U.S. Department of Energy

Portsmouth Gaseous Diffusion Plant

View from the X-710 Technical Services Building looking to the east at the Portsmouth Gaseous Diffusion Plant

Annual Site Environmental Report – 2013

December 2014

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Report – 2013
Piketon, Ohio

U.S. Department of Energy
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By
Fluor-B&W Portsmouth LLC, under Contract DE-AC30-10CC40017

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ACRONYMS AND ABBREVIATIONS

ACP	American Centrifuge Plant
BSFR	bulk survey for release
BWCS	B&W Conversion Services, LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
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*
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
EMS	Environmental Management System
FBP	Fluor-B&W Portsmouth LLC
IRM	interim remedial measure
kg	kilogram
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
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
PORTS	Portsmouth Gaseous Diffusion Plant
ppb	part per billion
ppm	part per million
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RI/FS	remedial investigation/feasibility study
SODI	Southern Ohio Diversification Initiative
TCE	trichloroethene
TLD	thermoluminescent dosimeter
TSCA	Toxic Substances Control Act
USEC	United States Enrichment Corporation
U.S. EPA	U.S. Environmental Protection Agency

VOC	volatile organic compound
WEMS	Wastren-EnergX Mission Support, LLC

DEFINITIONS

absorption – Taking up of energy from radiation by the medium 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 body of 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 particle 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 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 Resource Conservation and Recovery Act requirements.

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 and multiples of the curie are commonly used:

kilocurie (kCi) – 10^{3} Ci, one thousand curies; 3.7 x 10^{13} disintegrations per second.
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 or a dose of 5 rem to any tissue, including skin and the lens of the eye. The guidelines for radionuclides in air and water are provided in DOE Order 458.1, *Radiation Protection of the Public and the Environment*.

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 report, 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."

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 waste 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 with waste 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 natural radionuclides enter the body by ingestion of food or liquids or by inhalation. Radon is the major contributor to the annual dose for internal radionuclides.

irradiation – Exposure to 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 – The maximum concentration of a constituent in environmental media (soil, groundwater, etc.) that is considered protective of human health and the environment.

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.

quality factor – 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 quality factor is used because some types of radiation, such as alpha particles, are more biologically damaging than others.

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, 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 – A tissue specific number that represents the fraction of the total 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 2013. 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 28,370 residents (U.S. Census 2010).

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-B&W Portsmouth LLC (FBP), Wastren-EnergX Mission Support, LLC (WEMS), and B&W Conversion Services, LLC (BWCS) managed DOE programs at PORTS in 2013.

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.

USEC, Inc. is developing a gaseous centrifuge uranium enrichment plant at PORTS. USEC, Inc. leases buildings from DOE, but the gaseous centrifuge uranium enrichment plant is a commercial enterprise of USEC, Inc. and is not pursuant to a DOE contract. The USEC, Inc. 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.

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 USEC, Inc. operations at PORTS because their operations are not subject to DOE Orders. USEC,

Inc. 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.

USEC, Inc. 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 and FBP received one Notice of Violation from an inspection in 2013. DOE/FBP received a Notice of Violation from the inspection conducted by the U.S. Environmental Protection Agency (U.S. EPA) and the Ohio Environmental Protection Agency (Ohio EPA) on June 17-18, 2013. The Notice of Violation was for failing to close containers of used fluorescent lamps and failing to label a container of used oil with the words "used oil". The violations were abated by closing or appropriately labeling the containers. U.S. EPA stated in the Notice of Violation that DOE and FBP had resolved the violations. No further action was required.

ENVIRONMENTAL PROGRAMS

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

D&D Program

D&D of the PORTS gaseous diffusion process buildings and associated facilities is proceeding in accordance with the *April 13, 2010 Director's Final Findings and Orders for Removal Action and Remedial Investigation and Feasibility Study and Remedial Design and Remedial Action (which includes the July 16, 2012 Modification thereto)* (D&D DFF&O). 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.

In 2013, the planning and investigations necessary for D&D of the gaseous diffusion process buildings and associated facilities included collection of data specified in the work plans to characterize waste generated by D&D of the process buildings and other complex facilities and determine alternatives for disposition of the waste generated by D&D. The D&D process for removal of the X-600 Steam Plant Complex, X-744S Warehouse, X-624-1 Decontamination Pad, X-102 Cafeteria, and X-106 Tactical Response Building was underway in 2013. The structures were removed in 2013. The final reports were provided to Ohio EPA in December 2013 or 2014, and concurrence from Ohio EPA was received in 2014.

The Remedial Investigation and Feasibility Study (RI/FS) Reports for the Process Buildings and Waste Disposition decisions were submitted to Ohio EPA in January and February of 2013, respectively. The RI/FS Reports characterize site conditions, describe the nature of wastes to be generated during D&D, assess risks to human health and the environment, and evaluate potential remedial alternatives. Specific activities include identifying contaminants within the buildings (PCBs, radionuclides, and other chemicals), determining the quantity of wastes to be generated by D&D, and identifying alternatives for handling and disposing of wastes (reusing various materials, landfill disposal, etc.). DOE and Ohio EPA met throughout 2013 to address Ohio EPA comments on these reports. Revisions to the reports were submitted to Ohio EPA in 2014.

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. Corrective actions, also called remedial actions, are underway in each quadrant.

The Environmental Restoration Program is responsible for implementation of remedial actions selected by Ohio EPA for seven areas at PORTS where soil and/or groundwater contamination has been identified. Final remedial actions are reviewed by Ohio EPA 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. In 2013, five-year reviews were completed for the remedial actions implemented at the PK Landfill, Quadrant I Groundwater Investigative (5-Unit) Area, X-611A Former Lime Sludge Lagoons, and X-734 Landfills. Each review found that the remedial actions were protective of human health and the environment. Two additional projects were underway in 2013 to remediate soil and/or groundwater contamination in the Quadrant II Groundwater Investigative (7-Unit) Area and X-740 Former Waste Oil Handling Facility Area.

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 trichloroethene (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 2013, FBP shipped approximately 9800 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 2013, SODI received approximately 1380 tons of materials from PORTS, including recyclable metals, excess office furniture and equipment, over 350 radios, two refrigerators, and 115 passenger vehicles for auction.

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.pppo.energy.gov 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.org 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 Ohio Historic Preservation Office and other stakeholders 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* 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.* 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 2013, environmental monitoring information was collected for the following programs:

- ambient air
- direct radiation
- discharges to surface water
- local surface water
- sediment
- soil
- vegetation
- biota (crops, deer, fish, 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 2013 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, Dose, provides more information about the potential impacts to human health from radionuclides released by PORTS.

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, and DOE sets a 100 mrem/year limit for the dose from radionuclides from all potential pathways (air, water, and direct radiation). 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.

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 USEC, Inc. The maximum dose that a member of the public could receive from radiation released by PORTS in 2013 is 1.4 mrem, based on a maximum dose of 0.34 mrem from airborne radionuclides at the PORTS fence line, 0.0018 mrem from radionuclides released to the Scioto River, 0.96 mrem from direct radiation at station A29, and 0.069 mrem based on exposure to radionuclides detected at off-site monitoring locations in 2013. This dose calculation assumes that the same individual is exposed to the maximum dose calculated from each pathway. This dose (1.4 mrem) is significantly less than the 100 mrem/year limit set by DOE 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 (0.047 mrem) is also significantly less than the 10 mrem/year standard set by U.S. EPA.

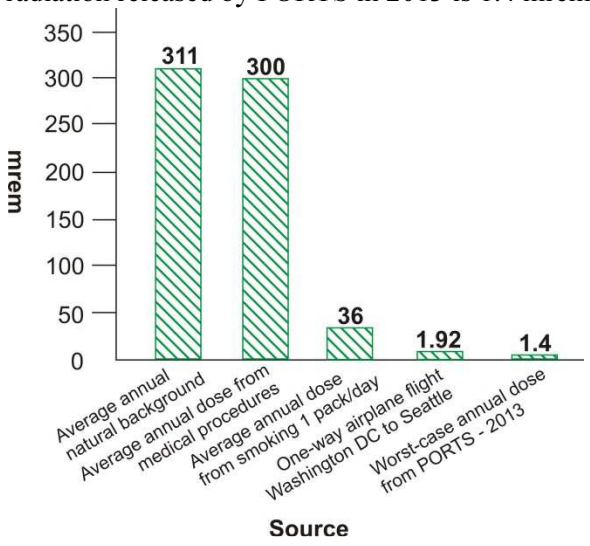

Figure 1. Comparison of dose from various common radiation sources.

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* describes the groundwater monitoring program for PORTS, which has been reviewed and approved by Ohio EPA. In general, samples are collected from wells at 12 groundwater monitoring areas and 14 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/X-120/Peter Kiewit (PK) Landfill (X-749/X-120 groundwater plume) (Quadrant I), Quadrant I Groundwater Investigative (5-Unit) Area/X-749A Classified Materials Disposal Facility (Quadrant I

Groundwater Investigative [5-Unit] Area groundwater plume), Quadrant II Groundwater Investigative (7-Unit) Area, X-701B 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 at the X-749/X-120/PK Landfill monitoring area is near the southern boundary of PORTS. In 2013, 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 2013 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 (neither increasing nor decreasing) during 2013.

The *Integrated Groundwater Monitoring Plan* 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.

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1. INTRODUCTION

1.1 SUMMARY

The Portsmouth Gaseous Diffusion Plant (PORTS) is located on a 5.9-square-mile site in a rural area of Pike County, Ohio. U.S. Department of Energy (DOE) activities at PORTS include environmental restoration, waste management, uranium operations, and decontamination and decommissioning (D&D) of the process buildings and associated facilities formerly used for the gaseous diffusion process of uranium enrichment. Fluor-B&W Portsmouth LLC (FBP) is the DOE contractor responsible for D&D of PORTS, which includes the three gaseous diffusion process buildings and other associated facilities.

The United States Enrichment Corporation (USEC) operated the gaseous diffusion uranium enrichment facilities at PORTS until 2001. USEC, Inc. (the parent company of USEC) 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 USEC, Inc. are not covered by this document because their operations are not subject to DOE Orders. However, some USEC, Inc. 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. USEC, Inc. 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.

1.2 BACKGROUND INFORMATION

PORTS, which produced enriched uranium via the gaseous diffusion process from 1954 through 2001, is owned by DOE (see Figure 1.1). 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 B&W Conversion Services, LLC (BWCS) managed DOE programs at PORTS in 2013.

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

USEC, Inc. 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 USEC, Inc. 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 *2013 Groundwater Monitoring Report*, which are available at the PORTS Environmental Information Center.

1.3 DESCRIPTION OF SITE LOCALE

PORTS is located in a rural area of Pike County, Ohio, on a 5.9-square-mile site. The site is 2 miles east of the Scioto River in a small valley running parallel to and approximately 120 feet above the Scioto River floodplain. Figure 1.2 depicts the plant site within the State of Ohio and its immediate environs.

Pike County has approximately 28,370 residents (U.S. Census 2010). 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 4,400 residents (U.S. Census 2010). 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 2,200 (U.S. Census 2010). 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.

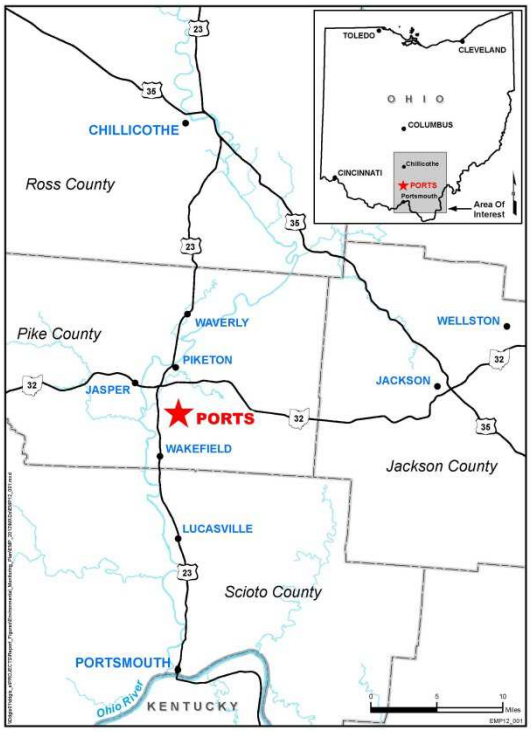

Figure 1.2. Location of PORTS.

Additional cities within 50 miles of the plant are Portsmouth (population 20,226), 22 miles south; Chillicothe (population 21,901), 27 miles north; and Jackson (population 6,397), 18 miles east (U.S. Census 2010). 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). 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 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 2013, 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 numerous 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 one Notice of Violation from an inspection conducted in 2013.

DOE/FBP received a Notice of Violation from the inspection conducted by the U.S. Environmental Protection Agency (U.S. EPA) and the Ohio Environmental Protection Agency (Ohio EPA) on June 17-18, 2013. The Notice of Violation was for failing to close containers of used fluorescent lamps and failing to label a container of used oil with the words "used oil". The violations were abated by closing or appropriately labeling the containers. U.S. EPA stated in the Notice of Violation that DOE and FBP had resolved the violations. No further action was required.

2.2 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 USEC, Inc. FBP is responsible for air emission permits and NPDES outfalls associated with the former gaseous diffusion plant operations.

USEC, Inc. 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 Resource Conservation and Recovery Act (RCRA) Part B permit for the storage of hazardous wastes. Appendix B lists the active environmental permits and registrations held by DOE and/or DOE contractors (FBP and BWCS) at the end of 2013.

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 2013, DOE contractors had no reportable quantity releases of hazardous substances subject to Section 103 notification requirements.

2.3.1.2 Emergency Planning and Community Right-To-Know Act

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

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

Section 304 of the Emergency Planning and Community Right-To-Know Act requires reporting of off-site reportable quantity releases to state and local authorities**.** During 2013, FBP and BWCS had no reportable quantity releases.

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 USEC, Inc. reported the following chemicals for 2013: 1,2-propanediol, aluminum oxide, aluminum

oxide hydrate, argon, asbestos, calcium chloride, calcium hydroxide, carbon dioxide, chlorine, citric acid, coal, dichlorotetrafluoroethane (CFC-114), diesel fuel #2, diesel fuel #2 (ultralow sulfur), ethylene glycol, fluorine, fluorotrichloromethane (CFC-11), gasoline, hydrogen fluoride, kerosene, lime calcium oxide, limestone, lubricating oils, methanol, mineral oils, nitric acid, nitrogen, PCBs, perfluoro-1,3-dimethylcyclohexane, petroleum asphalt, 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 2013, DOE contractors reported the release and/or off-site treatment of three chemicals:

- chlorine: used for water treatment;
- hydrogen fluoride: approximately 55 lbs released to the air from the DUF_6 Conversion Facility and 508 lbs treated off site; and
- nitrate compounds: approximately 27,600 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 2013, 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.

On January 28, 2013, 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 what was thought to be groundwater contaminated with trichloroethene (TCE). Site security personnel observed water coming out of the ground near a project to replace a force main that transferred TCE-contaminated groundwater to the X-622 Groundwater Treatment Facility. However, upon further investigation, the source of the water was determined to be a discharge point for a roof drainage system that had inadvertently been covered with soil during the force main replacement project. No hazardous waste or waste constituents were released during the event.

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. 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 2013.

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*. 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 Holding Pond, X-701B retention basins, X-744Y Waste Storage Yard (X-701B Holding Pond area), X-230J7 Holding Pond (X-701B Holding Pond 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. Chapter 6 discusses these monitoring results for 2013.

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*. Chapter 6 discusses the groundwater monitoring results for these units in 2013.

2.3.1.4 Federal Facility Compliance Act

Waste that is a mixture of RCRA hazardous waste and low-level radioactive waste (LLW) is currently stored at PORTS. RCRA hazardous waste is subject to Land Disposal Restrictions, which with limited exceptions do not allow the storage of hazardous waste for longer than one year. The Federal Facility Compliance Act, enacted by Congress in 1992, allows for the storage of mixed hazardous/LLW for longer than one year because treatment for this type of waste is not readily available. The Act also requires federal facilities to develop and submit site treatment plans for treatment of mixed wastes. On October 4, 1995, Ohio EPA issued a Director's Final Findings and Orders allowing the storage of mixed waste beyond one year and approving the Proposed Site Treatment Plan. An annual update to the Site Treatment Plan is required by these Director's Final Findings and Orders. The annual update to the Site Treatment Plan for fiscal year 2013 was submitted to Ohio EPA in December 2013.

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 2013: 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 2013. The *2013 PCB Document Log for the Portsmouth Gaseous Diffusion Plant* was prepared in June 2014. Approximately 6.8 tons of PCB waste (over 6200 kilograms [kg] gross weight) was generated and shipped off site in 2013. Waste contaminated with PCBs was generated during 2013 through D&D of the X-106 Tactical Response Building, X-102 Cafeteria, and other activities.

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 2013.

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 2013.

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 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 the *Authorization Agreement and Radioactive Waste Management Basis for Portsmouth Gaseous Diffusion Plant Facilities and Material Storage Areas* 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.

2.3.3.1 Clean Air Act

In 2013, FBP was 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, 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 when DOE became responsible for the air emission sources associated with the former gaseous diffusion production facilities and support facilities in 2011.

Facilities that are major sources of air pollutants are required to submit a Title V Air Permit Application to Ohio EPA. FBP submitted this permit application to Ohio EPA in March 2012 (Ohio EPA did not require submittal of the application until 2012). Ohio EPA issued the draft Title V Air Permit in November 2013 and the final permit in 2014. The air emission sources regulated by the previous Title V Permit (issued to USEC) were operated in accordance with the preceding Title V Permit.

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 2013, 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 2013.

BWCS was responsible for four permitted sources associated with the DUF_6 Conversion Facility. In 2013, 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 2013.

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

The National Emission Standards for Hazardous Air Pollutants (NESHAP) require 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 2013, 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. Radiological air emissions from FBP sources in 2013 were 0.02948 curie (Ci).

BWCS sources. In 2013, 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. Radiological air emissions from the DUF_6 Conversion Facility in 2013 were 0.0000409 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 2013 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.

The BWCS NPDES permit allows the discharge of process wastewaters from the DUF_6 Conversion Facility. One outfall is monitored under the permit; the discharge from this outfall flows through the X-230J5 Northwest Holding Pond (FBP NPDES Outfall 010) before reaching waters of the state. During 2013, no process wastewater was discharged through the BWCS NPDES outfall; discharges from the BWCS NPDES outfall only consisted of precipitation runoff. 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. Chapter 4, Section 4.3.5, and Chapter 5, Section 5.4.1.2, provide additional information on the BWCS NPDES outfall.

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 on April 30, 2013. FBP continued to monitor the FBP NPDES outfalls in accordance with the current permit throughout 2013 because Ohio EPA had not yet issued a new permit.

BWCS submitted an NPDES permit renewal application to Ohio EPA in November 2011 to replace the BWCS NPDES permit that expired on May 31, 2012. BWCS continued to monitor BWCS Outfall 001 in accordance with the current permit throughout 2013 because Ohio EPA had not yet issued a new permit.

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). Six permit limitations associated with the FBP NPDES permit effluent limitations were exceeded during 2013 (see Chapter 5, Section 5.4.1.1). The overall FBP NPDES compliance rate for 2013 was 99%. BWCS had 10 exceedances of NPDES permit effluent limitations in 2013 (see Chapter 5, Section 5.4.1.2); therefore the overall BWCS NPDES compliance rate for 2013 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 outfall is 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 2013, 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. These tanks include six diesel fuel tanks ranging in size from 500 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 2013.

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. No categorical exclusions for PORTS were posted on the DOE Portsmouth/Paducah Project Office website (www.pppo.energy.gov) in 2013.

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 site-wide threatened and endangered species habitat survey and an Indiana bat (*Myotis sodalis*) survey were completed in August 1996. No Indiana bats were found at PORTS. Few potential critical habitats were identified, and a report of the survey activities and results was provided to 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 proposed location for the on-site disposal facility, if this alternative is selected (see Chapter 3, Section 3.2.3). The study used nets set along the bats travel corridors, such as along stream or trails, to capture the bats. Data about the bats such as species, sex, and weight were collected. The captured bats were then banded and released.

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 Ohio 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 were 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.

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 Ohio Historic Preservation Office and other stakeholders 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 and WEMS 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.

Development of the FBP EMS began when FBP assumed responsibility for the PORTS D&D contract. FBP declared readiness for its EMS program in September 2013. An independent surveillance of the FBP EMS program was completed in the spring of 2014.

At the end of 2013, BWCS was in the process of developing an EMS program.

An annual EMS report is prepared to document DOE's progress, performance, and successes in implementing the EMS at PORTS. The highest priority aspects identified in the fiscal year 2013 EMS report were energy efficiency, water efficiency, and waste management/waste reduction.

The report stated that 80% or more of the established EMS objectives, targets, and programs were on schedule to be met. 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*

In 2009, Executive Order 13514 introduced 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 2013, 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.

In 2013, a wetland and stream assessment was completed for the northeast area of PORTS where the potential on-site disposal facility is planned, if this alternative is selected. Chapter 3, Sections 3.2.3 and 3.2.3.1 provide more information about the potential on-site disposal facility and the wetland and stream assessment.

2.4 OTHER MAJOR ENVIRONMENTAL ISSUES AND ACTIONS

This section summarizes environmental inspections of DOE activities at PORTS during 2013 and the results of these inspections.

2.4.1 Environmental Program Inspections

During 2013, 14 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 one Notice of Violation from an inspection in 2013.

DOE/FBP received a Notice of Violation from the inspection conducted by U.S. EPA and Ohio EPA on June 17-18, 2013. The Notice of Violation was for failing to close containers of used fluorescent lamps and failing to label a container of used oil with the words "used oil". The violations were abated by closing or appropriately labeling the containers. U.S. EPA stated in the Notice of Violation that DOE and FBP had resolved the violations. No further action was required.

2.5 UNPLANNED RELEASES

No unplanned releases from DOE activities at PORTS occurred in 2013.

2.6 SUMMARY OF PERMITS

Appendix B lists the permits held by DOE and/or DOE contractors in 2013.

Table 2.1. Environmental inspections of DOE activities at PORTS for 2013

Date	DOE contractor	Agency	Type	Notices of Violation
March 26	FBP	Ohio EPA	RCRA Hazardous Waste Permit compliance	None
April 17	FBP	Ohio EPA	NPDES compliance	None
April 17	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-230J6, X-230K, X230J5, X230J7, X230L Holding Ponds, X-623 Groundwater Treatment Facility)	None
May 7	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (5-Unit Groundwater Area)	None
May 9 (letter date)	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-700 and X-705 Basement Sumps – information review)	None
June17-18	FBP	Ohio EPA and U.S. EPA	RCRA compliance	See Section 2.4.2
June 12	FBP	Pike County Health Department and Ohio EPA	Closed solid waste landfills: X-749A, X-749, and X-735 (solid waste portion)	None
June 24	FBP	Ohio EPA	Clean Air Act compliance	None
August 21	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749B PK Landfill, X-735 Landfill)	None
August 28	FBP	Ohio EPA	RCRA Hazardous Waste Permit compliance	None
September 10	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-749 Landfill)	None
September 17	FBP	Ohio EPA	RCRA Corrective Action surveillance and maintenance (X-611A Prairie)	None
October 1	FBP	Ohio EPA	RCRA record review	None
October 29	FBP	Ohio EPA	RCRA Hazardous Waste Permit compliance	None

3. ENVIRONMENTAL PROGRAM INFORMATION

3.1 SUMMARY

The D&D process for removal of the X-600 Steam Plant Complex, X-744S Warehouse, X-624-1 Decontamination Pad, X-102 Cafeteria, and X-106 Tactical Response Building was underway in 2013. The structures were removed in 2013. The final reports were provided to Ohio EPA in December 2013 or 2014, and concurrence from Ohio EPA was received in 2014.

The Remedial Investigation and Feasibility Study Reports for the Process Buildings and Waste Disposition decisions were submitted to Ohio EPA in January and February of 2013, respectively. DOE and Ohio EPA met throughout 2013 to address Ohio EPA comments on these reports. Revisions to the reports were submitted to Ohio EPA in 2014.

In 2013, the Environmental Restoration Program was responsible for two projects to remediate soil and/or groundwater contamination in the Quadrant II Groundwater Investigative (7-Unit) Area and X-740 Former Waste Oil Handling Facility. Five-year reviews were completed for the remedial actions implemented at the PK Landfill, Quadrant I Groundwater Investigative (5-Unit) Area, X-611A Former Lime Sludge Lagoons, and X-734 Landfills. Each review found that the remedial actions were protective of human health and the environment.

In 2013, FBP shipped approximately 9800 tons of waste or other materials to off-site facilities for treatment, disposal, recycling, or reuse. Activities undertaken by the Environmental Sustainability, Training, 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 3.2.2 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 and 3.2.2. The PORTS Community Relations Plan 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 3.7 provides additional information on the PORTS Public Awareness Program.

The primary components of the D&D DFF&O are: 1) engineering evaluations/cost analyses and action memoranda for less complex facilities (non-time critical removal actions); 2) a remedial investigation/feasibility study (RI/FS) and record of decision for process buildings and complex facilities; and 3) an RI/FS and record of decision for evaluation and selection of alternatives for site-wide waste

disposition. The following sections discuss each component of the D&D DFF&O and the activities completed during 2013 for each component of the D&D DFF&O.

3.2.1 Non-time critical removal actions

The smaller and less complex buildings at PORTS undergo D&D using the process for non-time critical removal actions. This process begins with a removal site evaluation. The removal site evaluation includes a preliminary assessment of the facility, including anticipated wastes and volumes, and an evaluation of the likelihood of releases of hazardous substances. Existing analytical data are compiled, potential hazards to human health, safety and the environment are evaluated, and data needs (if any) are identified. If necessary, a sampling and analysis plan is prepared to collect data to characterize wastes that will be generated during D&D and identify areas of contamination. If required, a preliminary assessment report, removal site investigation work plan, and removal site investigation report are prepared, or the information included in these reports can be included in the engineering evaluation/cost analysis with Ohio EPA concurrence. If a preliminary assessment report, removal site investigation work plan, and/or removal site investigation report are prepared, Ohio EPA must review and concur with the documents.

An engineering evaluation/cost analysis is then prepared that includes the site characterization information obtained during the preliminary assessment, the technological options for removal of the facility/area, the recommended option for removal of the facility/area, and a schedule for completion of the work.

After Ohio EPA concurs with the engineering evaluation/cost analysis, a public comment period will commence. At the conclusion of the public comment period, DOE prepares an action memorandum to summarize and address public comments (if any). A removal action work plan is then prepared that details the activities necessary to remove the building. Upon completion of the building removal, a removal action completion report is submitted to Ohio EPA for review and concurrence.

DOE and Ohio EPA have developed a single engineering evaluation/cost analysis for 46 of the buildings to be removed as non-time critical removal actions. Ohio EPA concurred with the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures* in 2011. Sampling and analysis plans and removal action work plans are prepared as each building or group of buildings covered by the *Engineering Evaluation/Cost Analysis for the Plant Support Buildings and Structures* are prepared for D&D.

3.2.1.1 Non-time critical removal action activities in 2013

The D&D process for the following groups of buildings was underway or completed in 2013:

- X-100 Complex (X-100 Administration Building, X-100B Air Conditioner Equipment Building, X-101 Dispensary, and X-109C Monitoring Station) – completed in 2013,
- X-744S Warehouse and X-624-1 Decontamination Pad – underway in 2013,
- X-600 Steam Plant Complex (X-600 Steam Plant, X-600B Steam Plant Shop Building, and X-600C Ash Wash Treatment Building) – underway in 2013, and
- X-102 Cafeteria and X-106 Tactical Response Building – underway in 2013.

X-100 Complex (X-100 Administration Building, X-100B Air Conditioner Equipment Building, X-101 Dispensary, and X-109C Monitoring Station). D&D of the X-100 Complex (X-100 Administration Building, X-100B Air Conditioner Equipment Building, X-101 Dispensary, and X-109C Monitoring Station) was completed in 2012. A removal action completion report for the X-100 Complex was submitted to Ohio EPA in March 2013, and Ohio EPA provided concurrence on the report in June 2013. Disposal of all project waste was completed in April 2013.

X-744S Warehouse and X-624-1 Decontamination Pad. The removal action work plan for the X-744S Warehouse and X-624-1 Decontamination Pad was submitted to Ohio EPA in May 2013. Ohio EPA provided conditional concurrence of the plan in July 2013 and final concurrence in September 2013. Demolition of the areas was completed in July and August of 2013. Disposal of all project waste was completed in August 2013. DOE submitted the removal action completion report to Ohio EPA in December 2013. Ohio EPA provided concurrence on the report in 2014.

X-600 Steam Plant Complex (X-600 Steam Plant, X-600B Steam Plant Shop Building, and X-600C Ash Wash Treatment Building). DOE submitted the removal action work plan for the X-600 Steam Plant Complex to Ohio EPA in March 2013. Ohio EPA provided conditional concurrence of the plan in June 2013 and final concurrence in July 2013. Demolition of the complex began in April 2013 under conditional concurrence by Ohio EPA and was completed in October 2013, with the exception of site restoration, which was completed by the end of 2013. All project waste was disposed by the end of September 2013. A removal action completion report was submitted to Ohio EPA in 2014.

X-102 Cafeteria and X-106 Tactical Response Building. DOE submitted the removal action work plan for the X-102 Cafeteria and X-106 Tactical Response Building to Ohio EPA in June 2013. Ohio EPA provided conditional concurrence of the plan in July 2013 and final concurrence in August 2013. Demolition of the complex began in June 2013 under conditional concurrence by Ohio EPA and was completed in September 2013. All project waste and recyclables were dispositioned by the end of September 2013. A removal action completion report was submitted to Ohio EPA in 2014.

3.2.2 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 begins 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 RI/FS work plan details the tasks to be completed to characterize site conditions, determine the nature of wastes to be generated, assess the risk to human health and the environment, and evaluate potential remedial alternatives. Specific activities can include 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.). The RI/FS report provides the results of the RI/FS work plan. Ohio EPA reviews each report and must provide concurrence on the RI/FS work plan and RI/FS report (Ohio EPA comments on the pre-investigation evaluation report must be addressed in the RI/FS work plan). The pre-investigation evaluation report was completed in 2011, and the RI/FS work plan was concurred with in 2011.

A proposed plan that identifies the proposed remedial action is then prepared and made available for public comment. The record of decision finalizes the remedial action selected by DOE with concurrence from Ohio EPA (with public input) and implementation of the remedial actions begins.

3.2.2.1 Process buildings and complex facilities RI/FS activities in 2013

The *Remedial Investigation and Feasibility Study Report for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project* (Process Building RI/FS Report) was submitted to Ohio EPA in January 2013. Ohio EPA provided comments on the report in March 2013, and a revised Process Building RI/FS Report was submitted to Ohio EPA in September 2013. DOE and Ohio EPA met throughout 2013 to address Ohio EPA comments on the Process Building RI/FS Report, and Ohio EPA provided additional comments in 2014.

3.2.3 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 (completed in 2011), RI/FS work plan (concurred with in 2012), RI/FS report, proposed plan, and record of decision. Development of waste acceptance criteria for an on-site waste disposal facility (if this alternative is selected) is also included as part of the RI/FS work plan.

3.2.3.1 Site-wide waste disposition activities in 2013

The *Remedial Investigation and Feasibility Study Report for the Site-Wide Waste Disposition Evaluation Project* (Waste Disposition RI/FS Report) was submitted to Ohio EPA in February 2013. Ohio EPA provided comments on the report in April 2013, and a revised Waste Disposition RI/FS Report was submitted to Ohio EPA in September 2013. DOE and Ohio EPA met throughout 2013 to address Ohio EPA comments on the Waste Disposition RI/FS Report, and the second revision to the Waste Disposition RI/FS Report was submitted to Ohio EPA in 2014.

Specific sampling plans and other information that support the Waste Disposition RI/FS Report are discussed in the following paragraphs.

The *Phase I Sampling and Analysis Plan for Process Equipment Characterization in Support of the Site-wide Waste Disposition Project* was developed to characterize the waste generated by removal of the process gas systems in the former gaseous diffusion process buildings. Ohio EPA provided concurrence on the document in 2011. Sampling began in 2011, continued in 2012-2013, and will continue in 2014. Converters and containers of LLW characterized by this project were shipped off site for disposal in 2013.

The *Geotechnical Sampling and Analysis Plan for the Site-wide Waste Disposition Evaluation Project* and *Supplemental Geotechnical Sampling and Analysis Plan for the Site-wide Waste Disposition Evaluation Project* were developed to gather data to evaluate potential on-site disposal locations for some of the waste generated by D&D, if the alternative is selected. Data collected in accordance with these plans included water level measurements, soil/rock characterization, and measurement of naturally-occurring metals and other parameters in groundwater. Additional data included geotechnical properties of on-site soil and rock materials and sampling to confirm that environmental contamination is not present in the potential, proposed, on-site disposal location and the associated proposed support facilities. Quarterly groundwater sampling is being conducted to provide baseline data for groundwater in the potential on-site disposal locations, if the alternative is selected.

The *Test Plan for Batch Leaching of Contaminated Equipment and Debris from Building X-326* was developed in 2011 to conduct laboratory measurements and theoretical evaluations of the leachability of radionuclides (uranium and technetium-99) from process building debris in case the debris is placed in an on-site disposal facility, if the alternative is selected. Data were collected, and the report entitled

Analytical Results and Data Evaluation for Batch Leach Test Performed on Samples Collected from Process Gas Equipment in Building X-326 was submitted to Ohio EPA in November 2012. Ohio EPA provided conditional concurrence on the report with comments in January 2013. DOE submitted report revisions in February 2013 and received final concurrence from Ohio EPA in March 2013.

