plutonium-238	0.0153U	0.00552U	
	Plutonium-239/240	0.0204U	0.0166U	
	Technetium-99	0.259U	-1.08U	
	Uranium	2	0.536J	
	Uranium-233/234	0.635	0.314	
	Uranium-235/236	0.0346U	0.0189U	
	Uranium-238	0.668	0.177	
Scioto River	Americium-241	0.0229U	0.01U	
RW-6	Neptunium-237	0.0257U	0.00508U	
(upstream)	Plutonium-238	0.00539U	0.00572U	
	Plutonium-239/240	0.0216U	0U	
	Technetium-99	-0.348U	-0.405U	
	Uranium	2.24	1.6	
	Uranium-233/234	0.72	0.624	
	Uranium-235/236	0.062UJ	0.0196U	
	Uranium-238	0.742	0.535	
Little Beaver	Americium-241	0.055U	-0.0152U	
Creek	Neptunium-237	0.0142U	0.0105U	
RW-7	Plutonium-238	0.00973U	-0.0215U	
(downstream)	Plutonium-239/240	0.0146U	0.0161U	
	Technetium-99	-0.0113U	-0.539U	
	Uranium	0.226UJ	0.194U	
	Uranium-233/234	0.147UJ	0.127	
	Uranium-235/236	0U	0.0121U	
	Uranium-238	0.0761UJ	0.0634U	
RW-8	Americium-241	0U	0.0163U	
(downstream)	Neptunium-237	0.0537U	0.0253U	
	Plutonium-238	-0.0052U	0.0169U	
	Plutonium-239/240	0.0052U	0.0112U	
	Technetium-99	1.88U	1.55U	
	Uranium	1.23	2.24	
	Uranium-233/234	1.33	2.62	
	Uranium-235/236	0.0509UJ	0.114U	
	Uranium-238	0.404	0.736	
RW-12	Americium-241	0.0148U	0.0304U	0.0254U[d]
(upstream)	Neptunium-237	0U	-0.00515U	-0.00447U[d]
	Plutonium-238	-0.00953U	-0.00513U	0U[d]
	Plutonium-239/240	0.0143U	0.0205U	0.00483U[d]
	Technetium-99	-0.518U	-1.1U	-3.98E-15U[d]
	Uranium	0.132U	0.215U	0.126U[d]
	Uranium-233/234	0.0162U	0.11	0.089U[d]
	Uranium-235/236	0.00674U	0.0228U	0.0184U[d]
	Uranium-238	0.0433U	0.0688U	0.0395U[d]

Table 2.12. Local surface water monitoring program results – 2014 (continued)

Location	Parameter[a]	Second quarter[b,c]		Fourth quarter[b,c]
Big Beaver Creek RW-13 (downstream)	Americium-241	0.0179U	-0.0179U[d]	-0.0105U
	Neptunium-237	0.00968U	0.0253U[d]	0U
	Plutonium-238	0.0162U	0.0105U[d]	-0.00533U
	Plutonium-239/240	0.00541U	0.00526U[d]	0.032U
	Technetium-99	6.63UJ	3.46U[d]	3.59U
	Uranium	1.49	1.38[d]	1.3
	Uranium-233/234	2.32	2.08[d]	1.63
	Uranium-235/236	0.0704UJ	0.105UJ[d]	0.0612U
	Uranium-238	0.489	0.448[d]	0.428
RW-5 (upstream)	Americium-241	0.00894U		0.01U
	Neptunium-237	0.02U		0.00525U
	Plutonium-238	0U		0U
	Plutonium-239/240	0.0111U		0.028U
	Technetium-99	5.82UJ		1.89U
	Uranium	1.39		1.63
	Uranium-233/234	2.01		1.67
	Uranium-235/236	0.164		0.0676U
	Uranium-238	0.442		0.539
Big Run Creek RW-2 (downstream)	Americium-241	0.00518U		0.0217U
	Neptunium-237	0.0216U		0.0122U
	Plutonium-238	0.0104U		0U
	Plutonium-239/240	0.0418UJ		0.0483U
	Technetium-99	2.58U		-0.967U
	Uranium	0.19UJ		0.267U
	Uranium-233/234	0.22J		0.274
	Uranium-235/236	0.00651U		0.0136U
	Uranium-238	0.0628UJ		0.0876U
RW-3 (downstream)	Americium-241	0.0293U		0.0196U
	Neptunium-237	0.00496U		0U
	Plutonium-238	0.0052U		0.00667U
	Plutonium-239/240	0.026U		0.00667U
	Technetium-99	8.55		0.943U
	Uranium	0.624J		0.55J
	Uranium-233/234	0.52		0.697
	Uranium-235/236	0.0244U		0.0767U
	Uranium-238	0.206		0.173

Table 2.12. Local surface water monitoring program results – 2014 (continued)

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]	
Big Run Creek	Americium-241	0.0308U	0.0156U	
(continued)	Neptunium-237	0.0227U	0U	
RW-33	Plutonium-238	0.0107U	0U	
(upstream)	Plutonium-239/240	0.0746UJ	0.0166U	
	Technetium-99	0.236U	-0.581U	
	Uranium	0.129UJ	0.0468U	
	Uranium-233/234	0.0648UJ	0.0591U	
	Uranium-235/236	0.0115U	0.00612U	
	Uranium-238	0.0417UJ	0.0148U	
Background creeks	Americium-241	0.0436U	0.0317U	0.0191U
RW-10N	Neptunium-237	0.0151U	0.0132U	-0.00657U
	Plutonium-238	-0.0203U	0.0414U	0U
	Plutonium-239/240	0.0101U	0.0207U	0.0344U
	Technetium-99	-0.259U	-0.0224U	-0.448U
	Uranium	0.238UJ	0.294U	0.409J
	Uranium-233/234	0.0631UJ	0.114	0.177
	Uranium-235/236	0.00654U	0.0141U	0.0146U
	Uranium-238	0.0789UJ	0.0966U	0.135
RW-10S	Americium-241	0.0166U	0.00555U	
	Neptunium-237	-0.00514U	0U	
	Plutonium-238	0.0196U	-0.0232U	
	Plutonium-239/240	0.00979U	0.0232U	
	Technetium-99	-0.292U	1.07U	
	Uranium	0.165UJ	0.342J	
	Uranium-233/234	0.0754UJ	0.189	
	Uranium-235/236	0.0234U	0.0241U	
	Uranium-238	0.0518UJ	0.111	
RW-10E	Americium-241	0U	0.0109U	
	Neptunium-237	0U	-0.00449U	
	Plutonium-238	-0.00557U	0.00593U	
	Plutonium-239/240	0.0112U	-0.00593U	
	Technetium-99	-0.0787U	3.79U	
	Uranium	0.119U	0.223U	
	Uranium-233/234	0.139UJ	0.0795U	
	Uranium-235/236	0.0119U	0.0396U	
	Uranium-238	0.0383U	0.0689U	

Table 2.12. Local surface water monitoring program results – 2014 (continued)

Location	Parameter[a]	Second quarter[b,c]		Fourth quarter[b,c]
Background creeks	Americium-241	-0.00976U	0.00946U[d]	0.00526U
RW-10W	Neptunium-237	0.0204U	0.0314U[d]	-0.0051U
	Plutonium-238	0.0103U	-0.00526U[d]	-0.00644U
	Plutonium-239/240	0.0308U	0U[d]	0.0322U
	Technetium-99	-1.05U	0.0337U[d]	0.112U
	Uranium	0.339J	0.349J[d]	0.0546U
	Uranium-233/234	0.0779UJ	0.074UJ[d]	0.0534U
	Uranium-235/236	0.0121U	0.0115U[d]	0.0242U
	Uranium-238	0.112	0.116[d]	0.0146U

[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. Some results are provided in scientific notation. The number and sign (+ or -) to the right of the "E" indicate the number of places to the right or left of the decimal point. For example, 3.4E-04 is 0.00034 (the decimal point moves four places to the left); 2.1E+02 is 210 (the decimal point moves two places to the right).
[d]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 2.13. Sediment monitoring program results – 2014

Parameter	Unit	Location/results[a,b]			
		Scioto River and outfalls that discharge to the Scioto River			
		RM-6 Upstream @ Piketon	*RM-1 Downstream @ Lucasville*	*RM-9 Outfall 012*	*RM-10 Outfall 010/Outfall 013*
Aluminum	mg/kg	4790	7430	8750	5060
Americium-241	pCi/g	0.00767UJ	0.00246UJ	0UJ	0.003UJ
Antimony	mg/kg	0.0788DN	0.0931DN	0.174DN	0.0695DN
Arsenic	mg/kg	9.34	12.2	17.4	10.9
Barium	mg/kg	63.1	92.9	51.9	67.3
Beryllium	mg/kg	0.432D	0.584D	1.1D	0.537D
Cadmium	mg/kg	0.389D	0.512D	5.44D	0.251D
Calcium	mg/kg	41900*D	39600*D	11200*D	2990*D
Chromium	mg/kg	8.92	13	13.9	13.9
Copper	mg/kg	15.4N	21.5N	41.5N	11.1N
Iron	mg/kg	17500D	24600D	26800D	20000D
Lead	mg/kg	12.9	18.1	14.5	13.8
Magnesium	mg/kg	17200*N	15800*N	5700*N	1690*N
Manganese	mg/kg	461D	669D	405D	869D
Mercury	mg/kg	0.0375	0.0555	0.0491	0.0357
Neptunium-237	pCi/g	0.00282U	0U	0.00167U	0.00705UJ
Nickel	mg/kg	16.6	22.6	157	12.8
PCB, total[c]	µg/kg	93.3	6.74U	57.2	152J
PCB-1016	µg/kg	7.35U	6.74U	7.02U	7.16U
PCB-1221	µg/kg	7.35U	6.74U	7.02U	7.16U
PCB-1232	µg/kg	7.35U	6.74U	7.02U	7.16U
PCB-1242	µg/kg	7.35U	6.74U	7.02U	7.16U
PCB-1248	µg/kg	75	6.74U	7.02U	7.16U
PCB-1254	µg/kg	18.3	6.74U	7.02U	7.16U
PCB-1260	µg/kg	7.35U	6.74U	57.2	152J
PCB-1262	µg/kg	7.35U	6.74U	7.02U	7.16U
PCB-1268	µg/kg	7.35U	6.74U	7.02U	7.16U
Plutonium-238	pCi/g	0.000949UJ	0UJ	0.000949UJ	0.00194UJ
Plutonium-239/240	pCi/g	0.00285UJ	0.00536UJ	0.0038UJ	0.00388UJ
Selenium	mg/kg	0.747D	0.921D	1.51D	0.666D
Silicon	mg/kg	1210*DN	1620*DN	1260*DN	1170*DN
Silver	mg/kg	0.174U	0.226U	0.193U	0.15U
Technetium-99	pCi/g	-0.0618U	0.0361U	0.0915U	0.947
Thallium	mg/kg	0.177D	0.235D	0.581D	0.103D
Uranium	µg/g	2.36	3.62	6.3	4.25J
Uranium-233/234	pCi/g	0.738	1.12	2.05	2.03J
Uranium-235/236	pCi/g	0.0538	0.063	0.0906	0.123J
Uranium-238	pCi/g	0.784	1.21	2.1	1.41J
Zinc	mg/kg	73.8N	106N	556N	102N

Table 2.13. Sediment monitoring program results – 2014 (continued)

Parameter	Unit	Location/results[a,b]			
		Little Beaver Creek			
		RM-12 Upstream	*RM-11 X-230J7 Discharge*	*RM-11 X-230J7 Discharge (duplicate sample)*	*RM-8 Downstream @ Outfall 009 Discharge*
Aluminum	mg/kg	5010	4750	5000	7210
Americium-241	pCi/g	0.00412U	0.00275U	0.00115U	0.000764U
Antimony	mg/kg	0.0515N	0.0508N	0.0442N	0.0558DN
Arsenic	mg/kg	14.8*	11.6*	10.9*	9.34
Barium	mg/kg	50.4	55.3	56.2	82.7
Beryllium	mg/kg	0.835	0.717	0.648	0.661D
Cadmium	mg/kg	0.0363*U	0.0358*U	0.0371*U	0.303D
Calcium	mg/kg	1270*N	1440*N	1500*N	4150*D
Chromium	mg/kg	15.6*N	11.4*N	11.2*N	10.8
Copper	mg/kg	10.8	8.53	8.82	10.2N
Iron	mg/kg	29100D	22000D	20300D	18700D
Lead	mg/kg	19.1	16.2	15.5	16.3
Magnesium	mg/kg	1110	1030	1090	2320*N
Manganese	mg/kg	426D	678D	583D	775D
Mercury	mg/kg	0.073*	0.0595*	0.0638*	0.0735
Neptunium-237	pCi/g	0.00092U	0.000432U	0.000496U	0.00395U
Nickel	mg/kg	12.4	10.7	10.7	15.2
PCB, total[c]	µg/kg	8.25U	9.34	8.74	104J
PCB-1016	µg/kg	8.25U	7.72U	7.23U	6.74U
PCB-1221	µg/kg	8.25U	7.72U	7.23U	6.74U
PCB-1232	µg/kg	8.25U	7.72U	7.23U	6.74U
PCB-1242	µg/kg	8.25U	7.72U	7.23U	6.74U
PCB-1248	µg/kg	8.25U	7.72U	7.23U	6.74U
PCB-1254	µg/kg	8.25U	7.72U	7.23U	41.4
PCB-1260	µg/kg	8.25U	9.34	8.74	62.3J
PCB-1262	µg/kg	8.25U	7.72U	7.23U	6.74U
PCB-1268	µg/kg	8.25U	7.72U	7.23U	6.74U
Plutonium-238	pCi/g	0U	0.000737U	-0.000395U	0.00187UJ
Plutonium-239/240	pCi/g	0.00541UJ	0.00442UJ	0.00474UJ	0.00654UJ
Selenium	mg/kg	0.877DN	1.11DN	0.868DN	0.861D
Silicon	mg/kg	664*N	684*N	703*N	1360*DN
Silver	mg/kg	0.169U	0.17U	0.174U	0.19U
Technetium-99	pCi/g	-0.026U	0.509	0.461	0.803
Thallium	mg/kg	0.0577	0.0749	0.0826	0.138D
Uranium	µg/g	0.991	1.3	1.37	3.29
Uranium-233/234	pCi/g	0.422	1.22	1.27	1.65
Uranium-235/236	pCi/g	0.0183	0.0617	0.0605	0.0856
Uranium-238	pCi/g	0.33	0.429	0.453	1.09
Zinc	mg/kg	54.5*N	49.5*N	49.1*N	70.7N

Table 2.13. Sediment monitoring program results – 2014 (continued)

Parameter	Unit	Location/results[a,b]		
		LittleBig Beaver Creek	*Big Beaver Creek*	
		RM-7 Downstream @ Confluence	*RM-5 Upstream*	*RM-13 Downstream*
Aluminum	mg/kg	5260	4280	4680
Americium-241	pCi/g	0.000997UJ	0.00411U	0.00362U
Antimony	mg/kg	0.0517DN	0.0771DN	0.133DN
Arsenic	mg/kg	7.72	9.64	17.4
Barium	mg/kg	68.9	67.7	49.8
Beryllium	mg/kg	0.479D	0.493D	0.533D
Cadmium	mg/kg	0.185D	0.456D	0.494D
Calcium	mg/kg	1830*D	5750*D	4640*D
Chromium	mg/kg	7.92	10.7	11.9
Copper	mg/kg	10.1N	9.71N	15.4N
Iron	mg/kg	16400D	18200D	25400D
Lead	mg/kg	10.6	12.2	12.5
Magnesium	mg/kg	1550*N	2990*N	2300*N
Manganese	mg/kg	727D	547D	430D
Mercury	mg/kg	0.0246U	0.067	0.0415
Neptunium-237	pCi/g	0.00198U	0.0176	0.0092UJ
Nickel	mg/kg	15.3	17.7	18.6
PCB, total[c]	µg/kg	7.23U	102J	121J
PCB-1016	µg/kg	7.23U	7.23U	6.81U
PCB-1221	µg/kg	7.23U	7.23U	6.81U
PCB-1232	µg/kg	7.23U	7.23U	6.81U
PCB-1242	µg/kg	7.23U	7.23U	6.81U
PCB-1248	µg/kg	7.23U	7.23U	6.81U
PCB-1254	µg/kg	7.23U	36.8	6.81U
PCB-1260	µg/kg	7.23U	65.1J	121J
PCB-1262	µg/kg	7.23U	7.23U	6.81U
PCB-1268	µg/kg	7.23U	7.23U	6.81U
Plutonium-238	pCi/g	0.00265U	0.00393U	-0.000756UJ
Plutonium-239/240	pCi/g	0.000662U	0.00943U	0.00832UJ
Selenium	mg/kg	0.662D	0.62D	0.587D
Silicon	mg/kg	965*DN	1030*DN	779*DN
Silver	mg/kg	0.144U	0.158U	0.149U
Technetium-99	pCi/g	0.316	4.5	2.06
Thallium	mg/kg	0.113D	0.123D	0.118D
Uranium	µg/g	2.7J	3.92	4.23
Uranium-233/234	pCi/g	1.3J	3.26	2.34
Uranium-235/236	pCi/g	0.0756J	0.163	0.121
Uranium-238	pCi/g	0.894J	1.29	1.4
Zinc	mg/kg	44.1N	74.6N	80.1N

Table 2.13. Sediment monitoring program results – 2014 (continued)

Parameter	Unit	Location/results[a,b]			
		Big Run Creek			
		RM-33 Upstream	*RM-3 Downstream*	*RM-2 Downstream @ Wakefield*	*RM-2 Downstream @ Wakefield (duplicate sample)*
Aluminum	mg/kg	5330	5300	7120	6560
Americium-241	pCi/g	0.00167UJ	0.00628UJ	0.0037UJ	0.00679UJ
Antimony	mg/kg	0.073DN	0.181DN	0.18DN	0.246DN
Arsenic	mg/kg	12	25.5	42.8	41.6
Barium	mg/kg	57.9	59.2	59.8	58.3
Beryllium	mg/kg	0.578D	0.816D	1.27D	1.17D
Cadmium	mg/kg	0.188D	0.308D	1.1D	1.06D
Calcium	mg/kg	1080*D	10800*D	2870*D	2980*D
Chromium	mg/kg	9.6	21.3	28	24.6
Copper	mg/kg	9.72N	13.6N	21.2N	19.2N
Iron	mg/kg	21400D	34900D	62900D	56900D
Lead	mg/kg	15.1	17.4	30.9	26.6
Magnesium	mg/kg	987*N	4200*N	1780*N	1780*N
Manganese	mg/kg	584D	1240D	870D	836D
Mercury	mg/kg	0.027U	0.0271	0.0648	0.0447
Neptunium-237	pCi/g	0.00195U	0U	0.0864	0.00511U
Nickel	mg/kg	12.4	19.3	42.7	39.2
PCB, total[c]	µg/kg	6.67U	40.9J	6.68U	16.9J
PCB-1016	µg/kg	6.67U	7.04U	6.68U	7.02U
PCB-1221	µg/kg	6.67U	7.04U	6.68U	7.02U
PCB-1232	µg/kg	6.67U	7.04U	6.68U	7.02U
PCB-1242	µg/kg	6.67U	7.04U	6.68U	7.02U
PCB-1248	µg/kg	6.67U	7.04U	6.68U	7.02U
PCB-1254	µg/kg	6.67U	18	6.68U	7.02U
PCB-1260	µg/kg	6.67U	22.9J	6.68U	16.9J
PCB-1262	µg/kg	6.67U	7.04U	6.68U	7.02U
PCB-1268	µg/kg	6.67U	7.04U	6.68U	7.02U
Plutonium-238	pCi/g	0UJ	0UJ	0.00185UJ	0.000879UJ
Plutonium-239/240	pCi/g	0.00252UJ	0UJ	0.000926UJ	0.0044UJ
Selenium	mg/kg	0.698D	0.857D	0.818D	0.819D
Silicon	mg/kg	953*DN	856*DN	1130*DN	1020*DN
Silver	mg/kg	0.176U	0.167U	0.187U	0.178U
Technetium-99	pCi/g	-0.00273U	0.637	0.233J	0.368J
Thallium	mg/kg	0.108D	0.215D	0.148D	0.148D
Uranium	µg/g	2.42	3.79J	3.83J	3.74J
Uranium-233/234	pCi/g	0.873	1.59J	1.72J	1.61J
Uranium-235/236	pCi/g	0.0387	0.107J	0.108J	0.083J
Uranium-238	pCi/g	0.809	1.26J	1.27J	1.24J
Zinc	mg/kg	51.2N	127N	199N	184N

Table 2.13. Sediment monitoring program results – 2014 (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	4080	5180	2430	5400
Americium-241	pCi/g	0.00467UJ	0.00264U	0.00221U	0UJ
Antimony	mg/kg	0.0554DN	0.0466N	0.0325DNU	0.429DN
Arsenic	mg/kg	6.34	12.9*	2.83	38.1
Barium	mg/kg	48.2	52.2	35.7	53.8
Beryllium	mg/kg	0.491D	0.711	0.317D	1.12D
Cadmium	mg/kg	0.568D	0.042*	0.057D	2.12D
Calcium	mg/kg	9690*D	1930*N	5820*D	1240*D
Chromium	mg/kg	7.22	21.4*N	5.32	17.7
Copper	mg/kg	11.1N	9.09	3.25N	22.6N
Iron	mg/kg	14600D	30100D	8120D	42700D
Lead	mg/kg	12.3	19.9	6.07	18.8
Magnesium	mg/kg	5220*N	984	532*N	1050*N
Manganese	mg/kg	612D	692D	276D	675D
Mercury	mg/kg	0.0269U	0.0301*U	0.0269U	0.0278
Neptunium-237	pCi/g	0.0082UJ	-0.000515U	0.00103U	0.00891UJ
Nickel	mg/kg	21.4	10.7	4.98	46.2
PCB, total[c]	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1016	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1221	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1232	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1242	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1248	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1254	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1260	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1262	µg/kg	7.35U	8.01U	7.99U	7U
PCB-1268	µg/kg	7.35U	8.01U	7.99U	7U
Plutonium-238	pCi/g	0.00102UJ	0.00115U	0.00169U	0.00265UJ
Plutonium-239/240	pCi/g	0.00307UJ	0.00115U	0.00225U	0.00265UJ
Selenium	mg/kg	0.692D	0.775DN	0.401D	1.03D
Silicon	mg/kg	1140*DN	755*N	1100*DN	1270*DN
Silver	mg/kg	0.177U	0.182U	0.172U	0.166U
Technetium-99	pCi/g	-0.0844U	0.0337U	-0.086U	-0.052U
Thallium	mg/kg	0.122D	0.0669	0.0387D	0.326D
Uranium	µg/g	2.04	1.23	2.02	5.65J
Uranium-233/234	pCi/g	0.681	0.547	0.68	1.88J
Uranium-235/236	pCi/g	0.0394	0.0177	0.0379	0.11J
Uranium-238	pCi/g	0.68	0.412	0.673	1.88J
Zinc	mg/kg	70.7N	68.6*N	20.9N	180N

[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.
[c]Total PCBs are the sum of PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, PCB-1260, PCB-1262, and PCB-1268.