A wetland and stream assessment was completed in 2013 for the northeastern area of PORTS that is the proposed location for the on-site disposal facility, if this alternative is selected. The assessment identified and evaluated streams and wetlands in the study area in order to begin to determine mitigation requirements that may be necessary if the proposed on-site disposal facility is constructed. Mitigation may include improvements to on-site and off-site streams and wetlands in order to offset the removal of streams and wetlands for construction of the on-site disposal facility.

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 proposed location for the on-site disposal facility, if this alternative is selected. Chapter 2, Section 2.3.5.3, provides additional information about this study.

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. 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 would interrupt operations, or were areas that could 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).

DOE submitted the *Deferred Units RFI/CMS Work Plan for Solid Waste Management Units* to Ohio EPA in August 2013. DOE met with Ohio EPA in August and September to discuss details of the work plan, and Ohio EPA provided comments on the work plan in December 2013. The revised *Deferred Units RFI/CMS Work Plan for Solid Waste Management Units* was submitted to Ohio EPA in 2014. Preliminary activities to support the sampling outlined in the work plan such as sample location marking, sub-site surveys, and excavation permits, were underway in 2013.

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. Ohio EPA provided comments on the report in January 2013, which DOE responded to in February 2013. DOE and Ohio EPA conducted additional discussions throughout 2013 concerning the specific methods to be used to establish the soil background levels. Submittal of the final report is expected to occur in 2014.

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. 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).

Remedial actions required for the X-749B Peter Kiewit Landfill (PK Landfill) were provided in separate Decision Documents issued by Ohio EPA in 1996 and U.S. EPA in 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 2013 groundwater monitoring results for the X-749/X-120/PK Landfill (Section 6.4.1.4) and Quadrant I Groundwater Investigative (5-Unit) Area/X-749A Classified Materials Disposal Facility (Section 6.4.2.3).

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 Holding Pond	X-237 Groundwater Collection System – 1991 X-624 Groundwater Treatment Facility – 1991 (upgraded 2006) Extraction wells (3) – 1993 (removed 2009-2011) X-623 Groundwater Treatment Facility – 1993 X-701B sump – 1995 Groundwater remediation by oxidant injection – 2008 Groundwater and soil remediation by oxidant mixing – 2011

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

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

3.3.1.1 X-749/X-120 groundwater plume

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

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

The *First Five-Year Review for the X-749/X-120 Groundwater Plume*, submitted to Ohio EPA in 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. 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.

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 submitted to Ohio EPA in January 2013 and approved by Ohio EPA in April 2013. 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*.

Chapter 6, Section 6.4.1.4, provides additional information about the 2013 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. 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 was completed in 2008. This report, *the Second Five-Year Review for the X-749B Peter Kiewit 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. 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 was submitted to Ohio EPA in September 2013. This report, the *Third Five-Year Review for the X-749B Peter Kiewit 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. The next review of the remedial actions implemented at the PK Landfill will be submitted to Ohio EPA in 2018.

Chapter 6, Section 6.4.1.4, provides 2013 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 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. 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. This report, the *First Five-Year Review for the Five-Unit Groundwater*

Investigative Area and X-231A/X-231B Oil Biodegradation Plots, 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 September 2013. This report, the *Second Five-Year Review for the Five-Unit Groundwater Investigative Area and X-231A/X-231B Oil Biodegradation Plots*, found that the remedial actions implemented for the X-231A and X-231B Oil Biodegradation Plots and the Five-Unit Groundwater Investigative Area (the multimedia caps and groundwater extraction system) were continuing to eliminate potential exposure pathways to contaminants, control migration of the groundwater plume, and remove volatile organic compounds (VOCs) from groundwater. 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 6.4.2.3, provides information on the groundwater monitoring completed in the Quadrant I Groundwater Investigative (5-Unit) Area during 2013.

3.3.2 Quadrant II

The *Quadrant II Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 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.

Chapter 6 provides 2013 groundwater monitoring results for the following areas in Quadrant II that require groundwater monitoring: Quadrant II Groundwater Investigative (7-Unit) Area (Section 6.4.3.1), X-701B Holding Pond (Section 6.4.4.1), and X-633 Former Recirculating Cooling Water Complex (Section 6.4.5.1).

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. 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 *Interim Report for the 7-Unit Interim Remedial Measure,* submitted to Ohio EPA in November 2012, found that TCE degradation was occurring within the treatment areas based on data collected between 2010 and 2012. Monitoring data collected in 2013 indicated that significant TCE degradation had occurred within the treatment areas, although concentrations of TCE in groundwater within the treatment areas remained elevated. 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*.

Chapter 6, Sections 6.4.3 and 6.4.3.1, provide information about the groundwater monitoring completed at the Quadrant II Groundwater Investigative (7-Unit) Area during 2013.

3.3.2.2 X-701B Holding Pond

Remedial actions required by the Decision Document for X-701B, issued in 2003, include groundwater remediation by injection of a chemical oxidant. 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, Sections 6.4.4 and 6.4.4.1, provide information about the groundwater monitoring completed at the X-701B Holding Pond during 2013.

3.3.2.3 X-633 Former Recirculating Cooling Water Complex

The X-633 Recirculating Cooling Water Complex was demolished in 2010. A work plan for the RCRA investigation of soil and groundwater in the area, the *Resource Conservation and Recovery Act Work Plan for the Former X-633 Recirculating Cooling Water Complex,* was approved by Ohio EPA in 2010 and 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 2013 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.

3.3.3 Quadrant III

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

Over 700 hybrid poplar trees were planted on a 2.6-acre area above the X-740 groundwater plume in 1999. In 2003, a five-year review was completed for the X-740 groundwater plume to evaluate the effectiveness of the phytoremediation system. The report, entitled *Five-Year Evaluation Report for the X-740 Phytoremediation Project*, indicated that the trees in the phytoremediation system did not noticeably affect the overall groundwater flow in the Gallia at this area, although the trees did appear to influence water levels in individual wells. Concentrations of TCE in the X-740 groundwater plume had not decreased appreciably.

Upon review of the 2003 Five-Year Evaluation Report, Ohio EPA required another evaluation of this area in three years to determine if the phytoremediation system was effective in remediating the groundwater plume. Additional data collected for this evaluation included soil moisture at specified depths below ground surface, wind speed/direction, rainfall, air/soil temperature, tree growth rates, and sap flow measurements. The *Supplemental Evaluation to the Five-Year Evaluation Report for the X-740 Phytoremediation System,* submitted to Ohio EPA in 2007, found that the phytoremediation system had not performed as expected to remove TCE from groundwater in this area.

In response to Ohio EPA comments on the above mentioned report, DOE developed a work plan for 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 took place from 2011 through 2013. TCE has decreased in two wells within the area of the groundwater plume that was treated during the pilot study (see Section 6.4.7.1)

Chapter 6 provides 2013 groundwater monitoring results for the following areas in Quadrant III that require groundwater monitoring: X-616 Former Chromium Sludge Surface Impoundments (Section 6.4.6.1) and X-740 Former Waste Oil Handling Facility (Section 6.4.7.1).

3.3.4 Quadrant IV

The *Quadrant IV Cleanup Alternative Study/Corrective Measures Study* was approved by Ohio EPA in 1998. DOE received the Decision Document for Quadrant IV in 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 2013 groundwater monitoring results for the following areas in Quadrant IV that require groundwater monitoring: X-611A Former Lime Sludge Lagoons (Section 6.4.8.1), X-735 Landfills (Section 6.4.9.1), X-734 Landfills (Section 6.4.10.1), X-533 Former Switchyard Complex (Section 6.4.11.1), and X-344C Former Hydrogen Fluoride Storage Building (Section 6.4.12.1).

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 in 1996, which required a soil cover over the former lagoons and establishment of a prairie habitat. The soil cover and planting of the prairie were completed in 1997. The *Second Five-Year Review for the X-611A Prairie,* submitted to Ohio EPA in 2008, 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 *Third Five-Year Review for the X-611A Prairie* was submitted to Ohio EPA in June 2013. The report found that the soil cover and prairie habitat continued to meet the corrective 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.

Figure 3.1 X-611A Prairie.

3.3.4.2 X-734 Landfills

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

The *First Five-Year Review for the X-734 Landfill Area*, submitted to Ohio EPA in 2008, found that construction of the caps on the landfills had achieved remedial action objectives by isolating contaminants in soil and sediment from potential receptors. The caps were preventing contaminants in soil and sediment from migrating to groundwater and surface water.

The *Second Five-Year Review for the X-734 Landfill Area* was submitted to Ohio EPA in December 2013. The report found that the landfill caps have continued to achieve corrective action objectives by isolating contaminants in soil and sediment from potential receptors. 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 work plan for the RCRA investigation of soil and groundwater at the X-630 Recirculating Cooling Water Complex, the *Resource Conservation and Recovery Act Work Plan for 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 2013 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.

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 or EnergySolutions/Gallaher Road in 2013) 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 2013, SODI received approximately 1380 tons of materials from PORTS, including recyclable metals, excess office furniture and equipment, over 350 radios, two refrigerators, and 115 passenger vehicles for auction.

In 2013, FBP shipped approximately 9800 tons of materials to off-site facilities for treatment, disposal, recycling, or reuse (see Table 3.2).

Table 3.2. Waste Management Program off-site treatment, disposal, and recycling accomplishments for 2013

Waste type	Waste stream	Quantity (pounds[a])	Treatment or disposal, facility
RCRA	Aerosol cans, spent solvents, solids contaminated with solvents or metals, and ignitable liquids	3426	Environmental Quality Co.
RCRA	Reactive liquid (peroxide)	45	Ross Environmental
LLW	Scrap metal, and other solids from D&D of the X-600 Steam Plant Complex	14,315	EnergySolutions Clive, UT
LLW	Scrap metal and other solids from D&D of the X-600 Steam Plant Complex and X-100	184,474	EnergySolutions Bear Creek, TN
LLW	Uranium materials, scrap metal, and other solids	5,183,718	Nevada National Security Site
LLW/BSFR	Assorted solids from D&D of the X-600 Steam Plant Complex	1,879,070	EnergySolutions Gallaher Rd, TN
LLW/BSFR	Assorted solids (wood, metal, plastic, etc.)	983,735	Studsvik, Inc.
PCB	Light ballasts contaminated with PCBs (recyclable)	2040	Environmental Quality Co./Wayne Disposal
RCRA/LLW	Lab wastes and other materials contaminated with radionuclides and classified as RCRA hazardous waste	1746	Diversified Scientific Solutions
RCRA/LLW	D&D waste, sludge, alumina, and other solids contaminated with metals or solvents	54,969	EnergySolutions Clive, UT
RCRA/LLW	Alumina trap waste, sludge, and other solids contaminated with metals or solvents	45,369	Materials & Energy Corp.
RCRA/LLW	Alumina trap waste containing chromium	1949	Waste Control Specialists, TX
RCRA/PCB	Two transformers and metal duct work contaminated with metals	3101	Chemical Waste Management, Inc.
LLW/PCB	Oil/water mixture from X-333	1448	Diversified Scientific Solutions
LLW/PCB	Personal protective equipment, rags, and other solids	24	EnergySolutions Clive, UT
RCRA/LLW/ PCB	Lab wastes	90	Diversified Scientific Solutions

Table 3.2. Waste Management Program off-site treatment, disposal, and recycling accomplishments for 2013 (continued)

Waste type	Waste stream	Quantity (pounds[a])	Treatment or disposal, facility
Solid waste	D&D waste, concrete, asphalt, metal, and other materials	5,985,664	Rumpke/Pike Sanitation Landfill
Solid waste	Non-hazardous liquids (cleaners, etc.).	2327	Environmental Quality Co.
-	Coal and coal ash from D&D of the X-600 Steam Plant Complex	2,180,220	Sand Hill Coal Co.
-	Recyclable aluminum cans, batteries, electronic materials, plastic, batteries, metal, light bulbs, etc. (see Section 3.4)	315,380	Various (not including SODI)
-	Materials transferred to SODI (see Section 3.4)	2,764,363	-

[a]Pounds in net weight (waste only)

The following materials from FBP were sent off-site for recycling in 2013:

- aluminum cans: 1715 lbs
- batteries: 26,657 lbs
- circuit boards: 170 lbs
- electronic materials (computer equipment, etc.): 74,053 lbs
- light bulbs: 12,434 lbs
- mercury-containing thermostats/thermometers: 18 lbs
- scrap metal: 2,594,690 lbs
- paper/cardboard: 88,933 lbs
- plastic bottles: 4681 lbs
- transformer oil: 105,649 lbs.

3.5 ENVIRONMENTAL SUSTAINABILITY PROGRAM

DOE is committed to reducing 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 *Environmental Sustainability Plan* describes the Environmental Sustainability Program and integrates the tenets of an EMS (see Chapter 2, Section 2.3.6). 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.

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 U.S. Department of Energy Fiscal Year 2014 Site Sustainability Plan for the Portsmouth Gaseous Diffusion Plant* provides goals and progress through fiscal year 2013 for reductions in greenhouse gas emissions, water consumption, recycling/waste diversion, electronic stewardship, and other areas. The following accomplishments were listed for fiscal year 2013:

- a decrease of 33% in greenhouse gas emissions (primarily associated for electricity consumption) versus the fiscal year 2008 baseline emissions.
- 8.4% of electricity consumption from renewable energy sources, which exceeds the goal of 7.5%
- an increase in alternative fuel (E-85) consumption of 43.2% versus fiscal year 2012.
- a decrease of 10.9% in pounds of paper used per person versus fiscal year 2012.

In November 2013, PORTS won a Gold-Level Award in the Federal Electronic Challenge sponsored by U.S. EPA for implementing and maintaining a comprehensive program to reduce impacts associated with electronics, including computers/monitors, data servers, and copiers/printers/scanners. The program saves energy, reduces greenhouse gas emissions, and reduces operating costs. PORTS also received a Silver Level GreenBuy Award from DOE for fiscal year 2013 for buying products that save energy, conserve water, and reduce health and environmental impacts.

3.6 ENVIRONMENTAL TRAINING PROGRAM

DOE contractors at PORTS provide environmental training to increase employee awareness of environmental activities and to enhance the knowledge and qualifications of personnel performing tasks associated with environmental assessment, planning, and restoration. The program includes on- and off-site classroom instruction, on-the-job training, seminars, and specialized workshops and courses. Environmental training conducted or prepared by DOE contractors at PORTS includes hazardous waste

training required by RCRA and numerous Occupational Safety and Health Administration training requirements.

3.7 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.org 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.pppo.energy.gov 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 2013, environmental monitoring information was collected by DOE contractors (FBP and BWCS) and USEC, Inc. This chapter includes information on air emissions and water discharges from USEC, Inc. 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, and DOE sets a 100 mrem/year limit for the dose from radionuclides from all potential pathways. 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 direct radiation, and from radionuclides detected in 2013 by environmental monitoring programs for sediment and soil. The maximum dose a member of the public could receive from radiation released by PORTS in 2013 or detected by environmental monitoring programs in 2013 is 1.4 mrem/year. This summary of the dose calculations assumes that the same individual is 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 2013

Source of dose	Dose (mrem/year)[a]
Airborne radionuclides (fence line)	0.34
Radionuclides released to the Scioto River	0.0018
Direct radiation at station A29	0.96
Radionuclides detected by environmental monitoring programs (sediment and soil)	0.069
Total	1.4

[a]100 mrem/year is the DOE limit.

4.2 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. 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 2013, environmental monitoring data were collected by DOE contractors (FBP and BWCS) and USEC, Inc. This chapter provides information on the USEC, Inc. NPDES monitoring program and air emissions of radionuclides from USEC, Inc. sources. USEC, Inc. data are provided for informational purposes only; DOE cannot ensure the quality of USEC, Inc. data.

Data from the following environmental monitoring programs are included in this chapter:

- airborne discharges
- ambient air
- direct 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 Clean Air Act and NESHAP. 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 NESHAP apply only to airborne radiological releases.

Small quantities of radionuclides were released to the environment from PORTS operations during 2013. 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 2013 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 direct external radiation emanating from buildings or other objects. For 2013, doses are estimated for exposure to atmospheric releases, direct radiation, and releases to surface water (the Scioto River).

Doses are also estimated for exposure to radionuclides from PORTS operations that were detected in 2013 as part of the DOE environmental monitoring programs. 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. In 2013, doses are estimated for exposure to radionuclides detected by the monitoring programs for sediment and soil. Exposure to radionuclides detected in groundwater at PORTS is not included because contaminated groundwater at PORTS is not a source of drinking water.

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 natural 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 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).

- *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 an appropriate weighting factor. In this report, the term "effective dose" is often shortened to "dose."

- *Collective dose/collective effective dose* – the sum of the doses or effective dose 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."

4.3.2 Airborne Emissions

Airborne discharges of radionuclides from PORTS are regulated under the Clean Air Act NESHAP. 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 2013, 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 2013.

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. Emissions from the DOE/FBP sources in 2013 were calculated to be 0.02948 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. Emissions from the DOE/BWCS sources in 2013 were calculated to be 0.0000409 Ci.

Emissions from all DOE sources in 2013 were calculated to be 0.0295 Ci. USEC, Inc. reported emissions of 0.00000877 Ci from operation 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 2013 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 2013 was 0.047 mrem/year. The combined dose from USEC, Inc. (the Lead Cascade) and DOE sources is also 0.047 mrem/year. The dose from the USEC, Inc. 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).

DOE also completes a dose calculation using the CAP88-PC model for locations around the perimeter of the security fence of the PORTS process area (the limited access area). Emissions from the DOE radionuclide sources are used to determine the dose to a hypothetical person living at the fence line for the limited access area at each of the 16 directional sectors around the plant (i.e., north, north-northeast, northeast, east-northeast, etc.). In 2013, the maximum dose a hypothetical person living at the PORTS security fence line would receive from DOE radionuclide emissions was 0.34 mrem/year at the north sector of the security fence line for the limited access area. The maximum security fence line dose increased in 2013 (0.34 mrem/year) versus the 2012 maximum property fence line dose (0.10 mrem/year) due to differences in the distances to the sources and the close proximity of one of the radionuclide emission sources to the north sector of the security fence line.

This maximum fence line dose (0.34 mrem/year) was used to determine the maximum dose a member of the public could receive from radiation released by PORTS in 2013 (1.4 mrem/year) instead of the dose to the person who actually lives at the most exposed point near the plant (0.047 mrem/year) because the dose calculations assume that a person is exposed to the maximum dose calculated from each pathway.

The collective dose (or population dose) is the sum of the individual doses to the entire population within 50 miles of PORTS. In 2013, the population dose from PORTS emissions was 0.256 person-rem/year, (0.256 person-rem/year from DOE sources and 0.000046 person-rem/year from USEC, Inc.). 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 USEC, Inc. 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). In 2013, one of the ambient air monitoring stations, station A41 in Zahns Corner, was not in use because the station was being relocated due to road construction.

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 2013 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 0.0018 mrem/year at station A9, which is near the southwestern corner of the PORTS property boundary.

The highest net dose measured at the ambient air monitoring stations (0.0018 mrem/year at station A9) is 4% of the dose calculated from the combined DOE and USEC, Inc. point source emissions (0.047 mrem/year). This dose is significantly less than the 10 mrem/year NESHAP limit for airborne radiological releases and 100 mrem/year DOE limit for all radiological releases from a facility.

4.3.5 Discharges of Radionuclides from NPDES Outfalls

FBP, BWCS, and USEC, Inc. were responsible for NPDES outfalls at PORTS during 2013. The BWCS NPDES outfall is not monitored for radionuclides; therefore, it is not discussed in this section. A description of the FBP and USEC, Inc. outfalls and the discharges of radionuclides from these outfalls during 2013 are included in this section. Quarterly reports that provide radiological monitoring data for the NPDES outfalls are submitted to Ohio EPA by FBP and USEC, Inc. for their respective outfalls.

4.3.5.1 FBP outfalls

In 2013, 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, and oil can be diverted and contained. Water from this holding pond is discharged to a ditch that flows to Little Beaver Creek.

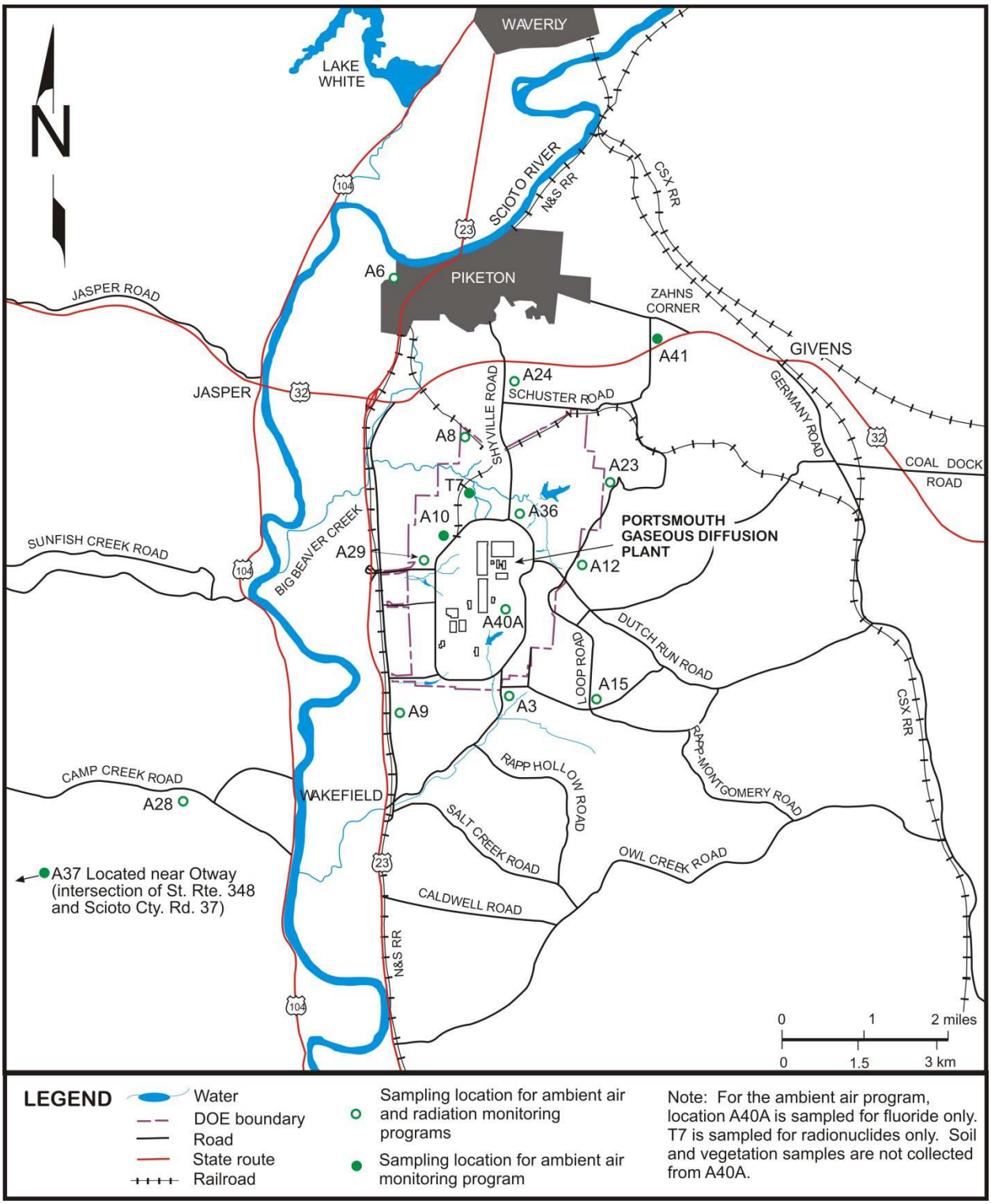

Figure 4.1. DOE ambient air and radiation monitoring locations.

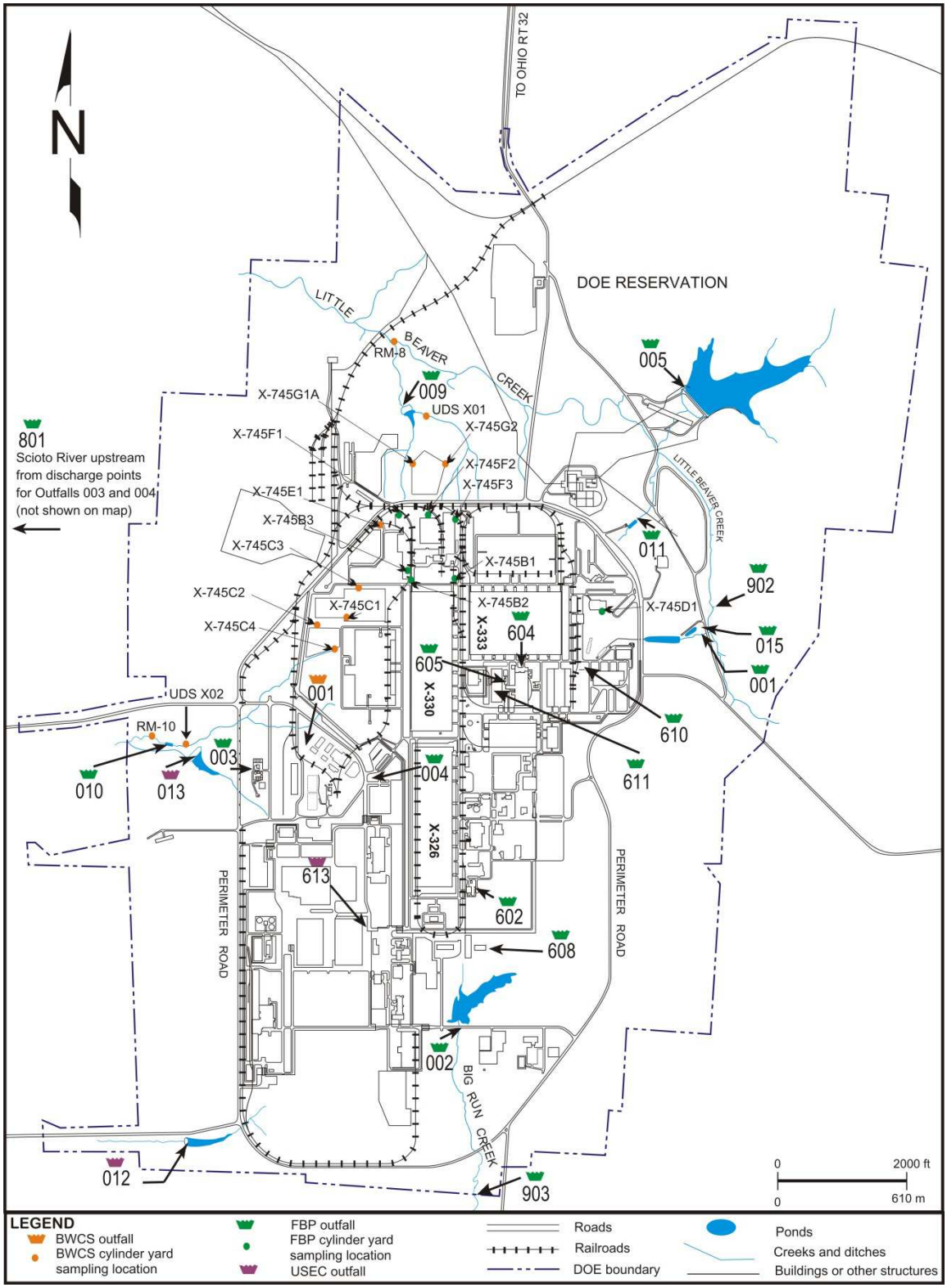

Figure 4.2. PORTS NPDES outfalls/monitoring points and cylinder storage yards sampling locations.

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 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 various 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, and oil can be contained. 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, and oil can be diverted and contained. 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, and oil can be diverted and contained. 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) – 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 3.2.1). 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 background monitoring location on the Scioto River upstream from FBP NPDES Outfalls 003 and 004. 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.

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 2013, uranium discharges from the FBP external outfalls (Outfalls 001, 002, 003, 004, 005, 009, 010, 011, and 015) were estimated at 7.9 kg. Total radioactivity (technetium-99 and isotopic uranium) released from the same outfalls was estimated at 0.022 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 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 2013.

4.3.5.2 USEC, Inc. outfalls

In 2013, USEC, Inc. 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 USEC, Inc. NPDES outfall follows.

USEC 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.

USEC 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.

USEC 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).

Transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240) and technetium-99 were not detected in any of the samples collected from USEC, Inc. NPDES outfalls in 2013.

Uranium discharges in 2013 from external USEC, Inc. NPDES outfalls (Outfalls 012 and 013) were estimated at 0.598 kg. These values were calculated using quarterly discharge monitoring reports for the USEC, Inc. 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 USEC, Inc. NPDES outfalls.

Discharges of radionuclides from USEC, Inc. 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 for all radiological releases from a facility.

4.3.6 Dose Calculation for Releases to Surface Water

Radionuclides are measured at the FBP and USEC, Inc. NPDES external outfalls (nine FBP outfalls and two USEC, Inc. 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 USEC, Inc. outfalls. As a conservative measure, radionuclides that were not detected were assumed to be present at the detection limit. Uranium measured at the USEC, Inc. 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* 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 (98% of the hypothetical dose from liquid effluents is from drinking water). The dose from radionuclides released to the Scioto River in 2013 (0.0018 mrem) is significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

4.3.7 Radiological Dose Calculation for Environmental Radiation

Radiation is emitted from uranium hexafluoride cylinders stored on site at PORTS in the cylinder storage yards located in the northwest portion of the site near Perimeter Road. Environmental 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* (see Section 4.6.2).

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. In 2013, the average dose recorded at the cylinder yards near Perimeter Road was 743 mrem/year, based on measurements by thermoluminescent dosimeters (TLDs) for an entire year at locations #41, #868, #874, #882, and #890. 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). Based on these assumptions, exposure to an on-site member of the public from radiation from the cylinder yards is approximately 0.74 mrem/year.

Environmental 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* (see Section 4.6.2). The total annual dose measured in 2013 at station A29, near the Ohio Valley Electric Corporation (OVEC), was 89 mrem/year. The total dose measured at eight of the off-site monitoring stations averaged 81 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 8 mrem/year difference between the average off-site dose (81 mrem/year) and the dose at station A29 (89 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 0.96 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 environmental radiation to a member of the public (0.96 mrem/year to a worker near station A29 versus 0.74 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 DOE limit 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 direct 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 2013 Radiation Exposure Information Reporting System report indicated that no visitors received a measurable dose (1 mrem or more).

More than 2600 DOE employees and DOE contractors were monitored throughout 2013. These workers received an average dose of 3.2 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 2013.

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. 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 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 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 (residential drinking water [well water], sediment, and soil) and biota (vegetation, deer, fish, crops, and dairy products) at off-site sampling locations with 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 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 2013, dose calculations were completed for public exposure to radionuclides detected in sediment and soil.

The following sections provide brief descriptions of the dose calculations for each monitoring program. 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* 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 2013 are significantly less than the DOE limit of 100 mrem/year.

Table 4.2. Summary of potential doses to the public from radionuclides detected by DOE environmental monitoring programs in 2013

Source of dose	Dose (mrem/year)[a]
Sediment	0.021
Soil	0.048
Total	0.069

[a]100 mrem/year is the DOE limit.

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 2013 from monitoring location RM-7, an off-site sampling location on Little Beaver Creek downstream from PORTS:

- technetium-99: 5.81 pCi/g, (picocuries per gram [pCi/g])
- uranium-233/234: 2.67 pCi/g,
- uranium-235/236: 0.127 pCi/g, and
- uranium-238: 0.994 pCi/g.

Based on an 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,* 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 0.021 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 regular sample collected at the ambient air monitoring station A8 (the northeast PORTS property boundary):

- uranium-233/234: 1.23 pCi/g,
- uranium-235/236: 0.062 pCi/g, and
- uranium-238: 1.25 pCi/g.

Based on an 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,* 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 0.048 mrem/year. Section 4.6.7 provides additional information on the soil 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 2002) 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 2013 from the northern side of the PORTS reservation (surface water sampling location NHP-SW01 and sediment sampling location RM-8) 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 2013. Section 4.6.5 and Chapter 6, Section 6.4.13 provide more information about these sediment and surface water sampling programs, respectively.

The maximum levels of radionuclides (neptunium-237, technetium-99 and uranium isotopes) were as follows:

Radionuclide	NHP-SW01	RM-8
Neptunium-237	0	0.0156 pCi/g
Technetium-99	0	2.86 pCi/g
Uranium-233/234	2.24 pCi/L	6.16 pCi/g
Uranium-235/236	0.127 pCi/L	0.3 pCi/g
Uranium-238	1.92 pCi/L	1.65 pCi/g

These values were entered into the RESRAD-BIOTA software that is designed to implement the DOE Technical Standard (DOE 2002). 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 2013, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations NHP-SW01 (surface water) and RM-8 (sediment) was 0.0223, 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 2013 from the northern side of the PORTS reservation (surface water sampling location NHP-SW01 and soil sampling location A8) 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 2013. Section 4.6.7 and Chapter 6, Section 6.4.13 provide additional information about these soil and surface water sampling programs, respectively.

No transuranic radionuclides or technetium-99 were detected in 2013 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	2.24 pCi/L	1.23 pCi/g
Uranium-235/236	0.127 pCi/L	0.062 pCi/g
Uranium-238	1.92 pCi/L	1.25 pCi/g

These values were entered into the RESRAD-BIOTA software that is designed to implement the DOE Technical Standard (DOE 2002). 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 2013, the RESRAD-BIOTA software output for the maximum levels of radionuclides detected at sampling locations NHP-SW01 (surface water) and A8 (soil) was 0.00106, 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 2013.