Table 2.14. Soil and vegetation monitoring at ambient air monitoring stations – 2014

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	0U	0U	0.00122U	0.00272U
Neptunium-237	0U	0U	0.000289U	0U
Plutonium-238	-0.000559U	0.00246U	0.000545U	0.000573U
Plutonium-239/240	0.00224UJ	0.00575U	0.00136U	0.0086UJ
Technetium-99	-0.121U	-0.0223U	-0.0357U	0.0188U
Uranium	0.0203J	3.93	0.00617UJ	3.49
Uranium-233/234	0.0056UJ	1.33	0.00188UJ	1.13
Uranium-235/236	0.000366U	0.0713	-0.000293U	0.0583
Uranium-238	0.00677J	1.31	0.00212UJ	1.16
	A10 – On site on northwest segment of Perimeter Road		*A29 – On site at OVEC*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.000858U	0.00204U	0.00246U	0.00155U
Neptunium-237	0.000549U	0U	0.00133U	0.00034U
Plutonium-238	-0.000287U	0U	-0.00103U	0.00249U
Plutonium-239/240	0.000287U	0.0023U	0.000344U	0.00871UJ
Technetium-99	-0.0783U	0.0255U	-0.00171U	0.0256U
Uranium	0.00565U	3.06	0.00242U	3.23
Uranium-233/234	0.00391UJ	1.03	0.000812U	1.02
Uranium-235/236	-0.000347U	0.0524	0U	0.0496
Uranium-238	0.00195U	1.02	0.000812U	1.08
	A36 – On site at X-611 Water Treatment Plant		*A6 – North of PORTS in Piketon*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00142U	0.00868UJ	0.000983U	-0.000595U
Neptunium-237	0.000234U	0U	0.000301U	0U
Plutonium-238	0.000285U	0.000745U	0U	0U
Plutonium-239/240	0.00114U	0.00969UJ	0U	0.0116UJ
Technetium-99	0.0269U	0.0602U	-0.173U	0.0399U
Uranium	0.000921U	3.16	0.0149J	3.56
Uranium-233/234	0.0013U	1.1	0.00261UJ	1.14
Uranium-235/236	0.000323U	0.0518	0.000325U	0.0613
Uranium-238	0.000259U	1.05	0.00497J	1.19

Table 2.14. Soil and vegetation monitoring at ambient air monitoring stations – 2014 (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	0.00172U	0U	0.000645U	0.00496U
Neptunium-237	0.000247U	0.000378U	0U	0.000708U
Plutonium-238	0U	0.00177U	0U	0.00128U
Plutonium-239/240	0.00165U	0.00826UJ	0.000642U	0.00574UJ
Technetium-99	-0.0561U	0.052U	0.027U	0.0269U
Uranium	0.00991UJ	3.3	0.0208J	3.41
Uranium-233/234	0.00382UJ	1.11	0.00452J	0.978
Uranium-235/236	0.00034U	0.0564	0.0014U	0.0498
Uranium-238	0.00328UJ	1.1	0.00678J	1.14
	A23 – Northeastern PORTS boundary		*A12 – Eastern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.000766U	0.00438UJ	0.000509U	0.00347U
Neptunium-237	-0.00262U	-0.000669U	0U	0U
Plutonium-238	-0.000265U	0.000659U	0.00077U	0.00207U
Plutonium-239/240	0.00159U	0.0105UJ	0.000257U	0.00622U
Technetium-99	-0.0359U	-0.00817U	0.0434U	0.0521U
Uranium	0.0124UJ	3.25	0.0289J	3.3
Uranium-233/234	0.0036U	1.02	0.0195	1.09
Uranium-235/236	0.00032U	0.0515	0.00215U	0.0621
Uranium-238	0.00412UJ	1.08	0.00938J	1.1
	A15 – Southeast of PORTS on Loop Road		*A3 – Southern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.000863U	0.00406U	0.00075U	0.001U
Neptunium-237	0U	0.000745U	0.000244U	0U
Plutonium-238	0.00054U	-0.00128U	0U	-0.000505U
Plutonium-239/240	0.00108U	0.0109UJ	0.00107U	0.00809UJ
Technetium-99	0.00727U	0.0897U	-0.0142U	0.0435U
Uranium	0.0127UJ	3.42	0.00369U	3.39
Uranium-233/234	0.00641J	1.13	0.00258UJ	1.06
Uranium-235/236	0.000957U	0.0644	-0.000321U	0.0613
Uranium-238	0.0041UJ	1.14	0.00129U	1.13

Table 2.14. Soil and vegetation monitoring at ambient air monitoring stations – 2014 (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	0.00274U	0.0106UJ	0.000692U	0.00314U
Neptunium-237	0.000745U	0.000794U	0.000442U	0.000732U
Plutonium-238	0U	0.00812UJ	-0.00025U	-0.000591U
Plutonium-239/240	0.00406UJ	0.0138UJ	0.000501U	0.00295U
Technetium-99	-0.0608U	0.0477U	-0.00791U	0.0339U
Uranium	0.191J	2.33	0.0211J	3.49
Uranium-233/234	0.0593	0.762	0.00629J	1.13
Uranium-235/236	0.00475UJ	0.0386	0.00058U	0.0501
Uranium-238	0.0636	0.776	0.00699J	1.16
	A37 – Background station near Otway			
	Vegetation	Soil		
Americium-241	0.00136U	0.00398U		
Neptunium-237	0U	0U		
Plutonium-238	0.000284U	0U		
Plutonium-239/240	0.00114U	0.0114UJ		
Technetium-99	-0.0541U	0.00426U		
Uranium	0.0269J	3.45		
Uranium-233/234	0.0125	1.11		
Uranium-235/236	0.00036U	0.0611		
Uranium-238	0.00898J	1.15		
	Duplicate vegetation samples		*Duplicate soil samples*	
	A6	A41A	A9	A37
Americium-241	0.000209U	0.000804U	0.00797UJ	0.000615U
Neptunium-237	0.000237U	0.000274U	0.000398U	0.00114U
Plutonium-238	-0.00021U	0U	-0.000724U	0.00128U
Plutonium-239/240	0.00084U	0.0009U	0.0101UJ	0.0122UJ
Technetium-99	-0.127U	-0.0527U	0.0817U	-0.00571U
Uranium	0.0114J	0.00544UJ	2.49	3.24
Uranium-233/234	0.00263UJ	0.0017UJ	0.787	1.07
Uranium-235/236	0U	0.000795U	0.0444	0.0575
Uranium-238	0.00384J	0.0017UJ	0.829	1.08

[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 2.15. Biota (fish) monitoring program results – 2014

Parameter	Unit	Location/fish/results[a,b]	
		Scioto River (RW-1) catfish	*Scioto River (RW-6) drum*
Americium-241	pCi/g	na	-0.000554U
Neptunium-237	pCi/g	na	0U
PCB, total[c]	µg/kg	24.4	47.6J
PCB-1248	µg/kg	18.1U	18.1U
PCB-1254	µg/kg	18.1U	18.1U
PCB-1260	µg/kg	24.4	47.6J
PCB-1268	µg/kg	18.1U	18.1U
Plutonium-238	pCi/g	na	0.00216UJ
Plutonium-239/240	pCi/g	na	0.000962U
Technetium-99	pCi/g	na	0.0819U
Uranium	µg/g	na	0.00168U
Uranium-233/234	pCi/g	na	0U
Uranium-235/236	pCi/g	na	0U
Uranium-238	pCi/g	na	0.000564U
		Scioto River (RW-6) drum (duplicate sample)	*Little Beaver Creek (RW-8) bass/bluegill[d]*
Americium-241	pCi/g	0.00224U	0.000267U
Neptunium-237	pCi/g	0.000507U	0.000536U
PCB, total[c]	µg/kg	30.3J	235
PCB-1248	µg/kg	18.8U	19.7U
PCB-1254	µg/kg	18.8U	19.7U
PCB-1260	µg/kg	30.3J	235
PCB-1268	µg/kg	18.8U	19.7U
Plutonium-238	pCi/g	0.000308U	0.000861U
Plutonium-239/240	pCi/g	0.00216U	0.00115U
Technetium-99	pCi/g	0.127UJ	0.0799U
Uranium	µg/g	0.000159U	0.00263U
Uranium-233/234	pCi/g	0.00165U	0.00166U
Uranium-235/236	pCi/g	0.000342U	0.000344U
Uranium-238	pCi/g	0U	0.00083U

[a]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated. na – not analyzed.
[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.
[c]Total PCBs are the sum of PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, PCB-1260, PCB-1262, and PCB-1268. PCB-1016, PCB-1221, PCB-1232, PCB-1242, and PCB-1262 were not detected in any of the samples.
[d]The sample analyzed for radionuclides was large mouth bass and the sample analyzed for PCBs was bluegill.

Table 2.16. Biota (crops) monitoring program results – 2014

Parameter	Unit	Location/crop/results[a,b]		
		Off-site #2 corn	*Off-site #2 peppers*	*Off-site #2 tomatoes*
Americium-241	pCi/g	0.00109U	0.00257U	0.000829U
Neptunium-237	pCi/g	0.000898U	-0.000296U	0.000575U
Plutonium-238	pCi/g	-0.000362U	0.000699U	-0.00037U
Plutonium-239/240	pCi/g	0.00181U	0.000699U	0U
Technetium-99	pCi/g	-0.0556U	0.0226U	-0.0058U
Uranium	µg/g	0.00324U	0.0000000821U	0.000159U
Uranium-233/234	pCi/g	0U	0.000511U	0U
Uranium-235/236	pCi/g	0.000323U	0U	0.000344U
Uranium-238	pCi/g	0.00104U	0U	0U
		Off-site #3 beans	*Off-site #3 beans (duplicate sample)*	*Off-site #3 corn*
Americium-241	pCi/g	-0.000278U	0.0025U	0.00171U
Neptunium-237	pCi/g	0U	0U	0U
Plutonium-238	pCi/g	0U	-0.000768U	0U
Plutonium-239/240	pCi/g	0.000812U	0U	0.000784U
Technetium-99	pCi/g	-0.000268U	-0.0731U	0.0178U
Uranium	µg/g	0.00358U	0.00241U	0.00142U
Uranium-233/234	pCi/g	0.000287U	0.000761U	0.000269U
Uranium-235/236	pCi/g	0.000357U	0.000316U	0.00134U
Uranium-238	pCi/g	0.00115U	0.000761U	0.000269U
		Off-site #3 corn (duplicate sample)	*Off-site #3 tomatoes*	*Off-site #3 tomatoes (duplicate sample)*
Americium-241	pCi/g	0.00138U	0.0011U	0.000521U
Neptunium-237	pCi/g	-0.000606U	0.000556U	0U
Plutonium-238	pCi/g	0U	0.000761U	0.000328U
Plutonium-239/240	pCi/g	0.000993U	0.000761U	0.00164U
Technetium-99	pCi/g	-0.011U	-0.0276U	-0.0903U
Uranium	µg/g	0.0011U	0.000146U	0.00106U
Uranium-233/234	pCi/g	0.0008U	0.000254U	0.000769U
Uranium-235/236	pCi/g	0.000664U	0.000316U	0.000637U
Uranium-238	pCi/g	0.000267U	0U	0.000256U

Table 2.16. Biota (crops) monitoring program results – 2014 (continued)

Parameter	Unit	Location/results[a,b]		
		Off-site #4 tomatoes	*Off-site #5 corn*	*Off-site #5 tomatoes*
Americium-241	pCi/g	0.000567U	0.00106U	0.000784U
Neptunium-237	pCi/g	-0.000273U	0.000269U	0U
Plutonium-238	pCi/g	-0.000782U	-0.000401U	-0.000322U
Plutonium-239/240	pCi/g	0.000782U	0.0016U	0.00193U
Technetium-99	pCi/g	-0.00291U	-0.0553U	-0.0188U
Uranium	µg/g	0.000945U	0.00355U	0.00109U
Uranium-233/234	pCi/g	0.000266U	0.000272U	0.000265U
Uranium-235/236	pCi/g	0.000331U	0.000676U	0.00066U
Uranium-238	pCi/g	0.000266U	0.00109U	0.000265U
		Off-site #6 corn	*Off-site #6 corn (duplicate sample)*	*Off-site #6 peppers*
Americium-241	pCi/g	0.00107U	0U	0.00164U
Neptunium-237	pCi/g	0.000271U	0U	0.000767U
Plutonium-238	pCi/g	0U	0.00141U	-0.000943U
Plutonium-239/240	pCi/g	0.00145U	0.00176U	0.000472U
Technetium-99	pCi/g	0.0546U	0.0122U	-0.0482U
Uranium	µg/g	0.00162U	0.00245U	0.000185U
Uranium-233/234	pCi/g	0.00109U	0.000515U	0.000641U
Uranium-235/236	pCi/g	0U	0.00032U	0.000399U
Uranium-238	pCi/g	0.000543U	0.000772U	0U
		Off-site #6 peppers (duplicate sample)	*Off-site #6 tomatoes*	*Off-site #6 tomatoes (duplicate sample)*
Americium-241	pCi/g	0.00166U	0.00322U	0.00251U
Neptunium-237	pCi/g	0.000311U	0U	0U
Plutonium-238	pCi/g	0.000461U	0U	-0.000332U
Plutonium-239/240	pCi/g	0.000922U	0.00068U	0.000995U
Technetium-99	pCi/g	0.0329U	0.0658U	-0.0408U
Uranium	µg/g	0.0016U	0.00369U	0.00223U
Uranium-233/234	pCi/g	0.00107U	0.000929U	0.00027U
Uranium-235/236	pCi/g	0U	0U	0.00134U
Uranium-238	pCi/g	0.000536U	0.00124U	0.000539U

[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 2.17. Biota (deer) monitoring program results – 2014

Parameter	Unit	January 2014[a,b]	November 2014[a,b]	December 2014[a,b]
		kidney		
Americium-241	pCi/g	0.00352U	0.000266U	0.00212U
Neptunium-237	pCi/g	0U	-0.000311U	0U
Plutonium-238	pCi/g	0.000403U	0.000823U	-0.000288U
Plutonium-239/240	pCi/g	0.00121U	0U	0.000864U
Technetium-99	pCi/g	-0.0989U	0.0414U	0.028U
Uranium	µg/g	0.00825U	0.00105U	0.00187U
Uranium-233/234	pCi/g	0.00261U	0.000767U	0.000286U
Uranium-235/236	pCi/g	0.00108U	0.000636U	0.000356U
Uranium-238	pCi/g	0.00261U	0.000256U	0.000572U
		liver		
Americium-241	pCi/g	-0.000476U	-0.00058U	0.000854U
Neptunium-237	pCi/g	0.000462U	0.000628U	0U
Plutonium-238	pCi/g	-0.000389U	0.00134U	-0.00055U
Plutonium-239/240	pCi/g	0.00117U	0.00134U	0.000275U
Technetium-99	pCi/g	-0.192U	0.0129U	0.0621U
Uranium	µg/g	0.0074U	0.002U	0.000724U
Uranium-233/234	pCi/g	0.00383UJ	0U	0.00121U
Uranium-235/236	pCi/g	0.000595U	0.000973U	-0.000375U
Uranium-238	pCi/g	0.00239U	0.000521U	0.000301U
		muscle		
Americium-241	pCi/g	0.00165U	0.00193U	-0.000269U
Neptunium-237	pCi/g	0U	0.000617U	0.000586U
Plutonium-238	pCi/g	-0.000403U	-0.000568U	-0.000262U
Plutonium-239/240	pCi/g	0.00161U	0.000568U	0.00131U
Technetium-99	pCi/g	-0.148U	-0.0207U	0.12U
Uranium	µg/g	0.00291U	0.00285U	0.000166U
Uranium-233/234	pCi/g	0.00041U	0.000283U	0.000864U
Uranium-235/236	pCi/g	0.00102U	0.000704U	0.000358U
Uranium-238	pCi/g	0.00082U	0.000849U	0U

Table 2.17. Biota (deer) monitoring program results – 2014 (continued)

Parameter	Unit	December 2014[a,b]	December 2014[a,b]
		kidney	
Americium-241	pCi/g	0U	-0.000551U
Neptunium-237	pCi/g	-0.000305U	0U
Plutonium-238	pCi/g	-0.000266U	0.00107U
Plutonium-239/240	pCi/g	0.00186U	0.000806U
Technetium-99	pCi/g	0.0495U	0.0287U
Uranium	µg/g	0.0000000443U	0.000000183U
Uranium-233/234	pCi/g	0.000276U	0.00114U
Uranium-235/236	pCi/g	0U	0U
Uranium-238	pCi/g	0U	0U
		liver	
Americium-241	pCi/g	0.000528U	0.000822U
Neptunium-237	pCi/g	0.000305U	-0.000269U
Plutonium-238	pCi/g	-0.000568U	-0.000281U
Plutonium-239/240	pCi/g	0.000568U	0.0014U
Technetium-99	pCi/g	-0.0252U	-0.0292U
Uranium	µg/g	0.000986U	0.00112U
Uranium-233/234	pCi/g	0.000555U	0U
Uranium-235/236	pCi/g	0.000345U	0.000677U
Uranium-238	pCi/g	0.000278U	0.000272U
		muscle	
Americium-241	pCi/g	0.000287U	0.00193U
Neptunium-237	pCi/g	0.000296U	0.000284U
Plutonium-238	pCi/g	0.000561U	0U
Plutonium-239/240	pCi/g	0.000561U	0.000269U
Technetium-99	pCi/g	-0.0136U	0.0605U
Uranium	µg/g	0.000827U	-0.000695U
Uranium-233/234	pCi/g	0.000834U	0.000579U
Uranium-235/236	pCi/g	0U	0.00036U
Uranium-238	pCi/g	0.000278U	-0.000289U

[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 2.18. Off-site dairy monitoring – 2014

Parameter	Units	Milk[a,b]	Eggs[a]
Americium-241	pCi/g	0.00057U	0.00192U
Neptunium-237	pCi/g	-0.000536U	0.000262U
Plutonium-238	pCi/g	-0.000598U	0.00284UJ
Plutonium-239/240	pCi/g	0.000299U	0.00171U
Technetium-99	pCi/g	-0.0724U	0.14UJ
Uranium	µg/g	0.00166U	0.000000218U
Uranium-233/234	pCi/g	0.000279U	0.00136U
Uranium-235/236	pCi/g	0U	0U
Uranium-238	pCi/g	0.000558U	0U

[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.