4.6 ENVIRONMENTAL RADIOLOGICAL MONITORING

This section discusses the radiological monitoring programs at PORTS: ambient air monitoring, environmental 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 USEC, Inc. 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 2013, samples were collected from 14 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 A41 in Zahns Corner was not in use in 2013 because the station was being relocated due to road construction.

No transuranic radionuclides were detected at the ambient air monitoring stations in 2013. Technetium-99 was detected at each of the 14 ambient air stations. The maximum activity of technetium-99 in ambient air was 0.042 picocurie per cubic meter (pCi/m^3) at station A9 (southwest of the plant on Old U.S. Route 23), which is well below the DOE derived concentration standard of 920 pCi/m^3.

Uranium-233/234 and uranium-238 were detected at each of the monitoring stations. The maximum activity of uranium-233/234 in ambient air (0.00031 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 (0.00012 pCi/m^3) was detected at station A10 (on site at the Don Marquis substation). These activities are well below the DOE derived concentration standards for uranium-233/234 (1.1 pCi/m^3) and uranium-238 (1.3 pCi/m^3).

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 (0.0018 mrem/year) was at station A9, which is southwest of the plant on Old U.S. Route 23. This hypothetical dose is well below the 10 mrem/year limit applicable to PORTS. Section 4.3.4 provides additional information about this dose calculation.

4.6.2 Environmental Radiation

Radiation is measured continuously with TLDs at five locations near the uranium hexafluoride 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.

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 743 mrem. Section 4.3.7 provides a dose calculation for the representative on-site member of the public, such as a delivery person, that is allowed on the portion of Perimeter Road near the cylinder storage yards (the general public is not allowed on the portion of Perimeter Road near the cylinder storage yards). The potential estimated dose from the cylinder yards to a delivery person (0.74 mrem/year) is significantly less than DOE's 100 mrem/year dose limit to the public for radionuclides from all potential pathways.

In 2013, the average annual dose measured at eight off-site locations (A3, A6, A9, A12, A15, A23, A24, and A28) was 81 mrem. Three locations within PORTS measured levels of radiation at least 50% higher than the average off-site radiation (81 mrem): location #874 (674 mrem) near the X-745C Cylinder Storage Yard; location #862 (125 mrem) south of the cylinder yards and west of the X-530A Switchyards; and location #933 (192 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 (ranging from 2 mrem to 12 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 (0.96 mrem/year) is significantly less than DOE's 100 mrem/year dose limit to the public for radionuclides from all potential pathways.

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 2013.

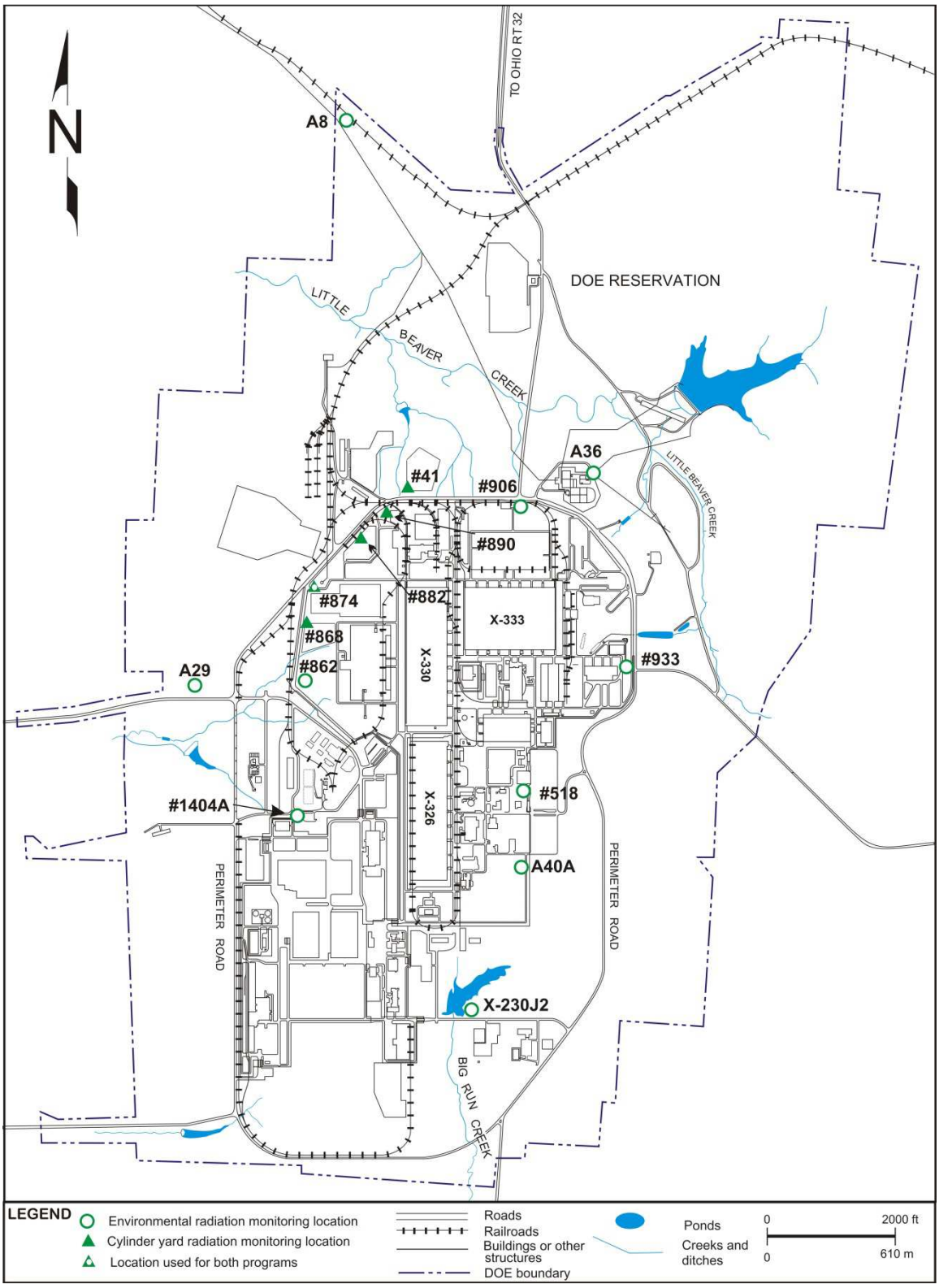

Figure 4.3. On-site radiation and cylinder yard dose monitoring locations.

4.6.3 Surface Water from Cylinder Storage Yards

In 2013, 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 2013 by FBP and BWCS, respectively.

4.6.3.1 FBP Cylinder Storage Yards

In 2013, 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 uranium (214 µg/L), alpha activity (47.2 pCi/L), and beta activity (63.7 pCi/L) were detected in the samples collected in September or October 2013 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 2013 (0.0018 mrem) is significantly less than the 100 mrem/year DOE 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. Figure 4.2 shows the sampling locations. Samples were analyzed for alpha activity, beta activity, and uranium.

Uranium was detected at a maximum concentration of 11 µg/L in the sample collected during July 2013 at sampling location X-745C4. Maximum levels of alpha activity and beta activity (38.5 and 32.6 pCi/L, respectively) were detected in the sample collected from X-745C4 in July or August 2013, respectively. 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 2013 (0.0018 mrem) is significantly less than the 100 mrem/year DOE limit for all radiological releases from a facility.

4.6.4 Local Surface Water

In 2013, 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*.

No transuranic radionuclides, technetium-99, or uranium-235/236 were detected in the local surface water samples collected during 2013. Maximum detections of uranium and uranium isotopes in local surface water samples were detected in the second quarter samples collected from locations RW-6 (the upstream location on the Scioto River in Piketon) or RW-7 (the downstream location on Little Beaver Creek).

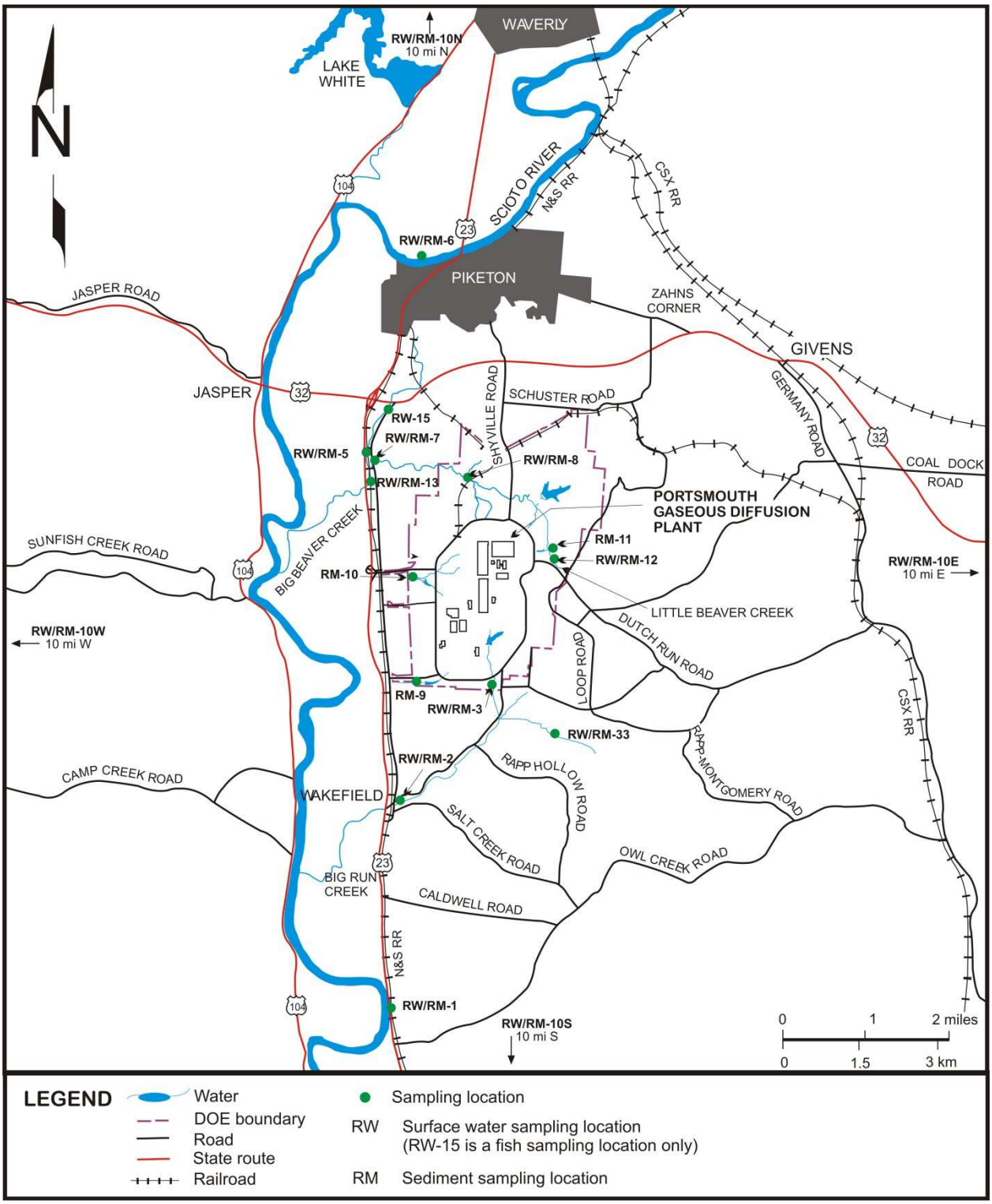

Figure 4.4. Local surface water and sediment monitoring locations.

Uranium was detected at 1.58 µg/L (RW-6), uranium-233/234 was detected at 1.69 pCi/L (RW-7), and uranium-238 was detected at 0.53 pCi/L (RW-6). Detections of uranium in local surface water samples in 2013 were well below the Ohio EPA drinking water standard for uranium (30 µg/L).

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*.

Uranium and uranium isotopes are naturally occurring, but may also be present due to PORTS activities. Maximum detections of uranium and uranium isotopes in sediment samples were detected at on-site sampling location RM-8 (Little Beaver Creek – see Figure 4.5). Uranium was detected at 5.05 micrograms per gram (µg/g), uranium-233/234 was detected at 6.16 pCi/g, uranium-235/236 was detected at 0.3 pCi/g, and uranium-238 was detected at 1.65 pCi/g. Uranium and uranium isotopes detected in the 2013 samples have been detected at similar levels in previous sampling events from 2002 through 2012.

Figure 4.5 Little Beaver Creek surface water/sediment sampling location RW/RM-8.

Neptunium-237 was detected at 0.0111 pCi/g at Big Beaver Creek sampling location RM-13 and at 0.0156 pCi/g at Little Beaver Creek at sampling location RM-8. These detections are much less than the U.S. EPA preliminary remediation goal for neptunium-237 in residential soil (1 pCi/g).

Technetium-99 is often detected in sediment samples collected at locations downstream from PORTS. In 2013, technetium-99 was detected in the sample collected from the upstream location on Big Beaver Creek (RM-5), the downstream location on Big Beaver Creek (RM-13), the downstream location on Big Run Creek (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 (5.81 pCi/g) was at location RM-7, a downstream location on Little Beaver Creek. These detections of technetium-99 are consistent with data from previous sampling events (2002 through 2012).

Section 4.3.9.1 provides a dose assessment to a member of the public based on detections of radionuclides at the downstream sampling location on Little Beaver Creek (RM-7). This off-site sampling location had the following levels of radionuclides detected in 2013 that would cause the highest dose to a member of the public: 5.81 pCi/g of technetium-99, 2.67 pCi/g of uranium-233/234, 0.127 pCi/g of uranium-235/236, and 0.994 pCi/g of uranium-238. The total potential dose to a member of the public resulting from PORTS operations (1.4 mrem/year), which includes this dose calculation (0.021 mrem/year), is well below the DOE standard of 100 mrem/year.

4.6.6 Settleable Solids

DOE collects semiannual water samples from nine effluent locations and three background locations (see Figure 4.6) 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 limits (5 pCi/g above background for alpha

activity and 50 pCi/g above background for beta activity). In 2013, settleable solids were detected at concentrations above 40 mg/L only at the background monitoring location for the Scioto River in Piketon (RW-6). Detections of settleable solids that monitor PORTS effluent ranged from 2.7 to 17.3 mg/L. These detections of settleable solids in PORTS effluent are less than 40 mg/L; therefore, monitoring results for the settleable solids monitoring program are in compliance with the DOE Order.

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*.

Plutonium-239/240 was detected at activities ranging from 0.00877 to 0.0189 pCi/g in the samples collected from 8 of the 15 monitoring stations, including the background station A37. These detections are much less than the U.S. EPA preliminary remediation goal for plutonium-239/240 (2.59 pCi/g) in residential soil, and are most likely present due to atmospheric fallout from nuclear weapons testing. No other transuranics were detected in any of the soil samples collected during 2013.

Technetium-99 was not detected in the soil samples collected during 2013. 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.

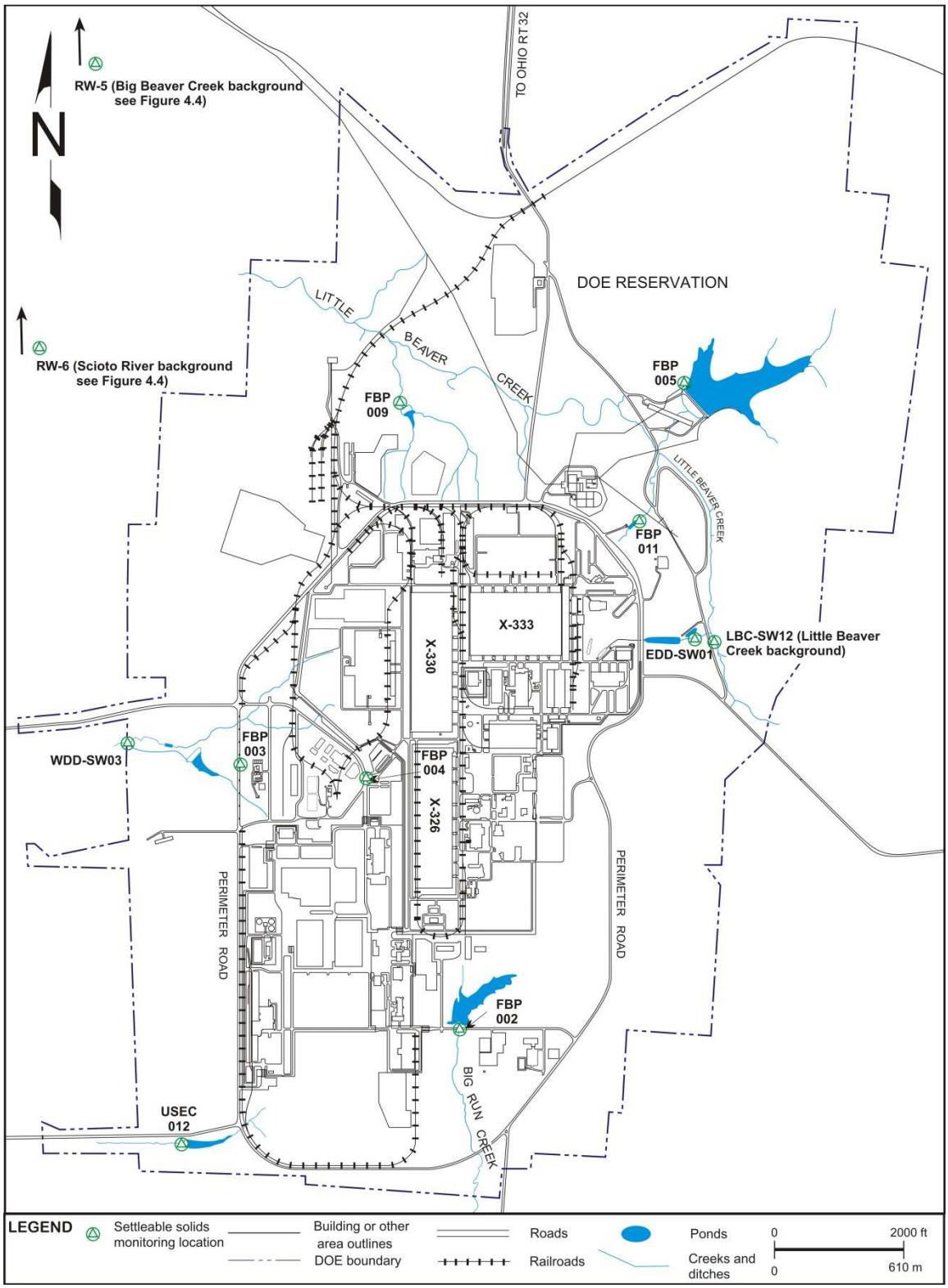

Figure 4.6. DOE settleable solids monitoring locations.

Section 4.3.9.2 provides a dose assessment based on the detections of uranium-233/234 (1.23 pCi/g), uranium-235/236 (0.062 pCi/g), and uranium-238 (1.25 pCi/g) in soil at the ambient air station with the detections of radionuclides that could cause the highest dose to a member of the public (the regular sample collected from station A8 at the PORTS north fence line). The total potential dose to a member of the public resulting from PORTS operations (1.4 mrem/year), which includes this dose calculation (0.048 mrem/year), is well below the DOE standard of 100 mrem/year.

4.6.8 Vegetation

To assess the uptake of radionuclides into plant material, vegetation samples 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*. No radionuclides were detected in the vegetation samples collected in 2013.

4.6.9 Biological Monitoring

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

4.6.9.1 Deer

Samples of liver, kidney, and muscle from deer killed on site in motor vehicle collisions are collected annually, if available. However, no samples were available for collection in 2013. No radionuclides were detected in the deer samples collected in November and December of 2012.

4.6.9.2 Fish

In 2013, samples from fish caught at downstream locations on the Scioto River (RW-1) and Little Beaver Creek (RW-8) as well as the upstream location on the Scioto River (RW-6) were analyzed for radionuclides. These radionuclides were 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 2013.

4.6.9.3 Crops

In 2013, crop samples, including peppers, corn, tomatoes, and cucumbers, 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 2013.

4.6.9.4 Milk and eggs

Samples were collected in 2013 of milk produced by a dairy near the town of Hatch (west of PORTS) and eggs from two farms (one near Hatch and another just south of 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 2013.

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 2013. 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 2013, FBP authorized 1577 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 – 2013

Items/materials	Number of release requests	Items/materials	Number of release requests
Waste/recycling/reuse		*Equipment/other materials*	
Septic waste	27	Vehicles	82
Trash	29	Equipment	280
Construction waste	29	Hand equipment	222
Light bulbs	54	Samples	64
Aerosol cans	25	Chemicals	18
Scrap metal	28	Personal protective equipment	39
Fuel	4	Records	202
Batteries	36	Electronics	82
Recyclables	20	Dosimeters	12
Oil	21		
Cylinders	19	Miscellaneous/uncategorized	114
Office furniture	87		
Pipe	10		
Copper transformers	73		

4.7.2 BWCS releases

In 2013, 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 1,210,187 gallons of aqueous hydrogen fluoride were shipped off site during 2013. The average total uranium activity of all the shipments was 0.0074 pCi/mL.

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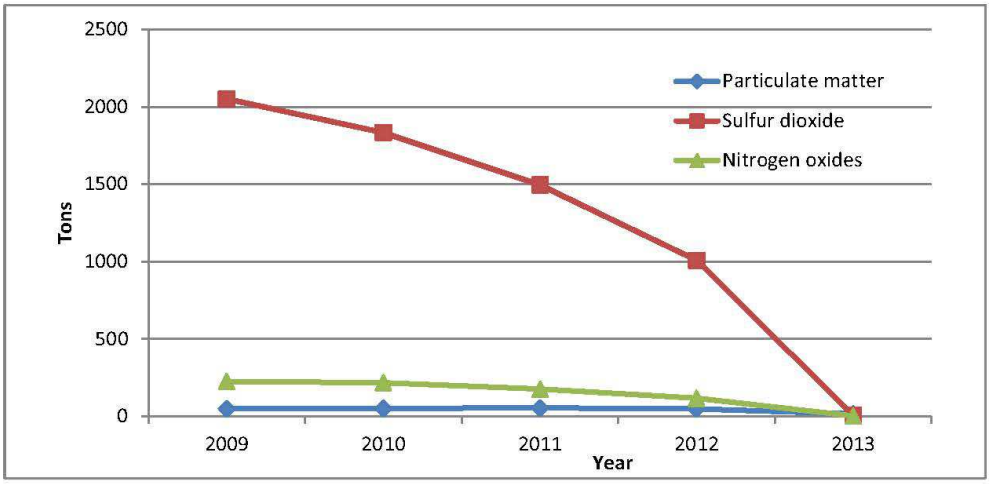
5. ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

5.1 SUMMARY

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

Discharges of non-radiological air pollutants from PORTS permitted emission sources decreased substantially in 2013 due to the demolition of the X-600 Steam Plant Complex. 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 2013 are similar to data collected in previous years.



Pollutant (tons)	2009	2010	2011	2012	2013
Particulate matter	48.9	51.2	54.6	47.5	15.75
Sulfur dioxide	2051	1833	1495	1007	5
Nitrogen oxides	225.7	217	176	117	1.59

Figure 5.1. Emissions of selected non-radiological air pollutants 2009 – 2013.

5.2 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* 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 USEC, Inc. specify discharge limitations, monitoring requirements, and/or reporting requirements for air emissions and water discharges. USEC, Inc. data for NPDES water discharges are included in this section to provide a more complete picture of environmental monitoring at PORTS. USEC, Inc. information for discharges to water is provided for informational purposes only; DOE cannot ensure the quality of USEC, Inc. 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.

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, emit 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.

Facilities that are major sources of air pollutants are 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 2013 in the *Ohio EPA Fee Emissions Report*: 15.75 tons of particulate matter, 7.34 tons of organic compounds, 5 tons of sulfur dioxide, and 1.59 tons of nitrogen oxides. These emissions decreased in 2013 versus previous years (see Figure 5.1) because of the demolition of the X-600 Steam Plant Complex. Emissions for 2013 are associated with the X-670A Cooling Tower, 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. 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 55 lbs of hydrogen fluoride emitted to the air in the Toxic Chemical Release Inventory for 2013 (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 2013, FBP reported emissions of 23,101.4 metric tons of carbon dioxide, 0.44 metric ton of methane, and 0.044 metric ton of nitrous oxide. These emissions result from combustion of the fuels used at the X-690 Boilers (natural gas and #2 fuel oil), which replaced the X-600 Steam Plant Complex.

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 2013, 72 tons (143,870 lbs) of material contaminated with asbestos 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 2013, samples for fluoride were collected weekly from 14 ambient air monitoring stations in and around PORTS (see Chapter 4, Figure 4.1), including a background ambient air monitoring station (A37) located approximately 13 miles southwest of the plant. In 2013, one of the ambient air monitoring stations, station A41 in Zahns Corner, was not in use because the station was being relocated due to road construction.

In 2013, fluoride was not detected in more than 80 percent of the samples collected for the ambient air monitoring program. The average ambient concentration of fluoride measured in samples collected at background station A37 was 0.017 microgram per cubic meter ($\mu g/m^3$). Average ambient concentrations of fluoride measured at the stations around PORTS ranged from 0.016 $\mu g/m^3$ at four stations (A6, A8, A10, and A36) to 0.022 $\mu g/m^3$ at three stations (A3, A12, and A23). 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 USEC, Inc. NPDES-permitted outfalls. PCBs are monitored in surface water downstream from the cylinder storage yards.

5.4.1 Water Discharges (NPDES Outfalls)

In 2013, DOE contractors (FBP and BWCS) were responsible for 19 NPDES discharge points (outfalls) or sampling points at PORTS. USEC, Inc. was responsible for three outfalls. This section describes non-radiological discharges from these outfalls during 2013.

5.4.1.1 FBP NPDES outfalls

In 2013, 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 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 2013, discharge limitations at the FBP NPDES monitoring locations were exceeded on six occasions.

The maximum daily concentration limit for carbonaceous biochemical oxygen demand (15 mg/L) at Outfall 003 (X-6619 Sewage Treatment Plant) was exceeded three times in 2013. The maximum daily loading limit for carbonaceous biochemical oxygen demand (22.7 kg/day) at Outfall 003 was exceeded once in 2013. The maximum daily exceedances ranged from 19 to 21 mg/L and the maximum daily loading exceedance was 22.8 kg/day. Each of these exceedances was caused by releases of cooling water containing propylene glycol to the sanitary sewer, which flowed to the X-6619 Sewage Treatment Plant.

In October 2013, the maximum concentration limit for chlorine (0.05 mg/L) was exceeded at Outfall 003 (X-6619 Sewage Treatment Plant) with a sample result of 0.12 mg/L. Operators immediately adjusted the dechlorination treatment and compliance was restored within approximately five hours.

In May 2013, the maximum concentration limit for fecal coliform (2000/100 milliliters [mL]) was exceeded at Outfall 003 (X-6619 Sewage Treatment Plant) with a sample result of 2300/100 mL. The exceedance was likely attributable to a release of cooling water containing propylene glycol that caused an upset to the X-6619 Sewage Treatment Plant.

In 2013, the overall FBP NPDES compliance rate with the NPDES permit was 99%.

5.4.1.2 BWCS NPDES outfall

BWCS is responsible for the NPDES permit for the discharge of process wastewaters from the DUF_6 Conversion Facility to the West Ditch, which flows to the X-230J5 Northwest Holding Pond (FBP NPDES Outfall 010) and then to the Scioto River. Chapter 4, Figure 4.2 shows the location of the BWCS NPDES outfall. Water discharged from BWCS Outfall 001 is monitored for the following chemicals and water quality parameters: temperature, biochemical oxygen demand, pH, suspended solids, oil and grease, ammonia-nitrogen, phosphorus, chlorine, and dissolved solids.

The monitoring data are submitted to Ohio EPA in a monthly discharge monitoring report. Although the outfall is permitted for the discharge of process wastewater, the only water released through BWCS NPDES Outfall 001 during 2013 was due to precipitation run-off. Process wastewater from the DUF_6 Conversion Facility has been discharged through the sanitary sewer system to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003) since 2008.

The daily maximum temperature limit of 50 °F and average monthly maximum temperature limit of 45 °F was exceeded at the BWCS outfall in January 2013 due to warmer than average weather.

Discharge limitations for total suspended solids (daily loading limit and average monthly loading limit) were exceeded twice during 2013, and discharge limitations for dissolved solids (daily concentration and daily loading) were exceeded six times during 2013. The exceedances were due to precipitation. The permit loading limits are based on an estimated process flow of water through the outfall. When precipitation increases the flow above the assumed amount, exceedances of the loading limits can occur.

Only precipitation run-off was discharged through the BWCS outfall during 2013. The overall BWCS NPDES compliance rate in 2013 was 99%.

5.4.1.3 USEC, Inc. NPDES outfalls

USEC, Inc. 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 USEC, Inc. NPDES outfall. Chemicals and water quality parameters monitored at each USEC, Inc. outfall are as follows:

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

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

- USEC 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 USEC, Inc. Outfalls 012, 013 and 613 occurred during 2013; therefore, the overall USEC, Inc. 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 2013. Section 5.5.2 presents the results for sediment samples collected as part of this program.

5.5 SEDIMENT

In 2013, 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 2013, samples were analyzed for 20 metals and PCBs, in addition to the radiological parameters discussed in Chapter 4.

PCBs (PCB-1260 and PCB-1254) were 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 west of the PORTS boundary (RM-7), Little Beaver Creek at the discharge point from the X-230J7 Pond (RM-11), downstream Big Run Creek at Wakefield (RM-2), and the West Drainage Ditch near Outfalls 010 and 013 (RM-10).

Two detections of PCBs in sediment around PORTS were slightly above the risk-based concentration of PCBs for protection of human health developed by U.S. EPA Region 9 and utilized by Ohio EPA: 220 micrograms per kilogram (µg/kg) or parts per billion (ppb). These detections were in the regular and duplicate samples collected at on-site sampling location RM-11 in Little Beaver Creek at the discharge point from the X-230J7 Pond (224 and 254 µg/kg, respectively). 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 2013 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 2013, PCBs (PCB-1260) were detected in at least one of the sediment samples collected from each location at concentrations up to 180 µg/kg (ppb). These concentrations 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. None of the samples contained PCBs above the risk-based concentration of PCBs for protection of human health developed by U.S. EPA Region 9 and utilized by Ohio EPA: 220 µg/kg (ppb).

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

5.6 BIOLOGICAL MONITORING - FISH

In 2013, 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) as part of the routine fish monitoring program at PORTS. 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 carp. The fish samples collected from the downstream Scioto River sampling location (RW-1) and Little Beaver Creek (RW-8) were bass.

PCBs (PCB-1254 and PCB-1260) were detected in fish collected from each location at concentrations ranging from 59.6 to 301 µg/kg (total PCBs). 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 (59.6 and 158 µg/kg) are above the unrestricted limit (50 µg/kg) and below the 1/week maximum limit (220 µg/kg). The concentrations of PCBs detected in regular and duplicate samples of bass caught on site in Little Beaver Creek (RW-8) were 207 and 301 µg/kg, respectively. The detection of PCBs in the duplicate sample (301 µg/kg) 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.

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6. GROUNDWATER PROGRAMS

6.1 SUMMARY

Groundwater monitoring at PORTS is required by a combination of state and federal regulations, legal agreements with Ohio EPA and 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/X-120/PK Landfill, Quadrant I Groundwater Investigative (5-Unit) Area, Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Holding Pond, and X-740 Former Waste Oil Handling Facility. In general, concentrations of contaminants detected within these plumes were stable (neither increasing nor decreasing) during 2013.

The X-749/X-120 groundwater plume at the X-749/X-120/PK Landfill monitoring area is near the southern boundary of PORTS. In 2013, 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 2013 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 *2013 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides further details on the groundwater plumes at PORTS, specific monitoring well identifications, and analytical results for monitoring wells. This document and other documents referenced in this chapter are available in the PORTS Environmental Information Center.

6.2 INTRODUCTION

This chapter provides an overview of groundwater monitoring at PORTS and the results of the groundwater monitoring program for 2013. The following sections provide an overview of the PORTS groundwater monitoring program followed by a review of the history and 2013 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 2013 was completed in accordance with the *Integrated Groundwater Monitoring Plan* dated June 2012. In June 2013, a revision to the *Integrated Groundwater Monitoring Plan* dated May 2013 was approved by Ohio EPA that incorporated minor revisions to the groundwater monitoring program such as clarification of the detection monitoring programs at the X-749A and X-735 Landfills, updates to special short-term studies, and increased monitoring frequencies for two wells in the X-616 Former Chromium Sludge Surface Impoundments monitoring area.

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 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. These areas (see Figure 6.1) are:

- Quadrant I
  - X-749/X-120/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 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.

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.

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/X-120/PK Landfill (X-749/X-120 groundwater plume), Quadrant I Groundwater Investigative (5-Unit) Area/X-749A Classified Materials Disposal Facility (Quadrant I Groundwater Investigative [5-Unit] Area groundwater plume), Quadrant II Groundwater Investigative (7-Unit) Area, X-701B 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 2013.