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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 – 2014
- Table 3.2. Predicted radiation doses from airborne releases at PORTS – 2014
- Table 3.3. Dose calculations for ambient air monitoring stations – 2014.

Table 3.1. Emissions (Ci/year) from DOE air emission sources – 2014

Radionuclide	Group 1[a]	Group 2[b]	Group 3[c]	DUF_6 facility[d]
Americium-241	9.765E-08	-	2.637E-08	-
Neptunium-237	1.142E-07	-	1.074E-08	-
Plutonium-238	1.429E-07	-	1.343E-11	-
Plutonium-239/240	2.746E-08	-	2.890E-08	-
Technetium-99	3.729E-03	9.557E-04	3.418E-03	-
Uranium-233/234	8.877E-05	5.101E-06	1.393E-04	1.11E-06
Uranium-235	8.284E-06	1.457E-06	5.164E-06	5.07E-08
Uranium-238	4.444E-04	4.675E-06	4.304E-05	2.72E-06
Thorium-228	3.740E-08	9.361E-09	3.390E-10	-
Thorium-230	3.750E-05	8.611E-07	3.400E-10	-
Thorium-231	8.284E-06	1.457E-06	5.070E-06	1.99E-07
Thorium-232	2.290E-09	0	2.070E-11	-
Thorium-234	4.428E-04	4.675E-06	4.154E-05	1.82E-05
Protactinium-234m	4.428E-04	4.675E-06	4.154E-05	1.82E-05
Total	5.202E-03	9.786E-04	3.693E-03	4.048E-05

[a]Group 1 consists of the X-326 Top Purge/Emergency Jet Vents, X-326 Seal Exhaust Vents, X-710 Vents, XT-847 Glove Box, 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-700 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.
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 – 2014

Effective dose to:	DOE releases	All PORTS releases (DOE and Centrus)
Maximally exposed individual (mrem/year)	0.017	0.017
Population[a] (person-rem/year)	0.151	0.151

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

Table 3.3. Dose calculations for ambient air monitoring stations – 2014

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A3	Americium-241	4.2E-09		
	Neptunium-237	1.6E-09		
	Plutonium-238	1.4E-09		
	Plutonium-239/240	1.8E-09		
	Technetium-99	1.9E-03		
	Uranium-233/234	1.4E-06		
	Uranium-235/236	9.7E-08	(0.0019)	
	Uranium-238	4.8E-07	1.9E-03	0
A6	Americium-241	4.3E-09		
	Neptunium-237	2.4E-09		
	Plutonium-238	7.8E-10		
	Plutonium-239/240	1.6E-09		
	Technetium-99	2.6E-03		
	Uranium-233/234	6.0E-07		
	Uranium-235/236	6.9E-08	(0.0026)	(0.00020)
	Uranium-238	5.0E-07	2.6E-03	2.0E-04
A8	Americium-241	2.8E-09		
	Neptunium-237	2.1E-09		
	Plutonium-238	1.4E-09		
	Plutonium-239/240	2.2E-09		
	Technetium-99	2.7E-03		
	Uranium-233/234	1.9E-06		
	Uranium-235/236	8.5E-08	(0.0027)	(0.00030)
	Uranium-238	3.8E-07	2.7E-03	3.0E-04
A9	Americium-241	1.4E-09		
	Neptunium-237	8.6E-10		
	Plutonium-238	6.7E-10		
	Plutonium-239/240	1.9E-09		
	Technetium-99	2.5E-03		
	Uranium-233/234	1.1E-06		
	Uranium-235/236	6.7E-08	(0.0025)	(0.00010)
	Uranium-238	8.0E-07	2.5E-03	1.0E-04

Table 3.3. Dose calculations for ambient air monitoring stations – 2014 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A10	Americium-241	1.4E-05		
	Neptunium-237	3.1E-08		
	Plutonium-238	6.4E-09		
	Plutonium-239/240	1.8E-08		
	Technetium-99	1.8E-03		
	Uranium-233/234	2.7E-06		
	Uranium-235/236	2.4E-07	(0.0018)	
	Uranium-238	4.5E-07	1.8E-03	0
A12	Americium-241	1.3E-05		
	Neptunium-237	3.7E-08		
	Plutonium-238	5.4E-09		
	Plutonium-239/240	1.5E-08		
	Technetium-99	2.2E-03		
	Uranium-233/234	2.0E-06		
	Uranium-235/236	2.0E-07	(0.0022)	
	Uranium-238	9.3E-07	2.2E-03	0
A15	Americium-241	1.9E-05		
	Neptunium-237	1.2E-07		
	Plutonium-238	2.0E-08		
	Plutonium-239/240	5.4E-08		
	Technetium-99	2.2E-03		
	Uranium-233/234	8.8E-07		
	Uranium-235/236	1.1E-07	(0.0023)	
	Uranium-238	5.2E-07	2.3E-03	0
A23	Americium-241	1.3E-05		
	Neptunium-237	4.3E-08		
	Plutonium-238	7.4E-09		
	Plutonium-239/240	2.1E-08		
	Technetium-99	2.3E-03		
	Uranium-233/234	1.9E-06		
	Uranium-235/236	1.5E-07	(0.0023)	
	Uranium-238	7.1E-07	2.3E-03	0
A24	Americium-241	3.9E-06		
	Neptunium-237	1.4E-07		
	Plutonium-238	3.9E-09		
	Plutonium-239/240	1.3E-08		
	Technetium-99	1.9E-03		
	Uranium-233/234	2.4E-06		
	Uranium-235/236	9.3E-08	(0.0019)	
	Uranium-238	6.1E-07	1.9E-03	0

Table 3.3. Dose calculations for ambient air monitoring stations – 2014 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A28	Americium-241	1.6E-05		
	Neptunium-237	2.7E-08		
	Plutonium-238	7.2E-09		
	Plutonium-239/240	2.0E-08		
	Technetium-99	1.8E-03		
	Uranium-233/234	1.3E-06		
	Uranium-235/236	2.1E-07	(0.0018)	
	Uranium-238	1.0E-06	1.8E-03	0
A29	Americium-241	1.1E-05		
	Neptunium-237	8.3E-08		
	Plutonium-238	4.1E-09		
	Plutonium-239/240	1.2E-08		
	Technetium-99	2.1E-03		
	Uranium-233/234	1.9E-06		
	Uranium-235/236	2.0E-07	(0.0021)	
	Uranium-238	9.6E-07	2.1E-03	0
A36	Americium-241	4.0E-09		
	Neptunium-237	7.4E-10		
	Plutonium-238	3.5E-10		
	Plutonium-239/240	1.3E-09		
	Technetium-99	8.4E-04		
	Uranium-233/234	4.5E-06		
	Uranium-235/236	7.2E-08	(0.00080)	
	Uranium-238	6.2E-07	8.0E-04	0
A37	Americium-241	2.8E-09		
	Neptunium-237	1.4E-09		
	Plutonium-238	1.3E-09		
	Plutonium-239/240	2.1E-09		
	Technetium-99	2.4E-03		
	Uranium-233/234	3.4E-07		
	Uranium-235/236	3.2E-08	(0.0024)	
	Uranium-238	3.2E-07	2.4E-03	-
A41A	Americium-241	1.0E-09		
	Neptunium-237	7.8E-10		
	Plutonium-238	2.3E-09		
	Plutonium-239/240	1.3E-09		
	Technetium-99	1.8E-03		
	Uranium-233/234	8.1E-07		
	Uranium-235/236	8.3E-08	(0.0018)	
	Uranium-238	4.7E-07	1.8E-03	0

Table 3.3. Dose calculations for ambient air monitoring stations – 2014 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
T7	Americium-241	2.6E-09		
	Neptunium-237	8.0E-10		
	Plutonium-238	6.7E-10		
	Plutonium-239/240	1.5E-09		
	Technetium-99	1.8E-03		
	Uranium-233/234	1.3E-06		
	Uranium-235/236	4.6E-08	(0.0018)	
	Uranium-238	3.0E-07	1.8E-03	0

[a]Parameters listed in **bold** type were detected at least once in the samples collected in 2014 (see Table 2.8).
[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 2014 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 2014. Sampling for radionuclides in many of the monitoring areas or wells is completed biennially (i.e., every two years in odd numbered years). Therefore, samples collected in 2014 at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility, Quadrant I Groundwater Investigative (5-Unit) Area, X-749A Classified Materials Disposal Facility, Quadrant II Groundwater Investigative (7-Unit) Area, and X-734 Landfills were not analyzed for radionuclides. 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 2014. 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 trichloroethene, 1,2-dimethylbenzene, 2-butanone, benzene, chloroethane, chloromethane, m,p-xylenes, and toluene were detected in trip and/or field blanks during 2014. 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 2014 meet this purpose.

Complete groundwater monitoring results for sampling completed as required by the *Integrated Groundwater Monitoring Plan* (DOE 2013, DOE 2014) are provided in the *2014 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* (DOE 2015). The *2014 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* also provides the following information not included in this Data Report:

- Results for non-routine sampling conducted during 2014 at the X-701B Former Holding Pond, 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 – 2014

- Table 4.2. VOCs detected at the PK Landfill – 2014

- Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2014

- Table 4.4. VOCs detected at the X-749A Classified Materials Disposal Facility – 2014

- Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2014

- Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2014

- Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014

- Table 4.8. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2014

- Table 4.9. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2014

- Table 4.10. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2014

- Table 4.11. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2014
- Table 4.12. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2014
- Table 4.13. VOCs detected at the X-735 Landfills – 2014
- Table 4.14. Results for radionuclides at the X-735 Landfills – 2014
- Table 4.15. VOCs detected at the X-734 Landfills – 2014
- Table 4.16. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2014
- Table 4.17. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2014
- Table 4.18. VOCs detected at surface water monitoring locations – 2014
- Table 4.19. Results for radionuclides at surface water monitoring locations – 2014

Results for exit pathway monitoring locations sampled during 2014 (that are part of the monitoring programs for other areas) are provided in the tables for their respective monitoring areas as follows:

- Table 4.1: VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility (wells X749-14B, X749-44G, X749-45G, X749-64B, X749-68G, X749-96G, X749-97G and X749-98G).
- Tables 4.6 and 4.7: VOCs and radionuclides detected at X-701B Former Holding Pond area well X701-48G.
- Tables 4.18 and 4.19: VOCs and radionuclides detected at surface water monitoring locations BRC-SW02, LBC-SW04, UND-SW02, and WDD-SW03.

The following laboratory data qualifiers are used in the tables in this section:

Data qualifier	Meaning
*	Organics (VOCs): surrogate values were outside control limits.
B	Inorganics (metals): the result was less than the practical quantitation limit but greater than or equal to the instrument detection limit. Organics (VOCs): the analyte was detected in the laboratory blank sample.
J	Organics (VOCs): the reported value is an estimated concentration greater than the method detection limit but less than the practical quantitation limit. Radionuclides: the reported result is above the minimum detectable activity but less than the laboratory reporting limit.
U	Undetected

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
PK-09G	Chloroform	µg/L			0.2 J	
	cis-1,2-Dichloroethene	µg/L			5.5	
	Trichloroethene	µg/L			320	
STSW-101G	1,1,1-Trichloroethane	µg/L		13		7.4
	1,1,2-Trichloroethane	µg/L		0.95 J		0.7 J
	1,1-Dichloroethane	µg/L		27		19
	1,1-Dichloroethene	µg/L		59		48
	1,2-Dichloroethane	µg/L		6.6		4.1
	Chloroform	µg/L		2.4		1.6
	cis-1,2-Dichloroethene	µg/L		18		15
	Tetrachloroethene	µg/L		1.2		0.74 J
	Trichloroethene	µg/L		65		44
STSW-102G	1,1,1-Trichloroethane	µg/L		12		8.3
	1,1,2-Trichloroethane	µg/L		0.27 U		0.4 J
	1,1-Dichloroethane	µg/L		84		91
	1,1-Dichloroethene	µg/L		40		46
	1,2-Dichloroethane	µg/L		38		33
	Chloroform	µg/L		3.8		3.5
	cis-1,2-Dichloroethene	µg/L		24		26
	Methylene chloride	µg/L		0.32 U		0.56 BJ
	Tetrachloroethene	µg/L		0.22 J		0.2 U
	trans-1,2-Dichloroethene	µg/L		0.15 U		0.19 J
	Trichloroethene	µg/L		200		200
X120-05G	Chloroethane	µg/L			2.1	
	Trichloroethene	µg/L			2.6	
X120-08G	1,1,1-Trichloroethane	µg/L			4.6	
	1,1,2-Trichloroethane	µg/L			0.56 J	
	1,1-Dichloroethane	µg/L			7.5	
	1,1-Dichloroethene	µg/L			29	
	1,2-Dichloroethane	µg/L			0.81 J	
	Chloroform	µg/L			0.94 J	
	cis-1,2-Dichloroethene	µg/L			0.62 J	
	Tetrachloroethene	µg/L			0.2 J	
	Trichloroethene	µg/L			15	
X120-10G	1,1,1-Trichloroethane	µg/L			8.5	
	1,1,2-Trichloroethane	µg/L			1.1	
	1,1-Dichloroethane	µg/L			17	
	1,1-Dichloroethene	µg/L			67	
	1,2-Dichloroethane	µg/L			1.3	
	Chloroform	µg/L			1.8	
	cis-1,2-Dichloroethene	µg/L			0.71 J	
	Trichloroethene	µg/L			15	
X120-11G	1,1-Dichloroethene	µg/L		0.56 J		0.71 J
	cis-1,2-Dichloroethene	µg/L		9.9		14
	Methylene chloride	µg/L		0.54 J		0.34 BJ
	trans-1,2-Dichloroethene	µg/L		0.24 J		0.2 J
	Trichloroethene	µg/L		250		180
	Vinyl chloride	µg/L		0.1 U		0.12 J
X749-04G	Acetone	µg/L			5.2 BJ	
	Chloroform	µg/L			0.45 J	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-04G	cis-1,2-Dichloroethene	µg/L			0.8 J	
	Tetrachloroethene	µg/L			4.4	
	Trichloroethene	µg/L			800	
X749-05G	1,1-Dichloroethane	µg/L			0.47 J	
	Acetone	µg/L			7.4 BJ	
	Carbon tetrachloride	µg/L			0.29 J	
	Chloroform	µg/L			0.85 J	
	cis-1,2-Dichloroethene	µg/L			0.91 J	
	Tetrachloroethene	µg/L			1.1	
	Trichloroethene	µg/L			56	
X749-06G	1,1,1-Trichloroethane	µg/L		47		40
	1,1,2-Trichloroethane	µg/L		4.4		5.8
	1,1-Dichloroethane	µg/L		210		260
	1,1-Dichloroethene	µg/L		150		220
	1,2-Dichloroethane	µg/L		5		5
	Acetone	µg/L		18 J		7.6 U
	Chloroform	µg/L		18		21
	cis-1,2-Dichloroethene	µg/L		41		68
	Tetrachloroethene	µg/L		15		23
	Trichloroethene	µg/L		720		920
	Vinyl chloride	µg/L		1.2 J		2
X749-07G	1,1,1-Trichloroethane	µg/L		15		16
	1,1,2-Trichloroethane	µg/L		0.36 J		0.27 U
	1,1-Dichloroethane	µg/L		22		45
	1,1-Dichloroethene	µg/L		27		32
	1,2-Dichloroethane	µg/L		8.8		20
	Chloroform	µg/L		1.8		1.9
	cis-1,2-Dichloroethene	µg/L		6.4		10
	Methylene chloride	µg/L		0.53 BJ		0.32 U
	Tetrachloroethene	µg/L		0.74 J		0.8 J
	trans-1,2-Dichloroethene	µg/L		0.15 U		0.2 J
	Trichloroethene	µg/L		74		100
	Vinyl chloride	µg/L		0.17 J		0.36 J
X749-08G	1,1,1-Trichloroethane	µg/L		6		6.2
	1,1-Dichloroethane	µg/L		1.7		1.8
	1,1-Dichloroethene	µg/L		7.2		8.7
	1,2-Dichloroethane	µg/L		0.27 J		0.13 U
	Chloroform	µg/L		0.18 J		0.17 J
	cis-1,2-Dichloroethene	µg/L		1.8		1.8
	Methylene chloride	µg/L		0.36 BJ		0.32 U
	Trichloroethene	µg/L		13		14
X749-09GA	1,1,1-Trichloroethane	µg/L		17		11
	1,1-Dichloroethane	µg/L		5.8		3.5
	1,1-Dichloroethene	µg/L		14		11
	1,2-Dichloroethane	µg/L		0.91 J		0.55 J
	Chloroform	µg/L		0.45 J		0.27 J
	cis-1,2-Dichloroethene	µg/L		3.4		3
	Trichloroethene	µg/L		14		9
X749-10GA	1,1-Dichloroethane	µg/L		3.7		4
	1,1-Dichloroethene	µg/L		7.3		11

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-10GA	Chloroethane	µg/L		0.41 U		0.57 J
	cis-1,2-Dichloroethene	µg/L		1.9		3.3
	Trichloroethene	µg/L		0.35 J		0.36 J
	Vinyl chloride	µg/L		0.6 J		1.5
X749-13G	1,1,1-Trichloroethane	µg/L		5.3		5
	1,1-Dichloroethane	µg/L		1.9		1.6
	1,1-Dichloroethene	µg/L		10		11
	Chloroform	µg/L		0.39 J		0.35 J
	cis-1,2-Dichloroethene	µg/L		1.4		1.8
	Trichloroethene	µg/L		15		15
X749-14B	Methylene chloride	µg/L		0.55 BJ		0.32 U
X749-20G	1,1,1-Trichloroethane	µg/L			0.95 J	
	1,1-Dichloroethane	µg/L			2.3	
	1,1-Dichloroethene	µg/L			1.9	
	Chloroform	µg/L			0.2 J	
	cis-1,2-Dichloroethene	µg/L			1.6	
	Methylene chloride	µg/L			0.57 J	
	Trichloroethene	µg/L			20	
X749-21G	1,1,1-Trichloroethane	µg/L		0.41 J		5.5
	1,1-Dichloroethane	µg/L		0.22 U		1.6
	1,1-Dichloroethene	µg/L		0.23 U		4.2
	Acetone	µg/L		6.4 J		1.9 U
	cis-1,2-Dichloroethene	µg/L		0.15 U		0.69 J
	Methylene chloride	µg/L		0.85 BJ		0.32 U
	Trichloroethene	µg/L		0.75 J		6
X749-22G	1,1-Dichloroethane	µg/L		2.7		2.2
	1,1-Dichloroethene	µg/L		3.1		2.8
	cis-1,2-Dichloroethene	µg/L		0.75 J		0.66 J
	Methylene chloride	µg/L		0.62 J		0.37 BJ
	Vinyl chloride	µg/L		0.37 J		0.47 J
X749-23G	Methylene chloride	µg/L		0.42 BJ		0.32 U
X749-24G	Methylene chloride	µg/L		0.5 BJ		0.32 U
X749-26G	1,1,1-Trichloroethane	µg/L		2.3		1.7
	1,1-Dichloroethane	µg/L		4.8		4.3
	1,1-Dichloroethene	µg/L		5.8		5
	1,2-Dichloroethane	µg/L		2.4		1.7
	Chloroform	µg/L		0.46 J		0.3 J
	cis-1,2-Dichloroethene	µg/L		0.84 J		0.83 J
	Trichloroethene	µg/L		12		8.9
X749-27G	1,1,1-Trichloroethane	µg/L		41		17
	1,1,2-Trichloroethane	µg/L		1.5		0.85 J
	1,1-Dichloroethane	µg/L		110		31
	1,1-Dichloroethene	µg/L		150		53
	1,2-Dichloroethane	µg/L		78		9.1
	Chloroethane	µg/L		2.4		0.67 J
	Chloroform	µg/L		12		3.9
	cis-1,2-Dichloroethene	µg/L		38		14
	Tetrachloroethene	µg/L		2.3		1.4
	trans-1,2-Dichloroethene	µg/L		0.23 J		0.15 U
	Trichloroethene	µg/L		210		90

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-27G	Vinyl chloride	µg/L		0.51 J		0.14 J
X749-28G	1,1,1-Trichloroethane	µg/L			9	
	1,1,2-Trichloroethane	µg/L			0.62 J	
	1,1-Dichloroethane	µg/L			9.7	
	1,1-Dichloroethene	µg/L			29	
	1,2-Dichloroethane	µg/L			0.99 J	
	Acetone	µg/L			15	
	Chloroform	µg/L			1.6	
	cis-1,2-Dichloroethene	µg/L			1.4	
	Tetrachloroethene	µg/L			0.59 J	
	Trichloroethene	µg/L			48	
X749-29G	Chloroform	µg/L			0.2 J	
	cis-1,2-Dichloroethene	µg/L			0.17 J	
	Trichloroethene	µg/L			7.8	
X749-30G	1,1-Dichloroethene	µg/L			1.3	
	Chloroform	µg/L			0.41 J	
	cis-1,2-Dichloroethene	µg/L			0.67 J	
	Trichloroethene	µg/L			25	
X749-33G	1,1,1-Trichloroethane	µg/L		19		16
	1,1,2-Trichloroethane	µg/L		0.79 J		1.1
	1,1-Dichloroethane	µg/L		41		36
	1,1-Dichloroethene	µg/L		69		67
	1,2-Dichloroethane	µg/L		25		11
	Chloroethane	µg/L		0.41 U		0.54 J
	Chloroform	µg/L		4.8		4.1
	cis-1,2-Dichloroethene	µg/L		6.5		9.9
	Tetrachloroethene	µg/L		1.2		1.3
	Trichloroethene	µg/L		120		110
	Vinyl chloride	µg/L		0.1 U		0.16 J
X749-35G	1,1,1-Trichloroethane	µg/L			49	
	1,1-Dichloroethane	µg/L			8.4	
	1,1-Dichloroethene	µg/L			26	
	Chloroform	µg/L			0.27 J	
	cis-1,2-Dichloroethene	µg/L			6.6	
	Tetrachloroethene	µg/L			0.21 J	
	Trichloroethene	µg/L			67	
	Vinyl chloride	µg/L			1.3	
X749-36G	1,1,1-Trichloroethane	µg/L			0.63 J	
	1,1-Dichloroethane	µg/L			0.94 J	
	1,1-Dichloroethene	µg/L			3.4	
	Trichloroethene	µg/L			2.6	
X749-37G	1,1,1-Trichloroethane	µg/L		4.3		7.6
	1,1,2-Trichloroethane	µg/L		0.41 J		0.54 J
	1,1-Dichloroethane	µg/L		9.7		12
	1,1-Dichloroethene	µg/L		22		32
	1,2-Dichloroethane	µg/L		0.13 U		1
	Chloroform	µg/L		0.7 J		0.96 J
	cis-1,2-Dichloroethene	µg/L		4		4.9
	Tetrachloroethene	µg/L		0.42 J		0.71 J
	Trichloroethene	µg/L		22		31

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-38G	1,1,1-Trichloroethane	µg/L		15		15
	1,1,2-Trichloroethane	µg/L		0.81 J		1.3
	1,1-Dichloroethane	µg/L		27		32
	1,1-Dichloroethene	µg/L		67		76
	1,2-Dichloroethane	µg/L		3.8		4
	Chloroform	µg/L		2.3		2.8
	cis-1,2-Dichloroethene	µg/L		19		23
	Tetrachloroethene	µg/L		1.6		1.3
	Trichloroethene	µg/L		74		86
	Vinyl chloride	µg/L		0.1 U		0.12 J
X749-40G	Benzene	µg/L			0.28 J	
	Chlorobenzene	µg/L			0.25 J	
	Chloroethane	µg/L			2.5	
	Chloroform	µg/L			0.41 J	
	Ethylbenzene	µg/L			0.57 J	
	Trichloroethene	µg/L			0.29 J	
X749-41G	Chloroform	µg/L		0.31 J		0.24 J
	cis-1,2-Dichloroethene	µg/L		2.2		2.3
	trans-1,2-Dichloroethene	µg/L		0.73 J		0.67 J
	Trichloroethene	µg/L		490		350
X749-42G	1,1,1-Trichloroethane	µg/L		0.66 J		0.43 J
	1,1-Dichloroethane	µg/L		0.97 J		0.74 J
	1,1-Dichloroethene	µg/L		2.6		2.4
	Chloroform	µg/L		0.18 J		0.16 U
	Trichloroethene	µg/L		4.3		6.7
X749-43G	1,1-Dichloroethene	µg/L			0.42 J	
	Trichloroethene	µg/L			0.27 J	
X749-44G	1,1-Dichloroethane	µg/L	0.22 U	0.22 U	0.22 U	0.53 J
	Methylene chloride	µg/L	0.32 U	0.32 U	0.6 BJ	0.32 U
	Trichloroethene	µg/L	0.22 J	0.28 J	0.32 J	0.85 J
X749-45G	1,1-Dichloroethane	µg/L	2.8	1.9	0.22 U	0.22 U
	1,1-Dichloroethene	µg/L	1.8	1.1	0.23 U	0.23 U
	cis-1,2-Dichloroethene	µg/L	2.4	1.8	0.15 U	0.15 U
	Trichloroethene	µg/L	6.2	3.8	0.47 J	0.31 J
X749-50B	1,1-Dichloroethane	µg/L			0.64 J	
X749-54B	1,1-Dichloroethane	µg/L		2.2		1.5
	Methylene chloride	µg/L		0.48 J		0.32 U
	Trichloroethene	µg/L		0.77 J		17
	Vinyl chloride	µg/L		0.29 J		0.46 J
X749-67G	1,1,1-Trichloroethane	µg/L	12	10	11	17
	1,1,2-Trichloroethane	µg/L	0.97 J	0.59 J	0.85 J	0.78 J
	1,1-Dichloroethane	µg/L	110	110	97	150
	1,1-Dichloroethene	µg/L	95	100	48	100
	1,2-Dichloroethane	µg/L	41	35	40	53
	Acetone	µg/L	3.8 U	3.8 U	6.9 J	1.9 U
	Benzene	µg/L	0.52 J	0.46 J	0.42 J	0.49 J
	Chloroethane	µg/L	2 J	2.2 J	1.1 J	1.5 J
	Chloroform	µg/L	5.4	4.9	4.7	6.4
	cis-1,2-Dichloroethene	µg/L	73	70	57	62
	Methylene chloride	µg/L	0.82 UJ	0.64 U	0.62 BJ	0.32 U

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-67G	Tetrachloroethene	µg/L	0.43 J	0.4 U	0.35 J	0.36 J
	trans-1,2-Dichloroethene	µg/L	0.47 J	0.47 J	0.38 J	0.46 J
	Trichloroethene	µg/L	440	410	290	400
	Vinyl chloride	µg/L	0.2 U	0.53 J	0.87 J	0.74 J
X749-99M	1,2-Dimethylbenzene	µg/L			0.42 J	
X749-102G	Methylene chloride	µg/L	0.32 U	0.32 U	0.59 BJ	0.32 U
X749-106G	1,1,1-Trichloroethane	µg/L		27		23
	1,1,2-Trichloroethane	µg/L		2.3		2.2
	1,1-Dichloroethane	µg/L		37		34
	1,1-Dichloroethene	µg/L		130		130
	1,2-Dichloroethane	µg/L		4.2		3.2
	Chloroform	µg/L		3.8		3.4
	cis-1,2-Dichloroethene	µg/L		3.9		4.6
	Methylene chloride	µg/L		0.32 U		0.36 BJ
	Tetrachloroethene	µg/L		1.4		1.2
	Trichloroethene	µg/L		89		80
	Vinyl chloride	µg/L		0.1 U		0.11 J
X749-107G	1,1,1-Trichloroethane	µg/L		31		23
	1,1,2-Trichloroethane	µg/L		2.5		2.3
	1,1-Dichloroethane	µg/L		44		38
	1,1-Dichloroethene	µg/L		140		120
	1,2-Dichloroethane	µg/L		5		3.4
	Chloroform	µg/L		4.6		3.7
	cis-1,2-Dichloroethene	µg/L		4.8		4.3
	Tetrachloroethene	µg/L		1.3		1
	Trichloroethene	µg/L		97		71
X749-108G	1,1,1-Trichloroethane	µg/L		48		40
	1,1,2-Trichloroethane	µg/L		2.6		2.6
	1,1-Dichloroethane	µg/L		50		49
	1,1-Dichloroethene	µg/L		110		150
	1,2-Dichloroethane	µg/L		5.3		4.1
	Chloroform	µg/L		5.4		4.9
	cis-1,2-Dichloroethene	µg/L		5.7		5.7
	Tetrachloroethene	µg/L		1.9		1.5
	Trichloroethene	µg/L		110		130
	Vinyl chloride	µg/L		0.23 J		0.26 J
X749-109G	1,1,1-Trichloroethane	µg/L		4.4		4.5
	1,1,2-Trichloroethane	µg/L		0.35 J		0.4 J
	1,1-Dichloroethane	µg/L		9.5		12
	1,1-Dichloroethene	µg/L		21		26
	1,2-Dichloroethane	µg/L		1.6		1.8
	Chloroform	µg/L		0.77 J		0.88 J
	cis-1,2-Dichloroethene	µg/L		3.5		4.2
	Methylene chloride	µg/L		1.1 BJ		0.32 U
	Trichloroethene	µg/L		22		24
X749-110G	1,1,1-Trichloroethane	µg/L		1.8		2.2
	1,1-Dichloroethane	µg/L		9.2		8.7
	1,1-Dichloroethene	µg/L		9.7		13
	1,2-Dichloroethane	µg/L		3.5		2.6
	Chloroethane	µg/L		0.73 J		0.67 J

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-110G	Chloroform	µg/L		0.94 J		0.45 J
	cis-1,2-Dichloroethene	µg/L		9.1		11
	trans-1,2-Dichloroethene	µg/L		0.15 U		0.34 J
	Trichloroethene	µg/L		38		36
	Vinyl chloride	µg/L		0.18 J		0.16 J
X749-112G	Methylene chloride	µg/L		0.4 BJ		0.32 U
X749-113G	1,1,1-Trichloroethane	µg/L		16		21
	1,1,2-Trichloroethane	µg/L		0.31 J		0.38 J
	1,1-Dichloroethane	µg/L		23		29
	1,1-Dichloroethene	µg/L		37		53
	1,2-Dichloroethane	µg/L		13		17
	Chloroform	µg/L		2.2		2.8
	cis-1,2-Dichloroethene	µg/L		4		4.6
	Methylene chloride	µg/L		0.42 BJ		0.32 U
	Tetrachloroethene	µg/L		0.47 J		0.56 J
	Trichloroethene	µg/L		51		58
X749-114G	1,1,1-Trichloroethane	µg/L			0.24 J	
	1,1-Dichloroethane	µg/L			0.33 J	
	Benzene	µg/L			0.24 J	
	cis-1,2-Dichloroethene	µg/L			0.86 J	
X749-115G	Benzene	µg/L			0.3 J	
	Chloroethane	µg/L			3.5	
	Chloroform	µg/L			0.21 J	
	cis-1,2-Dichloroethene	µg/L			5.4	
	Ethylbenzene	µg/L			0.22 J	
	Trichloroethene	µg/L			210	
X749-117G	Acetone	µg/L			3.7 BJ	
	Chloroform	µg/L			1.2	
	cis-1,2-Dichloroethene	µg/L			0.37 J	
	Tetrachloroethene	µg/L			0.45 J	
	Trichloroethene	µg/L			22	
X749-118G	1,1-Dichloroethane	µg/L			1.4	
	Carbon tetrachloride	µg/L			0.33 J	
	Chloroform	µg/L			0.52 J	
	cis-1,2-Dichloroethene	µg/L			1.1	
	Tetrachloroethene	µg/L			1.6	
	Trichloroethene	µg/L			76	
X749-119G	Chloroform	µg/L			1.2	
	cis-1,2-Dichloroethene	µg/L			0.59 J	
	Trichloroethene	µg/L			9.7	
X749-120G	1,1,1-Trichloroethane	µg/L			670	
	1,1,2-Trichloroethane	µg/L			110	
	1,1-Dichloroethane	µg/L			5100	
	1,1-Dichloroethene	µg/L			1800	
	1,2-Dichloroethane	µg/L			91 J	
	Chloroform	µg/L			390	
	cis-1,2-Dichloroethene	µg/L			1800	
	Methylene chloride	µg/L			90 J	
	Tetrachloroethene	µg/L			320	
	Trichloroethene	µg/L			12000	

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-120G	Vinyl chloride	µg/L			56 J	
X749-121G	1,1,1-Trichloroethane	µg/L			34	
	1,1,2-Trichloroethane	µg/L			1.1	
	1,1-Dichloroethane	µg/L			17	
	1,1-Dichloroethene	µg/L			160	
	1,2-Dichloroethane	µg/L			1.1	
	Acetone	µg/L			7.2 BJ	
	Chloroethane	µg/L			4.8	
	Chloroform	µg/L			1	
	cis-1,2-Dichloroethene	µg/L			13	
	Methylene chloride	µg/L			0.48 BJ	
	Tetrachloroethene	µg/L			0.31 J	
	Trichloroethene	µg/L			68	
	Vinyl chloride	µg/L			2.8	
X749-122G	1,1,1-Trichloroethane	µg/L			260	
	1,1,2-Trichloroethane	µg/L			3.9	
	1,1-Dichloroethane	µg/L			88	
	1,1-Dichloroethene	µg/L			250	
	1,2-Dichloroethane	µg/L			4.5	
	Acetone	µg/L			13 BJ	
	Benzene	µg/L			1.9 J	
	Chloroform	µg/L			3.4	
	cis-1,2-Dichloroethene	µg/L			57	
	Methylene chloride	µg/L			1.4 BJ	
	trans-1,2-Dichloroethene	µg/L			1.2 J	
	Trichloroethene	µg/L			660	
	Vinyl chloride	µg/L			5.8	
X749-BG9G	1,1,1-Trichloroethane	µg/L		0.16 U		0.22 J
	1,1-Dichloroethane	µg/L		0.22 U		0.22 J
	Acetone	µg/L		4 BJ		1.9 U
	Carbon disulfide	µg/L		0.59 J		0.45 U
	Methylene chloride	µg/L		0.52 BJ		0.32 U
	Trichloroethene	µg/L		0.21 J		0.78 J
X749-PZ02G	1,1-Dichloroethene	µg/L		0.23 U		0.27 J
	Methylene chloride	µg/L		0.32 U		0.37 BJ
	Trichloroethene	µg/L		0.37 J		0.57 J
X749-PZ03G	Acetone	µg/L		1.9 U		4.7 BJ
X749-PZ04G	1,1-Dichloroethane	µg/L	1.3	0.8 J	0.61 J	0.3 J
	1,1-Dichloroethene	µg/L	0.53 J	0.36 J	0.23 U	0.23 U
	Acetone	µg/L	1.9 U	1.9 U	1.9 U	6 BJ
	cis-1,2-Dichloroethene	µg/L	0.43 J	0.27 J	0.23 J	0.15 U
	Trichloroethene	µg/L	3.3	2.1	1.4	0.76 J
X749-PZ05G	Acetone	µg/L	1.9 U	1.9 U	3.5 UJ	8 BJ
X749-PZ06G	1,1,1-Trichloroethane	µg/L		18		12
	1,1,2-Trichloroethane	µg/L		1.4		1.4
	1,1-Dichloroethane	µg/L		32		27
	1,1-Dichloroethene	µg/L		78		66
	1,2-Dichloroethane	µg/L		3.3		2.5
	Acetone	µg/L		7.5 J		1.9 U
	Chloroform	µg/L		3		2.4

Table 4.1. VOCs detected at the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-PZ06G	cis-1,2-Dichloroethene	µg/L		3.9		3.9
	Tetrachloroethene	µg/L		0.47 J		0.32 J
	Trichloroethene	µg/L		52		49
X749-PZ07G	1,1-Dichloroethene	µg/L			0.47 J	
	Benzene	µg/L			0.19 J	
	Chloroethane	µg/L			2.8	
	Trichloroethene	µg/L			0.93 J	
X749-PZ10G	1,1,1-Trichloroethane	µg/L		9.7		11
	1,1,2-Trichloroethane	µg/L		0.36 J		0.48 J
	1,1-Dichloroethane	µg/L		0.57 J		0.67 J
	1,1-Dichloroethene	µg/L		100		110
	1,2-Dichloroethane	µg/L		0.43 J		0.13 U
	Acetone	µg/L		38		1.9 U
	Chloroform	µg/L		24		27
	cis-1,2-Dichloroethene	µg/L		0.48 J		0.56 J
	Methylene chloride	µg/L		0.8 BJ		0.32 U
	Trichloroethene	µg/L		450		460
X749-WPW	1,1,1-Trichloroethane	µg/L		56		76
	1,1,2-Trichloroethane	µg/L		0.8 J		1.1 U
	1,1-Dichloroethane	µg/L		69		81
	1,1-Dichloroethene	µg/L		100		180
	1,2-Dichloroethane	µg/L		16		8.5
	Benzene	µg/L		1.8		14
	Chloroethane	µg/L		0.67 J		1.6 U
	Chloroform	µg/L		14		6
	cis-1,2-Dichloroethene	µg/L		33		73
	Methylene chloride	µg/L		0.57 BJ		1.3 U
	Tetrachloroethene	µg/L		2.2		3 J
	trans-1,2-Dichloroethene	µg/L		0.17 J		0.78 J
	Trichloroethene	µg/L		360		700
	Vinyl chloride	µg/L		2.2		2.5 J

Table 4.2 VOCs detected at the PK Landfill – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
PK-10G	Acetone	µg/L		4.2 J		7.7 J
PK-11G	Methylene chloride	µg/L		1.4 BJ		0.36 BJ
PK-14G	Methylene chloride	µg/L		0.5 BJ		0.33 BJ
PK-15B	Methylene chloride	µg/L		1.4 BJ		0.38 BJ
	Vinyl chloride	µg/L		0.26 J		0.14 J
PK-16G	cis-1,2-Dichloroethene	µg/L		0.15 U		0.48 J
	Methylene chloride	µg/L		0.51 BJ		0.39 BJ
PK-17B	1,1-Dichloroethane	µg/L		3.8		4.2
	1,1-Dichloroethene	µg/L		0.52 J		0.62 J
	Acetone	µg/L		2.9 J		1.9 U
	Benzene	µg/L		0.27 J		0.32 J
	Chlorobenzene	µg/L		1		1.5
	cis-1,2-Dichloroethene	µg/L		58		64
	Methylene chloride	µg/L		1 BJ		0.37 BJ
	trans-1,2-Dichloroethene	µg/L		1.8		2
	Trichloroethene	µg/L		1.3		1.4
	Vinyl chloride	µg/L		16		18
PK-18B	Methylene chloride	µg/L		0.55 BJ		0.34 BJ
PK-19B	1,1-Dichloroethane	µg/L		0.42 J		0.34 J
	Chloroethane	µg/L		1.8 J		1.1 J
	Methylene chloride	µg/L		1.2 BJ		0.32 U
	Vinyl chloride	µg/L		0.13 J		0.17 J
PK-21B	1,1-Dichloroethane	µg/L		140		130
	1,1-Dichloroethene	µg/L		1.4		1.3
	1,2-Dichloroethane	µg/L		0.64 J		0.75 J
	Acetone	µg/L		1.9 J		1.9 U
	Benzene	µg/L		0.77 J		0.72 J
	cis-1,2-Dichloroethene	µg/L		12		12
	Methylene chloride	µg/L		1.4 BJ		0.32 U
	Trichloroethene	µg/L		0.38 J		0.34 J
	Vinyl chloride	µg/L		12		12
PK-PL6	1,1,1-Trichloroethane	µg/L	2.9	3.4	3.9	2.9
	1,1-Dichloroethane	µg/L	6	8.8	8.6	8.1
	1,1-Dichloroethene	µg/L	1.8	2.6	2.5	2.1
	Acetone	µg/L	1.9 U	3.5 J	1.9 U	1.9 U
	cis-1,2-Dichloroethene	µg/L	1.3	2.6	2.5	2.2
	Methylene chloride	µg/L	0.32 U	0.56 J	0.45 UJ	0.32 U
	Trichloroethene	µg/L	1.5	2.3	2.1	2.1
	Vinyl chloride	µg/L	0.27 J	0.59 J	1.2	0.1 U
PK-PL6A	1,1,1-Trichloroethane	µg/L	4.4	4.9	5.1	4.3
	1,1-Dichloroethane	µg/L	8.7	13	12	11
	1,1-Dichloroethene	µg/L	2.7	3.7	3.5	3.3
	Acetone	µg/L	1.9 U	4.7 J	1.9 U	1.9 U
	Carbon disulfide	µg/L	0.45 U	0.73 J	0.45 U	0.45 U
	cis-1,2-Dichloroethene	µg/L	1.7	3.5	2.8	2.7
	Methylene chloride	µg/L	0.32 U	0.58 J	0.41 UJ	0.32 U
	Trichloroethene	µg/L	2.3	3.1	2.9	3
	Vinyl chloride	µg/L	0.49 J	0.91 J	1.8	0.57 J