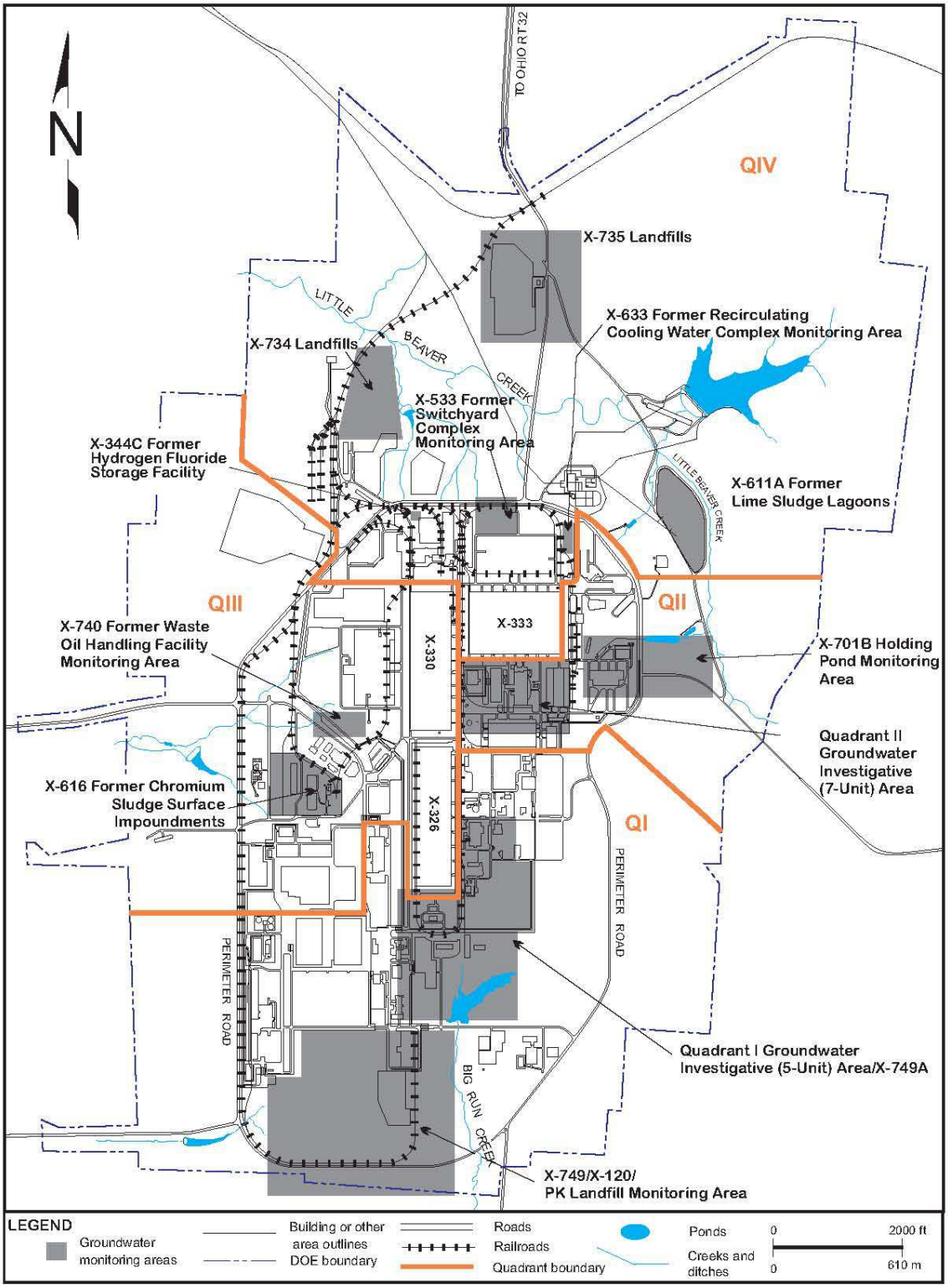

Figure 6.1. Groundwater monitoring areas at PORTS.

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS in 2013

Monitoring Area or Program	Analytes	
X-749/X-120/PK Landfill[a,b]		
X-749/X-120 groundwater plume	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	VOCs[c]	total metals[d]: Be, Cd, Cr, Mn, Ni
Quadrant I Groundwater Investigative (5-Unit) Area/ X-749A Classified Materials Disposal Facility[a,b]		
Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume	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 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	VOCs[c]	

Table 6.1. Analytical parameters for monitoring areas and programs at PORTS – 2013 (continued)

Monitoring Area or Program	Analytes
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
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.

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

In the southernmost portion of PORTS in Quadrant I, groundwater concerns focus on three contaminant sources: X-749 Contaminated Materials Disposal Facility, X-120 Old Training Facility, and PK Landfill. The X-749 Contaminated Materials Disposal Facility and X-120 Old Training Facility are contaminant sources to the X-749/X-120 groundwater plume. The PK 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).

Ninety-eight wells and one sump/extraction well were sampled during 2013 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 Old Training Facility

The former 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 facility, which no longer exists, included a machine shop, metal shop, paint shop, and several warehouses used during the construction of PORTS in the 1950s. Groundwater in the vicinity of this facility is contaminated with 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 former X-120 Old Training Facility to remediate the higher concentrations of TCE in groundwater in this area. Chapter 3, Section 3.3.1.1, provides additional information about the remedial actions implemented to address the X-749/X-120 groundwater plume.

Ninety-eight wells and one sump/extraction well were sampled during 2013 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 PK Landfill

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

During site investigations, intermittent seeps were observed emanating from the PK Landfill into Big Run Creek. In 1994, a portion of Big Run Creek was relocated approximately 50 feet to the east. A groundwater collection system was installed in the old creek channel to capture the seeps emanating from the landfill. A second collection system was constructed in 1997 on the southeastern landfill boundary to contain the groundwater plume migrating toward Big Run Creek from the southern portion of the PK Landfill. 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 2013, nine wells, two sumps, and two manholes were sampled to monitor the PK Landfill area. Table 6.1 lists the analytical parameters for the wells and sumps in this area.

6.4.1.4 Monitoring results for the X-749/X-120/PK Landfill in 2013

The X-749/X-120 groundwater plume is associated with the X-749/X-120/PK Landfill groundwater monitoring area (see Figure 6.2) in Quadrant I. The most extensive and most concentrated constituents associated with the X-749/X-120 plume 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 larger in 2013 compared to 2012 based on the decrease in TCE detected in well X749-29G to less than 5 µg/L (the preliminary remediation goal and definition of the plume perimeter). The concentrations of TCE detected in well X749-29G in the last three years have fluctuated above and below 5 µg/L (below 5 µg/L in 2011 and 2013 and above 5 µg/L in 2012). Concentrations of TCE remained less than 5 µg/L in 2013 in the other three wells that define the area (X120-05G, X749-PZ07G, and X749-36G).

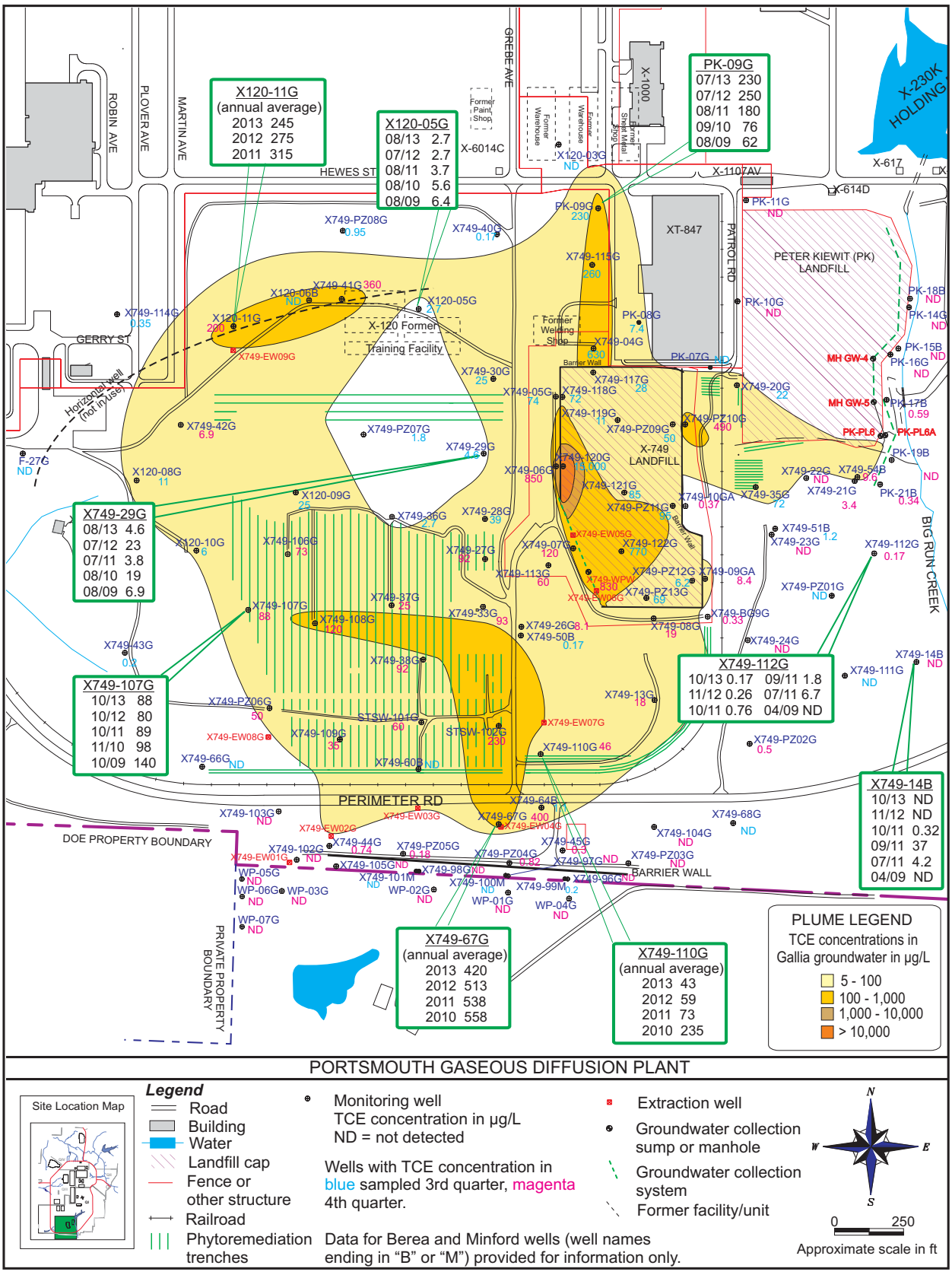

Figure 6.2. TCE-contaminated Gallia groundwater plume at the X-749/X-120/PK Landfill – 2013.

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.

Groundwater extraction wells X749-EW07G and X749-EW09G were installed in 2010 to remediate areas of higher TCE concentrations south of the X-749 Landfill and near the former X-120 facility, respectively. 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 2013 in well X749-67G (420 µg/L) has decreased from the average annual concentrations detected in 2012 (513 µg/L), 2011 (538 µg/L), and 2010 (558 µg/L). The average concentration of TCE detected in 2013 in well X749-110G (43 µg/L) has decreased from the average annual concentrations detected in 2012 (59 µg/L), 2011 (73 µg/L), and 2010 (235 µg/L). These results indicate that extraction well X749-EW07G is functioning as intended to reduce concentrations of TCE in this area.

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 2013 in well X120-11G (245 µg/L) has decreased from the average annual concentrations detected in 2012 (275 µg/L) and 2011 (315 µg/L). 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.

In 2013, TCE was not detected above the preliminary remediation goal of 5 µg/L in any well downgradient of the X-749 South Barrier Wall area groundwater extraction wells. In addition, no VOCs were detected in any of the seven off-site monitoring wells.

Samples were collected semiannually in 2013 from wells X749-112G and X749-14B because TCE was detected at concentrations up to 37 µg/L in wells X749-14B and 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. TCE was not detected in the second quarter sample collected from well X749-112G and detected at an estimated concentration of 0.17 µg/L in the fourth quarter sample. In well X749-14B, TCE was detected at 1.2 µg/L in the second quarter sample and was not detected in the fourth quarter sample. The concentrations of TCE detected in wells X749-112G and X749-14B in 2013 are typical for these wells.

Samples from selected wells that monitor the X-749/X-120 groundwater plume were analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and/or uranium-238). If detected, radionuclides were present 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).

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 also contaminated with low levels of VOCs. Most of the detections of VOCs in the PK Landfill monitoring wells are below preliminary remediation goals. In 2013, vinyl chloride was detected in samples collected from wells PK-17B and PK-21B at concentrations ranging from 14 to 17 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.

6.4.2 Quadrant I Groundwater Investigative (5-Unit) Area/X-749A Classified Materials Disposal Facility

In the northern portion of Quadrant I, groundwater concerns are focused on two areas: the Quadrant I Groundwater Investigative (5-Unit) Area and the X-749A Classified Materials Disposal Facility. The Quadrant I Groundwater Investigative (5-Unit) Area contains a number of buildings and other areas that are contaminant sources to the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume. The X-749A Classified Materials Disposal Facility, a closed landfill, is located at the eastern edge of the Quadrant I Groundwater Investigative (5-Unit) Area groundwater plume, but is not a source of contaminants detected in the plume.

6.4.2.1 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: the X-231A and X-231B Oil Biodegradation Plots, X-600 Steam Plant Complex, X-600A Coal Pile Yard, X-621 Coal Pile Runoff Treatment Facility, X-710 Technical Services Building, the X-760 Pilot Investigation Building, and the X-770 Mechanical Testing Facility. The X-231B Southwest Oil Biodegradation Plot was monitored prior to implementation of the *Integrated Groundwater Monitoring Plan*.

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

Thirty-one wells were sampled in 2013 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.

6.4.2.2 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 a source of contaminants detected in the plume.

Ten wells associated with the landfill were sampled in 2013. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.2.3 Monitoring results for the Quadrant I Groundwater Investigative (5-Unit) Area/X-749A in 2013

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 2013. However, the concentrations of TCE detected in wells X231B-07G (24 µg/L) and X231B-29G (5.2 µg/L), which are sampled biennially and monitor the western edge of the groundwater plume near the X-326 Process Building, have decreased since the wells were last sampled in 2011.

Samples from selected wells that monitor the Quadrant I Groundwater Investigative (5-Unit) Area/ X-749A Landfill were analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and/or uranium-238). If detected, radionuclides were present at levels below Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium).

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. The results for alkalinity, ammonia, calcium, chloride, iron, nitrate/nitrite, sodium, and sulfate did not require notification to Ohio EPA in 2013.

6.4.3 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 sampled annually or biennially as part of the routine monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

In 2013, some of the wells that provide routine monitoring of the Quadrant II Groundwater Investigative (7-Unit) Area were also monitored monthly from January through September as part of the IRM taking place in this area (see Chapter 3, Section 3.3.2.1). The *2013 Groundwater Monitoring Report for the*

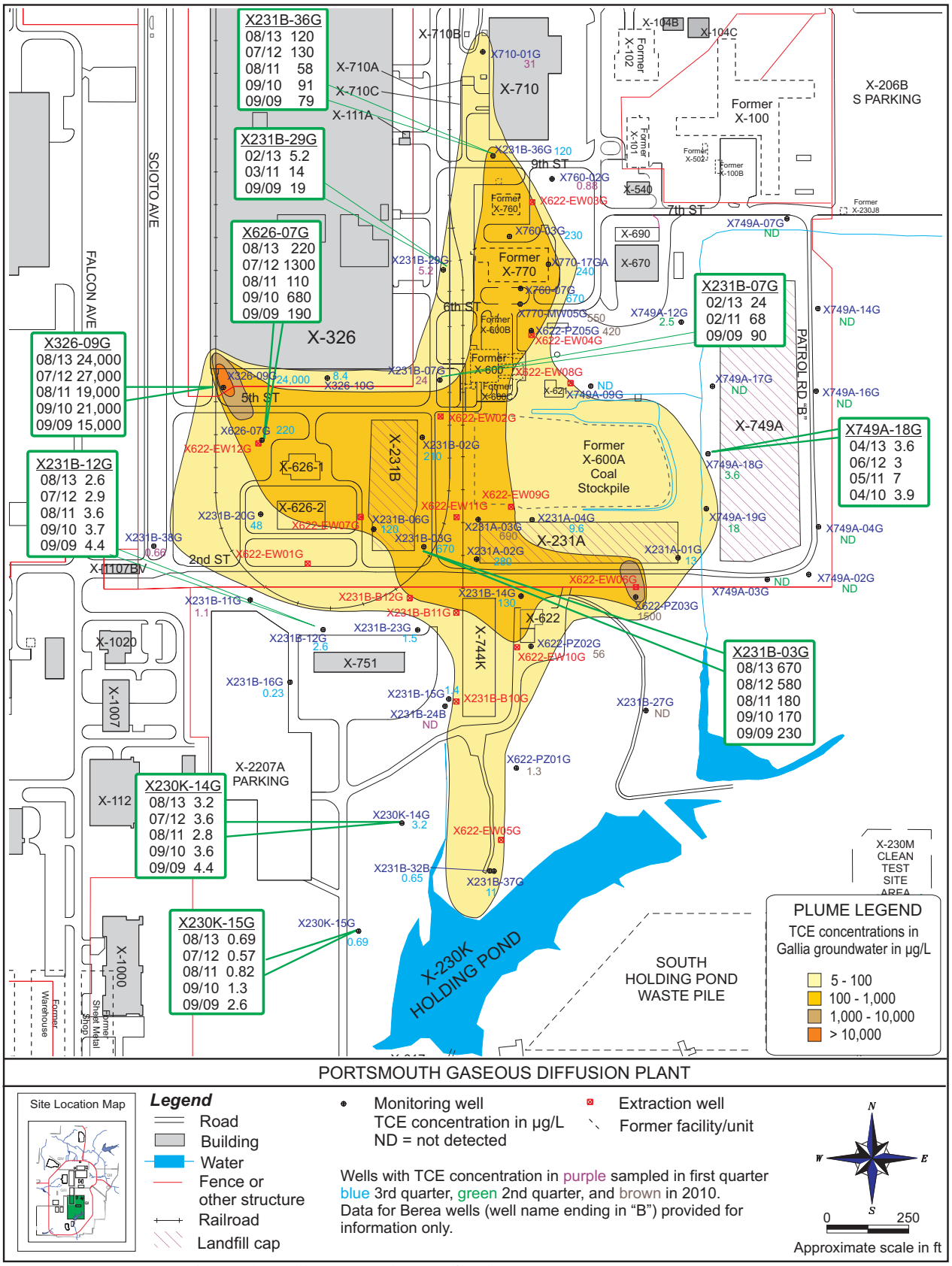

Figure 6.3. TCE-contaminated Gallia groundwater plume at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013.

Portsmouth Gaseous Diffusion Plant includes the monthly monitoring data collected to support the IRM in this area.

6.4.3.1 Monitoring results for the Quadrant II Groundwater Investigative (7-Unit) Area in 2013
A contaminated groundwater plume consisting primarily of TCE is associated with the Quadrant II Groundwater Investigative (7-Unit) Area (see Figure 6.4).

Wells at the eastern or southeastern boundary of the monitoring area, X700-03G, X701-26G, and X701-27G, were sampled monthly through September 2013 during the IRM to monitor movement of the east side of the Quadrant II Groundwater Investigative (7-Unit) Area plume towards the X-701B Holding Pond Area. TCE was not detected in any of the samples collected from well X700-03G. Concentrations of TCE detected in well X701-27G averaged 5.9 µg/L and ranged between 4 and 8.5 µg/L. These results are similar to the sample results for well X701-27G in 2012. Concentrations of TCE detected in well X701-26G averaged 2.4 µg/L and ranged between 0.83 and 4.8 µg/L. Concentrations of TCE have decreased in well X701-26G compared to 2012.

In the southeastern portion of the plume, TCE concentrations have decreased in well X720-01G.

Concentrations of TCE detected in the western portion of the plume were stable in 2013.

Samples from selected wells that monitor the Quadrant II Groundwater Investigative (7-Unit) Area were analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and/or uranium-238). If detected, radionuclides were present at levels below Ohio EPA drinking water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium).

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

The X-701B Holding Pond was used from the beginning of plant operations in 1954 until 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 Holding Pond. The X-744Y Waste Storage Yard is south of the X-701B Holding Pond. The yard is approximately 15 acres and surrounds the X-744G Bulk Storage Building. RCRA hazardous waste was managed in this area.

A contaminated groundwater plume extends from the X-701B Holding Pond towards Little Beaver Creek. Three groundwater extraction wells were installed in 1993 southeast of the X-701B 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.

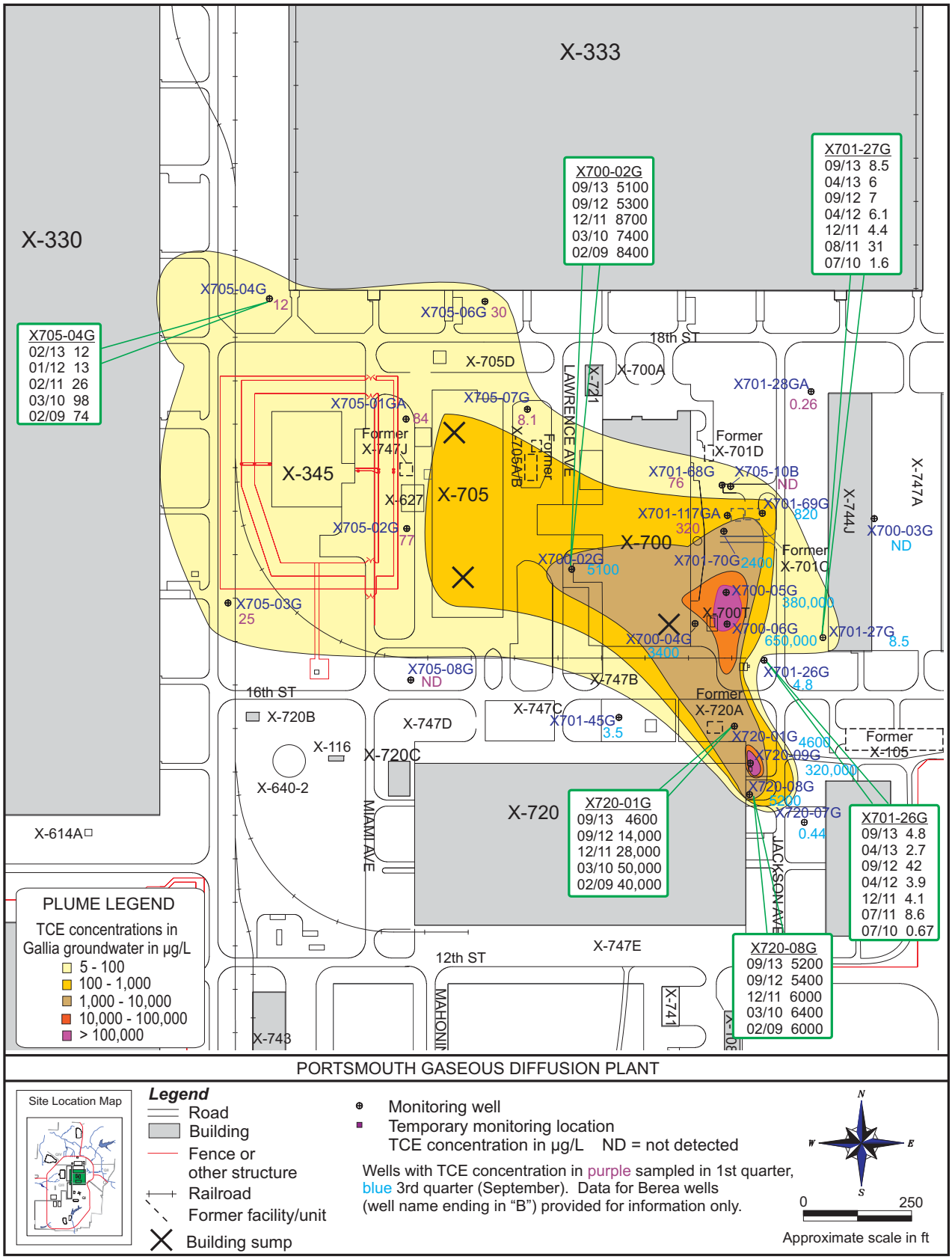

Figure 6.4. TCE-contaminated Gallia groundwater plume at the Quadrant II Groundwater Investigative (7-Unit) Area – 2013.

Groundwater remediation in the X-701B Holding Pond Area was initiated in 2006 (see Chapter 3, Section 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 6.5 shows the IRM area.

Fifty-three wells were sampled in 2013 as part of the routine monitoring program for the X-701B Holding Pond. Table 6.1 lists the analytical parameters for the wells that are part of the *Integrated Groundwater Monitoring Plan*.

Additional surface water locations were sampled in 2013 to provide supplemental information about TCE concentrations in surface water near the X-701B Holding Pond area associated with the X-237 Groundwater Collection System in 2012. The *2013 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.

6.4.4.1 Monitoring results for the X-701B Holding Pond in 2013

In general, concentrations of TCE detected in wells within the X-701B plume in 2013 were similar to previous years. However, concentrations of TCE more than doubled in wells X701-BW2G and X701-130G that monitor the western portion of the plume, west of the IRM area.

In the third quarter, the concentration of TCE increased to 69 µg/L in well X701-01G, which is one of the wells that defines the small plume south of the X-744G Building. The TCE concentrations in the wells that define the plume near the X-744G Building have rebounded since the completion of the IRM in 2011 to concentrations similar to detected in 2009 prior to the IRM (see Figure 6.5).

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 and/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.

Samples from five wells in or 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.

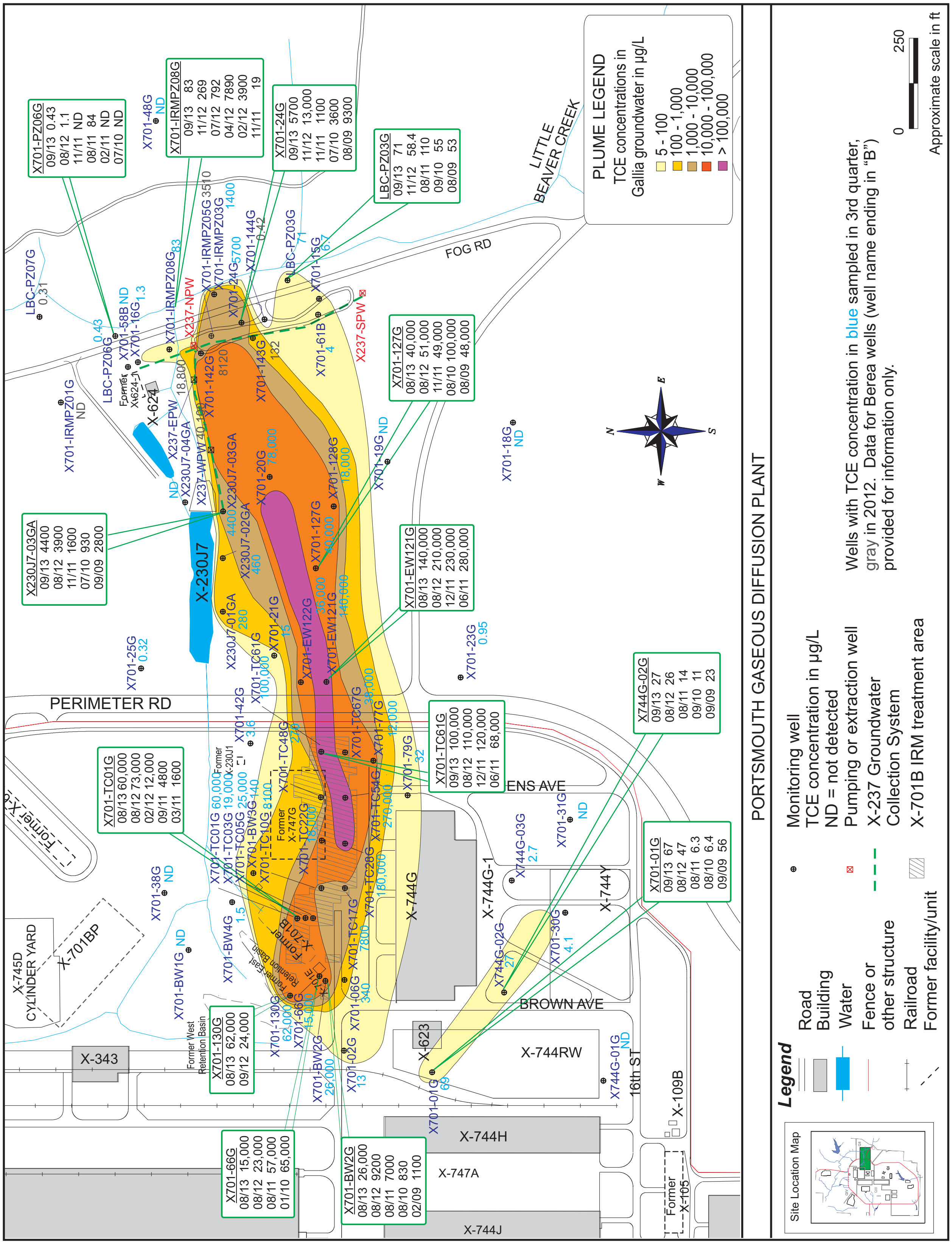

Figure 6.5. TCE-contaminated Gallia groundwater plume at the X-701B Holding Pond – 2013.

6.4.5 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.

6.4.5.1 Monitoring results for the X-633 Former Recirculating Cooling Water Complex in 2013

Chromium was detected in both of the X-633 monitoring wells in 2013. Samples collected from well X633-07G contained chromium at concentrations above the preliminary remediation goal of 100 µg/L: 640 µg/L (second quarter) and 880 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.

6.4.6 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. Nine wells are sampled annually and seven wells are sampled biennially as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

6.4.6.1 Monitoring results for the X-616 Former Chromium Sludge Surface Impoundments in 2013

Chromium is of special concern at X-616 because of the previous use of the area. In 2013, 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.

In February 2013, TCE was detected near or above the preliminary remediation goal (5 µg/L) in several wells, including three wells that do not typically contain TCE above 5 µg/L. However, TCE was also detected at 11 µg/L in the trip blank associated with these samples, which indicates that the TCE detected in the well samples could have resulted from sample contamination. Therefore, the wells were sampled again in March 2013. TCE was not detected in the samples collected from two of the three wells, which indicates the detections of TCE in the February 2013 samples from the wells were most likely the result of sample contamination. However, TCE was detected in the March 2013 sample collected from well X616-13G at 7.4 µg/L, which was similar to the February 2013 sample (7.2 µg/L). TCE has not been detected above the preliminary remediation goal (5 µg/L) in previous samples collected from well X616-13G. Figure 6.7 shows the concentrations of TCE detected in the X-616 wells in 2013.

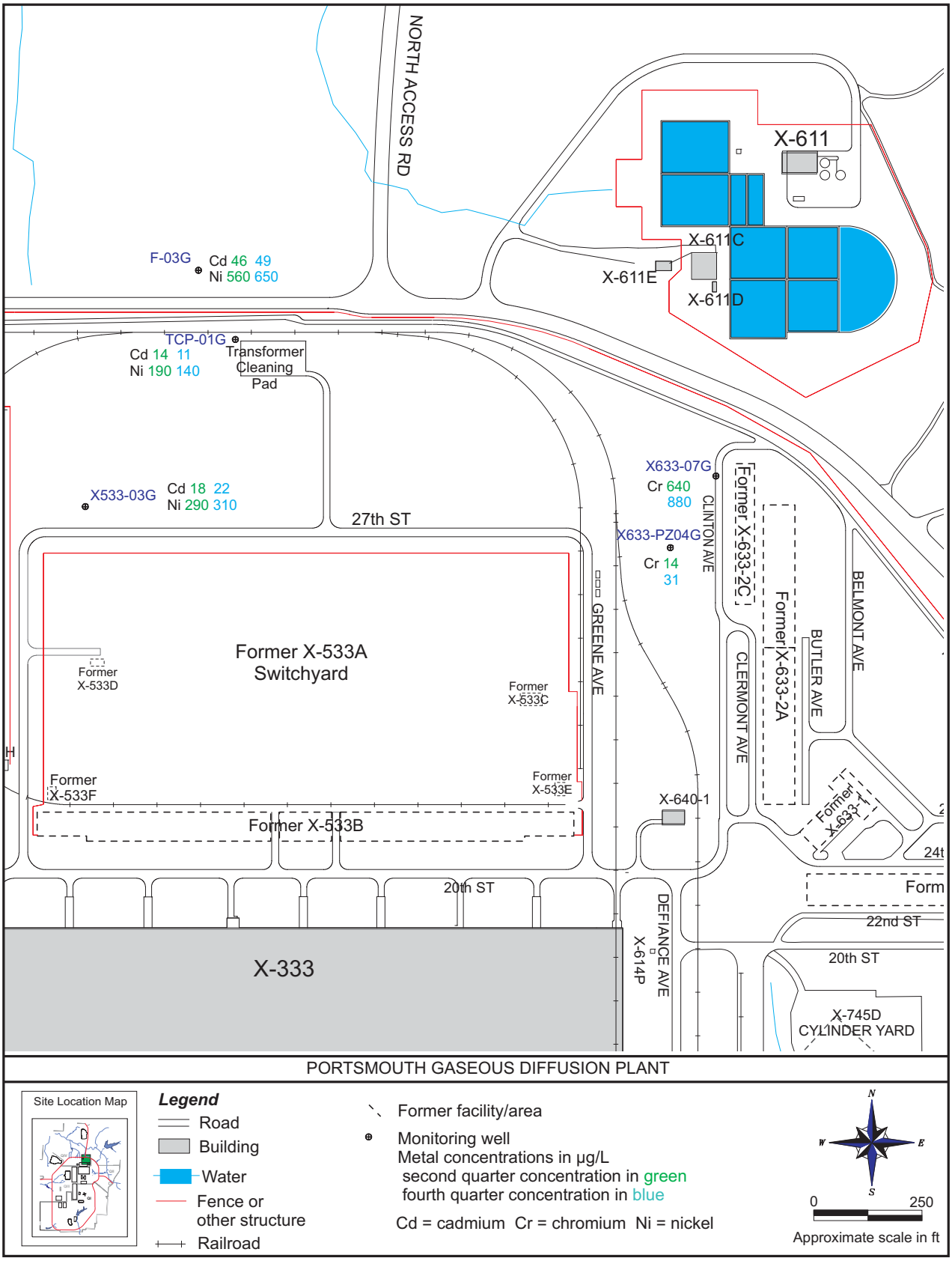

Figure 6.6. Metal concentrations in groundwater at the X-633 Former Recirculating Cooling Water Water Complex and X-533 Former Switchyard Complex – 2013.