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X230K-14G	cis-1,2-Dichloroethene	µg/L			0.37 J	
	Trichloroethene	µg/L			3.9	
X230K-15G	Trichloroethene	µg/L			0.63 J	
X231A-01G	1,1-Dichloroethane	µg/L			1.4	
	1,1-Dichloroethene	µg/L			0.25 J	
	Benzene	µg/L			0.18 J	
	Chloroform	µg/L			0.23 J	
	cis-1,2-Dichloroethene	µg/L			1.1	
	Trichloroethene	µg/L			22	
X231A-02G	1,1,1-Trichloroethane	µg/L			2.4	
	1,1-Dichloroethane	µg/L			1.7	
	1,1-Dichloroethene	µg/L			37	
	Chloroform	µg/L			1.4	
	cis-1,2-Dichloroethene	µg/L			11	
	Trichloroethene	µg/L			180	
	Trichlorofluoromethane	µg/L			0.75 J	
X231A-04G	1,1-Dichloroethene	µg/L			1.1	
	Chloroform	µg/L			0.23 J	
	cis-1,2-Dichloroethene	µg/L			0.59 J	
	Trichloroethene	µg/L			8.3	
X231B-02G	1,1,1-Trichloroethane	µg/L	0.32 U		0.22 J	
	1,1-Dichloroethane	µg/L	1.1 J		0.22 U	
	1,1-Dichloroethene	µg/L	7.9		15	
	Chloroform	µg/L	2.1		0.77 J	
	cis-1,2-Dichloroethene	µg/L	18		11	
	trans-1,2-Dichloroethene	µg/L	0.58 J		0.9 J	
	Trichloroethene	µg/L	320		200	
	Vinyl chloride	µg/L	0.38 J		0.1 U	
X231B-03G	1,1,1-Trichloroethane	µg/L	2.7		3	
	1,1,2-Trichloroethane	µg/L	0.71 J		0.93 J	
	1,1-Dichloroethane	µg/L	2.3		2.8	
	1,1-Dichloroethene	µg/L	110		100 *	
	1,2-Dichloroethane	µg/L	0.29 J		0.13 U	
	Benzene	µg/L	0.22 J		0.26 J	
	Chloroform	µg/L	0.37 J		0.39 J	
	cis-1,2-Dichloroethene	µg/L	9.2		9.5	
	Tetrachloroethene	µg/L	0.25 J		0.25 J	
	trans-1,2-Dichloroethene	µg/L	0.8 J		2.1	
	Trichloroethene	µg/L	180		160	
X231B-06G	1,1,1-Trichloroethane	µg/L	9.8		4.8	
	1,1-Dichloroethane	µg/L	6.6		3.4	
	1,1-Dichloroethene	µg/L	13		15 *	
	Chloroform	µg/L	0.17 J		0.16 U	
	cis-1,2-Dichloroethene	µg/L	0.35 J		0.55 J	
	Tetrachloroethene	µg/L	0.21 J		0.2 U	
	Trichloroethene	µg/L	14		57	
X231B-12G	1,1,1-Trichloroethane	µg/L			0.74 J	
	1,1-Dichloroethene	µg/L			2.8	
	Trichloroethene	µg/L			3.2	
X231B-14G	1,1,1-Trichloroethane	µg/L			1.7	

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231B-14G	1,1-Dichloroethane	µg/L			1.4	
	1,1-Dichloroethene	µg/L			22	
	Chloroform	µg/L			1.1	
	cis-1,2-Dichloroethene	µg/L			7.2	
	trans-1,2-Dichloroethene	µg/L			0.26 J	
	Trichloroethene	µg/L			130	
X231B-15G	cis-1,2-Dichloroethene	µg/L			0.42 J	
	Trichloroethene	µg/L			2.1	
X231B-16G	1,1,1-Trichloroethane	µg/L			0.4 J	
	1,1-Dichloroethene	µg/L			1.9	
	Chloroform	µg/L			2.3	
	Trichloroethene	µg/L			0.22 J	
X231B-20G	1,1,1-Trichloroethane	µg/L			0.72 J	
	1,1-Dichloroethene	µg/L			20 *	
	Chloroform	µg/L			0.96 J	
	cis-1,2-Dichloroethene	µg/L			0.23 J	
	Trichloroethene	µg/L			34	
	Trichlorofluoromethane	µg/L			1.6 J	
X231B-23G	1,1,1-Trichloroethane	µg/L			0.18 J	
	1,1-Dichloroethene	µg/L			1	
	Chloroform	µg/L			0.81 J	
	Trichloroethene	µg/L			0.67 J	
X231B-32B	Trichloroethene	µg/L			0.77 J	
X231B-36G	Chloroform	µg/L			0.47 J	
	cis-1,2-Dichloroethene	µg/L			0.93 J	
	Trichloroethene	µg/L			180	
X231B-37G	1,1-Dichloroethane	µg/L			1.3	
	1,1-Dichloroethene	µg/L			1.5	
	cis-1,2-Dichloroethene	µg/L			7.7	
	trans-1,2-Dichloroethene	µg/L			1.1	
	Trichloroethene	µg/L			12	
	Vinyl chloride	µg/L			0.85 J	
X326-09G	1,1-Dichloroethene	µg/L	450		200	
	Chloroform	µg/L	160		170	
	cis-1,2-Dichloroethene	µg/L	160		180	
	Trichloroethene	µg/L	28000		27000	
X326-10G	1,1-Dichloroethene	µg/L			3	
	cis-1,2-Dichloroethene	µg/L			1.1	
	Trichloroethene	µg/L			8.6	
X622-PZ01G	1,1-Dichloroethene	µg/L			0.35 J	
	Benzene	µg/L			0.18 J	
	cis-1,2-Dichloroethene	µg/L			11	
	Methylene chloride	µg/L			0.42 BJ	
	trans-1,2-Dichloroethene	µg/L			0.77 J	
	Trichloroethene	µg/L			5.4	
	Vinyl chloride	µg/L			0.32 J	
X622-PZ02G	1,1,1-Trichloroethane	µg/L			1	
	1,1-Dichloroethane	µg/L			0.94 J	
	1,1-Dichloroethene	µg/L			13	
	Chloroform	µg/L			0.67 J	

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X622-PZ02G	cis-1,2-Dichloroethene	µg/L			5.5	
	Methylene chloride	µg/L			0.47 BJ	
	trans-1,2-Dichloroethene	µg/L			0.15 J	
	Trichloroethene	µg/L			110	
	Trichlorofluoromethane	µg/L			0.82 J	
X622-PZ03G	1,1,1-Trichloroethane	µg/L			1.2 J	
	1,1-Dichloroethane	µg/L			2.1	
	1,1-Dichloroethene	µg/L			6	
	Chloroform	µg/L			0.44 J	
	cis-1,2-Dichloroethene	µg/L			7.9	
	Methylene chloride	µg/L			1.3 BJ	
	Trichloroethene	µg/L			360	
	Trichlorofluoromethane	µg/L			6	
X626-07G	1,1,1-Trichloroethane	µg/L	2.5		3.2	
	1,1,2-Trichloroethane	µg/L	1.4		1.9 J	
	1,1-Dichloroethane	µg/L	1.3		1.6 J	
	1,1-Dichloroethene	µg/L	250		240 *	
	1,2-Dichloroethane	µg/L	0.69 J		0.26 U	
	Benzene	µg/L	0.58 J		0.62 J	
	Chloroform	µg/L	0.71 J		0.6 J	
	cis-1,2-Dichloroethene	µg/L	1.6		1.5 J	
	Trichloroethene	µg/L	110		110	
	Vinyl chloride	µg/L	0.11 J		0.1 U	
X749A-09G	Trichloroethene	µg/L			0.16 J	
X760-03G	1,1-Dichloroethene	µg/L			0.24 J	
	Chloroform	µg/L			0.41 J	
	cis-1,2-Dichloroethene	µg/L			7	
	Trichloroethene	µg/L			290	
X760-07G	1,1-Dichloroethene	µg/L			0.58 J	
	Acetone	µg/L			9.6 J	
	Chloroform	µg/L			0.37 J	
	cis-1,2-Dichloroethene	µg/L			16	
	Trichloroethene	µg/L			560	
	Vinyl chloride	µg/L			0.42 J	
X770-17GA	cis-1,2-Dichloroethene	µg/L	0.85 J		0.86 J	
	Trichloroethene	µg/L	260		290	

Table 4.4 VOCs detected at the X-749A Classified Materials Disposal Facility – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749A-12G	cis-1,2-Dichloroethene	µg/L		5.6		
	Trichloroethene	µg/L		2.9		
X749A-17G	1,1-Dichloroethene	µg/L		0.23 U		0.23 J
X749A-18G	cis-1,2-Dichloroethene	µg/L		0.75 J		
	Trichloroethene	µg/L		14		
X749A-19G	Chloroform	µg/L		0.21 J		
	cis-1,2-Dichloroethene	µg/L		2.5		
	Trichloroethene	µg/L		33		

Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X700-02G	1,1,1-Trichloroethane	µg/L	9 J			
	1,1-Dichloroethane	µg/L	14 J			
	1,1-Dichloroethene	µg/L	130			
	Acetone	µg/L	180 J			
	cis-1,2-Dichloroethene	µg/L	1700			
	trans-1,2-Dichloroethene	µg/L	4 J			
	Trichloroethene	µg/L	5300			
	Vinyl chloride	µg/L	260			
X700-04G	1,1-Dichloroethane	µg/L			4.5 J	
	1,1-Dichloroethene	µg/L			19 J	
	cis-1,2-Dichloroethene	µg/L			3600	
	Methylene chloride	µg/L			11 BJ	
	trans-1,2-Dichloroethene	µg/L			34	
	Trichloroethene	µg/L			2600	
	Vinyl chloride	µg/L			3500	
X700-05G	1,1-Dichloroethene	µg/L			300 J	
	Acetone	µg/L			2400 BJ	
	cis-1,2-Dichloroethene	µg/L			110000	
	Methylene chloride	µg/L			580 BJ	
	Trichloroethene	µg/L			150000	
	Vinyl chloride	µg/L			4100	
X700-06G	1,1,2-Trichloroethane	µg/L	1200 J			
	Chloroform	µg/L	530 J			
	cis-1,2-Dichloroethene	µg/L	3100			
	Methylene chloride	µg/L	1200 BJ			
	Trichloroethene	µg/L	1E+06			
	Vinyl chloride	µg/L	640			
X701-26G	1,1-Dichloroethene	µg/L	0.23 U		1.3	
	Chloroform	µg/L	0.56 J		0.46 J	
	Methylene chloride	µg/L	0.32 U		0.32 BJ	
	Tetrachloroethene	µg/L	2.9		2.5	
	Trichloroethene	µg/L	1.4		4.1	
X701-27G	1,1,1-Trichloroethane	µg/L	0.65 J		0.66 J	
	1,1-Dichloroethane	µg/L	0.48 J		0.47 J	
	1,1-Dichloroethene	µg/L	2		1.8	
	cis-1,2-Dichloroethene	µg/L	0.34 J		0.77 J	
	Methylene chloride	µg/L	0.32 U		0.32 BJ	
	Trichloroethene	µg/L	6.5		11	
X701-69G	cis-1,2-Dichloroethene	µg/L	290			
	trans-1,2-Dichloroethene	µg/L	6.3			
	Trichloroethene	µg/L	1100			
	Vinyl chloride	µg/L	0.59 J			
X705-02G	1,1-Dichloroethene	µg/L	0.65 J			
	cis-1,2-Dichloroethene	µg/L	0.61 J			
	Trichloroethene	µg/L	46			
X705-03G	1,1-Dichloroethane	µg/L	1.2			
	1,1-Dichloroethene	µg/L	2.7			
	cis-1,2-Dichloroethene	µg/L	6.9			
	Tetrachloroethene	µg/L	0.46 J			
	trans-1,2-Dichloroethene	µg/L	0.44 J			

Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X705-03G	Trichloroethene	µg/L	30			
X705-04G	1,1-Dichloroethene	µg/L	0.4 J			
	Bromodichloromethane	µg/L	0.37 J			
	Carbon tetrachloride	µg/L	12			
	Chloroform	µg/L	270			
	Tetrachloroethene	µg/L	2.2			
	Trichloroethene	µg/L	19			
X720-01G	1,1,1-Trichloroethane	µg/L	20			
	1,1-Dichloroethane	µg/L	27			
	1,1-Dichloroethene	µg/L	80			
	cis-1,2-Dichloroethene	µg/L	5000			
	trans-1,2-Dichloroethene	µg/L	10 J			
	Trichloroethene	µg/L	4800			
	Vinyl chloride	µg/L	620			
X720-08G	1,1-Dichloroethene	µg/L	73			
	cis-1,2-Dichloroethene	µg/L	17 J			
	Methylene chloride	µg/L	15 BJ			
	Tetrachloroethene	µg/L	11 J			
	Trichloroethene	µg/L	5300			
X720-09G	1,1,1-Trichloroethane	µg/L	2400			
	1,1-Dichloroethene	µg/L	10000			
	cis-1,2-Dichloroethene	µg/L	1800 J			
	Methylene chloride	µg/L	960 BJ			
	Toluene	µg/L	720 J			
	Trichloroethene	µg/L	390000			
	Vinyl chloride	µg/L	1100 J			

Table 4.6. VOCs detected at the X-701B Former Holding Pond – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ03G	Acetone	µg/L	10		1.9 U	
	cis-1,2-Dichloroethene	µg/L	87		93	
	Methylene chloride	µg/L	0.32 U		0.49 BJ	
	trans-1,2-Dichloroethene	µg/L	0.76 J		0.89 J	
	Trichloroethene	µg/L	19		45	
	Vinyl chloride	µg/L	0.1 U		0.18 J	
LBC-PZ06G	Acetone	µg/L	16		1.9 U	
	Methylene chloride	µg/L	0.32 U		0.46 BJ	
	Trichloroethene	µg/L	0.22 J		0.17 J	
X230J7-01GA	cis-1,2-Dichloroethene	µg/L	0.83 J		0.89 J	
	Trichloroethene	µg/L	360		320	
X230J7-02GA	Chloroform	µg/L	0.32 U		0.35 J	
	cis-1,2-Dichloroethene	µg/L	2.1		3.4	
	Trichloroethene	µg/L	400		400	
X230J7-03GA	cis-1,2-Dichloroethene	µg/L	240		240	
	Tetrachloroethene	µg/L	2 J		2 U	
	trans-1,2-Dichloroethene	µg/L	4.8 J		6.1 J	
	Trichloroethene	µg/L	2700		2600	
	Vinyl chloride	µg/L	7.7 J		1 U	
X237-EPW	Acetone	µg/L			820 J	
	cis-1,2-Dichloroethene	µg/L			2100	
	Trichloroethene	µg/L			13000	
X237-WPW	cis-1,2-Dichloroethene	µg/L			4200	
	Tetrachloroethene	µg/L			41 J	
	trans-1,2-Dichloroethene	µg/L			31 J	
	Trichloroethene	µg/L			51000	
	Vinyl chloride	µg/L			9.7 J	
X701-01G	1,1-Dichloroethene	µg/L	0.23 J		1.1	
	Acetone	µg/L	8.2 J		1.9 U	
	cis-1,2-Dichloroethene	µg/L	4.4		26	
	Methylene chloride	µg/L	0.32 U		0.39 BJ	
	trans-1,2-Dichloroethene	µg/L	0.15 U		0.79 J	
	Trichloroethene	µg/L	32		170	
	Vinyl chloride	µg/L	0.1 U		0.34 J	
X701-02G	1,1-Dichloroethene	µg/L	0.26 J		0.31 J	
	Acetone	µg/L	5.2 J		3.3 J	
	cis-1,2-Dichloroethene	µg/L	5.4		4.7	
	Trichloroethene	µg/L	18		14	
X701-06G	1,1-Dichloroethane	µg/L	1.3		1.3 J	
	1,1-Dichloroethene	µg/L	11		8.3	
	Acetone	µg/L	1.9 U		7.5 J	
	Chloroform	µg/L	0.46 J		0.48 J	
	cis-1,2-Dichloroethene	µg/L	18		27	
	trans-1,2-Dichloroethene	µg/L	0.55 J		0.5 J	
	Trichloroethene	µg/L	390		350	
	Vinyl chloride	µg/L	0.43 J		0.33 J	
X701-15G	cis-1,2-Dichloroethene	µg/L	230		240	
	trans-1,2-Dichloroethene	µg/L	2.4		9.3	
	Trichloroethene	µg/L	3.4		8.1	
	Vinyl chloride	µg/L	0.18 J		0.1 U	

Table 4.6. VOCs detected at the X-701B Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-16G	cis-1,2-Dichloroethene	µg/L	0.15 U		0.19 J	
	Trichloroethene	µg/L	0.45 J		0.9 J	
X701-18G	Acetone	µg/L			26	
X701-19G	Acetone	µg/L	1.9 U		5.6 J	
X701-20G	cis-1,2-Dichloroethene	µg/L	1900		2100	
	Tetrachloroethene	µg/L	80 U		78 J	
	trans-1,2-Dichloroethene	µg/L	60 U		31 J	
	Trichloroethene	µg/L	86000		84000	
X701-21G	1,2-Dichlorobenzene	µg/L	0.26 J		0.27 J	
	Chloroform	µg/L	0.18 J		0.3 J	
	cis-1,2-Dichloroethene	µg/L	17		27	
	trans-1,2-Dichloroethene	µg/L	0.15 U		0.3 J	
	Trichloroethene	µg/L	14		28	
	Vinyl chloride	µg/L	0.82 J		2.1	
X701-23G	Trichloroethene	µg/L			2.6	
X701-24G	1,1,2-Trichloroethane	µg/L	3.3 J		11 U	
	cis-1,2-Dichloroethene	µg/L	930		1200	
	Methylene chloride	µg/L	5.6 BJ		13 U	
	trans-1,2-Dichloroethene	µg/L	4.6 J		9.3 J	
	Trichloroethene	µg/L	1500		5600	
	Vinyl chloride	µg/L	1.8		23	
X701-25G	Acetone	µg/L	7.6 J		1.9 U	
	Trichloroethene	µg/L	0.16 U		0.56 J	
X701-30G	Acetone	µg/L	2.8 J		1.9 U	
	Methylene chloride	µg/L	0.32 U		0.47 BJ	
	Trichloroethene	µg/L	4.1		3.5	
	Trichlorofluoromethane	µg/L	1.2 J		0.73 J	
X701-31G	Methylene chloride	µg/L			0.48 BJ	
	Trichloroethene	µg/L			0.18 J	
X701-38G	1,2-Dichlorobenzene	µg/L			0.24 J	
	Chloroform	µg/L			0.17 J	
X701-40G	cis-1,2-Dichloroethene	µg/L			4.2	
	Methylene chloride	µg/L			0.42 BJ	
	Tetrachloroethene	µg/L			0.38 J	
	Trichloroethene	µg/L			2.1	
X701-42G	1,2-Dichlorobenzene	µg/L			0.34 J	
	Acetone	µg/L			3.6 J	
	cis-1,2-Dichloroethene	µg/L			35	
	Trichloroethene	µg/L			8.2	
	Vinyl chloride	µg/L			1.9	
X701-48G	Methylene chloride	µg/L			0.45 BJ	
X701-58B	Acetone	µg/L			3.6 J	
	Benzene	µg/L			0.35 J	
X701-61B	1,2-Dimethylbenzene	µg/L			0.28 J	
	Acetone	µg/L			86 B	
	Ethylbenzene	µg/L			0.17 J	
	m,p-Xylenes	µg/L			3.7	
	Trichloroethene	µg/L			0.29 J	
X701-66G	Chloroform	µg/L	16 J		28 J	
	cis-1,2-Dichloroethene	µg/L	240		310	