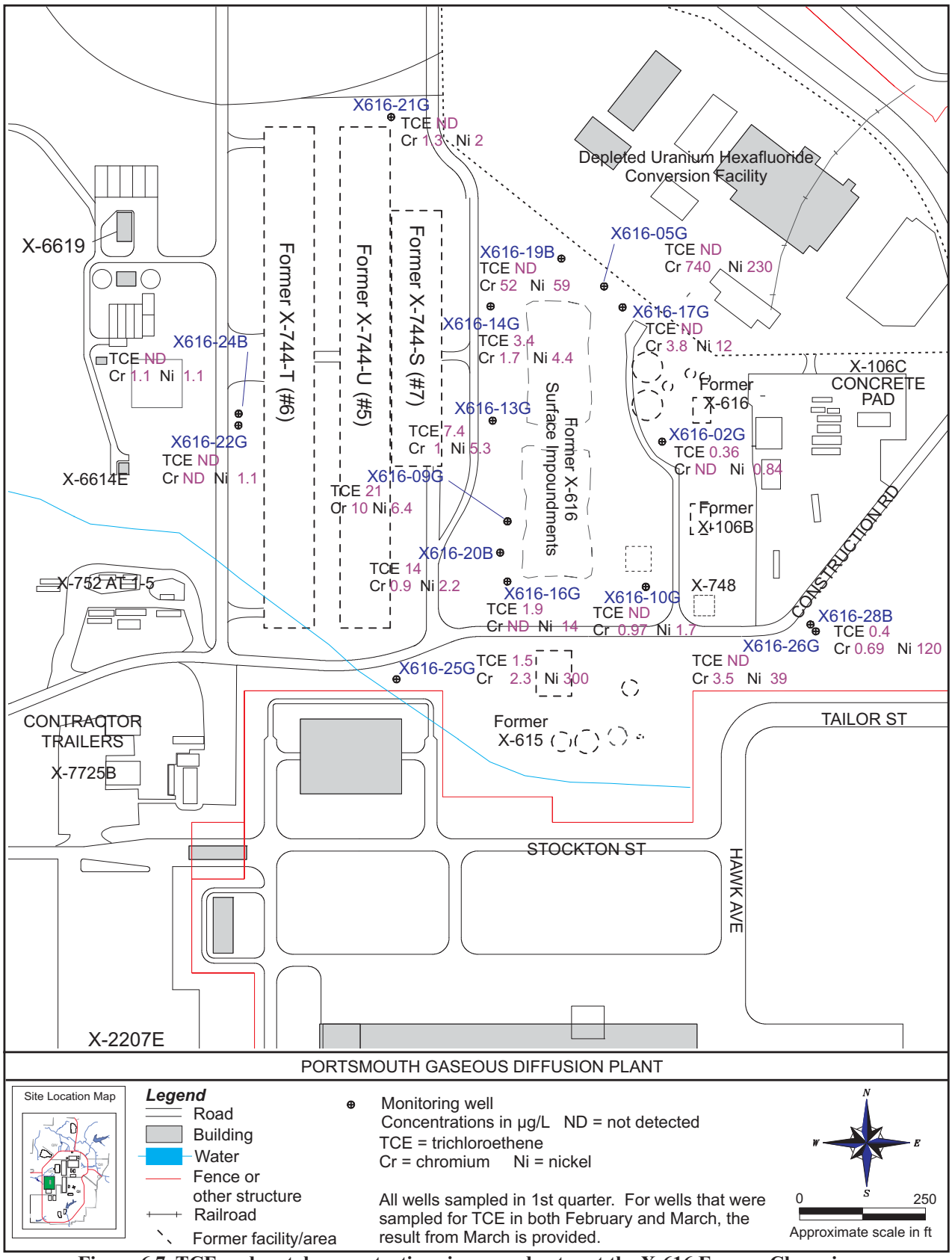

Figure 6.7. TCE and metal concentrations in groundwater at the X-616 Former Chromium Sludge Surface Impoundments – 2013.

6.4.7 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 began in 2010 and was completed in 2013. 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. However, monitoring of the area has continued in support of the pilot study underway in this area. Twelve monitoring wells were sampled quarterly in 2013, including six new monitoring wells installed for the pilot study.

6.4.7.1 Monitoring results for the X-740 Former Waste Oil Handling Facility in 2013

A contaminated groundwater plume consisting primarily of TCE is located near the X-740 Former Waste Oil Handling Facility (see Figure 6.8) in Quadrant III. Figure 6.8 shows the TCE groundwater plume in 2013 for the X-740 area and concentrations of TCE detected in 2010-2013 in two new wells that monitor the current pilot study (X740-18G and X740-22G). TCE has decreased to less than 5 µg/L in well X740-18G. TCE is also decreasing in well X740-22G, which is downgradient from the treatment area. TCE has decreased in well X740-03G from over 1000 µg/L (prior to the pilot study) to an average of 62 µg/L in 2013. Well X740-03G typically had the highest concentrations of TCE detected in the X-740 monitoring area.

6.4.8 X-611A Former Lime Sludge Lagoons

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

As part of the RCRA Corrective Action Program, a prairie habitat has been developed in this area by placing a soil cover over the north, middle, and south lagoons. A soil berm was also constructed outside the northern boundary of the north lagoon to facilitate shallow accumulation of water in this low-lying area. Chapter 3, Section 3.3.4.1, provides more information about this remediation. Six wells are sampled semiannually as part of the monitoring program for this area. Table 6.1 lists the analytical parameters for the wells in this area.

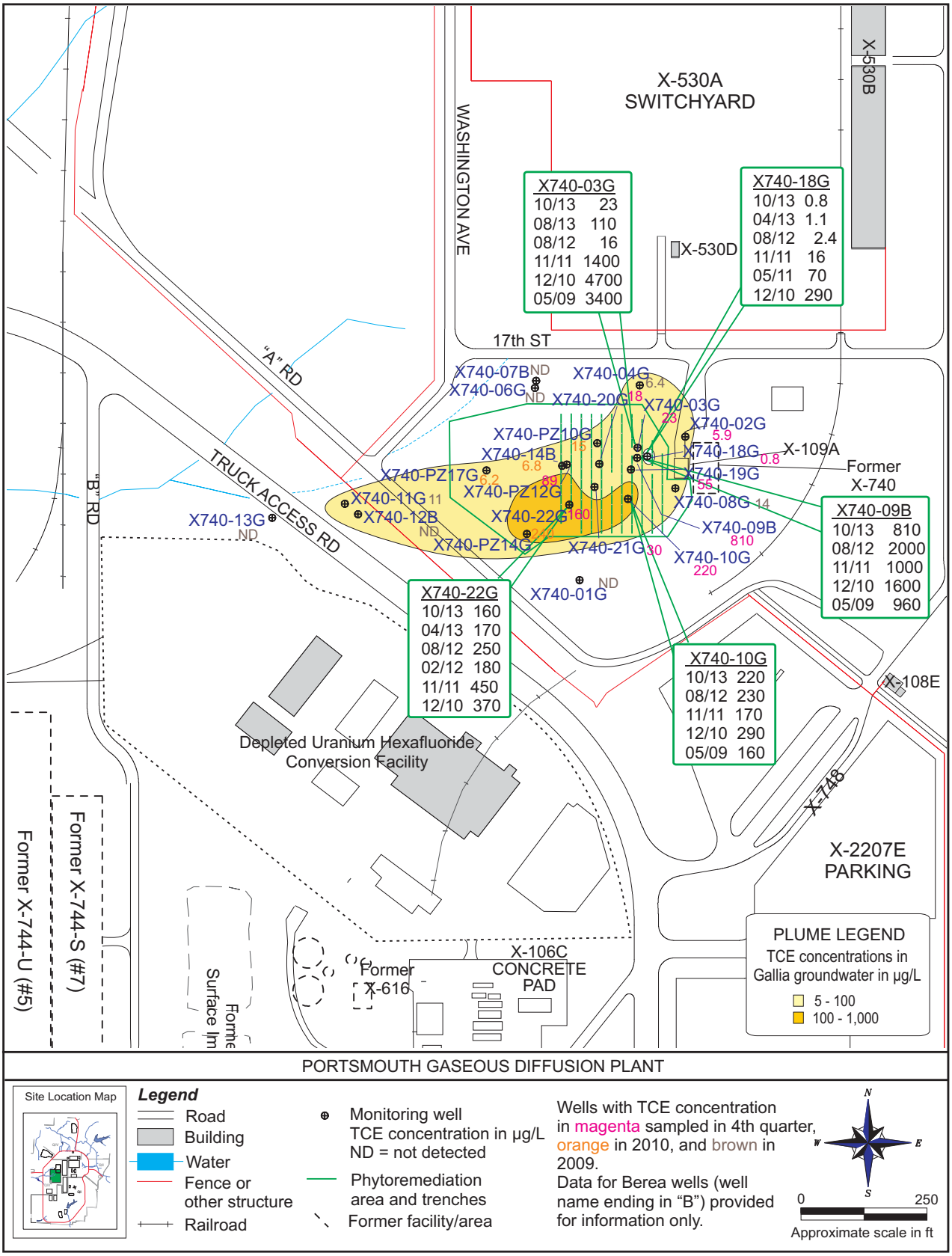

Figure 6.8. TCE-contaminated Gallia groundwater plume near the X-740 Former Waste Oil Handling Facility – 2013.

6.4.8.1 Monitoring results for the X-611A Former Lime Sludge Lagoons in 2013

The six monitoring wells at X-611A are sampled and analyzed for beryllium and chromium. In 2013, chromium was detected in the samples collected from four of the six wells in this area at concentrations between 1.3 and 57 µg/L, which are below the preliminary remediation goal (100 µg/L).

In 2013, beryllium was detected in each of the six wells in this area at concentrations of 1.5 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 2013.

6.4.9 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. In addition, the *Corrective Measures Plan for the X-735 Landfill* was approved by Ohio EPA in 2008. 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. Eighteen wells were sampled in 2013 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.

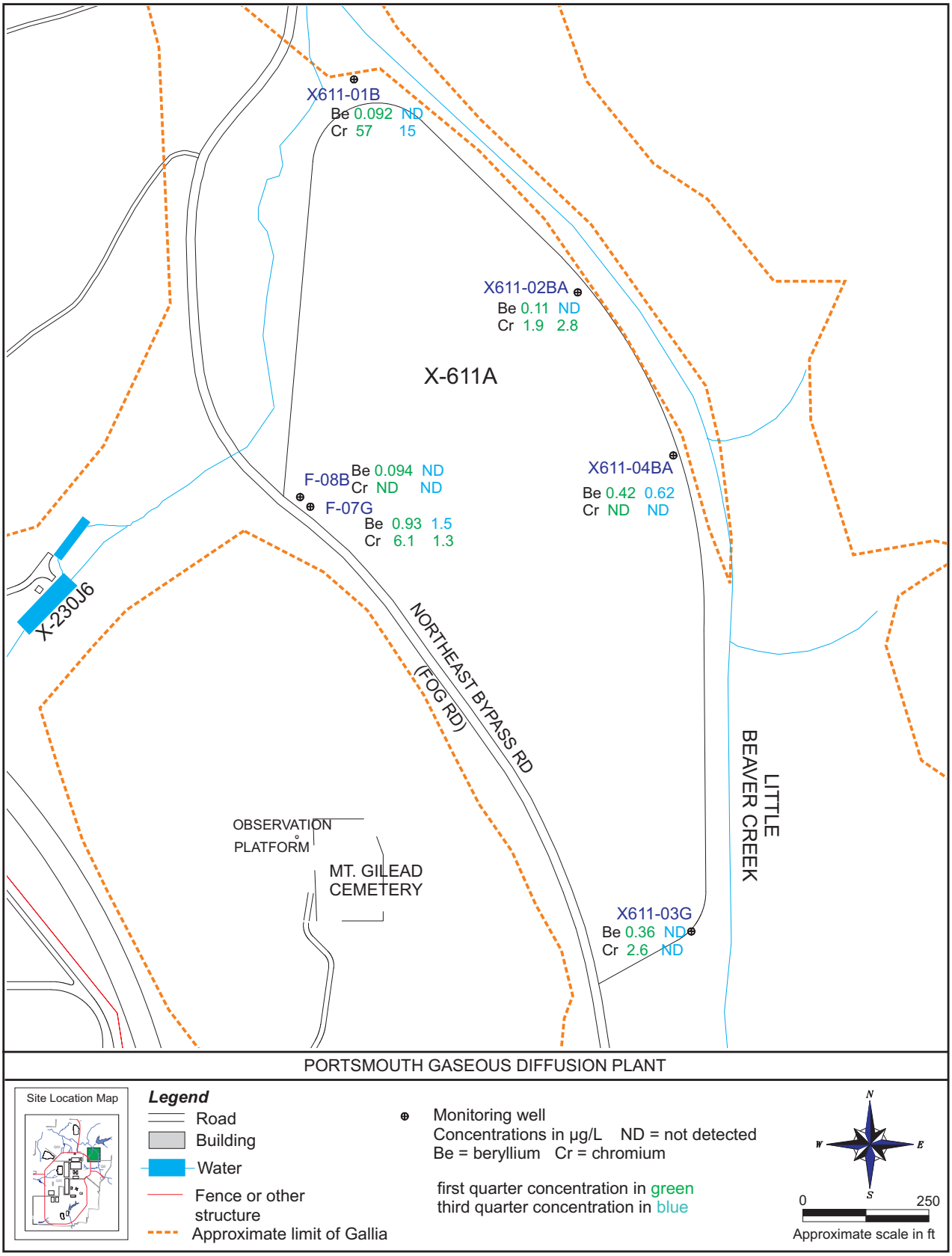

Figure 6.9. Metal concentrations in groundwater at the X-611A Former Lime Sludge Lagoons – 2013.

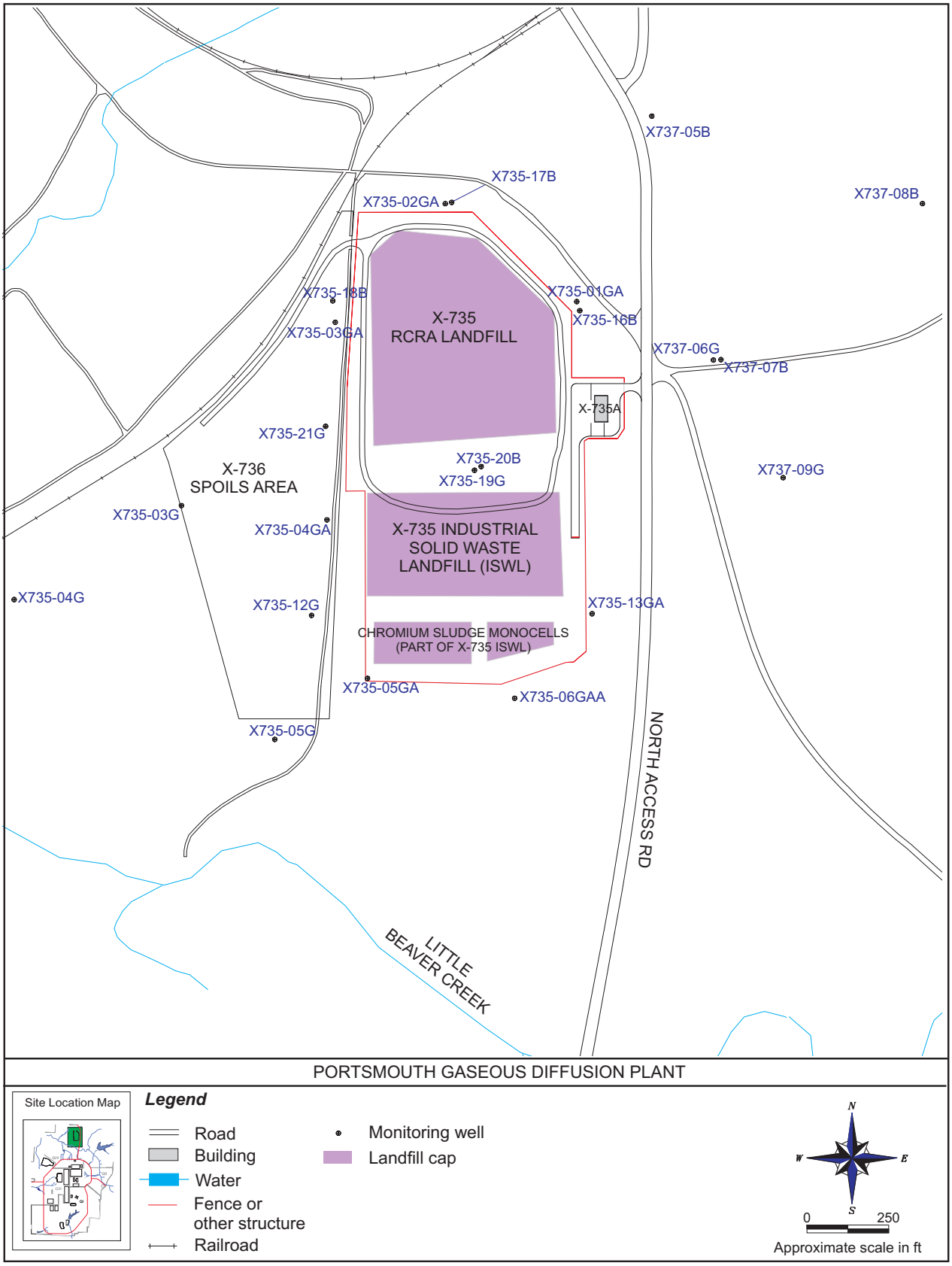

Figure 6.10. Monitoring wells at the X-735 Landfills.

6.4.9.1 Monitoring results for the X-735 Landfills in 2013

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 2013.

The detection monitoring program for X-735 Berea wells continued in 2013. 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 2013.

Samples from the 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).

6.4.10 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 organics, 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.

6.4.10.1 Monitoring results for the X-734 Landfills in 2013

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 2013, 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.

Samples from the X-734 monitoring wells were also analyzed for radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and uranium-238). If detected, radionuclides were present at levels below Ohio EPA drinking

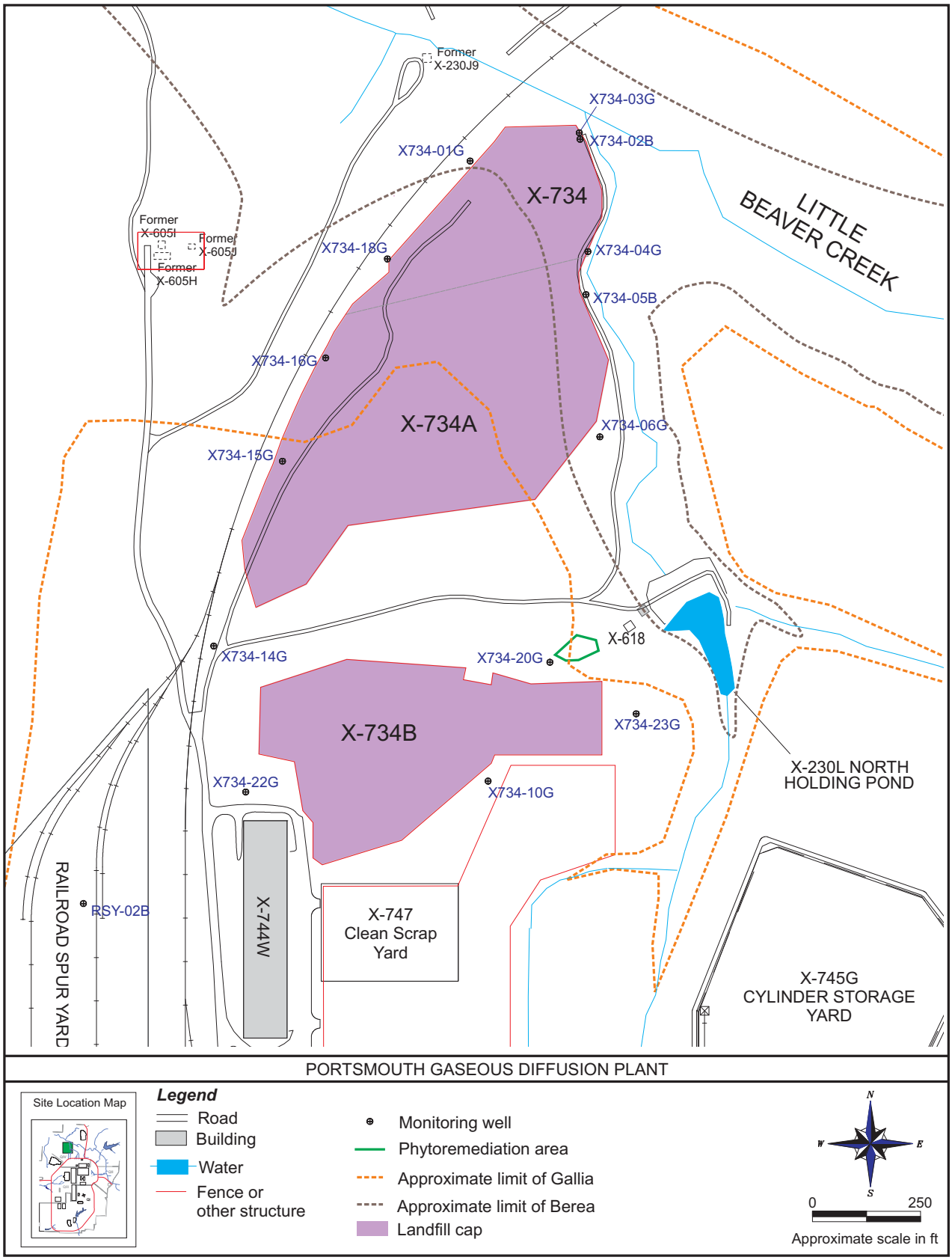

Figure 6.11. Monitoring wells at the X-734 Landfills.

water standards (900 pCi/L for technetium-99 based on a 4 mrem/year dose from beta emitters, and 30 µg/L for uranium).

6.4.11 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.

6.4.11.1 Monitoring results for the X-533 Former Switchyard Complex in 2013

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 2013 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 14 to 49 µg/L, and concentrations of nickel detected in the wells ranged from 140 to 650 µg/L. Figure 6.6 shows the concentrations of metals detected in the X-533 wells in 2013.

6.4.12 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 applicable 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).

6.4.12.1 Monitoring results for the X-344C Former Hydrogen Fluoride Storage Building in 2013

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 2013 at low concentrations of 2 µg/L or less, which are less than the preliminary remediation goals. These detections are consistent with the data collected at this well in 2009 through 2012.

6.4.13 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:

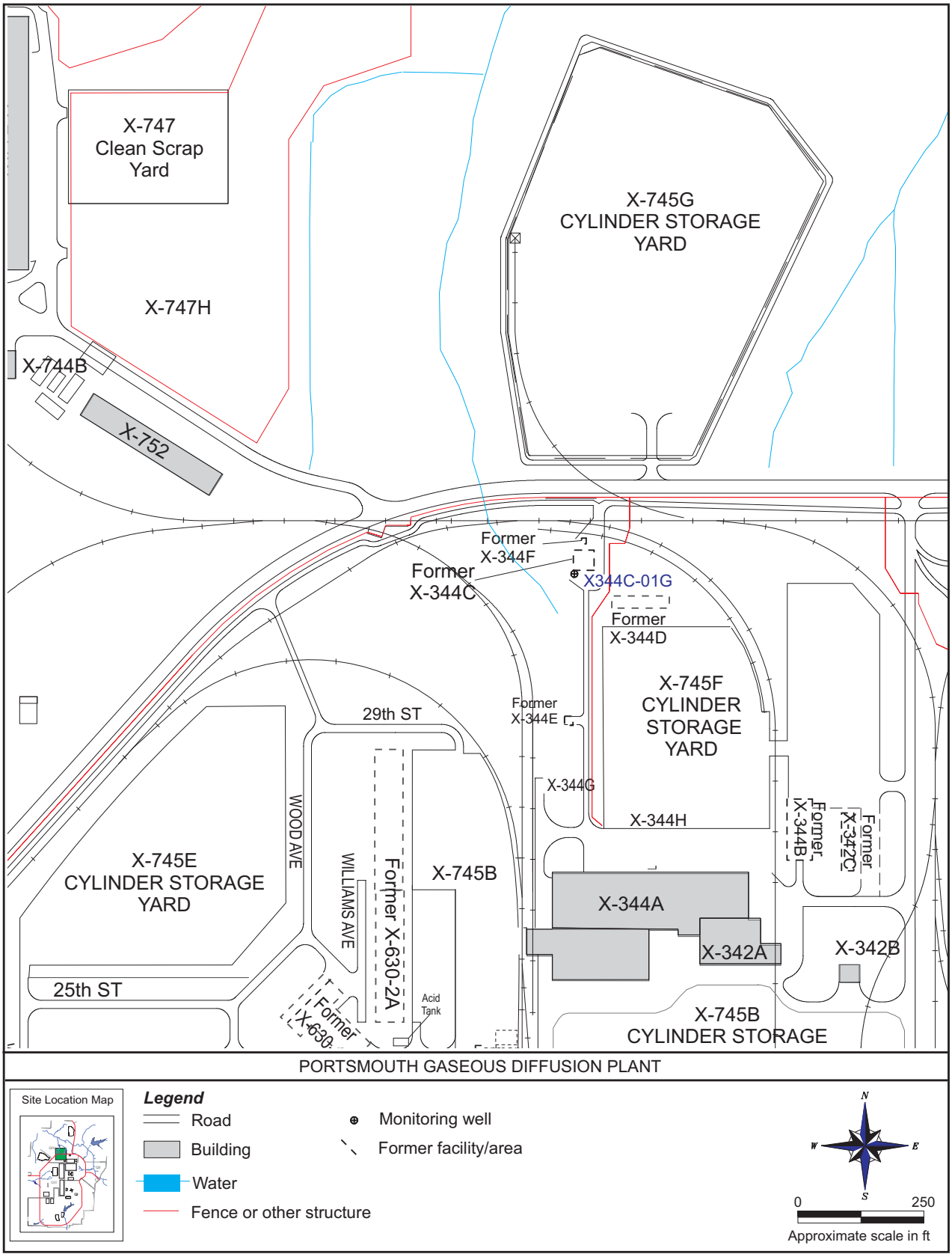

Figure 6.12. Monitoring well at the X-344C Former Hydrogen Fluoride Storage Building.

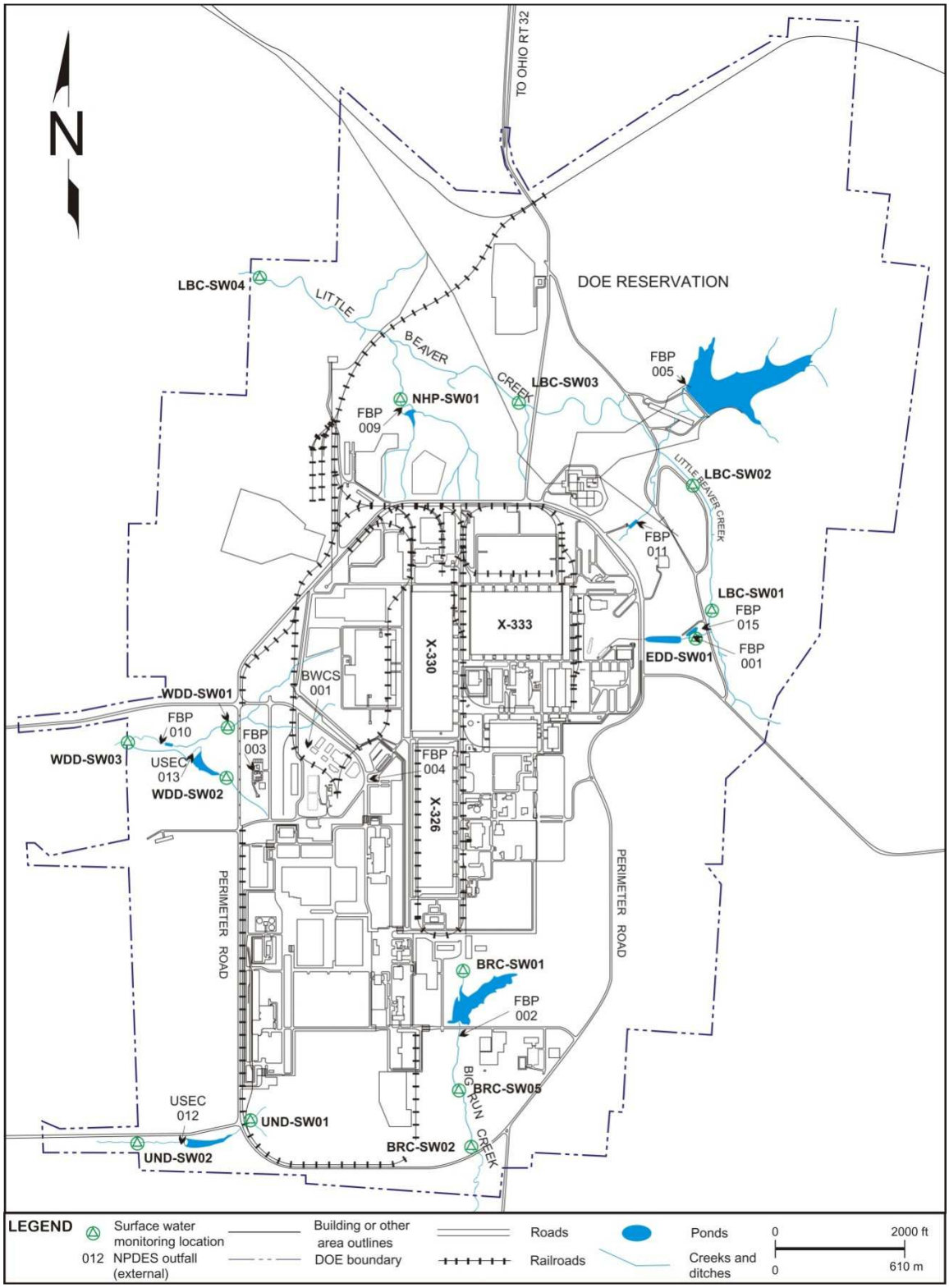

Figure 6.13. Surface water monitoring locations.

- Little Beaver Creek and East Drainage Ditch sample locations LBC-SW01, LBC-SW02, and EDD-SW01 assess possible X-701B area plume 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 and the X-749/X-120/PK Landfill area.

- 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.

6.4.13.1 Monitoring results for surface water in 2013

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 applicable Ohio EPA 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 2013, TCE was detected at 1.1 to 6.2 µg/L in each of the four samples collected from the Southwestern Drainage Ditch at UND-SW01. 1,1-Dichloroethene and *cis*-1,2-dichloroethene were also detected at estimated concentrations less than 0.55 µg/L in one or more of the samples. VOCs, including TCE, 1,1-dichloroethene 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 applicable Ohio EPA water quality criterion for TCE (810 µg/L) for the protection of human health in the Ohio River drainage basin.

TCE and *cis*-1,2-dichloroethene were routinely detected at concentrations of 1.7 µg/L or less in the samples collected from East Drainage Ditch sampling location EDD-SW01 and Little Beaver Creek sampling locations LBC-SW01 and LBC-SW02. TCE was also detected at an estimated concentration of

0.2 µg/L in the first quarter sample collected from Little Beaver Creek sampling location LBC-SW03. TCE and *cis*-1,2-dichloroethene were not detected in samples collected from downstream Little Beaver Creek sampling location LBC-SW04. The detections of TCE were well below the applicable Ohio EPA 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 2013 were analyzed for selected transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). No transuranics were detected in the surface water samples collected during 2013.

Technetium-99 was detected at levels ranging from 9.8 to 18.7 pCi/L in the first quarter 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 well below the Ohio EPA drinking water standard for technetium-99 (900 pCi/L, based on a 4 mrem/year dose from beta emitters). Technetium-99 was not detected in any of the other surface water samples collected during 2013.

Uranium was routinely detected in the 2013 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.

6.4.14 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.*

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).

One residential drinking water source was added to the program in the fourth quarter of 2013, therefore, seven residential drinking water sources participated in the program in 2013 (see Figure 6.14). Wells are sampled semiannually with samples analyzed for the parameters listed in Table 6.1. The PORTS water supply (RES-012 on Figure 6.14) is also sampled as part of this program. Sampling locations may be added or deleted if requested by a resident and as program requirements dictate. Typically, sampling locations are deleted when a resident obtains a public water supply.

In the first and third quarters of 2013, TCE was detected at estimated concentrations of 0.18 µg/L and 0.51 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.