Table 4.6. VOCs detected at the X-701B Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-66G	Methylene chloride	µg/L	13 U		36 J	
	Tetrachloroethene	µg/L	9.2 J		20 U	
	Trichloroethene	µg/L	8600		13000	
X701-77G	cis-1,2-Dichloroethene	µg/L			91	
	Methylene chloride	µg/L			20 J	
	Tetrachloroethene	µg/L			24 J	
	Trichloroethene	µg/L			6800	
X701-79G	cis-1,2-Dichloroethene	µg/L			5.9	
	Trichloroethene	µg/L			51	
X701-127G	1,1,2-Trichloroethane	µg/L	68 J		60 J	
	Acetone	µg/L	380 U		1200 J	
	cis-1,2-Dichloroethene	µg/L	1200		1100	
	Methylene chloride	µg/L	110 BJ		64 U	
	Trichloroethene	µg/L	49000		47000	
X701-128G	Acetone	µg/L	1100		850 J	
	cis-1,2-Dichloroethene	µg/L	270		200	
	Trichloroethene	µg/L	23000		20000	
X701-130G	cis-1,2-Dichloroethene	µg/L			1400	
	Tetrachloroethene	µg/L			210 J	
	Trichloroethene	µg/L			210000	
X701-139G	1,1,2-Trichloroethane	µg/L			3.3 J	
	cis-1,2-Dichloroethene	µg/L			22	
	Methylene chloride	µg/L			5.8 BJ	
	Tetrachloroethene	µg/L			2.5 J	
	Trichloroethene	µg/L			2900	
X701-141G	cis-1,2-Dichloroethene	µg/L			1	
	Trichloroethene	µg/L			160	
X701-142G	1,1,2-Trichloroethane	µg/L			18 J	
	cis-1,2-Dichloroethene	µg/L			3900	
	trans-1,2-Dichloroethene	µg/L			34 J	
	Trichloroethene	µg/L			9000	
	Vinyl chloride	µg/L			160	
X701-143G	1,1,2-Trichloroethane	µg/L			3 J	
	1,1-Dichloroethene	µg/L			5.7	
	cis-1,2-Dichloroethene	µg/L			2100	
	trans-1,2-Dichloroethene	µg/L			17	
	Trichloroethene	µg/L			1200	
	Vinyl chloride	µg/L			77	
X701-144G	1,1-Dichloroethene	µg/L			0.69 J	
	cis-1,2-Dichloroethene	µg/L			560	
	trans-1,2-Dichloroethene	µg/L			4.4	
	Trichloroethene	µg/L			1.4 J	
	Vinyl chloride	µg/L			110	
X701-BW2G	1,1-Dichloroethene	µg/L			73 J	
	Acetone	µg/L			1000 J	
	Chloroform	µg/L			180 J	
	cis-1,2-Dichloroethene	µg/L			360	
	Methylene chloride	µg/L			90 J	
	Trichloroethene	µg/L			33000	
X701-BW3G	1,1-Dichloroethane	µg/L			0.55 J	

Table 4.6. VOCs detected at the X-701B Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-BW3G	1,1-Dichloroethene	µg/L			1.4	
	Chloroform	µg/L			0.24 J	
	cis-1,2-Dichloroethene	µg/L			93	
	Tetrachloroethene	µg/L			0.24 J	
	trans-1,2-Dichloroethene	µg/L			0.38 J	
	Trichloroethene	µg/L			100	
	Vinyl chloride	µg/L			6.5	
X701-BW4G	cis-1,2-Dichloroethene	µg/L	0.23 J		3.9	
	trans-1,2-Dichloroethene	µg/L	0.15 U		0.28 J	
	Trichloroethene	µg/L	0.77 J		1	
X701-EW121G	1,1,1-Trichloroethane	µg/L	160 U		44 J	
	1,1,2,2-Tetrachloroethane	µg/L	210 U		120 J	
	cis-1,2-Dichloroethene	µg/L	3100		2100	
	Methylene chloride	µg/L	580 BJ		64 U	
	Tetrachloroethene	µg/L	200 U		210	
	trans-1,2-Dichloroethene	µg/L	180 J		150 J	
	Trichloroethene	µg/L	140000		120000	
X701-EW122G	1,1,2,2-Tetrachloroethane	µg/L	140		180 J	
	cis-1,2-Dichloroethene	µg/L	320		390	
	Methylene chloride	µg/L	120 J		64 U	
	Tetrachloroethene	µg/L	120		140 J	
	trans-1,2-Dichloroethene	µg/L	37 J		53 J	
	Trichloroethene	µg/L	26000		33000	
X701-IRMPZ03G	1,1,2-Trichloroethane	µg/L	2.6 J		2.7 U	
	1,1-Dichloroethene	µg/L	1.3 J		2.3 U	
	cis-1,2-Dichloroethene	µg/L	430		760	
	trans-1,2-Dichloroethene	µg/L	5.3		5.6 J	
	Trichloroethene	µg/L	710		1600	
	Vinyl chloride	µg/L	0.9 J		0.89 J	
X701-IRMPZ04G	1,1,2-Trichloroethane	µg/L			24 J	
	cis-1,2-Dichloroethene	µg/L			1300	
	Methylene chloride	µg/L			29 BJ	
	Tetrachloroethene	µg/L			10 J	
	Trichloroethene	µg/L			21000	
X701-IRMPZ07G	1,1,2-Trichloroethane	µg/L			71 J	
	cis-1,2-Dichloroethene	µg/L			5900	
	Methylene chloride	µg/L			120 BJ	
	Tetrachloroethene	µg/L			61 J	
	trans-1,2-Dichloroethene	µg/L			32 J	
	Trichloroethene	µg/L			64000	
	Vinyl chloride	µg/L			300	
X701-IRMPZ08G	1,1,2-Trichloroethane	µg/L	4.6 J		2.7 U	
	1,1-Dichloroethene	µg/L	2.5 J		2.3 U	
	cis-1,2-Dichloroethene	µg/L	800		910	
	trans-1,2-Dichloroethene	µg/L	4.3 J		5.7 J	
	Trichloroethene	µg/L	2200		1400	
	Vinyl chloride	µg/L	3.1 J		2.8 J	
X701-TC01G	1,1,1-Trichloroethane	µg/L	220		160 J	
	1,1,2,2-Tetrachloroethane	µg/L	120 J		52 J	
	1,1-Dichloroethene	µg/L	46 U		47 J	

Table 4.6. VOCs detected at the X-701B Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC01G	Acetone	µg/L	380 U		490 J	
	cis-1,2-Dichloroethene	µg/L	4500		6500	
	Methylene chloride	µg/L	64 U		98 J	
	Tetrachloroethene	µg/L	150 J		95 J	
	trans-1,2-Dichloroethene	µg/L	260		160 J	
	Trichloroethene	µg/L	48000		69000	
	Vinyl chloride	µg/L	110 J		130 J	
X701-TC03G	1,1,1-Trichloroethane	µg/L	100		150 J	
	1,1,2,2-Tetrachloroethane	µg/L	300		420	
	1,1,2-Trichloroethane	µg/L	36 J		54 U	
	1,1-Dichloroethane	µg/L	9.2 J		44 U	
	Acetone	µg/L	260 J		380 U	
	Bromomethane	µg/L	9.2 J		42 U	
	Chloromethane	µg/L	64 J		110 J	
	cis-1,2-Dichloroethene	µg/L	2800		5900	
	Methylene chloride	µg/L	13 U		80 J	
	Tetrachloroethene	µg/L	55		61 J	
	trans-1,2-Dichloroethene	µg/L	500		870	
	Trichloroethene	µg/L	18000		64000	
	Vinyl chloride	µg/L	34 J		97 J	
X701-TC05G	1,1,1-Trichloroethane	µg/L	83 J		140 J	
	1,1,2,2-Tetrachloroethane	µg/L	300		420	
	1,1,2-Trichloroethane	µg/L	34 J		54 U	
	Acetone	µg/L	190 U		650 J	
	Chloromethane	µg/L	94 J		140 J	
	cis-1,2-Dichloroethene	µg/L	2100		3800	
	Tetrachloroethene	µg/L	44 J		62 J	
	trans-1,2-Dichloroethene	µg/L	390		590	
	Trichloroethene	µg/L	23000		35000	
	Vinyl chloride	µg/L	26 J		42 J	
X701-TC10G	1,1,1-Trichloroethane	µg/L	37 J		43 J	
	1,1,2,2-Tetrachloroethane	µg/L	69 J		63 J	
	Acetone	µg/L	3000 B		190 U	
	Chloromethane	µg/L	30 U		41 J	
	cis-1,2-Dichloroethene	µg/L	1600		2200	
	Methylene chloride	µg/L	32 U		66 BJ	
	Tetrachloroethene	µg/L	67 J		35 J	
	trans-1,2-Dichloroethene	µg/L	200		280	
	Trichloroethene	µg/L	15000		14000	
	Vinyl chloride	µg/L	34 J		47 J	
X701-TC17G	1,1,1-Trichloroethane	µg/L	21 J		21	
	1,1,2,2-Tetrachloroethane	µg/L	11 U		21	
	1,1,2-Trichloroethane	µg/L	14 J		10	
	1,1-Dichloroethane	µg/L	11 U		1.7 J	
	2-Butanone	µg/L	100 U		48	
	Acetone	µg/L	780 B		660	
	Benzene	µg/L	8 U		2.1 J	
	Bromomethane	µg/L	11 U		6.5 J	
	Chloroform	µg/L	14 J		12	
	Chloromethane	µg/L	140		180	

Table 4.6. VOCs detected at the X-701B Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC17G	cis-1,2-Dichloroethene	µg/L	150		100	
	Methylene chloride	µg/L	16 U		6.3 BJ	
	Tetrachloroethene	µg/L	54		28	
	trans-1,2-Dichloroethene	µg/L	12 J		10	
	Trichloroethene	µg/L	12000		8300	
X701-TC22G	1,1,1-Trichloroethane	µg/L	16 U		56 J	
	1,1,2,2-Tetrachloroethane	µg/L	130		150	
	1,1,2-Trichloroethane	µg/L	38 J		46 J	
	Acetone	µg/L	770 J		350 J	
	cis-1,2-Dichloroethene	µg/L	590		940 J	
	Methylene chloride	µg/L	50 BJ		32 U	
	Tetrachloroethene	µg/L	47 J		140	
	trans-1,2-Dichloroethene	µg/L	93 J		140 J	
	Trichloroethene	µg/L	19000		53000	
X701-TC28G	1,1,1-Trichloroethane	µg/L	240 J		260	
	1,1,2,2-Tetrachloroethane	µg/L	330 J		280	
	1,1,2-Trichloroethane	µg/L	110 U		58 J	
	Acetone	µg/L	3100 J		380 U	
	cis-1,2-Dichloroethene	µg/L	730		790	
	Methylene chloride	µg/L	230 BJ		130 BJ	
	Tetrachloroethene	µg/L	670		860	
	trans-1,2-Dichloroethene	µg/L	60 U		63 J	
	Trichloroethene	µg/L	220000		250000	
X701-TC48G	1,1,1-Trichloroethane	µg/L	1.4 J		1.5 J	
	1,1,2,2-Tetrachloroethane	µg/L	2.4 J		7.2	
	1,1,2-Trichloroethane	µg/L	15		15	
	2-Butanone	µg/L	95		73	
	4-Methyl-2-pentanone	µg/L	35		4.9 U	
	Acetone	µg/L	710 B		740	
	Benzene	µg/L	4		3.7 J	
	Bromomethane	µg/L	8.2		5.1 J	
	Chloroform	µg/L	5.3		5	
	Chloromethane	µg/L	130		92	
	cis-1,2-Dichloroethene	µg/L	18		28	
	Methylene chloride	µg/L	1.3 U		6.2 BJ	
	Tetrachloroethene	µg/L	6.5		15	
	trans-1,2-Dichloroethene	µg/L	1.9 J		3.9 J	
	Trichloroethene	µg/L	750		1300	
X701-TC54G	1,1,1-Trichloroethane	µg/L	240 J		230 J	
	1,1,2,2-Tetrachloroethane	µg/L	2000		1200	
	Acetone	µg/L	5900 BJ		2200 J	
	cis-1,2-Dichloroethene	µg/L	230 J		340 J	
	Tetrachloroethene	µg/L	1000		630	
	Trichloroethene	µg/L	200000		240000	
X701-TC61G	1,1,1-Trichloroethane	µg/L	91 J		120 J	
	1,1,2,2-Tetrachloroethane	µg/L	890		900	
	1,1,2-Trichloroethane	µg/L	79 J		110 J	
	Acetone	µg/L	380 U		880 J	
	cis-1,2-Dichloroethene	µg/L	500		770	
	Tetrachloroethene	µg/L	630		510	

Table 4.6. VOCs detected at the X-701B Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC61G	trans-1,2-Dichloroethene	µg/L	69 J		100 J	
	Trichloroethene	µg/L	93000		100000	
X701-TC67G	1,1,1-Trichloroethane	µg/L	16 U		23 J	
	1,1,2,2-Tetrachloroethane	µg/L	21 U		47 J	
	cis-1,2-Dichloroethene	µg/L	280		280	
	Methylene chloride	µg/L	56 BJ		32 U	
	Tetrachloroethene	µg/L	110		91 J	
	Trichloroethene	µg/L	33000		29000	
X744G-01G	Acetone	µg/L	3.6 J		1.9 U	
X744G-02G	Acetone	µg/L	6 J		1.9 U	
	cis-1,2-Dichloroethene	µg/L	1.6		2.1	
	Trichloroethene	µg/L	25		23 J	
	Trichlorofluoromethane	µg/L	3.8		3.4	
X744G-03G	cis-1,2-Dichloroethene	µg/L	0.31 J		0.28 J	
	Methylene chloride	µg/L	0.32 U		0.57 BJ	
	Trichloroethene	µg/L	3.9		3.3	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ03G	Technetium-99	pCi/L	-1.93 U			
	Uranium	µg/L	0.139 U			
	Uranium-233/234	pCi/L	0.0496 U			
	Uranium-235/236	pCi/L	0.0112 U			
	Uranium-238	pCi/L	0.0451 U			
LBC-PZ06G	Technetium-99	pCi/L	-1.82 U			
	Uranium	µg/L	0.242 U			
	Uranium-233/234	pCi/L	0.142 J			
	Uranium-235/236	pCi/L	0.0059 U			
	Uranium-238	pCi/L	0.0804 U			
X230J7-01GA	Technetium-99	pCi/L	3.65 U			
	Uranium	µg/L	0.164 U			
	Uranium-233/234	pCi/L	0.0389 U			
	Uranium-235/236	pCi/L	0.0215 U			
	Uranium-238	pCi/L	0.0518 U			
X230J7-02GA	Technetium-99	pCi/L	61.1			
	Uranium	µg/L	0.202 U			
	Uranium-233/234	pCi/L	0.0503 U			
	Uranium-235/236	pCi/L	0.0052 U			
	Uranium-238	pCi/L	0.0671 U			
X230J7-03GA	Americium-241	pCi/L	0.031 U			
	Neptunium-237	pCi/L	0.0101 U			
	Plutonium-238	pCi/L	-0.009 U			
	Plutonium-239/240	pCi/L	0.0779 U			
	Technetium-99	pCi/L	38.4			
	Uranium	µg/L	0.311 J			
	Uranium-233/234	pCi/L	0.119 J			
	Uranium-235/236	pCi/L	0.0218 U			
	Uranium-238	pCi/L	0.101 J			
X230J7-04GA	Technetium-99	pCi/L			-2.75 U	
	Uranium	µg/L			0.116 U	
	Uranium-233/234	pCi/L			0.0527 U	
	Uranium-235/236	pCi/L			0.0131 U	
	Uranium-238	pCi/L			0.0369 U	
X701-01G	Technetium-99	pCi/L	-1.77 U			
	Uranium	µg/L	2.65			
	Uranium-233/234	pCi/L	1.31			
	Uranium-235/236	pCi/L	0.0445 U			
	Uranium-238	pCi/L	0.884			
X701-02G	Technetium-99	pCi/L	0.915 U			
	Uranium	µg/L	0.592 J			
	Uranium-233/234	pCi/L	0.47			
	Uranium-235/236	pCi/L	0.0409 U			
	Uranium-238	pCi/L	0.193 J			
X701-06G	Technetium-99	pCi/L	46.9			
	Uranium	µg/L	0.666 J			
	Uranium-233/234	pCi/L	0.413			
	Uranium-235/236	pCi/L	0.0416 U			
	Uranium-238	pCi/L	0.217 J			
X701-15G	Technetium-99	pCi/L	-0.192 U			

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-15G	Uranium	µg/L	0.139 U			
	Uranium-233/234	pCi/L	0.0505 U			
	Uranium-235/236	pCi/L	0.0057 U			
	Uranium-238	pCi/L	0.0459 U			
X701-16G	Technetium-99	pCi/L	0.711 U			
	Uranium	µg/L	0.0857 U			
	Uranium-233/234	pCi/L	0.0271 U			
	Uranium-235/236	pCi/L	0.0112 U			
	Uranium-238	pCi/L	0.0271 U			
X701-18G	Technetium-99	pCi/L			-1.45 U	
	Uranium	µg/L			0.0319 U	
	Uranium-233/234	pCi/L			0.0404 U	
	Uranium-235/236	pCi/L			0.0112 U	
	Uranium-238	pCi/L			0.00898 U	
X701-19G	Technetium-99	pCi/L	-2.07 U			
	Uranium	µg/L	0.0708 U			
	Uranium-233/234	pCi/L	0.0092 U			
	Uranium-235/236	pCi/L	0.0057 U			
	Uranium-238	pCi/L	0.0229 U			
X701-20G	Americium-241	pCi/L	0 U		0.0424 U	
	Neptunium-237	pCi/L	0 U		0.0362 U	
	Plutonium-238	pCi/L	0.0045 U		0 U	
	Plutonium-239/240	pCi/L	0.0358 U		0.0283 U	
	Technetium-99	pCi/L	127		130	
	Uranium	µg/L	0.14 U		0.232 U	
	Uranium-233/234	pCi/L	0.0272 U		0.0486 U	
	Uranium-235/236	pCi/L	0.0113 U		0 U	
	Uranium-238	pCi/L	0.0453 U		0.0778 U	
X701-21G	Technetium-99	pCi/L	355			
	Uranium	µg/L	0.23 U			
	Uranium-233/234	pCi/L	0.0534 U			
	Uranium-235/236	pCi/L	0.0111 U			
	Uranium-238	pCi/L	0.0757 U			
X701-23G	Technetium-99	pCi/L			5.64 J	
	Uranium	µg/L			0.00273 U	
	Uranium-233/234	pCi/L			0.0331 U	
	Uranium-235/236	pCi/L			0.00588 U	
	Uranium-238	pCi/L			0 U	
X701-24G	Americium-241	pCi/L	0.0318 U			
	Neptunium-237	pCi/L	0.0297 U			
	Plutonium-238	pCi/L	-0.005 U			
	Plutonium-239/240	pCi/L	0.0303 U			
	Technetium-99	pCi/L	2.7 U			
	Uranium	µg/L	0.624 J			
	Uranium-233/234	pCi/L	0.328			
	Uranium-235/236	pCi/L	0.0062 U			
	Uranium-238	pCi/L	0.209 J			
X701-25G	Technetium-99	pCi/L	-2.23 U			
	Uranium	µg/L	0.0113 U			
	Uranium-233/234	pCi/L	0.0047 U			