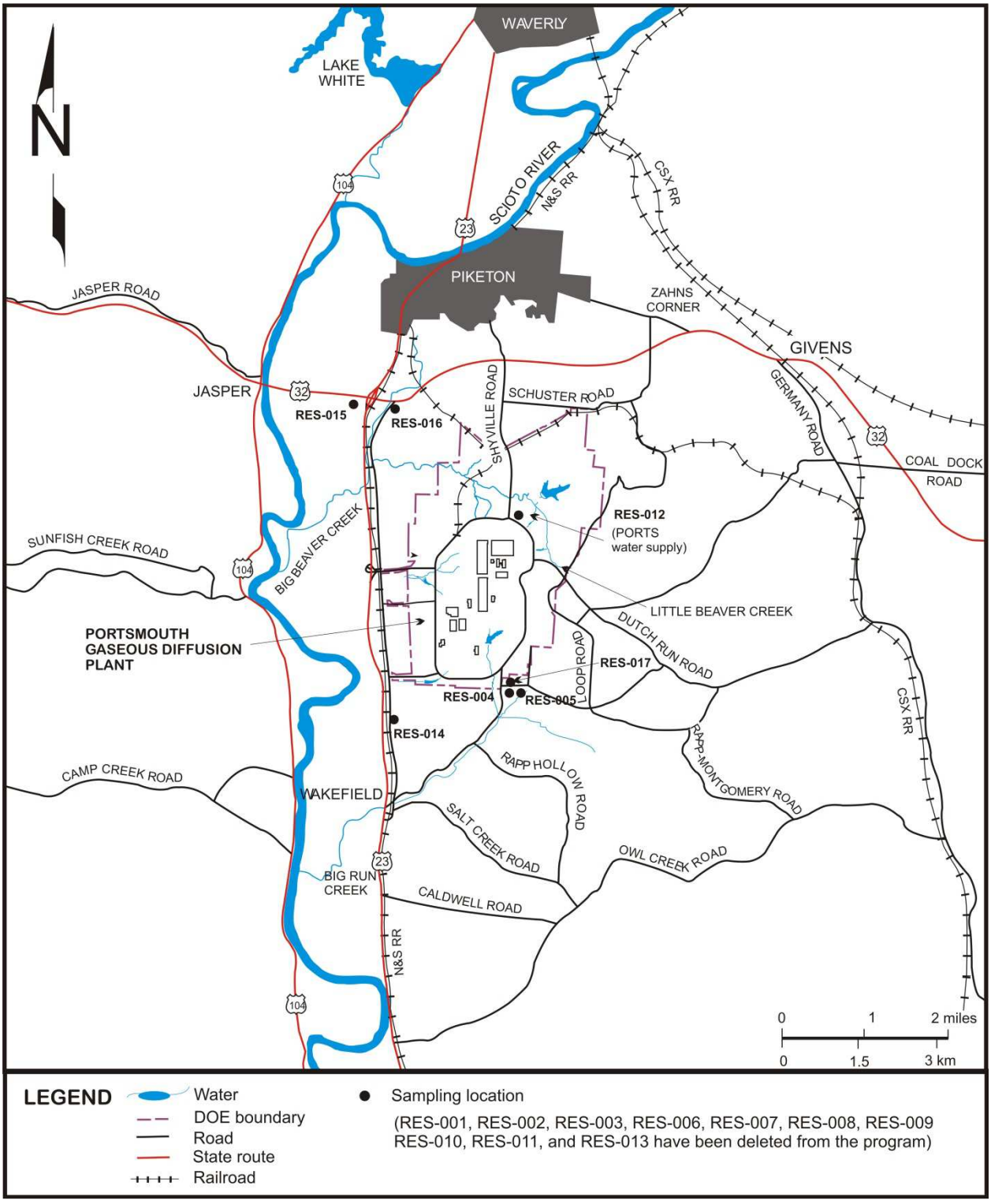

Figure 6.14. Water supply monitoring locations.

Chlorination byproducts called trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in treated drinking water, were detected in both the first and third quarter samples collected from residential sampling locations RES-004, RES-005, and RES-015. The total concentration of these trihalomethanes was less than the Ohio EPA drinking water standard (80 µg/L for total trihalomethanes).

Each sample was analyzed for transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). No transuranics or technetium-99 were detected in any of the water supply samples collected in 2013. 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. Trihalomethanes (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), which are common residuals in chlorinated drinking water, were detected in samples collected from the Western Drainage Ditch at concentrations well below Ohio EPA non-drinking water quality criteria for trihalomethanes for the protection of human health in the Ohio River drainage basin (see Section 6.4.13.1).

Technetium-99 was detected at 9.8 pCi/L in the first quarter sample collected at the surface water exit pathway monitoring location on Little Beaver Creek (LBC-SW04). This detection is well below the Ohio EPA drinking water standard for technetium-99 (900 pCi/L, based on a 4 mrem/year dose from beta emitters).

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/ X-120/PK Landfill area (see Section 6.4.1.3) at concentrations below the Ohio EPA drinking water standard for TCE (5 µg/L) and preliminary remediation goals.

The exit pathway monitoring wells were also sampled 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 exit pathway monitoring wells in 2013. 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.

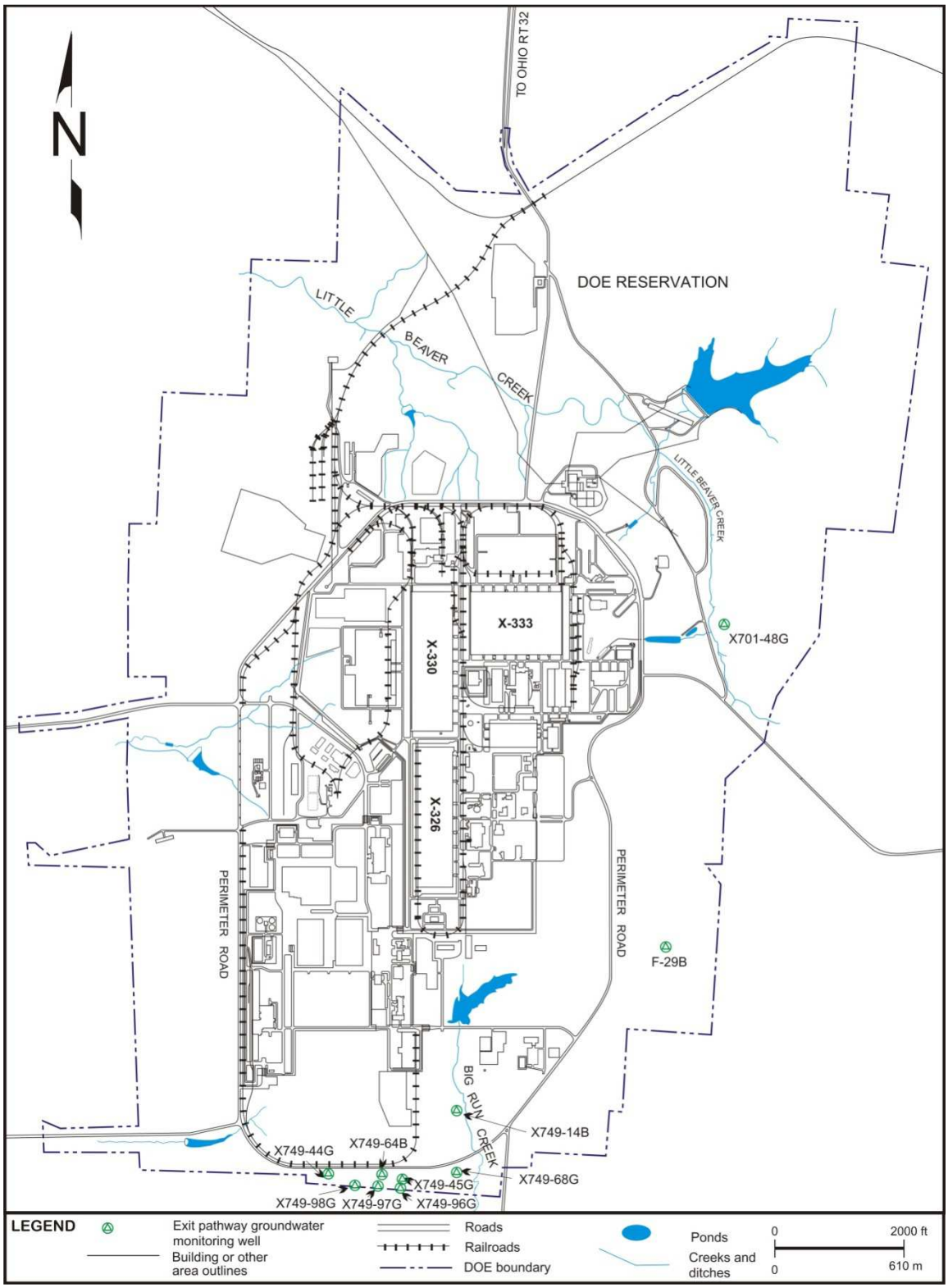

Figure 6.15. Exit pathway monitoring locations.

6.6 GROUNDWATER TREATMENT FACILITIES

In 2013, a combined total of approximately 30.5 million gallons of water were treated at the X-622, X-623, X-624, and X-627 Groundwater Treatment Facilities. Approximately 27 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 2013

Facility	Gallons of water treated	Gallons of TCE removed
X-622	17,079,200	2
X-623	101,700	0.03
X-624	2,972,620	10
X-627	10,349,300	15

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 2013, 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 2013.

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, the X-623 Groundwater Treatment Facility treated TCE-contaminated groundwater from a sump in the bottom of the X-701B 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 2013, 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 February, April, May, and September of 2013.

The facility treated 101,700 gallons of water during 2013, thereby removing approximately 0.03 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 2013.

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 almost 3 million gallons of water in 2013, thereby removing approximately 10 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 2013.

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 groundwater is extracted from sumps located in the basement of each building (see Figure 6.4).

Over 10 million gallons of groundwater were processed during 2013, thereby removing 15 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 2013.

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7. QUALITY ASSURANCE

7.1 SUMMARY

Quality assurance and quality control are essential components of DOE environmental monitoring programs at PORTS. Quality is integrated into sample preservation, field data and sample collection, sample transportation, 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 2013 participated in the DOE Consolidated Audit Program and Mixed-Analyte Performance Evaluation Program.

7.2 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 2013 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 2013, samples collected for DOE environmental monitoring programs at PORTS such as NPDES monitoring, groundwater monitoring required by the *Integrated Groundwater Monitoring Plan*, and environmental monitoring required by the *Environmental Monitoring Plan for the Portsmouth Gaseous Diffusion Plant*, 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.

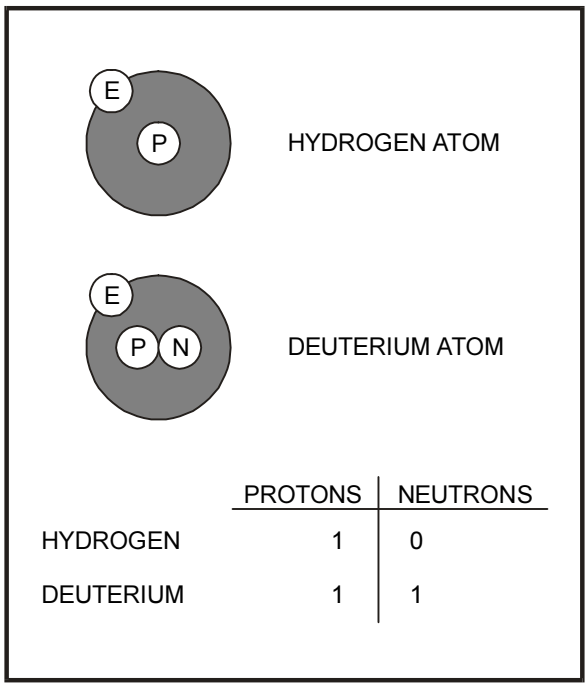

Figure A.1. Isotopes of the element hydrogen

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.

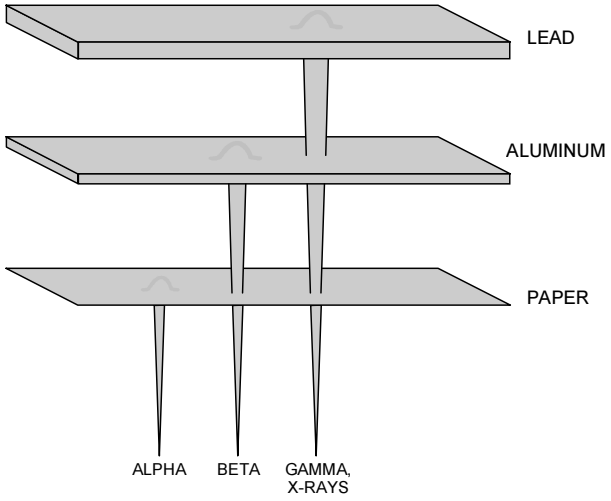

Figure A.2. Penetrating power of radiation.

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-235 (^{235}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.

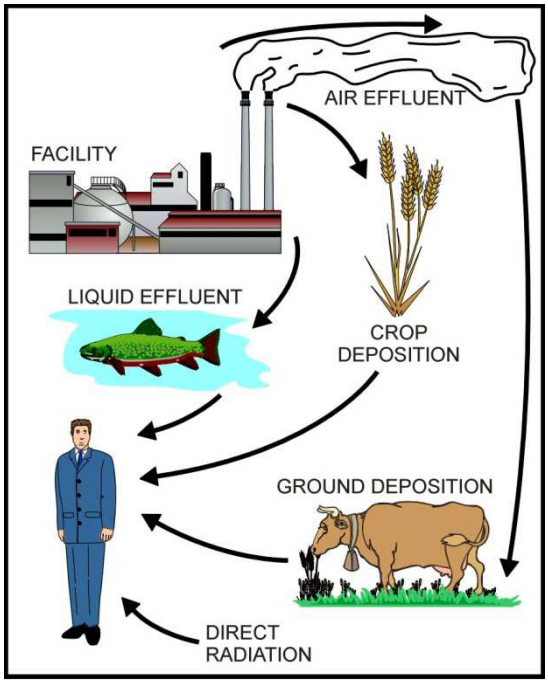

Figure A.3. Possible radiation pathways.

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:

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

- **committed dose** – The calculated total 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 dose is expressed in units of rem (or sievert).

- **committed effective dose** – The sum of the committed doses to various tissues in the body, each multiplied by an appropriate 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 weighting factor. The effective dose includes the committed effective doses from internal deposition of radionuclides and the effective doses attributable to sources external to the body.

- **collective dose/collective effective dose** – The sums of the doses or effective doses of all individuals in an exposed population expressed in units of person-rem (or person-sievert). When the collective dose of interest is for a specific organ, the units would be organ-rem (or organ-sievert). This dose is also called the population dose.

A.6 DOSE

Many terms are used to report dose. Several factors are taken into account, including the amount of radiation absorbed, the organ absorbing the radiation, and the effect of the radiation over a 50-year period. The term “dose” in this report includes the committed effective dose and effective dose attributable to penetrating radiation from sources external to the body.

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 2010a).

Table A.2. Comparison and description of various dose levels

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

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 isotope of potassium, ^{40}K; and isotopes 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 (0666000000)	P0090473	7/31/2003	8/21/2008	Extended
Title V Permit Renewal Application(0666005004)	P0109662	Draft 11/7/2013 Final 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*KD	9/1/2011	4/30/2013	Permit renewal submitted June 2012
Safe Drinking Water Act – License to Operate a Public Water System	OH6632414	1/1/2013	1/30/2014	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	NO_3
Nitrite	NO_2
Phosphorus	P
Phosphate	PO_4
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Sulfate	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).

DOE/PPPO/03-0598&D1

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U.S. Department of Energy

Portsmouth Gaseous Diffusion Plant

View from the X-710 Technical Services Building looking to the east at the Portsmouth Gaseous Diffusion Plant

Annual Site Environmental Data – 2013

December 2014

U.S. Department of Energy
Portsmouth Gaseous Diffusion Plant
Annual Site Environmental Data – 2013
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0599&D1

December 2014

By
Fluor-B&W Portsmouth LLC, under Contract DE-AC30-10CC40017

FBP-ER-PRO-WD-RPT-0033, Revision 2

This document has been approved for public release:

Henry H. Thomas	9/10/2014
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Samuel Eldridge	9/10/2014
Export Controlled Information Officer	Date

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TABLES

ACRONYMS AND ABBREVIATIONS

ACP	American Centrifuge Plant
BWCS	B&W Conversion Services, LLC
°C	degrees Celsius
Ci	curie
cm	centimeter
DOE	U.S. Department of Energy
DUF_6	depleted uranium hexafluoride
FBP	Fluor-B&W Portsmouth LLC
°F	degrees Fahrenheit
g	gram
GPD	gallons per day
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
USEC	United States Enrichment Corporation
VOC	volatile organic compound

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1. INTRODUCTION

Environmental monitoring at the 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 2013 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 – 2013* (DOE/PPPO/03-0598&D1).

Radiological monitoring data presented in this Data Report and discussed in the *Annual Environmental Report for 2013* indicate that the maximum dose a member of the public could receive from radionuclides released by PORTS in 2013 or detected by environmental monitoring programs in 2013 is 1.4 millirem (mrem). This dose is significantly less than the 100 mrem limit set by the U.S. Department of Energy (DOE).

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 – 2013* provides more information about non-radiological chemicals released from PORTS or detected by PORTS monitoring programs during 2013.

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2. ENVIRONMENTAL MONITORING

This section provides environmental monitoring data collected in 2013 by DOE contractors Fluor-B&W Portsmouth LLC (FBP) and B&W Conversion Services, LLC (BWCS). Data collected by USEC, Inc. 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 USEC, Inc. NPDES outfall water samples – 2013
- Table 2.2. FBP and BWCS NPDES permit summaries – 2013
- Table 2.3. FBP NPDES discharge and compliance rates – 2013
- Table 2.4. BWCS NPDES discharge and compliance rates – 2013
- Table 2.5. USEC, Inc. NPDES discharge monitoring results – 2013
- Table 2.6. Radionuclides in surface water runoff samples from BWCS cylinder storage yards – 2013
- Table 2.7. Drainage basin monitoring of surface water and sediment for BWCS cylinder storage yards – 2013
- Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2013
- Table 2.9. Environmental radiation monitoring program (mrem) – 2013
- Table 2.10. Environmental radiation monitoring (mrem) at locations near cylinder storage yards – 2013
- Table 2.11. Settleable solids monitoring results – 2013
- Table 2.12. Local surface water monitoring program results – 2013
- Table 2.13. Sediment monitoring program results – 2013
- Table 2.14. Soil and vegetation monitoring at ambient air monitoring stations – 2013
- Table 2.15. Biota (fish) monitoring program results – 2013
- Table 2.16. Biota (crops) monitoring program results – 2013
- Table 2.17. Off-site dairy monitoring – 2013.

Table 2.1. Radionuclide concentrations in FBP and USEC, Inc. NPDES outfall water samples – 2013

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
001	Americium-241	4(4)	0	< 0.0115	
	Neptunium-237	4(4)	0	< 0.00772	
	Plutonium-238	4(4)	0	< 0.007683	
	Plutonium-239/240	4(4)	0	< 0.006866	
	Technetium-99	22(9)	0	42.3	
	Uranium	22(1)	< 0.1563	2.424	
	Uranium-233/234	12(0)	0.4595	3.715	1.605
	Uranium-235/236	12(5)	0	0.1653	
	Uranium-238	12(1)	< 0.04941	0.6832	0.2958
002	Americium-241	4(4)	0	< 0.01099	
	Neptunium-237	4(4)	0	0	
	Plutonium-238	4(4)	< 0.006288	< 0.0292	
	Plutonium-239/240	4(4)	0	< 0.0146	
	Technetium-99	22(22)	0	< 5.98	
	Uranium	22(1)	0.3952	1.376	0.8706
	Uranium-233/234	12(0)	0.3509	0.9983	0.7075
	Uranium-235/236	12(9)	< 0.01022	0.09752	
	Uranium-238	12(0)	0.1317	0.4562	0.2505
003	Americium-241	4(4)	0	< 0.00004238	
	Neptunium-237	4(4)	0	< 0.00738	
	Plutonium-238	4(4)	0	< 0.00736	
	Plutonium-239/240	4(4)	0	< 0.02206	
	Technetium-99	22(0)	55.4	140	103
	Uranium	22(0)	0.8957	8.99	3.586
	Uranium-233/234	12(0)	1.042	10.01	3.953
	Uranium-235/236	12(2)	< 0.008949	0.4232	
	Uranium-238	12(0)	0.2966	2.104	0.8152
004	Americium-241	4(4)	0	< 0.02683	
	Neptunium-237	4(4)	0	< 0.00001556	
	Plutonium-238	4(4)	< 0.007764	< 0.02371	
	Plutonium-239/240	4(4)	0	< 0.007899	
	Technetium-99	22(22)	0	< 4.99	
	Uranium	22(3)	< 0.1571	0.4064	
	Uranium-233/234	12(2)	< 0.07405	0.2737	
	Uranium-235/236	12(12)	0	< 0.02384	
	Uranium-238	12(3)	< 0.05177	0.1366	
005	Technetium-99	4(4)	0	< 0.617	
	Uranium	4(2)	< 0.08398	0.2244	

Table 2.1. Radionuclide concentrations in FBP and USEC, Inc. NPDES outfall water samples – 2013 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
009	Americium-241	4(4)	< 0.008942	< 0.03923	
	Neptunium-237	4(4)	0	< 0.007686	
	Plutonium-238	4(4)	0	< 0.01443	
	Plutonium-239/240	4(4)	< 0.000007206	< 0.02295	
	Technetium-99	22(21)	0	9.06	
	Uranium	22(0)	1.632	7.784	4.794
	Uranium-233/234	12(0)	0.6163	3.253	2.018
	Uranium-235/236	12(2)	< 0.01877	0.1925	
	Uranium-238	12(0)	0.5467	2.602	1.598
010	Americium-241	4(4)	0	< 0.01747	
	Neptunium-237	4(4)	0	< 0.007373	
	Plutonium-238	4(4)	< 0.000007138	< 0.02941	
	Plutonium-239/240	4(4)	< 0.007144	< 0.0146	
	Technetium-99	22(22)	0	< 4.23	
	Uranium	22(0)	0.7646	3.353	2.138
	Uranium-233/234	12(0)	0.2922	1.64	0.8852
	Uranium-235/236	12(9)	< 0.008771	0.1387	
	Uranium-238	12(0)	0.2559	1.119	0.5620
011	Americium-241	4(4)	< 0.01048	< 0.01766	
	Neptunium-237	4(4)	0	0	
	Plutonium-238	4(4)	0	< 0.03262	
	Plutonium-239/240	4(4)	0	< 0.007671	
	Technetium-99	22(22)	0	< 3.7	
	Uranium	22(0)	0.8658	2.298	1.573
	Uranium-233/234	13(0)	0.3702	0.9307	0.6861
	Uranium-235/236	13(9)	0	0.07011	
	Uranium-238	13(0)	0.2892	0.7657	0.5100
015	Americium-241	4(4)	0	< 0.01125	
	Neptunium-237	4(4)	0	< 0.00001516	
	Plutonium-238	4(4)	0	< 0.01677	
	Plutonium-239/240	4(4)	0	< 0.008384	
	Technetium-99	12(7)	0	36	
	Uranium	12(0)	< 0.2672	1.613	1.084
	Uranium-233/234	12(0)	0.279	1.464	0.9396
	Uranium-235/236	12(7)	< 0.01115	0.08617	
	Uranium-238	12(0)	0.08829	0.5347	0.3601
608	Americium-241	4(4)	0	< 0.013	
	Neptunium-237	4(4)	0	< 0.01547	
	Plutonium-238	4(4)	0	< 0.02964	
	Plutonium-239/240	4(4)	0	< 0.01426	
	Technetium-99	12(0)	135	483	289
	Uranium	12(0)	0.1498	0.7345	0.4058
	Uranium-233/234	12(1)	< 0.0831	0.3804	0.1864
	Uranium-235/236	12(12)	0	< 0.06308	
	Uranium-238	12(0)	0.04607	0.246	0.1347

Table 2.1. Radionuclide concentrations in FBP and USEC, Inc. NPDES outfall water samples – 2013 (continued)

NPDES outfall[a]	Parameter[b]	Number of samples[c]	Minimum[d]	Maximum[d]	Average[e]
		FBP Outfalls			
610	Americium-241	5(5)	< 0.007866	< 0.0259	
	Neptunium-237	5(5)	0	< 0.007309	
	Plutonium-238	5(5)	0	< 0.01436	
	Plutonium-239/240	5(5)	< 0.000007282	< 0.01369	
	Technetium-99	8(0)	10.2	217	48.0
	Uranium	8(0)	0.423	7.963	3.299
	Uranium-233/234	8(0)	0.5847	11.18	4.691
	Uranium-235/236	8(1)	0	0.4797	0.1889
	Uranium-238	8(0)	0.1422	2.632	1.091
611	Americium-241	4(4)	< 0.009777	< 0.02697	
	Neptunium-237	4(4)	0	< 0.03013	
	Plutonium-238	4(4)	0	< 0.02762	
	Plutonium-239/240	4(4)	0	< 0.01503	
	Technetium-99	12(0)	477	877	740
	Uranium	12(0)	4.516	7.305	5.215
	Uranium-233/234	12(0)	4.448	11.23	5.852
	Uranium-235/236	12(0)	0.1847	0.5148	0.2671
	Uranium-238	12(0)	1.497	2.408	1.728
		USEC Outfalls			
012	Americium-241	4(4)	< 0.0274	< 0.099	
	Neptunium-237	4(4)	< 0.0204	< 0.135	
	Plutonium-238	4(4)	< 0.0204	< 0.069	
	Plutonium-239/240	4(4)	< 0.0204	< 0.089	
	Technetium-99	52(52)	< 5.67	< 9.28	
	Uranium	52(0)	0.53	1.9	1.18
013	Americium-241	4(4)	< 0.024	< 0.119	
	Neptunium-237	4(4)	< 0.0506	< 0.087	
	Plutonium-238	4(4)	< 0.02	< 0.053	
	Plutonium-239/240	4(4)	< 0.0186	< 0.067	
	Technetium-99	52(52)	< 5.65	< 9.31	
	Uranium	52(0)	0.26	2.02	1.01

[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 – 2013

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	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	mg/L	1/week	24-hr composite	20	45
FBP Outfall 003 (X-6619 Sewage Treatment Plant)					
Acute toxicity, *Ceriodaphnia dubia*	TUa	1/2months	24-hr composite		
Acute toxicity, *Pimephales promelas*	TUa	1/2months	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[b]	mg/L	Daily	Grab		0.038
Copper, total recoverable	µg/L	1/month	24-hr composite		
Fecal coliform[b]	#/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	1/2weeks	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 – 2013 (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	1/2months	24-hr composite		1
Acute toxicity, *Pimephales promelas*	TUa	1/2months	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	1/2weeks	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	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	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	1/2weeks	Grab		6.5–9.0
Precipitation, total	in	Daily	24-hr total		
Total suspended solids	mg/L	1/2weeks	24-hr composite	30	45
Zinc, total recoverable	µg/L	1/month	24-hr composite		

Table 2.2. FBP and BWCS NPDES permit summaries – 2013 (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	1/2weeks	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	1/2weeks	Grab	10	15
pH	SU	1/2weeks	Grab		6.5–9.0
Precipitation, total	in	Daily	24-hr total		
Total suspended solids	mg/L	1/2weeks	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		*c*
pH	SU	1/2weeks	Grab		6.5–9.0
Trichloroethene	µg/L	1/2weeks	Grab	10	10
FBP Outfall 602 (X-621 Coal Pile Runoff Treatment Facility)					
Flow rate	MGD	Daily	24-hr total (estimate)		
Iron, total	µg/L	1/2weeks	Grab	3500	7000
Manganese, total	µg/L	1/2weeks	Grab	2000	4000
pH	SU	1/2weeks	Grab		6.0–10.0
Precipitation, total	in	Daily	24-hr total		
Total suspended solids	mg/L	1/2weeks	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 – 2013 (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	1/2weeks	Grab		
1,2-*trans*-dichloroethene	µg/L	1/2weeks	Grab	25	66
Trichloroethene	µg/L	1/2weeks	Grab		10
FBP Outfall 610 (X-623 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2weeks	Grab		
1,2-*trans*-dichloroethene	µg/L	1/2weeks	Grab	25	66
Trichloroethene	µg/L	1/2weeks	Grab	10	10
FBP Outfall 611 (X-627 Groundwater Treatment Facility)					
Flow rate	MGD	Daily	24-hr total		
pH	SU	1/2weeks	Grab		
Trichloroethene	µg/L	1/2weeks	Grab	10	10
FBP Monitoring Station 902 (Downstream Far Field Monitoring)					
Water temperature	°C	2/week	24-hr maximum	*d*	*d*
FBP Monitoring Station 903 (Downstream Far Field Monitoring)					
Water temperature	°C	2/week	24-hr maximum	*d*	*d*
FBP Monitoring Station 801 (Upstream Monitoring)					
48-hr acute toxicity, *Ceriodaphnia dubia*	% affected	1/2months	Grab		
96-hr acute toxicity, *Pimephales promelas*	% affected	1/2months	Grab		

Table 2.2. FBP and BWCS NPDES permit summaries – 2013 (continued)

Effluent characteristics		Monitoring requirements		Discharge limitations	
Parameter	Units	Measurement frequency	Sampling type	Concentration/Loading[a]	
				Monthly	Daily
BWCS Outfall 001					
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	*d*	*d*

[a]If provided in the permit, the loading limit, in kg/day or kg/month, is provided in parentheses.
[b]Summer only (May through October).
[c]No detectable PCBs.
[d]Maximum daily and monthly average limits vary according to month.