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-25G	Uranium-235/236	pCi/L	-0.006 U			
	Uranium-238	pCi/L	0.0047 U			
X701-30G	Technetium-99	pCi/L	2.36 U			
	Uranium	µg/L	0.248 U			
	Uranium-233/234	pCi/L	0.129 J			
	Uranium-235/236	pCi/L	-0.006 U			
	Uranium-238	pCi/L	0.0843 U			
X701-31G	Technetium-99	pCi/L			1.06 U	
	Uranium	µg/L			0.149 U	
	Uranium-233/234	pCi/L			0.0522 U	
	Uranium-235/236	pCi/L			0.0195 U	
	Uranium-238	pCi/L			0.047 U	
X701-38G	Technetium-99	pCi/L			-0.439 U	
	Uranium	µg/L			0.0784 U	
	Uranium-233/234	pCi/L			0.00979 U	
	Uranium-235/236	pCi/L			0.0122 U	
	Uranium-238	pCi/L			0.0245 U	
X701-42G	Technetium-99	pCi/L			490	
	Uranium	µg/L			0.257 J	
	Uranium-233/234	pCi/L			0.0976 J	
	Uranium-235/236	pCi/L			0.0173 U	
	Uranium-238	pCi/L			0.0837 U	
X701-48G	Americium-241	pCi/L			0.0302 U	
	Neptunium-237	pCi/L			0 U	
	Plutonium-238	pCi/L			-0.00539 U	
	Plutonium-239/240	pCi/L			0.0108 U	
	Technetium-99	pCi/L			0.561 U	
	Uranium	µg/L			0.00601 U	
	Uranium-233/234	pCi/L			0.0261 U	
	Uranium-235/236	pCi/L			0.013 U	
	Uranium-238	pCi/L			0 U	
X701-58B	Technetium-99	pCi/L			3.75 U	
	Uranium	µg/L			0.253 U	
	Uranium-233/234	pCi/L			0.228	
	Uranium-235/236	pCi/L			0.0129 U	
	Uranium-238	pCi/L			0.0829 U	
X701-61B	Technetium-99	pCi/L			3.07 U	
	Uranium	µg/L			0.378 U	
	Uranium-233/234	pCi/L			0.134 U	
	Uranium-235/236	pCi/L			0.0277 U	
	Uranium-238	pCi/L			0.123 U	
X701-66G	Americium-241	pCi/L	0.0146 U		0.0296 U	
	Neptunium-237	pCi/L	0.0106 U		0.0234 U	
	Plutonium-238	pCi/L	0 U		0.00903 U	
	Plutonium-239/240	pCi/L	0.0266 U		0.0181 U	
	Technetium-99	pCi/L	1670		1990	
	Uranium	µg/L	0.281 J		0.289 U	
	Uranium-233/234	pCi/L	0.119 J		0.146 J	
	Uranium-235/236	pCi/L	0.0065 U		0 U	
	Uranium-238	pCi/L	0.0935 U		0.0972 U	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-77G	Technetium-99	pCi/L			64.4	
	Uranium	µg/L			0.362 J	
	Uranium-233/234	pCi/L			0.0403 U	
	Uranium-235/236	pCi/L			0.00556 U	
	Uranium-238	pCi/L			0.121 J	
X701-79G	Technetium-99	pCi/L			73.6	
	Uranium	µg/L			0.123 U	
	Uranium-233/234	pCi/L			0.0773 U	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.0412 U	
X701-127G	Americium-241	pCi/L	0.033 U		0.0185 U	
	Neptunium-237	pCi/L	0 U		0 U	
	Plutonium-238	pCi/L	-0.005 U		0.0125 U	
	Plutonium-239/240	pCi/L	0.0203 U		0.0188 U	
	Technetium-99	pCi/L	57.5		73.5	
	Uranium	µg/L	0.095 U		0.0295 U	
	Uranium-233/234	pCi/L	0.0283 U		0.0248 U	
	Uranium-235/236	pCi/L	0.0235 U		0 U	
	Uranium-238	pCi/L	0.0283 U		0.00991 U	
X701-128G	Americium-241	pCi/L	0.0182 U			
	Neptunium-237	pCi/L	0.0204 U			
	Plutonium-238	pCi/L	0 U			
	Plutonium-239/240	pCi/L	0.0044 U			
	Technetium-99	pCi/L	10.8			
	Uranium	µg/L	0.336 J			
	Uranium-233/234	pCi/L	0.109 J			
	Uranium-235/236	pCi/L	0.0281 U			
	Uranium-238	pCi/L	0.109 J			
X701-130G	Technetium-99	pCi/L			1500	
	Uranium	µg/L			8.51	
	Uranium-233/234	pCi/L			13.1	
	Uranium-235/236	pCi/L			0.724	
	Uranium-238	pCi/L			2.75	
X701-BW1G	Technetium-99	pCi/L			-0.168 U	
	Uranium	µg/L			0.126 U	
	Uranium-233/234	pCi/L			0.0411 U	
	Uranium-235/236	pCi/L			0.00731 U	
	Uranium-238	pCi/L			0.0411 U	
X701-BW2G	Technetium-99	pCi/L			816	
	Uranium	µg/L			0.126 U	
	Uranium-233/234	pCi/L			0.0744 U	
	Uranium-235/236	pCi/L			0.0142 U	
	Uranium-238	pCi/L			0.04 U	
X701-BW3G	Technetium-99	pCi/L			190	
	Uranium	µg/L			0.106 U	
	Uranium-233/234	pCi/L			0.0131 U	
	Uranium-235/236	pCi/L			0.00543 U	
	Uranium-238	pCi/L			0.0349 U	
X701-BW4G	Technetium-99	pCi/L	319			
	Uranium	µg/L	0.117 U			

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-BW4G	Uranium-233/234	pCi/L	0.0289 U			
	Uranium-235/236	pCi/L	0.0359 U			
	Uranium-238	pCi/L	0.0337 U			
X701-EW121G	Technetium-99	pCi/L	139		163	
	Uranium	µg/L	0.48 J		0.382 J	
	Uranium-233/234	pCi/L	0.12 J		0.133 J	
	Uranium-235/236	pCi/L	0.0062 U		0.00719 U	
	Uranium-238	pCi/L	0.16 J		0.127 J	
X701-EW122G	Technetium-99	pCi/L	208		234	
	Uranium	µg/L	0.44 J		0.357 J	
	Uranium-233/234	pCi/L	0.151 J		0.202 J	
	Uranium-235/236	pCi/L	0.0117 U		0.0139 U	
	Uranium-238	pCi/L	0.146 J		0.118 J	
X701-TC01G	Americium-241	pCi/L	-0.015 U		0.0232 U	
	Neptunium-237	pCi/L	0.0769 U		0 U	
	Plutonium-238	pCi/L	0.0045 U		-0.00484 U	
	Plutonium-239/240	pCi/L	0.0181 U		0 U	
	Technetium-99	pCi/L	976		442	
	Uranium	µg/L	5.02		2.72	
	Uranium-233/234	pCi/L	3.88		1.83	
	Uranium-235/236	pCi/L	0.248		0.0757 U	
	Uranium-238	pCi/L	1.65		0.903	
X701-TC03G	Americium-241	pCi/L	0.0574 U		0.0134 U	
	Neptunium-237	pCi/L	0 U		0 U	
	Plutonium-238	pCi/L	0.0093 U		-0.00473 U	
	Plutonium-239/240	pCi/L	0.0046 U		0.0142 U	
	Technetium-99	pCi/L	1890		1350	
	Uranium	µg/L	7.28		4.37	
	Uranium-233/234	pCi/L	2.49		1.5	
	Uranium-235/236	pCi/L	0.185 J		0.0528 U	
	Uranium-238	pCi/L	2.42		1.46	
X701-TC05G	Americium-241	pCi/L	0.0443 U		0.0288 U	
	Neptunium-237	pCi/L	0.031 U		0.0195 U	
	Plutonium-238	pCi/L	0.0136 U		0.00495 U	
	Plutonium-239/240	pCi/L	0 U		0.0149 U	
	Technetium-99	pCi/L	1620		1530	
	Uranium	µg/L	3.79		4.24	
	Uranium-233/234	pCi/L	1.58		1.67	
	Uranium-235/236	pCi/L	0.095 U		0.0518 U	
	Uranium-238	pCi/L	1.26		1.42	
X701-TC10G	Americium-241	pCi/L	0.0307 U		0.056 U	
	Neptunium-237	pCi/L	0.0117 U		0.0104 U	
	Plutonium-238	pCi/L	0.0208 U		-0.00507 U	
	Plutonium-239/240	pCi/L	0.026 U		0.0203 U	
	Technetium-99	pCi/L	1210		825	
	Uranium	µg/L	8.12		17.9	
	Uranium-233/234	pCi/L	3		7.05	
	Uranium-235/236	pCi/L	0.156 U		0.277	
	Uranium-238	pCi/L	2.71		5.98	
X701-TC17G	Americium-241	pCi/L	0.0104 U		0.0373 U	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC17G	Neptunium-237	pCi/L	0.0331 U		0 U	
	Plutonium-238	pCi/L	0.0054 U		-0.00488 U	
	Plutonium-239/240	pCi/L	0.0109 U		0.0537 U	
	Technetium-99	pCi/L	662		508	
	Uranium	µg/L	32.9		43.2	
	Uranium-233/234	pCi/L	0.744		16.6	
	Uranium-233/234	pCi/L	12.2		16.6	
	Uranium-235/236	pCi/L	0.581		0.786	
	Uranium-235/236	pCi/L	0.0856 U		0.786	
	Uranium-238	pCi/L	11		14.4	
	Uranium-238	pCi/L	0.694		14.4	
X701-TC22G	Americium-241	pCi/L	0.0509 U		0.0177 U	
	Neptunium-237	pCi/L	0.0109 U		-0.0106 U	
	Plutonium-238	pCi/L	0.0087 U		-0.0136 U	
	Plutonium-239/240	pCi/L	0 U		0.0273 U	
	Technetium-99	pCi/L	1240		1080	
	Uranium	µg/L	1		1.91	
	Uranium-233/234	pCi/L	0.369		0.727	
	Uranium-235/236	pCi/L	0.0754 U		0.0424 U	
	Uranium-238	pCi/L	0.325		0.636	
X701-TC28G	Americium-241	pCi/L	0 U		0.0239 U	
	Neptunium-237	pCi/L	0 U		0 U	
	Plutonium-238	pCi/L	0 U		0.00905 U	
	Plutonium-239/240	pCi/L	0 U		0.0362 U	
	Technetium-99	pCi/L	951		784	
	Uranium	µg/L	19.9		18.8	
	Uranium-233/234	pCi/L	8.21		7.31	
	Uranium-235/236	pCi/L	0.47		0.419	
	Uranium-238	pCi/L	6.6		6.25	
X701-TC48G	Americium-241	pCi/L	0.02 U		0.00871 U	
	Neptunium-237	pCi/L	0 U		-0.00975 U	
	Plutonium-238	pCi/L	0.0049 U		0.00963 U	
	Plutonium-239/240	pCi/L	0.0146 U		0.0482 U	
	Technetium-99	pCi/L	107		115	
	Uranium	µg/L	56.9		71.4	
	Uranium-233/234	pCi/L	20.9		26	
	Uranium-235/236	pCi/L	1.06		1.37	
	Uranium-238	pCi/L	19		23.8	
X701-TC54G	Americium-241	pCi/L	0.0186 U		0.0216 U	
	Neptunium-237	pCi/L	0.0297 U		0.0103 U	
	Plutonium-238	pCi/L	0 U		0 U	
	Plutonium-239/240	pCi/L	0.0292 U		0.0193 U	
	Technetium-99	pCi/L	675		676	
	Uranium	µg/L	2.1		2.4	
	Uranium-233/234	pCi/L			0.772	
	Uranium-235/236	pCi/L			0.0197 U	
	Uranium-238	pCi/L			0.803	
X701-TC61G	Americium-241	pCi/L	0.0188 U		0.0494 U	
	Neptunium-237	pCi/L	0 U		0.0203 U	
	Plutonium-238	pCi/L	0.0101 U		-0.00474 U	

Table 4.7. Results for radionuclides at the X-701B Former Holding Pond – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC61G	Plutonium-239/240	pCi/L	0.0101 U		0.0142 U	
	Technetium-99	pCi/L	536		546	
	Uranium	µg/L	2.11		3.21	
	Uranium-233/234	pCi/L	0.759		1.05	
	Uranium-235/236	pCi/L	0.0607 U		0.0684 U	
	Uranium-238	pCi/L	0.699		1.07	
X701-TC67G	Americium-241	pCi/L	0.0048 U		0.0214 U	
	Neptunium-237	pCi/L	0.0148 U		-0.00983 U	
	Plutonium-238	pCi/L	0.0044 U		-0.0049 U	
	Plutonium-239/240	pCi/L	0.0308 U		0.0147 U	
	Technetium-99	pCi/L	218		197	
	Uranium	µg/L	0.469 J		0.498 J	
	Uranium-233/234	pCi/L	0.14 J		0.16 J	
	Uranium-235/236	pCi/L	0.007 U		0.0176 U	
	Uranium-238	pCi/L	0.157 J		0.165 J	

Table 4.8. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X633-07G	Chromium	µg/L		950		270
X633-PZ04G	Chromium	µg/L		15		40

Table 4.9. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-02G	Trichloroethene	µg/L	0.16 J			
X616-05G	Trichlorofluoromethane	µg/L	0.31 J			
X616-09G	1,1,1-Trichloroethane	µg/L	3.4		5.3	
	1,1-Dichloroethane	µg/L	3.2		4.4	
	1,1-Dichloroethene	µg/L	25		38	
	cis-1,2-Dichloroethene	µg/L	3.2		3.3	
	Methylene chloride	µg/L	0.32 U		0.4 BJ	
	Trichloroethene	µg/L	20		28	
X616-13G	1,1,1-Trichloroethane	µg/L	2.7		3.4	
	1,1-Dichloroethane	µg/L	0.71 J		0.78 J	
	1,1-Dichloroethene	µg/L	16		19	
	cis-1,2-Dichloroethene	µg/L	0.3 J		0.39 J	
	Trichloroethene	µg/L	8.4		10	
	Trichlorofluoromethane	µg/L	4.2		4.2	
X616-14G	1,1,1-Trichloroethane	µg/L	1		1.5	
	1,1-Dichloroethane	µg/L	0.22 J		0.27 J	
	1,1-Dichloroethene	µg/L	5.6		7.1	
	Methylene chloride	µg/L	0.32 U		0.37 BJ	
	Trichloroethene	µg/L	1.4		2	
	Trichlorofluoromethane	µg/L	0.46 J		0.49 J	
X616-16G	1,1-Dichloroethene	µg/L	0.34 J			
	cis-1,2-Dichloroethene	µg/L	1.3			
	Trichloroethene	µg/L	1.5			
X616-20B	1,1,1-Trichloroethane	µg/L	0.16 U		0.44 J	
	1,1-Dichloroethane	µg/L	0.29 J		0.74 J	
	1,1-Dichloroethene	µg/L	1.4		4.7	
	cis-1,2-Dichloroethene	µg/L	0.29 J		0.48 J	
	Methylene chloride	µg/L	0.32 U		0.41 BJ	
	Trichloroethene	µg/L	7.3		16	
X616-25G	cis-1,2-Dichloroethene	µg/L	0.55 J		0.65 J	
	Trichloroethene	µg/L	1.3		1.3	
X616-28B	1,1,1-Trichloroethane	µg/L	0.77 J			
	1,1-Dichloroethene	µg/L	0.61 J			
	Trichloroethene	µg/L	0.4 J			

Table 4.10. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-05G	Chromium	µg/L	1300			
X616-25G	Chromium	µg/L	2.7			

Table 4.11. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-02G	1,1,1-Trichloroethane	µg/L		3.59		3.82
	1,1-Dichloroethane	µg/L		3.32		3.43
	1,1-Dichloroethene	µg/L		5.49		5.73
	Trichloroethene	µg/L		7.2		7.2
X740-03G	1,1,1-Trichloroethane	µg/L		0.34 J		1 U
	1,1-Dichloroethane	µg/L		3.77		3.21
	1,1-Dichloroethene	µg/L		78.5		74
	1,2-Dichloroethane	µg/L		10		10
	Acetone	µg/L		2.98 J		5 U
	Chloroethane	µg/L		7.66		13.2
	cis-1,2-Dichloroethene	µg/L		463		896
	Tetrachloroethene	µg/L		0.6 J		1 U
	Toluene	µg/L		0.4 J		0.59 J
	trans-1,2-Dichloroethene	µg/L		1.2		1.4
	Trichloroethene	µg/L		30.6		9.98
	Vinyl chloride	µg/L		10.5		18.8
X740-08G	1,1,1-Trichloroethane	µg/L		2		
	1,1-Dichloroethane	µg/L		14		
	1,1-Dichloroethene	µg/L		2.8		
	cis-1,2-Dichloroethene	µg/L		13		
	Methylene chloride	µg/L		0.34 BJ		
	trans-1,2-Dichloroethene	µg/L		4.6		
	Trichloroethene	µg/L		9.1		
	Vinyl chloride	µg/L		0.12 J		
X740-09B	1,1,1-Trichloroethane	µg/L		11.8 J		3.45
	1,1-Dichloroethane	µg/L		27.2		24.7
	1,1-Dichloroethene	µg/L		251		243
	1,2-Dichloroethane	µg/L		68.2		49.1
	Chloroform	µg/L		20 U		0.56 J
	cis-1,2-Dichloroethene	µg/L		1080		899
	Tetrachloroethene	µg/L		19.2 J		14.2
	trans-1,2-Dichloroethene	µg/L		20 U		1.01
	Trichloroethene	µg/L		852		883
	Vinyl chloride	µg/L		20 U		1.56
X740-10G	1,1,1-Trichloroethane	µg/L		0.9 J		3.21
	1,1,2-Trichloroethane	µg/L		1 U		0.33 J
	1,1-Dichloroethane	µg/L		1.7		6.59
	1,1-Dichloroethene	µg/L		10.1		58.4
	1,2-Dichloroethane	µg/L		4.21		11.3
	cis-1,2-Dichloroethene	µg/L		19.9		128
	Tetrachloroethene	µg/L		1.54		4.49
	trans-1,2-Dichloroethene	µg/L		1 U		0.34 J
	Trichloroethene	µg/L		78.4		271
	Vinyl chloride	µg/L		1 U		0.56 J
X740-11G	1,1,1-Trichloroethane	µg/L		0.86 J		
	1,1-Dichloroethane	µg/L		0.47 J		
	1,1-Dichloroethene	µg/L		7.4		
	1,2-Dichloroethane	µg/L		2.4		
	Chloroform	µg/L		0.22 J		
	Methylene chloride	µg/L		0.37 BJ		

Table 4.11. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-11G	Trichloroethene	µg/L		25		
X740-13G	Acetone	µg/L		2.9 J		
X740-14B	1,1-Dichloroethene	µg/L		0.26 J		
	Acetone	µg/L		5.4 J		
	Trichloroethene	µg/L		1.6		
X740-18G	1,1-Dichloroethene	µg/L		1.38		1.18
	2-Butanone	µg/L		62.8		111
	Acetone	µg/L		70		165
	Chloroethane	µg/L		0.86 J		0.93 J
	cis-1,2-Dichloroethene	µg/L		13.4		16.3
	Methylene chloride	µg/L		1.22 BJ		5 U
	Trichloroethene	µg/L		1 U		0.39 J
	Vinyl chloride	µg/L		0.91 J		1.41
X740-19G	1,1-Dichloroethane	µg/L		1 U		0.48 J
	1,1-Dichloroethene	µg/L		2.24		6.16
	1,2-Dichloroethane	µg/L		0.87 J		1.1
	cis-1,2-Dichloroethene	µg/L		1.77		12.2
	Tetrachloroethene	µg/L		1.18		1.3
	Trichloroethene	µg/L		27		34.1
X740-20G	1,1-Dichloroethene	µg/L		0.39 J		0.58 J
	cis-1,2-Dichloroethene	µg/L		0.58 J		1.07
	Trichloroethene	µg/L		6.91		7.91
X740-21G	1,1-Dichloroethene	µg/L		1.23		1.81
	1,2-Dichloroethane	µg/L		0.48 J		0.51 J
	cis-1,2-Dichloroethene	µg/L		1 U		0.31 J
	Tetrachloroethene	µg/L		1 U		0.4 J
	Trichloroethene	µg/L		14		15.3
X740-22G	1,1,1-Trichloroethane	µg/L		1.39		2.04
	1,1-Dichloroethane	µg/L		0.79 J		1.24 J
	1,1-Dichloroethene	µg/L		12.2		21.2
	1,2-Dichloroethane	µg/L		3.75		5.02
	cis-1,2-Dichloroethene	µg/L		0.89 J		2
	Tetrachloroethene	µg/L		1.6		2.78
	Trichloroethene	µg/L		87.3		144
X740-23M	Methylene chloride	µg/L		1.41 BJ		5 U
X740-PZ10G	1,1,1-Trichloroethane	µg/L		0.37 J		
	1,1-Dichloroethene	µg/L		0.43 J		
	Acetone	µg/L		6.9 J		
	Tetrachloroethene	µg/L		0.33 J		
	Trichloroethene	µg/L		9.2		
X740-PZ12G	1,1,1-Trichloroethane	µg/L		2.12		1.87
	1,1-Dichloroethane	µg/L		0.73 J		0.74 J
	1,1-Dichloroethene	µg/L		10.3		9.09
	1,2-Dichloroethane	µg/L		3.52		3.68
	Chloroform	µg/L		0.38 J		0.44 J
	Tetrachloroethene	µg/L		1.54		0.84 J
	Trichloroethene	µg/L		86.9		76.1
X740-PZ14G	1,1,1-Trichloroethane	µg/L		2.8		
	1,1-Dichloroethane	µg/L		1.3		
	1,1-Dichloroethene	µg/L		29		