Table 2.3. FBP NPDES discharge and compliance rates – 2013

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(11)	< 0.318	0.5		µg/L
Chlorine, total residual	-	48(34)	< 0.01	0.03		mg/L
Dissolved solids	-	48(0)	179	319	226	mg/L
Flow rate	-	365	0.091	2.846	0.944	MGD
Fluoride, total	-	12(0)	0.05	0.3	0.2	mg/L
Oil & grease	100	48(48)	< 5	< 5		mg/L
monthly average[d]	100	12	0	0		mg/L
pH	100	63	7.06	8.69	7.76	SU
Precipitation, total	-	365	0	1.88	0.108	in
Silver, total recoverable	-	12(10)	0.75	< 7.27		µg/L
Total suspended solids	100	48(31)	1	8.4		mg/L
monthly average[d]	100	12	0	4.8		mg/L
Zinc, total recoverable	-	12(1)	< 4.3	53.5	19.6	µg/L
Outfall 002 (X-230K South Holding Pond)						
Cadmium, total recoverable	-	15(15)	< 1	< 1		µg/L
Flow rate	-	363	0.001	2.635	0.446	MGD
Fluoride, total	-	12(0)	0.1	0.7	0.2	mg/L
Mercury, total	100	12(0)	0.821	3.93	1.94	ng/L
monthly average[d]	100	12	0.821	3.93	1.94	ng/L
Mercury, total (loading)	100	12	6.25E-07	7.64E-06	2.76E-06	kg/day
monthly average[d]	100	12	2.17E-05	2.80E-04	1.07E-04	kg/day
Oil & grease	100	48(48)	< 5	< 5		mg/L
monthly average[d]	-	12	0	0		mg/L
pH	100	49	6.67	8.66	7.59	SU
Silver, total recoverable	100	48(48)	< 1	< 1		µg/L
monthly average[d]	100	12	0	0		µg/L
Silver, total recoverable (loading)	100	48	0	0		kg/day
monthly average[d]	100	12	0	0		kg/day
Thallium, total recoverable	100	48(48)	< 1	< 1		µg/L
monthly average[d]	100	12	0	0		µg/L
Thallium, total recoverable (loading)	100	48	0	0		kg/day
monthly average[d]	100	12	0	0		kg/day
Total suspended solids	100	48(2)	< 2	25.8	7.8	mg/L
monthly average[d]	100	12	2.4	15.8	7.8	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	94	48(41)	2.5	21		mg/L
monthly average[d]	100	12	0	5.7		mg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2013 (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)	98	48	0	22.8		kg/day
monthly average[d]	100	12	0	6.8		kg/day
Chlorine, total residual[b]	99	105(78)	< 0.02	0.12		mg/L
Copper, total recoverable	-	12(11)	< 0.754	< 9.72		µg/L
Fecal coliform[b]	96	25(0)	5	2300	154	#/100 mL
monthly average[d]	100	6	11.3	472	140	#/100 mL
Flow rate	-	365	0.066	1.667	0.296	MGD
Mercury, total	-	13(0)	1.23	101	14.3	ng/L
Nitrogen, ammonia (NH_3)	-	24(7)	< 0.1	4.2		mg/L
Nitrite plus nitrate	-	12(1)	< 0.1	9.5	6.9	mg/L
Oil & grease	-	4(4)	< 5	< 5		mg/L
pH	100	205	6.55	7.91	7.20	SU
Silver, total recoverable	-	12(11)	< 1.34	< 7.27		µg/L
Total suspended solids	100	48(29)	1.1	5.2		mg/L
monthly average[d]	100	12	0	2.5		mg/L
Total suspended solids (loading)	100	48	0	6.2		kg/day
monthly average[d]	100	12	0	3.1		kg/day
Zinc, total recoverable	-	12(0)	13	75.7	31	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	100	48(39)	< 0.02	0.03		mg/L
Copper, total recoverable	-	12(0)	5.85	165	53.0	µg/L
Dissolved solids	100	12(0)	187	313.5	244	mg/L
monthly average[d]	100	12	187	313.5	244	mg/L
Dissolved solids (loading)	100	12	51	158	98	kg/day
monthly average[d]	100	12	52	151	106	kg/day
Flow rate	-	365	0.072	0.206	0.113	MGD
Mercury, total	-	12(1)	< 0.2	7.73	1.96	ng/L
Oil & grease	100	12(11)	< 5	5.2		mg/L
monthly average[d]	100	12	0	5.2		mg/L
pH	100	12	7.24	7.98	7.52	SU
Total suspended solids	100	12(3)	< 2	7.2		mg/L
monthly average[d]	100	12	0	7.2		mg/L
Total suspended solids (loading)	100	12	0	3.9		kg/day
monthly average[d]	100	12	0	3.7		kg/day
Zinc, total recoverable	-	12(0)	7.8	200.5	55.1	µg/L
Outfall 005 (X-611B Lime Sludge Lagoons)						
Flow rate	-	18	0.06732	2.1542	0.8231	MGD
pH	100	3	7.97	8.95	8.48	SU
Total suspended solids	100	3(0)	4.8	8.6	6.5	mg/L
monthly average[d]	100	1	6.5			mg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2013 (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(11)	< 0.318	0.4		µg/L
Flow rate	-	365	0.094	3.240	0.710	MGD
Fluoride, total	-	12(0)	0.1	0.2	0.2	mg/L
Oil & grease	100	12(12)	< 5	< 5		mg/L
monthly average[d]	100	12	0	0		mg/L
pH	100	192	6.75	8.81	7.67	SU
Precipitation, total	-	365	0	1.88	0.108	in
Total suspended solids	100	48(13)	< 2	115		mg/L
monthly average[d]	100	12	0.75	11.8		mg/L
Zinc, total recoverable	-	12(1)	< 1.7	19.1	11.3	µg/L
Outfall 010 (X-230J5 Northwest Holding Pond)						
Cadmium, total recoverable	-	12(8)	< 0.318	0.8		µg/L
Flow rate	-	365	0.1208	0.9212	0.448	MGD
Mercury, total	-	12(2)	< 0.2	3.44		ng/L
Oil & grease	100	12(12)	< 5	< 5		mg/L
monthly average[d]	100	12	0	0		mg/L
pH	100	27	7.21	8.67	7.78	SU
Precipitation, total	-	365	0	1.88	0.108	in
Total suspended solids	100	24(5)	< 2	50.6		mg/L
monthly average[d]	100	12	1.4	20.9		mg/L
Zinc, total recoverable	-	12(0)	10.2	62.2	30.8	µg/L
Outfall 011 (X-230J6 Northeast Holding Pond)						
Cadmium, total recoverable	-	12(10)	< 0.318	0.45		µg/L
Chlorine, total residual	-	24(18)	< 0.01	0.03		mg/L
Copper, total recoverable	-	12(10)	< 0.754	11.6		µg/L
Flow rate	-	365	0.000181	0.390	0.038	MGD
Fluoride, total	-	12(0)	0.2	0.3	0.2	mg/L
Oil & grease	100	24(24)	< 5	< 5		mg/L
monthly average[d]	100	12	0	0		mg/L
pH	100	35	7.27	8.66	7.88	SU
Precipitation, total	-	365	0	1.88	0.108	in
Total suspended solids	100	24(8)	< 2	15		mg/L
monthly average[d]	100	12	0	9		mg/L
Zinc, total recoverable	-	12(2)	< 1.7	27.2		µg/L
Outfall 015 (X-624 Groundwater Treatment Facility)						
Flow rate	-	360	0.0004	0.0379	0.0083	MGD
pH	100	25	6.98	7.92	7.54	SU
Trichloroethene	100	25(6)	< 0.3	6.41		µg/L
monthly average[d]	100	12	0.17	3.5		µg/L
PCBs	-	4(4)	< 0.096	< 0.52		µg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2013 (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	-	58	0	0.205	0.047	MGD
Iron, total	100	12(0)	121	1820	762	µg/L
monthly average[d]	100	10	121	1820	849	µg/L
Manganese, total	100	12(0)	61.7	458	204	µg/L
monthly average[d]	100	10	61.7	458	217	µg/L
pH	100	13	7.18	9.05	8.21	SU
Precipitation, total	-	344	0	1.74	0.11	in
Total suspended solids	100	13(0)	4.6	36.5	11.2	mg/L
monthly average[d]	100	10	4.6	22.2	10.6	mg/L
Outfall 604 (X-700 Biodenitrification Facility)						
Copper, total	-	5(2)	2.4	15.6		µg/L
Iron, total	-	5(0)	81	360	190	µg/L
Flow rate	-	44	0.00336	0.11114	0.031	MGD
Nickel, total	-	5(4)	0.9	< 1.82		µg/L
Nitrogen, nitrate	-	5(1)	< 0.1	29.7		mg/L
pH	100	5	6.94	7.85	7.52	SU
Zinc, total	-	5(2)	< 1	82.7		µg/L
Outfall 605 (X-705 Microfiltration Treatment System)						
Chromium, hexavalent	-	3(3)	< 0.02	< 0.02		µg/L
Chromium, total	-	3(3)	< 0.708	< 0.863		µg/L
Copper, total	-	3(1)	3.4	< 9.72		µg/L
Flow rate	-	20	0.0018	0.01142	0.006	MGD
Iron, total	-	3(3)	< 6.92	< 9.12		µg/L
Nickel, total	-	3(0)	2	6.5	4.5	µg/L
Nitrogen, ammonia (NH_3)	-	3(2)	< 0.1	0.1		mg/L
Nitrogen, nitrate	-	3(0)	0.22	11.8	5.6	mg/L
Nitrogen, nitrite	-	3(3)	< 0.1	< 0.1		mg/L
Nitrogen, Kjeldahl	-	3(0)	1.5	2.8	2.2	mg/L
Oil & grease	-	3(3)	< 5	< 5		mg/L
pH	100	3	7.07	7.97	7.56	SU
Sulfate (SO_4)	-	3(0)	57.2	63.9	61.1	mg/L
Total suspended solids	100	3(3)	< 2	< 2		mg/L
monthly average[d]	100	3	0	0		mg/L
Trichloroethene	-	3(3)	< 1	< 1		µg/L
Zinc, total	-	3(1)	< 1	3.8		µg/L
Outfall 608 (X-622 Groundwater Treatment Facility)						
Flow rate	-	361	0.0001	0.0725	0.047	MGD
pH	-	25	7.24	8.40	7.72	SU
Trichloroethene	100	25(0)	1.18	4.645	2.5	µg/L
1,2-*trans*-dichloroethene	100	25(25)	< 0.3	< 1		µg/L
monthly average[d]	100	12	0	0		µg/L
Outfall 610 (X-623 Groundwater Treatment Facility)						
Flow rate	-	13	0.00248	0.0176	0.008	MGD
pH	-	9	6.93	7.54	7.19	SU
Trichloroethene	100	9(9)	< 0.3	< 1		µg/L
monthly average[d]	100	8	0	0		µg/L
1,2-*trans*-dichloroethene	100	9(9)	< 0.3	< 1		µg/L
monthly average[d]	100	8	0	0		µg/L

Table 2.3. FBP NPDES discharge and compliance rates – 2013 (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	-	364	0.0027	0.048	0.027	MGD
pH	-	25	7.58	8.27	7.96	SU
Trichloroethene	100	25(0)	0.35	6.05	2.0	µg/L
monthly average[d]	100	12	0.48	4.6	2.1	µg/L
Monitoring Station 801 (Upstream Monitoring)						
48-hr acute toxicity, *Ceriodaphnia dubia*	-	6(6)	0	0		% affected
96-hr acute toxicity, *Pimephales promelas*	-	6(4)	0	45		% affected
Monitoring Station 902 (Downstream Far Field Monitoring)						
Water temperature	100	97	4	29	16	°C
monthly average	100	12	5	27	16	°C
Monitoring Station 903 (Downstream Far Field Monitoring)						
Water temperature	100	97	0	28	15	°C
monthly average	100	12	4	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 – 2013

Parameter	NPDES compliance rate (%)[a]	Number of measurements[b]	Concentration (and loading if applicable) Minimum	Maximum	Average[c]	Units
		Outfall 001				
Biochemical oxygen demand	-	32(8)	< 1	5.69		mg/L
Chlorine, total residual	100	250(0)	0.01625	0.025	0.020	mg/L
Dissolved solids	97	32(0)	180	4250	899	mg/L
Dissolved solids (loading)	84	32	0.757	492	54.1	kg/day
Flow rate	-	365	500	270,818	6616	GPD
Nitrogen-ammonia	-	32(4)	< 0.017	0.276	0.103	mg/L
Oil and grease	-	12(1)	< 1.11	2.78	1.7	mg/L
pH	100	250	6.55	8.03	7.08	SU
Phosphorus, total	-	32(14)	< 0.017	0.114		mg/L
Total suspended solids	100	32(2)	< 1.14	25.8	5.3	mg/L
monthly average[d]	100	12	5.2	15.3	5.2	mg/L
Total suspended solids (loading)	97	32	0	2.6	0.31	kg/day
monthly average[d]	92	12	0	0.72	0.29	kg/day
Temperature	99	250	41.7	74.2	58.1	°F
monthly average	92	12	44	72	57.9	°F

[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. USEC, Inc. NPDES discharge monitoring results – 2013

Parameter	Number of samples[a]	Concentration			Units
		Minimum	Maximum	Average[b]	
Outfall 012 (X-230M Southwest Holding Pond)					
Cadmium	11(6)	0.078	0.70		µg/L
Chlorine	25(16)	0.01	0.03		mg/L
Copper	11(7)	1.1	< 10.1		µg/L
Flow rate	365	0.0176	1.675	0.207	MGD
Iron	13(0)	144	936	475	µg/L
Oil and grease	24(24)	< 1.7	< 5		mg/L
PCBs, total	1(1)	< 0.43			µg/L
pH	24	7.12	8.19	7.78	SU
Selenium	11(9)	< 1	< 4.52		µg/L
Silver	11(6)	< 0.02	18.7		µg/L
Suspended solids	24(2)	< 2	33.8	7.0	mg/L
Thallium	11(10)	< 0.066	7.09		µg/L
Trichloroethene	13(13)	< 0.16	< 1		µg/L
Outfall 013 (X-230N West Holding Pond)					
Antimony	11(7)	0.29	< 4.34		µg/L
Arsenic	11(1)	< 0.5	53.3	22.3	µg/L
Chlorine	26(16)	< 0.01	0.06		mg/L
Copper	11(6)	0.43	11		µg/L
Flow rate	365	0.0117	1.395	0.187	MGD
Oil and grease	24(23)	< 1.7	< 5		mg/L
PCBs, total	1(1)	< 0.42			µg/L
pH	24	7.32	8.35	7.85	SU
Suspended solids	24(10)	< 1.1	22.8		mg/L
Thallium	11(9)	< 0.066	< 7.09		µg/L
Zinc	11(1)	< 1.7	31.6	16	µg/L
Outfall 613 (X-6002 Particulate Separator)					
Chlorine	19(11)	< 0.02	0.13		mg/L
Flow rate	98	0.0003	0.011	0.0012	MGD
Suspended solids	19(4)	< 2	90.8		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 – 2013

Sample location	Parameter	Units	Number of samples[a]	Minimum[b]	Maximum	Average[c]
			FBP cylinder storage yards			
X745-B1	Alpha activity	pCi/L	6(5)	< 0.302	8.39	
	Beta activity	pCi/L	6(2)	< 1.88	33.4	
	Uranium	µg/L	6(0)	0.192	1.64	0.677
X745-B2	Alpha activity	pCi/L	9(1)	< 3.39	47.2	17.7
	Beta activity	pCi/L	9(4)	< 2.49	63.7	
	Uranium	µg/L	9(0)	7.53	214	43.5
X745-B3	Alpha activity	pCi/L	6(4)	< 1.81	10.2	
	Beta activity	pCi/L	6(3)	< 3.14	29.7	
	Uranium	µg/L	6(0)	0.218	2.39	1.11
X745-D1	Alpha activity	pCi/L	10(8)	< 0.967	14.6	
	Beta activity	pCi/L	10(5)	< 3.51	11.7	
	Uranium	µg/L	10(0)	0.0834	9.92	2.77
X745-F1	Alpha activity	pCi/L	11(11)	0	< 3.18	
	Beta activity	pCi/L	11(9)	< 2.09	10.7	
	Uranium	µg/L	11(0)	0.228	1.64	0.733
X745-F2	Alpha activity	pCi/L	11(10)	< 0.597	6.54	
	Beta activity	pCi/L	11(7)	< 2.07	12.6	
	Uranium	µg/L	11(0)	0.319	4.01	2.61
X745-F3	Alpha activity	pCi/L	11(10)	< 0.989	4.84	
	Beta activity	pCi/L	11(9)	< 0.195	8.59	
	Uranium	µg/L	11(0)	0.89	6.68	2.82
			BWCS cylinder storage yards			
X745-C1	Alpha activity	pCi/L	12(6)	< 0.976	9.40	
	Beta activity	pCi/L	12(3)	< 0.582	5.53	
	Uranium	µg/L	12(0)	0.37	6.5	2.8
X745-C2	Alpha activity	pCi/L	12(5)	< 0.819	3.29	
	Beta activity	pCi/L	12(1)	< 1.08	4.61	2.46
	Uranium	µg/L	12(0)	0.57	8.4	4.2
X745-C3	Alpha activity	pCi/L	12(6)	0	5.08	
	Beta activity	pCi/L	12(0)	1.45	3.25	2.49
	Uranium	µg/L	12(0)	0.24	3.5	1.3
X745-C4	Alpha activity	pCi/L	12(5)	0	38.5	
	Beta activity	pCi/L	12(0)	2.23	32.6	8.36
	Uranium	µg/L	12(0)	0.62	11	4.3
X745-E1	Alpha activity	pCi/L	12(7)	< 0.225	4.12	
	Beta activity	pCi/L	12(0)	1.68	8.45	4.64
	Uranium	µg/L	12(0)	0.26	1.5	0.69

Table 2.6. Radionuclides in surface water runoff samples from FBP and BWCS cylinder storage yards – 2013

Sample location	Parameter	Units	Number of samples[a]	Minimum[b]	Maximum	Average[c]
BWCS cylinder storage yards (continued)						
X745-G1A	Alpha activity	pCi/L	12(4)	< 0.912	20.6	
	Beta activity	pCi/L	12(0)	2.4	20.1	6.81
	Uranium	µg/L	12(0)	0.40	6	2.6
X745-G2	Alpha activity	pCi/L	12(7)	< 0.0796	4.59	
	Beta activity	pCi/L	12(1)	1.11	4.60	2.49
	Uranium	µg/L	12(1)	0.23	3.3	1.6

[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 – 2013

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	0.26U	11U	0.27U	0.26U	11U
	PCB-1248	0.23U	0.26U	11U	0.27U	0.26U	11U
	PCB-1254	0.16U	0.18U	6.8U	0.18U	0.18U	7.2U
	PCB-1260	0.16U	0.18U	8.9J	0.18U	0.18U	37J
	PCB-1262	0.16U	0.18U	6.8U	0.18U	0.18U	7.2U
	PCB-1268	0.16U	0.18U	6.8U	0.18U	0.18U	7.2U
	Total PCB[c]	0.16U	0.18U	8.9J	0.18U	0.18U	37J
RM-8	PCB-1242	0.23U	0.23U	10U	0.25U	0.25U	11U
	PCB-1248	0.23U	0.23U	10U	0.25U	0.25U	11U
	PCB-1254	0.16U	0.16U	6.3U	0.17U	0.17U	7.2U
	PCB-1260	0.16U	0.16U	7.6J	0.17U	0.17U	7.2U
	PCB-1262	0.16U	0.16U	6.3U	0.17U	0.17U	7.2U
	PCB-1268	0.16U	0.16U	6.3U	0.17U	0.17U	7.2U
	Total PCB[c]	0.16U	0.16U	7.6J	0.17U	0.17U	7.2U
UDS X02	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	6.9U	0.16U	0.16U	8.4U
	PCB-1260	0.16U	0.16U	41	0.16U	0.16U	39J
	PCB-1262	0.16U	0.16U	6.9U	0.16U	0.16U	8.4U
	PCB-1268	0.16U	0.16U	6.9U	0.16U	0.16U	8.4U
	Total PCB[c]	0.16U	0.16U	41	0.16U	0.16U	39J
RM-10	PCB-1242	0.23U	0.23U	11U	0.23U	0.23U	11U
	PCB-1248	0.23U	0.23U	11U	0.23U	0.23U	11U
	PCB-1254	0.16U	0.16U	6.7U	0.16U	0.16U	7.2U
	PCB-1260	0.16U	0.16U	13J	0.16U	0.16U	20J
	PCB-1262	0.16U	0.16U	6.7U	0.16U	0.16U	7.2U
	PCB-1268	0.16U	0.16U	6.7U	0.16U	0.16U	7.2U
	Total PCB[c]	0.16U	0.16U	13J	0.16U	0.16U	20J

Table 2.7. Drainage basin monitoring of surface water and sediment for BWCS cylinder storage yards – 2013 (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	13U	0.23U	0.23U	9.9U
	PCB-1248	0.23U	0.23U	13U	0.23U	0.23U	9.9U
	PCB-1254	0.16U	0.16U	8.3U	0.16U	0.16U	6.2U
	PCB-1260	0.16U	0.16U	57	0.16U	0.16U	6.2U
	PCB-1262	0.16U	0.16U	8.3U	0.16U	0.16U	6.2U
	PCB-1268	0.16U	0.16U	8.3U	0.16U	0.16U	6.2U
	Total PCB[c]	0.16U	0.16U	57	0.16U	0.16U	6.2U
RM-8	PCB-1242	0.23U	0.23U	11U	0.23U	0.23U	11U
	PCB-1248	0.23U	0.23U	11U	0.23U	0.23U	11U
	PCB-1254	0.16U	0.16U	6.8U	0.16U	0.16U	7U
	PCB-1260	0.16U	0.16U	6.8U	0.16U	0.16U	11J
	PCB-1262	0.16U	0.16U	6.8U	0.16U	0.16U	7U
	PCB-1268	0.16U	0.16U	6.8U	0.16U	0.16U	7U
	Total PCB[c]	0.16U	0.16U	6.8U	0.16U	0.16U	11J
UDS X02	PCB-1242	0.23U	0.23U	12U	0.23U	0.23U	18U
	PCB-1248	0.23U	0.23U	12U	0.23U	0.23U	18U
	PCB-1254	0.16U	0.16U	7.6U	0.16U	0.16U	11U
	PCB-1260	0.16U	0.16U	66	0.16U	0.16U	180
	PCB-1262	0.16U	0.16U	7.6U	0.16U	0.16U	11U
	PCB-1268	0.16U	0.16U	7.6U	0.16U	0.16U	11U
	Total PCB[c]	0.16U	0.16U	66	0.16U	0.16U	180
RM-10	PCB-1242	0.23U	0.23U	11U	0.23U	0.23U	12U
	PCB-1248	0.23U	0.23U	11U	0.23U	0.23U	12U
	PCB-1254	0.16U	0.16U	7U	0.16U	0.16U	7.6U
	PCB-1260	0.16U	0.16U	24J	0.16U	0.16U	20J
	PCB-1262	0.16U	0.16U	7U	0.16U	0.16U	7.6U
	PCB-1268	0.16U	0.16U	7U	0.16U	0.16U	7.6U
	Total PCB[c]	0.16U	0.16U	24J	0.16U	0.16U	20J

[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; 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 – 2013

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c]	Average[c, e]
	On-site air samplers				
A8	Americium-241	3(3)	3.6E-06	4.2E-06	
	Fluoride	41(43)	4.7E-03	2.5E-02	
	Neptunium-237	3(3)	0	0	
	Plutonium-238	3(3)	0	2.9E-06	
	Plutonium-239/240	3(3)	1.0E-06	3.0E-06	
	Technetium-99	12(2)	0	3.4E-02	
	Uranium	12(4)	2.0E-05	5.4E-05	
	Uranium-233/234	12(1)	3.5E-06	9.9E-05	3.0E-05
	Uranium-235/236	12(11)	0	1.6E-05	
	Uranium-238	12(5)	4.4E-06	1.8E-05	
A10	Americium-241	4(4)	6.1E-07	6.4E-06	
	Fluoride	51(47)	1.4E-02	2.2E-02	
	Neptunium-237	4(4)	0	1.9E-06	
	Plutonium-238	4(4)	0	6.2E-07	
	Plutonium-239/240	4(4)	5.6E-07	5.0E-06	
	Technetium-99	12(0)	3.3E-04	1.9E-02	8.0E-03
	Uranium	12(3)	2.2E-05	3.7E-04	
	Uranium-233/234	12(1)	4.9E-06	1.4E-04	5.2E-05
	Uranium-235/236	12(12)	0	8.9E-06	
	Uranium-238	12(2)	7.4E-06	1.2E-04	
A29	Americium-241	4(4)	2.3E-06	3.6E-06	
	Fluoride	49(35)	1.3E-02	3.8E-02	
	Neptunium-237	4(4)	0	2.2E-06	
	Plutonium-238	4(4)	0	1.7E-06	
	Plutonium-239/240	4(4)	1.1E-06	5.8E-06	
	Technetium-99	12(0)	1.7E-03	2.5E-02	7.8E-03
	Uranium	12(1)	2.7E-05	9.0E-05	
	Uranium-233/234	12(0)	2.1E-05	7.7E-05	3.5E-05
	Uranium-235/236	12(12)	0	6.1E-06	
	Uranium-238	12(1)	8.1E-06	2.9E-05	
A36	Americium-241	4(4)	2.5E-06	7.1E-06	
	Fluoride	51(45)	1.2E-02	3.3E-02	
	Neptunium-237	4(4)	0	1.8E-06	
	Plutonium-238	4(4)	0	1.7E-06	
	Plutonium-239/240	4(4)	6.2E-07	4.4E-06	
	Technetium-99	12(1)	1.3E-04	2.2E-02	5.7E-03
	Uranium	12(1)	2.6E-05	5.2E-05	
	Uranium-233/234	12(0)	2.3E-05	3.1E-04	6.9E-05
	Uranium-235/236	12(11)	4.9E-07	1.6E-05	
	Uranium-238	12(2)	8.6E-06	1.5E-05	
A40A	Fluoride	52(34)	1.3E-02	3.6E-02	

Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2013 (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)	1.2E-06	4.3E-06	
	Neptunium-237	4(4)	0	2.7E-06	
	Plutonium-238	4(4)	0	1.8E-06	
	Plutonium-239/240	4(4)	5.7E-07	4.8E-06	
	Technetium-99	12(1)	0	1.7E-02	7.6E-03
	Uranium	12(5)	1.5E-05	6.7E-05	
	Uranium-233/234	12(0)	1.5E-05	4.0E-05	2.4E-05
	Uranium-235/236	12(12)	6.8E-07	8.2E-06	
	Uranium-238	12(5)	4.8E-06	2.1E-05	
		Off-site air samplers			
A3	Americium-241	4(4)	6.4E-07	4.3E-06	
	Fluoride	52(33)	1.4E-02	4.4E-02	
	Neptunium-237	4(4)	0	6.4E-07	
	Plutonium-238	4(4)	0	1.2E-06	
	Plutonium-239/240	4(4)	1.2E-06	4.6E-06	
	Technetium-99	12(0)	4.4E-04	2.9E-02	1.0E-02
	Uranium	12(2)	2.4E-05	7.5E-05	
	Uranium-233/234	12(0)	2.0E-05	1.2E-04	4.0E-05
	Uranium-235/236	12(12)	0	5.7E-06	
	Uranium-238	12(1)	7.9E-06	2.5E-05	
A6	Americium-241	3(3)	2.3E-06	6.6E-06	
	Fluoride	43(42)	1.3E-02	3.6E-02	
	Neptunium-237	3(3)	0	1.4E-06	
	Plutonium-238	3(3)	0	2.3E-06	
	Plutonium-239/240	3(3)	1.8E-06	5.8E-06	
	Technetium-99	12(1)	4.5E-05	1.5E-02	5.9E-03
	Uranium	12(0)	1.6E-05	7.7E-05	4.0E-05
	Uranium-233/234	12(1)	7.1E-07	2.7E-05	1.5E-05
	Uranium-235/236	12(11)	7.0E-07	1.5E-05	
	Uranium-238	12(2)	4.2E-06	2.5E-05	
A9	Americium-241	4(4)	0	4.4E-06	
	Fluoride	51(47)	6.2E-03	2.5E-02	
	Neptunium-237	4(4)	0	0	
	Plutonium-238	4(4)	0	1.7E-06	
	Plutonium-239/240	4(4)	2.5E-06	5.3E-06	
	Technetium-99	12(4)	0	4.2E-02	8.5E-03
	Uranium	12(0)	4.4E-05	1.0E-04	
	Uranium-233/234	12(0)	2.1E-05	4.1E-05	2.9E-05
	Uranium-235/236	12(12)	5.4E-07	6.4E-06	
	Uranium-238	12(0)	1.4E-05	3.4E-05	

Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2013 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c]	Average[c, e]
A12	Americium-241	4(4)	1.3E-06	3.6E-06	
	Fluoride	51(32)	1.4E-02	4.7E-02	
	Neptunium-237	4(4)	0	1.2E-06	
	Plutonium-238	4(4)	0	1.7E-06	
	Plutonium-239/240	4(4)	1.9E-06	4.0E-06	
	Technetium-99	12(1)	5.6E-05	2.4E-02	7.8E-03
	Uranium	12(3)	1.2E-05	6.5E-05	
	Uranium-233/234	12(0)	1.7E-05	1.7E-04	4.1E-05
	Uranium-235/236	12(12)	0	8.4E-06	
	Uranium-238	12(3)	3.7E-06	2.1E-05	
A15	Americium-241	4(4)	3.2E-06	5.1E-06	
	Fluoride	51(50)	1.5E-02	2.4E-02	
	Neptunium-237	4(4)	0	1.3E-06	
	Plutonium-238	4(4)	0	1.2E-06	
	Plutonium-239/240	4(4)	5.6E-07	5.4E-06	
	Technetium-99	12(0)	2.5E-04	2.1E-02	6.7E-03
	Uranium	12(2)	2.1E-05	5.2E-05	
	Uranium-233/234	12(2)	6.5E-06	6.3E-05	2.4E-05
	Uranium-235/236	12(12)	0	4.3E-06	
	Uranium-238	12(2)	6.9E-06	1.7E-05	
A23	Americium-241	4(4)	3.0E-06	6.4E-06	
	Fluoride	43(38)	1.7E-02	3.7E-02	
	Neptunium-237	4(4)	0	6.9E-07	
	Plutonium-238	4(4)	0	1.1E-06	
	Plutonium-239/240	4(4)	1.2E-06	4.1E-06	
	Technetium-99	12(2)	2.3E-05	1.6E-02	5.3E-03
	Uranium	12(2)	2.5E-05	7.4E-05	
	Uranium-233/234	12(0)	1.7E-05	1.8E-04	4.7E-05
	Uranium-235/236	12(12)	5.0E-07	1.1E-05	
	Uranium-238	12(2)	8.4E-06	2.4E-05	
A24	Americium-241	4(4)	1.1E-06	5.7E-06	
	Fluoride	52(41)	1.3E-02	3.1E-02	
	Neptunium-237	4(4)	0	2.0E-06	
	Plutonium-238	4(4)	0	2.2E-06	
	Plutonium-239/240	4(4)	1.8E-06	4.4E-06	
	Technetium-99	12(1)	0	1.7E-02	7.1E-03
	Uranium	12(0)	2.6E-05	1.1E-04	
	Uranium-233/234	12(0)	1.7E-05	1.1E-04	4.2E-05
	Uranium-235/236	12(12)	9.7E-07	5.7E-06	
	Uranium-238	12(0)	8.4E-06	3.6E-05	

Table 2.8. Ambient air monitoring program summary for radionuclides and fluoride – 2013 (continued)

Sampling Location	Parameter[a]	No. of measurements[b]	Minimum[c, d]	Maximum[c, d]	Average[c, e]
A28	Americium-241	4(4)	1.2E-06	5.6E-06	
	Fluoride	49(44)	1.3E-02	3.1E-02	
	Neptunium-237	4(4)	0	7.2E-07	
	Plutonium-238	4(4)	0	6.0E-07	
	Plutonium-239/240	4(4)	5.6E-07	6.4E-06	
	Technetium-99	12(0)	1.3E-03	1.9E-02	7.7E-03
	Uranium	12(2)	2.3E-05	4.8E-05	
	Uranium-233/234	12(1)	6.3E-06	2.0E-05	1.5E-05
	Uranium-235/236	12(12)	0	4.6E-06	
	Uranium-238	12(3)	7.3E-06	1.5E-05	
A37 (background)	Americium-241	4(4)	0	6.5E-06	
	Fluoride	52(41)	1.3E-02	2.8E-02	
	Neptunium-237	4(4)	0	7.1E-07	
	Plutonium-238	4(4)	0	1.9E-06	
	Plutonium-239/240	4(4)	1.9E-06	3.6E-06	
	Technetium-99	12(0)	2.8E-04	2.3E-02	6.5E-03
	Uranium	12(3)	2.1E-05	5.1E-05	
	Uranium-233/234	12(4)	7.5E-06	1.7E-05	1.2E-05
	Uranium-235/236	12(12)	0	4.4E-06	
	Uranium-238	12(3)	6.9E-06	1.7E-05	
A41[f]					

[a]All parameters are measured in pCi/m^3 with the exception of uranium and fluoride which are measured in µg/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 A41 in Zahns Corner was not in use because the station was being relocated due to road construction.

Table 2.9. Environmental radiation monitoring program (mrem) – 2013

Location	First quarter	Second quarter	Third quarter	Fourth quarter	Cumulative annual whole body dose[a]
#1404A	18	18	22	21	79
#518	20	19	19	20	78
#862	30	32	30	33	125
#874	156	201	171	146	674
#906	18	19	19	18	74
#933	[b]	55	48	41	192
A12	19	24	19	19	81
A15	20	23	21	21	85
A23	20	21	21	21	83
A24	21	21	21	22	85
A28	18	19	21	19	77
A29	22	23	22	22	89
A3	18	19	19	21	77
A36	21	20	21	21	83
A40A	20	21	22	20	83
A6	19	20	20	21	80
A8	25	22	23	23	93
A9	20	22	19	22	83
X-230J2	21	22	23	20	86
Control[c]	14	14	13	14	55
Trip blank[c]	16	17	16	16	65

[a]The annual occupational whole body dose limit set by Title 10 of the *Code of Federal Regulations* Part 20 is 5000 mrem.
[b]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. Environmental radiation monitoring (mrem) at locations near cylinder storage yards – 2013

Location	First quarter[a]			Second quarter[a]		
	Deep[b]	N[c]	Shallow[d]	Deep[b]	N[c]	Shallow[d]
#41	133	ND	133	157	ND	157
#868	236	ND	236	324	ND	324
#874	160	ND	160	194	ND	194
#882	263	ND	263	303	ND	303
#890	57	ND	57	75	ND	75
Trip blank	16	ND	16	17	ND	17

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	151	ND	151	130	ND	130	571	ND	571
#868	284	ND	284	325	ND	325	1169	ND	1169
#874	146	ND	146	155	ND	155	655	ND	655
#882	244	ND	244	259	ND	259	1069	ND	1069
#890	67	ND	67	54	ND	54	253	ND	253
Trip blank	16	ND	16	16	ND	16	65	ND	65

[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 – 2013

Sampling location	Parameter[a]	Unit	Results[b] April 2013		Results[b] November 2013	
Little Beaver Creek						
EDD-SW01 (FBP Outfalls 001& 015)	Settleable solids	mg/L	4.1		4U	
	Suspended solids	mg/L	4.1		4U	
FBP Outfall 005	Settleable solids	mg/L	ns		ns	
	Suspended solids	mg/L	ns		ns	
FBP Outfall 009	Settleable solids	mg/L	4U		4U	
	Suspended solids	mg/L	4U		4U	
FBP Outfall 011	Settleable solids	mg/L	9.1		4U	
	Suspended solids	mg/L	14.9		4U	
Big Run Creek						
FBP Outfall 002	Settleable solids	mg/L	6.5		4U	
	Suspended solids	mg/L	6.5		5.5	
Scioto River						
USEC NPDES Outfall 012	Settleable solids	mg/L	4U		4U	
	Suspended solids	mg/L	10.2		6.4	
WDD-SW03 (FBP Outfall 010 & USEC Outfall 013)	Settleable solids	mg/L	2.7J	6.3J[c]	6.1J	4U[c]
	Suspended solids	mg/L	10.4J	14.7J[c]	4U	4U[c]
FBP Outfall 003	Settleable solids	mg/L	4.9		4U	
	Suspended solids	mg/L	9.3		4U	
FBP Outfall 004	Settleable solids	mg/L	4U		4U	
	Suspended solids	mg/L	4U		4U	
Background locations						
RW-6 (Scioto River)	Settleable solids	mg/L	50.8		51.4	
	Suspended solids	mg/L	71.8		21.7	
	Alpha activity[d]	pCi/g	95.9J		23.2J	
	Beta activity[d]	pCi/g	30.6J		24.2J	
RW-5 (Big Beaver Creek)	Settleable solids	mg/L	13.9J	17.3J[c]	4U	4U[c]
	Suspended solids	mg/L	13.9J	17.3J[c]	4.5	4U[c]
LBC-SW12 (Little Beaver Creek)	Settleable solids	mg/L	4U		4U	
	Suspended solids	mg/L	4U		4U	

[a]Suspended solids are the solids in a water sample (such as silt or clay particles) that can be trapped by a filter. Settleable solids are a component of suspended solids defined as the particles that settle out of suspension in water within a defined time period.
[b]Abbreviations and data qualifiers are as follows: ns – not sampled (the outfall was not in use when samples were collected).
J – The reported result is estimated. U – undetected.
[c]This result is for the duplicate sample collected from this location. A duplicate sample is a sample collected from the same location at the same time and using the same sampling device (if possible) as the regular sample.
[d]Alpha and beta activity are analyzed in the solid portion of the sample only when settleable solids are above 40 mg/L.