Table 4.11. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-PZ14G	1,2-Dichloroethane	µg/L		6.6		
	Acetone	µg/L		2.2 J		
	Chloroform	µg/L		0.66 J		
	cis-1,2-Dichloroethene	µg/L		0.43 J		
	Tetrachloroethene	µg/L		2.1		
	Trichloroethene	µg/L		180		
X740-PZ17G	1,1,1-Trichloroethane	µg/L		1.6		
	1,1-Dichloroethane	µg/L		0.53 J		
	1,1-Dichloroethene	µg/L		8.5		
	1,2-Dichloroethane	µg/L		2.9		
	Chloroform	µg/L		0.27 J		
	Methylene chloride	µg/L		0.39 BJ		
	Tetrachloroethene	µg/L		0.2 J		
	Trichloroethene	µg/L		39		

Table 4.12. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-07G	Beryllium	µg/L	2.6		0.59 B	
	Chromium	µg/L	6.4		2.7	
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	0.86 B		4.2	
X611-02BA	Beryllium	µg/L	0.08 U		0.08 U	
	Chromium	µg/L	0.53 B		0.5 U	
X611-03G	Beryllium	µg/L	0.08 U		0.08 U	
	Chromium	µg/L	0.5 U		0.5 U	
X611-04BA	Beryllium	µg/L	0.6 B		0.9 B	
	Chromium	µg/L	0.5 U		0.5 U	

Table 4.13. VOCs detected at the X-735 Landfills – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-02GA	1,1-Dichloroethane	µg/L		0.22 J		
	cis-1,2-Dichloroethene	µg/L		0.2 J		
X735-03G	Trichloroethene	µg/L		0.34 J		
X737-09G	Chloromethane	µg/L		0.43 J		

Table 4.14. Results for radionuclides at the X-735 Landfills – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-03G	Technetium-99	pCi/L		0.617 U		
	Uranium	µg/L		0.683 U		
	Uranium-233/234	pCi/L		0.185 U		
	Uranium-235/236	pCi/L		0.0461 U		
	Uranium-238	pCi/L		0.222 U		
X735-04G	Technetium-99	pCi/L		-0.978 U		
	Uranium	µg/L		0.458 U		
	Uranium-233/234	pCi/L		0.121 U		
	Uranium-235/236	pCi/L		0.06 U		
	Uranium-238	pCi/L		0.145 U		
X735-05G	Technetium-99	pCi/L		0.101 U		
	Uranium	µg/L		0.305 U		
	Uranium-233/234	pCi/L		0.075 U		
	Uranium-235/236	pCi/L		0.0155 U		
	Uranium-238	pCi/L		0.1 U		
X735-12G	Technetium-99	pCi/L		-1.27 U		
	Uranium	µg/L		0.266 U		
	Uranium-233/234	pCi/L		0.0255 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0894 U		

Table 4.15. VOCs detected at the X-734 Landfills – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X734-01G	2-Butanone	µg/L		2.5 J		2 U
X734-02B	Acetone	µg/L		1.9 U		4.3 J
	Methylene chloride	µg/L		0.32 U		0.34 J
X734-03G	1,4-Dichlorobenzene	µg/L		0.25 J		0.36 J
	Acetone	µg/L		1.9 U		4.9 J
	Methylene chloride	µg/L		0.32 U		0.72 J
X734-04G	Acetone	µg/L		1.9 U		2.7 J
	Methylene chloride	µg/L		0.32 U		0.41 J
X734-05B	1,2-Dimethylbenzene	µg/L		0.19 U		0.31 J
	Acetone	µg/L		1.9 U		13
	Benzene	µg/L		0.18 J		1.9
	Ethylbenzene	µg/L		0.22 J		0.47 J
	Toluene	µg/L		0.17 U		0.79 J
X734-06G	Acetone	µg/L		3.4 BJ		2.9 J
	Methylene chloride	µg/L		0.32 U		0.74 J
X734-10G	Acetone	µg/L		1.9 U		2.6 J
X734-14G	Acetone	µg/L		2 BJ		1.9 U
X734-16G	Acetone	µg/L		31		11
X734-20G	Acetone	µg/L		2.6 J		1.9 U
	Methylene chloride	µg/L		0.32 U		0.57 J
X734-22G	2-Butanone	µg/L		2.1 J		2 U
X734-23G	cis-1,2-Dichloroethene	µg/L		2.2		2.5
	Methylene chloride	µg/L		0.32 U		0.4 J
	trans-1,2-Dichloroethene	µg/L		0.15 U		0.16 J
	Vinyl chloride	µg/L		0.66 J		0.55 J

Table 4.16. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-03G	Cadmium	µg/L		46		54
	Nickel	µg/L		490		760
TCP-01G	Cadmium	µg/L		8.7		9.9
	Nickel	µg/L		120		130
X533-03G	Cadmium	µg/L		23		25
	Nickel	µg/L		330		330

Table 4.17. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X344C-01G	cis-1,2-Dichloroethene	µg/L	1.8			
	trans-1,2-Dichloroethene	µg/L	0.17 J			
	Trichloroethene	µg/L	0.33 J			
	Vinyl chloride	µg/L	0.13 J			

Table 4.18. VOCs detected at surface water monitoring locations – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Acetone	µg/L	14 UJ	11	4.6 J	4.7 J
	Bromodichloromethane	µg/L	1.3	1.5	1.5	2.4
	Bromoform	µg/L	0.19 U	0.19 U	0.19 U	1.7
	Chloroform	µg/L	2.3	2.8	2.6	6.3
	Dibromochloromethane	µg/L	1.6	1.1	1.6	2.3
BRC-SW02	Acetone	µg/L	11 UJ	1.9 U	1.9 U	3.6 J
BRC-SW05	Acetone	µg/L	7.9 UJ	5.6 J	1.9 U	4.1 J
EDD-SW01	Acetone	µg/L	5 J	1.9 U	5.3 BJ	1.9 U
	Bromodichloromethane	µg/L	2.1	2	1.9	0.81 J
	Bromoform	µg/L	0.3 J	0.19 U	0.6 J	0.59 J
	Chloroform	µg/L	3.3	3.7	2.5	2
	cis-1,2-Dichloroethene	µg/L	0.31 J	17	0.31 J	1.1
	Dibromochloromethane	µg/L	1.7	1.3	2.2	0.89 J
	Trichloroethene	µg/L	0.69 J	43	0.49 J	0.86 J
	Vinyl chloride	µg/L	0.1 U	0.12 J	0.1 U	0.1 U
LBC-SW01	Acetone	µg/L	2.9 J	1.9 U	8.2 BJ	1.9 U
	Bromodichloromethane	µg/L	0.74 J	0.59 J	1.6	0.45 J
	Bromoform	µg/L	0.19 U	0.19 U	0.59 J	0.42 J
	Chloroform	µg/L	1.2	1.1	2.1	1
	cis-1,2-Dichloroethene	µg/L	0.99 J	1.1	0.26 J	0.63 J
	Dibromochloromethane	µg/L	0.57 J	0.4 J	1.9	0.52 J
	Methylene chloride	µg/L	0.32 U	0.32 U	0.33 BJ	0.32 U
	Trichloroethene	µg/L	3.6	3.1	0.35 J	0.54 J
LBC-SW02	Acetone	µg/L	1.9 U	1.9 U	5 BJ	1.9 U
	Bromodichloromethane	µg/L	0.67 J	0.44 J	0.58 J	0.25 J
	Bromoform	µg/L	0.19 U	0.19 U	0.19 U	0.29 J
	Chloroform	µg/L	1.1	0.83 J	0.67 J	0.56 J
	cis-1,2-Dichloroethene	µg/L	0.95 J	0.73 J	0.15 U	0.44 J
	Dibromochloromethane	µg/L	0.58 J	0.31 J	0.78 J	0.31 J
	Trichloroethene	µg/L	3.4	2.1	0.16 U	0.26 J
LBC-SW03	Acetone	µg/L	1.9 U	1.9 U	5.3 BJ	1.9 U
	Bromodichloromethane	µg/L	0.22 J	0.22 J	0.17 U	0.17 U
	Chloroform	µg/L	0.31 J	0.34 J	0.16 U	0.16 U
	cis-1,2-Dichloroethene	µg/L	1.2	0.28 J	0.15 U	0.15 U
	Dibromochloromethane	µg/L	0.41 J	0.17 J	0.17 U	0.17 U
	Trichloroethene	µg/L	3.7	0.8 J	0.16 U	0.16 U
LBC-SW04	Acetone	µg/L	1.9 U	1.9 U	3.8 BJ	1.9 U
	Bromodichloromethane	µg/L	0.18 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	0.55 J	0.15 U	0.15 U	0.15 U
	Dibromochloromethane	µg/L	0.38 J	0.17 U	0.17 U	0.17 U
	Trichloroethene	µg/L	1.9	0.16 U	0.16 U	0.16 U
NHP-SW01	Acetone	µg/L	3.2 J	1.9 U	6.1 BJ	1.9 U
	Bromodichloromethane	µg/L	0.32 J	0.24 J	0.22 J	0.17 U
	Chloroform	µg/L	0.48 J	0.34 J	0.35 J	0.16 U
	Dibromochloromethane	µg/L	0.52 J	0.18 J	0.34 J	0.17 U
UND-SW01	Acetone	µg/L	1.9 U	1.9 U	5.2 BJ	2 J
	cis-1,2-Dichloroethene	µg/L	0.15 U	0.27 J	0.15 U	0.15 U
	Trichloroethene	µg/L	1.4	4.3	0.2 J	1.3
UND-SW02	Acetone	µg/L	1.9 U	1.9 U	7.9 BJ	8.4 J

Table 4.18. VOCs detected at surface water monitoring locations – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
WDD-SW01	Bromodichloromethane	µg/L	0.48 J	0.19 J	0.25 J	0.22 J
	Bromoform	µg/L	0.19 U	0.8 J	0.19 U	1
	Chloroform	µg/L	0.48 J	0.19 J	0.18 J	0.16 U
	Dibromochloromethane	µg/L	0.54 J	0.45 J	0.67 J	0.62 J
WDD-SW02	Acetone	µg/L	3.6 UJ	3.6 J	40	1.9 U
	Chloroform	µg/L	0.16 U	0.16 U	0.16 U	0.2 J
	Dibromochloromethane	µg/L	0.17 U	0.17 U	0.17 U	0.17 J
WDD-SW03	Bromodichloromethane	µg/L	0.17 J	0.17 U	0.17 U	0.17 U
	Bromoform	µg/L	0.19 U	0.29 J	0.19 U	0.19 U
	Chloroform	µg/L	0.17 J	0.16 U	0.16 U	0.16 U
	Dibromochloromethane	µg/L	0.2 J	0.17 U	0.17 U	0.17 U

Table 4.19. Results for radionuclides at surface water monitoring locations – 2014

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Americium-241	pCi/L		0.0199 U		0.0274 U
	Neptunium-237	pCi/L		0.0129 U		0.0197 U
	Plutonium-238	pCi/L		0.00997 U		0.0108 U
	Plutonium-239/240	pCi/L		0.0299 U		0.0162 U
	Technetium-99	pCi/L	-2 U	8.63	4 U	1.01 U
	Uranium	µg/L	2.73	0.427 J	0.288 U	0.935 J
	Uranium-233/234	pCi/L	2	0.431	0.221	2.08
	Uranium-235/236	pCi/L	0.2 J	0.0331 U	0.0131 U	0.105 J
	Uranium-238	pCi/L	0.885	0.138 J	0.0948 U	0.298
BRC-SW02	Americium-241	pCi/L		0.00478 U		0.0175 U
	Neptunium-237	pCi/L		0.0259 U		0.00923 U
	Plutonium-238	pCi/L		0 U		-0.0108 U
	Plutonium-239/240	pCi/L		0.0294 U		0.0323 U
	Technetium-99	pCi/L	-2.83 U	60.2	5.99 U	1.62 U
	Uranium	µg/L	0.979 J	1.25	0.479 U	0.5 J
	Uranium-233/234	pCi/L	0.92	0.849	0.493	0.56
	Uranium-235/236	pCi/L	0.0196 U	0.0885 U	0.0278 U	0.0268 U
	Uranium-238	pCi/L	0.326	0.407	0.157 U	0.164 J
BRC-SW05	Americium-241	pCi/L		0.0339 U		0.0364 U
	Neptunium-237	pCi/L		0 U		0.0265 U
	Plutonium-238	pCi/L		0.02 U		0.00549 U
	Plutonium-239/240	pCi/L		0.0351 U		0.0165 U
	Technetium-99	pCi/L	-3 U	76.5	2.88 U	3.19 U
	Uranium	µg/L	1.39	1.51	0.865 J	0.806 J
	Uranium-233/234	pCi/L	1.19	1.27	0.563	0.592
	Uranium-235/236	pCi/L	0.0488 U	0.0483 U	0.0255 U	0.0843 U
	Uranium-238	pCi/L	0.461	0.5	0.287	0.258
EDD-SW01	Americium-241	pCi/L		0.0231 U		0 U
	Neptunium-237	pCi/L		0.0293 U		0.01 U
	Plutonium-238	pCi/L		0.00516 U		0.00673 U
	Plutonium-239/240	pCi/L		0 U		0.0269 U
	Technetium-99	pCi/L	18.3	9.86	-0.921 U	7.45
	Uranium	µg/L	3.05	1.24	0.556 J	2.83
	Uranium-233/234	pCi/L	5.63	2.33	0.833	4.05
	Uranium-235/236	pCi/L	0.237	0.176 J	0.0424 U	0.257
	Uranium-238	pCi/L	0.989	0.391	0.18 J	0.912
LBC-SW01	Americium-241	pCi/L		0.0228 U		0.0394 U
	Neptunium-237	pCi/L		0.0551 U		0 U
	Plutonium-238	pCi/L		0.0155 U		0 U
	Plutonium-239/240	pCi/L		0 U		0.0222 U
	Technetium-99	pCi/L	6.5	2.77 U	0.134 U	3.87 U
	Uranium	µg/L	1.16	0.422 J	0.493 J	1.6
	Uranium-233/234	pCi/L	1.99	0.779	0.734	2.3
	Uranium-235/236	pCi/L	0.0952 U	0.034 U	0.042 U	0.113 U
	Uranium-238	pCi/L	0.373	0.137 J	0.159 J	0.518
LBC-SW02	Americium-241	pCi/L		0.0089 U		0.00792 U
	Neptunium-237	pCi/L		0.0591 U		0.00594 U
	Plutonium-238	pCi/L		0.00974 U		-0.0191 U
	Plutonium-239/240	pCi/L		0 U		0.0255 U
	Technetium-99	pCi/L	10.2	4.21 U	-0.583 U	5.45 U

Table 4.19. Results for radionuclides at surface water monitoring locations – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-SW02	Uranium	µg/L	1.43	0.506 J	0.487 J	1.89
	Uranium-233/234	pCi/L	2.45	0.815	1.17	2.41
	Uranium-235/236	pCi/L	0.113 U	0.0699 U	0.0571 U	0.172 J
	Uranium-238	pCi/L	0.464	0.159 J	0.155 J	0.608
LBC-SW03	Americium-241	pCi/L		0.0257 U		0.00795 U
	Neptunium-237	pCi/L		0.0377 U		0.00641 U
	Plutonium-238	pCi/L		-0.0051 U		-0.0267 U
	Plutonium-239/240	pCi/L		0.128		-0.00668 U
	Technetium-99	pCi/L	1.48 U	3.43 U	1.5 U	4.45 U
	Uranium	µg/L	0.645 J	0.444 J	0.437 J	1.61
	Uranium-233/234	pCi/L	1.08	0.816	1.01	1.6
	Uranium-235/236	pCi/L	0.0064 U	0.0689 U	0.0534 U	0.0747 U
	Uranium-238	pCi/L	0.216 J	0.138 J	0.138 J	0.528
LBC-SW04	Americium-241	pCi/L		0.0271 U		0.0202 U
	Neptunium-237	pCi/L		0.118 U		-0.0054 U
	Plutonium-238	pCi/L		-0.005 U		-0.00493 U
	Plutonium-239/240	pCi/L		0.0099 U		0.00986 U
	Technetium-99	pCi/L	2.13 U	4.4	3.4 U	2.95 U
	Uranium	µg/L	1.04	0.843 J	0.733 J	1.76
	Uranium-233/234	pCi/L	0.807	1.04	1.15	1.65
	Uranium-235/236	pCi/L	0.0302 U	0.087 U	0.0938 U	0.0972 U
	Uranium-238	pCi/L	0.345	0.27	0.232 J	0.576
NHP-SW01	Americium-241	pCi/L		0.00477 U		-0.0075 U
	Neptunium-237	pCi/L		0.0531 U		0.0115 U
	Plutonium-238	pCi/L		0.019 U		0.0131 U
	Plutonium-239/240	pCi/L		0.0238 U		0.0263 U
	Technetium-99	pCi/L	1.67 U	0.382 U	-0.852 U	0.27 U
	Uranium	µg/L	5.82	3.45	3.35	5.51
	Uranium-233/234	pCi/L	2.97	1.61	1.51	2.56
	Uranium-235/236	pCi/L	0.225	0.0805 U	0.123 U	0.216 J
	Uranium-238	pCi/L	1.92	1.15	1.11	1.82
UND-SW01	Americium-241	pCi/L		0.0106 U		0.0321 U
	Neptunium-237	pCi/L		0.0272 U		-0.00908 U
	Plutonium-238	pCi/L		0.00543 U		-0.00571 U
	Plutonium-239/240	pCi/L		0.0272 U		0.0228 U
	Technetium-99	pCi/L	-3.82 U	-0.45 U	-2.5 U	-1.64 U
	Uranium	µg/L	2.16	2.11	2.6	1.87
	Uranium-233/234	pCi/L	0.928	1.04	1.07	0.774
	Uranium-235/236	pCi/L	0.0666 U	0.0498 U	0.0511 U	0.0266 U
	Uranium-238	pCi/L	0.714	0.701	0.867	0.625
UND-SW02	Americium-241	pCi/L		0.0308 U		0.022 U
	Neptunium-237	pCi/L		0.0121 U		0 U
	Plutonium-238	pCi/L		0.0101 U		-0.0106 U
	Plutonium-239/240	pCi/L		0.0354 U		0.0159 U
	Technetium-99	pCi/L	-3.24 U	1.03 U	-1.57 U	-0.876 U
	Uranium	µg/L	1.14	2.07	0.783 J	1.31
	Uranium-233/234	pCi/L	0.566	0.686	0.273	0.62
	Uranium-235/236	pCi/L	0.0222 U	0.0285 U	0.0292 U	0.0388 U
	Uranium-238	pCi/L	0.379	0.692	0.259	0.433
WDD-SW01	Americium-241	pCi/L		0.0263 U		0.0134 U

Table 4.19. Results for radionuclides at surface water monitoring locations – 2014 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
WDD-SW01	Neptunium-237	pCi/L		0.0132 U		0.009 U
	Plutonium-238	pCi/L		0 U		-0.00562 U
	Plutonium-239/240	pCi/L		0.0251 U		0.0337 U
	Technetium-99	pCi/L	10.9	11.6	1.62 U	1.61 U
	Uranium	µg/L	3.74	2.28	0.986 J	2.39
	Uranium-233/234	pCi/L	1.64	0.852	0.393	1.09
	Uranium-235/236	pCi/L	0.14 J	0.0593 U	0.0233 U	0.0498 U
	Uranium-238	pCi/L	1.24	0.757	0.328	0.796
WDD-SW02	Americium-241	pCi/L		0.0217 U		0.0137 U
	Neptunium-237	pCi/L		-0.0258 U		0 U
	Plutonium-238	pCi/L		0.0111 U		0.00532 U
	Plutonium-239/240	pCi/L		0.0276 U		0.0372 U
	Technetium-99	pCi/L	-2.62 U	2.21 U	4.04 U	-0.673 U
	Uranium	µg/L	3.24	2.68	1.52	1.45
	Uranium-233/234	pCi/L	2	1.82	0.571	0.771
	Uranium-235/236	pCi/L	0.133 J	0.096 U	0.0273 U	0.0323 U
	Uranium-238	pCi/L	1.07	0.884	0.505	0.481
WDD-SW03	Americium-241	pCi/L		0.015 U		0.00446 U
	Neptunium-237	pCi/L		0.11 U		0 U
	Plutonium-238	pCi/L		0.0203 U		0.00538 U
	Plutonium-239/240	pCi/L		0.0254 U		0.0108 U
	Technetium-99	pCi/L	8.41	9.34	0.618 U	2.9 U
	Uranium	µg/L	3.22	1.92	1.15	2.68
	Uranium-233/234	pCi/L	1.73	1.07	0.5	1.12
	Uranium-235/236	pCi/L	0.13 J	0.0548 U	0.101 U	0.0539 U
	Uranium-238	pCi/L	1.06	0.638	0.372	0.893

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