Table 2.12. Local surface water monitoring program results – 2013

Location	Parameter[a]	Second quarter[b,c]		Fourth quarter[b,c]
Scioto River	Americium-241	0.0255U		-0.00454U
RW-1	Neptunium-237	0U		0U
(downstream)	Plutonium-238	-0.0141U		0.0157U
	Plutonium-239/240	0.0236U		0.0157U
	Technetium-99	1.55U		1.8U
	Uranium	1.37		0.285UJ
	Uranium-233/234	0.549		0.157
	Uranium-235/236	0.0341U		0.0112U
	Uranium-238	0.456		0.0942UJ
Scioto River	Americium-241	0.023U		0.0375U
RW-6	Neptunium-237	0.0156U		0.00564U
(upstream)	Plutonium-238	0U		-0.00531U
	Plutonium-239/240	0.00471U		0.0106U
	Technetium-99	-0.779U		-0.124U
	Uranium	1.58		1.48
	Uranium-233/234	0.555		0.618
	Uranium-235/236	0U		0.0366U
	Uranium-238	0.53		0.49
Little Beaver	Americium-241	0.0289U		0.0321U
Creek	Neptunium-237	-0.00946U		0U
RW-7	Plutonium-238	-0.00462U		-0.00492U
(downstream)	Plutonium-239/240	0.0139U		0U
	Technetium-99	4.82U		0.0227U
	Uranium	1.38J		0.436
	Uranium-233/234	1.69		0.169
	Uranium-235/236	0.109UJ		0.012U
	Uranium-238	0.446		0.145
RW-8	Americium-241	0.00969U		0.00875U
(downstream)	Neptunium-237	0U		0.0173U
	Plutonium-238	-0.0139U		-0.0052U
	Plutonium-239/240	0.0232U		-0.0156U
	Technetium-99	4.51U		4.01U
	Uranium	0.928J		0.749J
	Uranium-233/234	1.32		1.1
	Uranium-235/236	0.0779UJ		0.0655UJ
	Uranium-238	0.3		0.241
RW-12	Americium-241	0.0141U	0.0262U[d]	-0.00468U
(upstream)	Neptunium-237	-0.00496U	-0.00943U[d]	0.0181U
	Plutonium-238	0U	0.00462U[d]	0.0116U
	Plutonium-239/240	0.015U	0.00925U[d]	0.0116U
	Technetium-99	0.147U	2.27U[d]	-0.633U
	Uranium	0.0421U	0.131UJ[d]	0.17U
	Uranium-233/234	0U	0.0192U[d]	0.0423U
	Uranium-235/236	0U	0.00596U[d]	0.00584U
	Uranium-238	0.0142U	0.0431UJ[d]	0.0564U

Table 2.12. Local surface water monitoring program results – 2013 (continued)

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]
Big Beaver Creek	Americium-241	0.00444U	0.0334U
RW-13	Neptunium-237	0.00788U	0.0182U
(downstream)	Plutonium-238	0U	0.00523U
	Plutonium-239/240	0.0316U	0.00523U
	Technetium-99	0.0565U	2.37U
	Uranium	0.199UJ	1.06
	Uranium-233/234	0.205	1.35
	Uranium-235/236	0.0277U	0.0507U
	Uranium-238	0.0624UJ	0.349
RW-5	Americium-241	0.0199U	0.0416U
(upstream)	Neptunium-237	0U	0.00711U
	Plutonium-238	0U	0.00501U
	Plutonium-239/240	0.0414UJ	0U
	Technetium-99	2.47U	3.48U
	Uranium	0.0768U	1.14
	Uranium-233/234	0.0739UJ	1.48
	Uranium-235/236	0.00766U	0.0772U
	Uranium-238	0.0246U	0.372
Big Run Creek	Americium-241	0.0224U	0U
RW-2	Neptunium-237	0.00489U	0.0117U
(downstream)	Plutonium-238	0.0213U	-0.0101U
	Plutonium-239/240	0.016U	0.0101U
	Technetium-99	-0.169U	-0.282U
	Uranium	0.186UJ	0.451
	Uranium-233/234	0.0756UJ	0.205
	Uranium-235/236	0.0125U	0.0278U
	Uranium-238	0.0605U	0.147
RW-3	Americium-241	0.00866UJ	0.0534U
(downstream)	Neptunium-237	0U	0U
	Plutonium-238	-0.00892U	-0.0114U
	Plutonium-239/240	0.00446U	0.0057U
	Technetium-99	0.418U	-0.52U
	Uranium	0.9J	0.451
	Uranium-233/234	0.886	0.485
	Uranium-235/236	0.0697UJ	0.0304U
	Uranium-238	0.292	0.147

Table 2.12. Local surface water monitoring program results – 2013 (continued)

Location	Parameter[a]	Second quarter[b,c]		Fourth quarter[b,c]	
Big Run Creek	Americium-241	-0.00476U		0.016U	
(continued)	Neptunium-237	0U		0.0182U	
RW-33	Plutonium-238	0.00536U		0U	
(upstream)	Plutonium-239/240	0.00536U		0.00487U	
	Technetium-99	1.73U		-1.71U	
	Uranium	0.0473U		0.314	
	Uranium-233/234	0.0053U		0.135	
	Uranium-235/236	0U		-0.00601U	
	Uranium-238	0.0159U		0.106	
Background creeks	Americium-241	0.0278U		0.0337U	
RW-10N	Neptunium-237	-0.014U		-0.0115U	
	Plutonium-238	0.00533U		-0.00834U	
	Plutonium-239/240	0.0213U		0.025U	
	Technetium-99	3.87U		2.48U	
	Uranium	0.135UJ		0.457	
	Uranium-233/234	0.0242U		0.157	
	Uranium-235/236	0.012U		0.0122U	
	Uranium-238	0.0436UJ		0.152	
RW-10S	Americium-241	0.0138U	0.0187U[d]	0.0138U	
	Neptunium-237	-0.00463U	-0.00504U[d]	0.00623U	
	Plutonium-238	0.0229U	-0.0049U[d]	0U	
	Plutonium-239/240	0.0229U	0.0049U[d]	0.00507U	
	Technetium-99	-0.0791U	3.31U[d]	0.373U	
	Uranium	0.513	0.623[d]	0.236UJ	
	Uranium-233/234	0.208	0.205[d]	0.0828	
	Uranium-235/236	0.0133U	0U[d]	0.00542U	
	Uranium-238	0.17	0.209[d]	0.0784UJ	
RW-10E	Americium-241	0.0235U		0.0281U	0.0371U[d]
	Neptunium-237	-0.00911U		0U	0U[d]
	Plutonium-238	0.00952U		-0.0193U	-0.00498U[d]
	Plutonium-239/240	0.00953U		0.0435U	0.00499U[d]
	Technetium-99	1.39U		-0.644U	0.509U[d]
	Uranium	0.048U		0.0645U	0.0693U[d]
	Uranium-233/234	0.0101U		0.0303U	0.0224U[d]
	Uranium-235/236	0.00628U		0U	0.00557U[d]
	Uranium-238	0.0152U		0.0217U	0.0224U[d]

Table 2.12. Local surface water monitoring program results – 2013 (continued)

Location	Parameter[a]	Second quarter[b,c]	Fourth quarter[b,c]	
Background creeks	Americium-241	0.0286U	0.0236U	0.0292U[d]
RW-10W	Neptunium-237	0.00474U	-0.00566U	0U[d]
	Plutonium-238	0U	0.0174U	0.0121U[d]
	Plutonium-239/240	0.00503U	0.0116U	0.0121U[d]
	Technetium-99	-0.757U	-1.68U	-2.77U[d]
	Uranium	0.0741U	0.0713U	0.0729U[d]
	Uranium-233/234	-0.0149U	0.0311U	0.0132U[d]
	Uranium-235/236	0U	0.0111U	0.0164U[d]
	Uranium-238	0.0249U	0.0222U	0.0219U[d]

[a]Results are reported in µg/L (uranium) and pCi/L (all other parameters).
[b]Abbreviations and data qualifiers are as follows: U – undetected. J – the reported result is estimated.
[c]Because of the statistical nature of radiation detection, results for samples that have no radioactivity are often negative values because background radioactivity is subtracted out.
[d]This result is for the duplicate sample collected from this location. A duplicate sample is a sample collected from the same location at the same time and using the same sampling device (if possible) as the regular sample.

Table 2.13. Sediment monitoring program results – 2013

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	3640	3880	6350	5480
Americium-241	pCi/g	0.00121U	0.00354U	0.0015U	0.00246U
Antimony	mg/kg	0.04NU	0.04NU	0.04NU	0.04NU
Arsenic	mg/kg	5.3	6.1	12.2*	11.5
Barium	mg/kg	37.1	42.9	36.4	48.8
Beryllium	mg/kg	0.27	0.3	0.97	0.56
Cadmium	mg/kg	0.18	0.19	0.83	0.12
Calcium	mg/kg	24600N	28600N	1050	1220N
Chromium	mg/kg	6.6*	6.8*	12.2	13.3*
Copper	mg/kg	8.6	9.5	20.8N	8.6
Iron	mg/kg	10800*	11700*	30200*	19700*
Lead	mg/kg	8.1	7.8	9.4	10.8
Magnesium	mg/kg	10700N	12300N	1670	975N
Manganese	mg/kg	280N	328N	786	403N
Mercury	mg/kg	0.07B	0.02B	0.02U	0.02B
Neptunium-237	pCi/g	0.000858U	0U	0.000638U	-0.000927U
Nickel	mg/kg	9.9*	11.2*	48.9N	10.3*
PCB, total[c]	µg/kg	9.58U	9.4U	8.77U	88
PCB-1016	µg/kg	9.58U	9.4U	8.77U	9.47U
PCB-1221	µg/kg	9.58U	9.4U	8.77U	9.47U
PCB-1232	µg/kg	9.58U	9.4U	8.77U	9.47U
PCB-1242	µg/kg	9.58U	9.4U	8.77U	9.47U
PCB-1248	µg/kg	9.58U	9.4U	8.77U	9.47U
PCB-1254	µg/kg	9.58U	9.4U	8.77U	9.47U
PCB-1260	µg/kg	9.58U	9.4U	8.77U	88
PCB-1262	µg/kg	9.58U	9.4U	8.77U	9.47U
PCB-1268	µg/kg	9.58U	9.4U	8.77U	9.47U
Plutonium-238	pCi/g	0.00157U	0.0011U	0.000613U	0.00203U
Plutonium-239/240	pCi/g	0.000522U	0.00165U	0.00184U	0.00203U
Selenium	mg/kg	0.26N	0.25N	0.2N	0.22N
Silicon	mg/kg	363	315	308	338
Silver	mg/kg	0.36U	0.39U	0.39U	0.38U
Technetium-99	pCi/g	-0.00407U	-0.0606U	-0.0635U	0.664
Thallium	mg/kg	0.12	0.13	0.16	0.08
Uranium	µg/g	1.67	1.95	3.25	3.71
Uranium-233/234	pCi/g	0.541	0.649	1.06	1.65
Uranium-235/236	pCi/g	0.0259	0.0312	0.0591	0.0936
Uranium-238	pCi/g	0.558	0.652	1.08	1.23
Zinc	mg/kg	47.2*	49.2*	152	65.8*

Table 2.13. Sediment monitoring program results – 2013 (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	5850	3150	2860	4460
Americium-241	pCi/g	0.000735UJ	0.00215U	0.00386U	0.00512UJ
Antimony	mg/kg	0.04NU	0.07BN	0.08BN	0.08BN
Arsenic	mg/kg	21.2	9.1*	6.8*	31
Barium	mg/kg	41.8	18.7	18.3	49.9
Beryllium	mg/kg	0.74	0.27	0.22	0.96
Cadmium	mg/kg	0.04U	0.09	0.09	0.62
Calcium	mg/kg	847N	2320	2640	12300N
Chromium	mg/kg	20.3*	9.3	6.8	22.9*
Copper	mg/kg	9	13.2N	12.3N	11.9
Iron	mg/kg	40900*	13000*	9380*	57500*
Lead	mg/kg	17	8.8	7.7	16.8
Magnesium	mg/kg	1190N	1450	1620	3390N
Manganese	mg/kg	598N	77.2	77.9	898N
Mercury	mg/kg	0.02U	0.11	0.11	0.17
Neptunium-237	pCi/g	0U	0.00279U	0.00334U	0.0156
Nickel	mg/kg	12.1*	6.4N	5.9N	28.6*
PCB, total[c]	µg/kg	9.51U	224	254	103
PCB-1016	µg/kg	9.51U	8.8U	8.42U	9.54U
PCB-1221	µg/kg	9.51U	8.8U	8.42U	9.54U
PCB-1232	µg/kg	9.51U	8.8U	8.42U	9.54U
PCB-1242	µg/kg	9.51U	8.8U	8.42U	9.54U
PCB-1248	µg/kg	9.51U	8.8U	8.42U	9.54U
PCB-1254	µg/kg	9.51U	100	107	9.54U
PCB-1260	µg/kg	9.51U	124	147	103
PCB-1262	µg/kg	9.51U	8.8U	8.42U	9.54U
PCB-1268	µg/kg	9.51U	8.8U	8.42U	9.54U
Plutonium-238	pCi/g	0.000708UJ	0.00159U	0.0017U	0.00231UJ
Plutonium-239/240	pCi/g	0.00142UJ	0.00796U	0.00806U	0.00847UJ
Selenium	mg/kg	0.16N	0.4N	0.38N	0.21N
Silicon	mg/kg	255	270	248	254
Silver	mg/kg	0.36U	0.36U	0.38U	0.36U
Technetium-99	pCi/g	0.11U	3.29	3.08	2.86
Thallium	mg/kg	0.05B	0.08	0.08	0.18
Uranium	µg/g	1.83	2.22	2.7	5.05
Uranium-233/234	pCi/g	0.678	2.79	3.21	6.16
Uranium-235/236	pCi/g	0.0386	0.142	0.145	0.3
Uranium-238	pCi/g	0.609	0.725	0.886	1.65
Zinc	mg/kg	48.7*	91.3	85	151*

Table 2.13. Sediment monitoring program results – 2013 (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	4100	4460	4000
Americium-241	pCi/g	0.00747UJ	0.00428U	0.00177U
Antimony	mg/kg	0.04BN	0.04NU	0.07BN
Arsenic	mg/kg	7.4	5.4	23
Barium	mg/kg	44	46.1	34.3
Beryllium	mg/kg	0.43	0.37	0.64
Cadmium	mg/kg	0.41	0.13	0.28
Calcium	mg/kg	4770N	1470N	12000N
Chromium	mg/kg	9.2*	6.9*	18.9*
Copper	mg/kg	8.4	7.7	10.2
Iron	mg/kg	13500*	11300*	35100*
Lead	mg/kg	8.5	7.6	10.2
Magnesium	mg/kg	2980N	1330N	4350N
Manganese	mg/kg	401N	450N	842N
Mercury	mg/kg	0.08B	0.02U	0.01U
Neptunium-237	pCi/g	0.0034U	-0.000811U	0.0111
Nickel	mg/kg	16.7*	12.2*	24*
PCB, total[c]	µg/kg	78.4	9.43U	9.43U
PCB-1016	µg/kg	9.4U	9.43U	9.43U
PCB-1221	µg/kg	9.4U	9.43U	9.43U
PCB-1232	µg/kg	9.4U	9.43U	9.43U
PCB-1242	µg/kg	9.4U	9.43U	9.43U
PCB-1248	µg/kg	9.4U	9.43U	9.43U
PCB-1254	µg/kg	9.4U	9.43U	9.43U
PCB-1260	µg/kg	78.4	9.43U	9.43U
PCB-1262	µg/kg	9.4U	9.43U	9.43U
PCB-1268	µg/kg	9.4U	9.43U	9.43U
Plutonium-238	pCi/g	0.00285U	-0.00057U	0.00164U
Plutonium-239/240	pCi/g	0.00427UJ	0.00228U	0.00438UJ
Selenium	mg/kg	0.21N	0.15N	0.15N
Silicon	mg/kg	285	276	205
Silver	mg/kg	0.39U	0.38U	0.35U
Technetium-99	pCi/g	5.81	0.304	4.21
Thallium	mg/kg	0.11	0.09	0.1
Uranium	µg/g	3.02	2.2	2.92
Uranium-233/234	pCi/g	2.67	0.862	2.32
Uranium-235/236	pCi/g	0.127	0.0466	0.113
Uranium-238	pCi/g	0.994	0.732	0.962
Zinc	mg/kg	66.1*	36.7*	135*

Table 2.13. Sediment monitoring program results – 2013 (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	7020	4940	6450	6730
Americium-241	pCi/g	0.00294UJ	0.00316U	0.00356UJ	0.00329U
Antimony	mg/kg	0.13BN	0.06BN	0.04NU	0.04NU
Arsenic	mg/kg	53.1	11.8	14	15.9
Barium	mg/kg	52.1	38.5	47.1	48.9
Beryllium	mg/kg	2	0.52	0.62	0.65
Cadmium	mg/kg	0.34	0.17	0.22	0.28
Calcium	mg/kg	731N	1090N	735N	794N
Chromium	mg/kg	43.4*	8.9*	14.4*	14.5*
Copper	mg/kg	19.2	9.5	9.5	10.3
Iron	mg/kg	132000*	15000*	21600*	21800*
Lead	mg/kg	25	10.6	14.6	15.2
Magnesium	mg/kg	807N	748N	1030N	1080N
Manganese	mg/kg	1140N	338N	501N	495N
Mercury	mg/kg	0.02U	0.02B	0.03B	0.02B
Neptunium-237	pCi/g	-0.000641U	0.000795U	0.000839U	0.000813U
Nickel	mg/kg	36.7*	11*	15.6*	16.3*
PCB, total[c]	µg/kg	9.06U	19U	59.9	63.9
PCB-1016	µg/kg	9.06U	19U	9.36U	9.58U
PCB-1221	µg/kg	9.06U	19U	9.36U	9.58U
PCB-1232	µg/kg	9.06U	19U	9.36U	9.58U
PCB-1242	µg/kg	9.06U	19U	9.36U	9.58U
PCB-1248	µg/kg	9.06U	19U	9.36U	9.58U
PCB-1254	µg/kg	9.06U	19U	9.36U	9.58U
PCB-1260	µg/kg	9.06U	19U	59.9	63.9
PCB-1262	µg/kg	9.06U	19U	9.36U	9.58U
PCB-1268	µg/kg	9.06U	19U	9.36U	9.58U
Plutonium-238	pCi/g	0.00363UJ	-0.000433U	0.000511U	0.00188U
Plutonium-239/240	pCi/g	0.00182UJ	0.00173U	0.00665UJ	0.00751UJ
Selenium	mg/kg	0.17N	0.59N	0.24N	0.23N
Silicon	mg/kg	242	346	286	357
Silver	mg/kg	0.36U	0.39U	0.38U	0.39U
Technetium-99	pCi/g	-0.0576U	0.517	0.152U	0.0498U
Thallium	mg/kg	0.17	0.2	0.12	0.12
Uranium	µg/g	4.22	2.69	2.53	2.43
Uranium-233/234	pCi/g	1.53	1.45	1.1	1.04
Uranium-235/236	pCi/g	0.0741	0.0708	0.0632	0.0658
Uranium-238	pCi/g	1.41	0.892	0.841	0.808
Zinc	mg/kg	200*	74.5*	61.3*	65.3*

Table 2.13. Sediment monitoring program results – 2013 (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	2940	6280	1090	4870
Americium-241	pCi/g	-0.00135U	0.00235UJ	0.00334U	0.00104UJ
Antimony	mg/kg	0.04NU	0.04NU	0.04NU	0.11BN
Arsenic	mg/kg	3.5	24.9	3.5	27.2
Barium	mg/kg	26.3	54.9	9.8	36.9
Beryllium	mg/kg	0.27	0.86	0.26	0.92
Cadmium	mg/kg	0.3	0.04U	0.04U	1.2
Calcium	mg/kg	4710N	3650N	194N	4530N
Chromium	mg/kg	5.2*	26.1*	6.8*	13.7*
Copper	mg/kg	5.9	9.8	1.5B	15.4
Iron	mg/kg	8340*	45400*	10300*	34600*
Lead	mg/kg	6.4	18.5	2.8	13
Magnesium	mg/kg	2900N	2100N	98N	3180N
Manganese	mg/kg	245N	1220N	50N	532N
Mercury	mg/kg	0.02U	0.02U	0.02U	0.02B
Neptunium-237	pCi/g	0.000853U	0.00141U	0.00125U	-0.000754U
Nickel	mg/kg	11.9*	13.8*	2.6*	29.6*
PCB, total[c]	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1016	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1221	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1232	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1242	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1248	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1254	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1260	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1262	µg/kg	9.43U	9.33U	9.36U	9.51U
PCB-1268	µg/kg	9.43U	9.33U	9.36U	9.51U
Plutonium-238	pCi/g	0U	-0.00064U	-0.000785U	0.000662U
Plutonium-239/240	pCi/g	0.00248U	0.00512UJ	0.00118U	0.00397U
Selenium	mg/kg	0.18N	0.2N	0.1NU	0.42N
Silicon	mg/kg	318	311	210	293
Silver	mg/kg	0.36U	0.38U	0.35U	0.34U
Technetium-99	pCi/g	-0.0652U	0.0163U	-0.00407U	-0.0545U
Thallium	mg/kg	0.06B	0.06B	0.04U	0.26
Uranium	µg/g	1.16	1.99	0.761	4.34
Uranium-233/234	pCi/g	0.403	0.748	0.23	1.42
Uranium-235/236	pCi/g	0.0184	0.0387	0.0135	0.0649
Uranium-238	pCi/g	0.388	0.662	0.254	1.45
Zinc	mg/kg	39.4*	60.5*	13.2*	116*

[a]Abbreviations and data qualifiers are as follows: * – duplicate analysis is not within control limits. B (metals) – the result is less than the practical quantitation limit but greater than or equal to the instrument detection limit. 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 – 2013

Parameter[a]	Location/results[b,c]			
	A8 – On site at northwest boundary		*T7 – On site near X-230L North Holding Pond*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00086U	0.00185U	0.000583U	0.00665UJ
Neptunium-237	0U	0.000818U	0.000326U	0.00132U
Plutonium-238	0.000275U	0.000519U	0U	-0.00129U
Plutonium-239/240	0.000549U	0.00104U	0.000288U	0.0181
Technetium-99	0U	-0.0828U	0.0189U	-0.0719U
Uranium	0.00822UJ	3.75	0.00287U	2.67
Uranium-233/234	0.00266U	1.23	0.000808U	0.885
Uranium-235/236	0.000662U	0.062	0.00101U	0.0648
Uranium-238	0.00266UJ	1.25	0.000808U	0.889
	A10 – On site on northwest segment of Perimeter Road		*A29 – On site at OVEC*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.000872U	0U	0.00115U	0.00245U
Neptunium-237	0U	0.00211U	0U	-0.000634U
Plutonium-238	0U	-0.000484U	0U	0.0012U
Plutonium-239/240	0.00175U	0.00387U	0.00116U	0.00519U
Technetium-99	-0.000589U	-0.106U	0.0424U	-0.00377U
Uranium	0.00102U	2.62	0.003U	2.68
Uranium-233/234	0.000573U	0.872	0.000264U	0.814
Uranium-235/236	0.000356U	0.0532	-0.000329U	0.0362
Uranium-238	0.000286U	0.871	0.00106U	0.895
	A36 – On site at X-611 Water Treatment Plant		*A6 – North of PORTS in Piketon*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00225U	0.00624UJ	0.00171U	0.00284U
Neptunium-237	-0.000362U	0.0019UJ	0.00031U	0U
Plutonium-238	0.000293U	-0.000898U	0U	0U
Plutonium-239/240	0.00088U	0.0153	0.000593U	0.0062UJ
Technetium-99	0.00118U	-0.00301U	0.00942U	-0.027U
Uranium	0.00618U	2.46J	0.00306U	2.95
Uranium-233/234	0.00187U	0.861J	0.00054U	0.923
Uranium-235/236	0.00133U	0.0631J	-0.000336U	0.0476
Uranium-238	0.00187U	0.817J	0.00108U	0.983

Table 2.14. Soil and vegetation monitoring at ambient air monitoring stations – 2013 (continued)

Parameter[a]	Location/results[b,c]			
	A24 – North of PORTS at Schuster Road		*A41A[d] - North of PORTS at Zahns Corner*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00115U	0.00312U	0.000871U	0.00472UJ
Neptunium-237	-0.000342U	-0.00056U	0U	0.000458U
Plutonium-238	-0.000292U	0.00125U	0.000268U	0U
Plutonium-239/240	0.00205U	0.00877	0.00107U	0.00865UJ
Technetium-99	0.00118U	-0.0225U	0.0153U	-0.109U
Uranium	0.00244U	2.43	0.00292U	2.38
Uranium-233/234	0U	0.767	0.000823U	0.808
Uranium-235/236	0U	0.0428	0.00102U	0.0465
Uranium-238	0.000821U	0.81	0.000823U	0.793
	A23 – Northeastern PORTS boundary		*A12 – Eastern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00201U	0.00611UJ	0.000881U	0.00349U
Neptunium-237	0.00107U	0.000834U	0U	-0.000532U
Plutonium-238	0.000283U	0.000919U	0.000277U	0.000927U
Plutonium-239/240	0.000567U	0.0106	0.000554U	0.00325U
Technetium-99	0.0318U	0.0766U	0.00353U	-0.0232U
Uranium	0.00785U	2.84	0.000664U	2.24
Uranium-233/234	0.00315U	0.808	0.000829U	0.815
Uranium-235/236	0.000783U	0.0512	-0.000344U	0.0456
Uranium-238	0.00252U	0.945	0.000276U	0.747
	A15 – Southeast of PORTS on Loop Road		*A3 – Southern PORTS boundary*	
	Vegetation	Soil	Vegetation	Soil
Americium-241	0.00063U	0.00468U	0.00137U	0.00323U
Neptunium-237	0U	0U	-0.000668U	0.000463U
Plutonium-238	-0.00111U	0.00126U	0.000594U	0.000948U
Plutonium-239/240	0.00111U	0.013	0.000892U	0.00806UJ
Technetium-99	-0.00647U	-0.0489U	0.0212U	0U
Uranium	0.00197U	2.4	0.00243U	2.12
Uranium-233/234	0.00166U	0.775	0.00163U	0.796
Uranium-235/236	0.00069U	0.0469	0U	0.0382
Uranium-238	0.000555U	0.798	0.000817U	0.705

Table 2.14. Soil and vegetation monitoring at ambient air monitoring stations – 2013 (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	0.00114U	0.00859UJ	0U	0.00545UJ
Neptunium-237	0.000335U	0U	0U	0.000637U
Plutonium-238	0U	0.000412U	-0.000289U	0U
Plutonium-239/240	0.000841U	0.0189	0.000289U	0.0112
Technetium-99	0.0542U	-0.144U	-0.0183U	0.0489U
Uranium	0.000000176U	1.78	0.00362U	2.43
Uranium-233/234	0.0011U	0.575	0.000531U	0.817
Uranium-235/236	0U	0.0384	0.00099U	0.0523
Uranium-238	0U	0.591	0.00106U	0.809
	A37 – Background station near Otway			
	Vegetation	Soil		
Americium-241	0.00164U	0.00428U		
Neptunium-237	0.000962U	0U		
Plutonium-238	-0.00028U	0U		
Plutonium-239/240	0.00112U	0.0134		
Technetium-99	-0.02U	-0.0233U		
Uranium	0.000153U	2.64		
Uranium-233/234	0.000532U	0.871		
Uranium-235/236	0.000331U	0.0481		
Uranium-238	0U	0.878		
	Duplicate vegetation samples		*Duplicate soil samples*	
	A15	A29	A3	A8
Americium-241	0.000861U	0.00141U	0.00371U	0.00132U
Neptunium-237	0.000324U	0.000302U	0U	0U
Plutonium-238	-0.000575U	0.000307U	-0.000439U	0.000598U
Plutonium-239/240	0.00144U	0.000921U	0.00835UJ	0.00239U
Technetium-99	0.0465U	-0.0371U	0.012U	-0.0603U
Uranium	0.00667U	0.00176U	2.16	3.58
Uranium-233/234	0.00302UJ	0.00109U	0.839	1.15
Uranium-235/236	0.00205U	0.00204U	0.0427	0.0504
Uranium-238	0.00192U	0.000273U	0.72	1.2

[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.
[d]Although ambient air monitoring station A41 was not in use because the station was being relocated due to road construction, soil and vegetation samples were collected near the location of replacement station A41A.

Table 2.15. Biota (fish) monitoring program results – 2013

Parameter	Unit	Location/fish/results[a,b]	
		Scioto River (RW-1) bass	*Scioto River (RW-6) carp*
Americium-241	pCi/g	0.00385U	0.00182U
Neptunium-237	pCi/g	-0.000908U	0U
PCB, total[c]	µg/kg	158	59.6
PCB-1248	µg/kg	4.82U	4.95U
PCB-1254	µg/kg	82.5	40.3
PCB-1260	µg/kg	75.8	19.3
PCB-1268	µg/kg	4.82U	4.95U
Plutonium-238	pCi/g	0.00113U	0U
Plutonium-239/240	pCi/g	0.00113U	0.00189U
Technetium-99	pCi/g	0.0226U	-0.0996U
Uranium	µg/g	0.00147U	0.0016U
Uranium-233/234	pCi/g	0U	0U
Uranium-235/236	pCi/g	0.000887U	0.000963U
Uranium-238	pCi/g	0.000356U	0.000387U
		Little Beaver Creek (RW-8) bass	*Little Beaver Creek (RW-8) bass (duplicate sample)*
Americium-241	pCi/g	0.000736U	-0.0011U
Neptunium-237	pCi/g	0U	0.000823U
PCB, total[c]	µg/kg	207D	301D
PCB-1248	µg/kg	9.47U	9.52U
PCB-1254	µg/kg	64.1D	83.6D
PCB-1260	µg/kg	143D	217D
PCB-1268	µg/kg	9.47U	9.52U
Plutonium-238	pCi/g	-0.000384U	-0.000744U
Plutonium-239/240	pCi/g	0.00115U	0.000745U
Technetium-99	pCi/g	0.00263U	0.0109U
Uranium	µg/g	0.00332U	0.00188U
Uranium-233/234	pCi/g	0.000349U	0.00174U
Uranium-235/236	pCi/g	0.000434U	-0.000434U
Uranium-238	pCi/g	0.00105U	0.000698U

[a]Abbreviations and data qualifiers are as follows: D – the reported value was identified from a secondary dilution. 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. PCB-1016, PCB-1221, PCB-1232, PCB-1242, and PCB-1262 were not detected in any of the samples.

Table 2.16. Biota (crops) monitoring program results – 2013

Parameter	Unit	Location/crop/results[a,b]		
		Off-site #2 corn	*Off-site #2 cucumbers*	*Off-site #2 green beans*
Americium-241	pCi/g	-0.00031U	0.000294U	0U
Neptunium-237	pCi/g	0U	0.000627U	-0.000338U
Plutonium-238	pCi/g	-0.000852U	0U	-0.000574U
Plutonium-239/240	pCi/g	0.000284U	-0.000583U	0.000574U
Technetium-99	pCi/g	-0.0421U	0.0274U	0.0462U
Uranium	µg/g	-0.000156U	0.00219U	0.00155U
Uranium-233/234	pCi/g	0.000812U	0.000286U	0.000576U
Uranium-235/236	pCi/g	-0.000336U	0.00107U	-0.000358U
Uranium-238	pCi/g	0U	0.000572U	0.000576U
		Off-site #2 green beans (duplicate sample)	*Off-site #2 green peppers*	*Off-site #2 tomatoes*
Americium-241	pCi/g	0.00371UJ	0.000607U	0.00317UJ
Neptunium-237	pCi/g	0.000665U	0U	0.000327U
Plutonium-238	pCi/g	0.000295U	0.000574U	0.000917U
Plutonium-239/240	pCi/g	0U	0U	0U
Technetium-99	pCi/g	0.0658U	-0.0274U	0.000294U
Uranium	µg/g	0.00168U	0.000159U	0.000976U
Uranium-233/234	pCi/g	0U	0U	0.000275U
Uranium-235/236	pCi/g	0U	0.000344U	0.000342U
Uranium-238	pCi/g	0.000566U	0U	0.000275U
		Off-site #3 cucumbers	*Off-site #3 green beans*	*Off-site #3 tomatoes*
Americium-241	pCi/g	0.000839U	0.00143U	0.00137U
Neptunium-237	pCi/g	0U	-0.000654U	0.000333U
Plutonium-238	pCi/g	-0.000283U	0U	0U
Plutonium-239/240	pCi/g	0.00113U	0.000299U	0U
Technetium-99	pCi/g	-0.0112U	0.0306U	-0.0259U
Uranium	µg/g	0.000856U	0.000504U	0.00114U
Uranium-233/234	pCi/g	0U	0.000292U	-0.000276U
Uranium-235/236	pCi/g	0U	0.00109U	0.000686U
Uranium-238	pCi/g	0.000288U	0U	0.000276U

Table 2.16. Biota (crops) monitoring program results – 2013 (continued)

Parameter	Unit	Location/results[a,b]		
		Off-site #4 cauliflower	*Off-site #4 cucumbers*	*Off-site #4 green peppers*
Americium-241	pCi/g	0.00296U	0.0017U	0.00291U
Neptunium-237	pCi/g	-0.000347U	-0.000344U	0.000333U
Plutonium-238	pCi/g	0.000596U	0U	-0.00114U
Plutonium-239/240	pCi/g	0.000298U	0U	0U
Technetium-99	pCi/g	0.0803U	0.104U	-0.0174U
Uranium	µg/g	0.000901U	0.00101U	0.00232U
Uranium-233/234	pCi/g	0.00101U	0.00114U	0.000835U
Uranium-235/236	pCi/g	0.000315U	0.000354U	-0.000346U
Uranium-238	pCi/g	0.000254U	0.000284U	0.000835U
		Off-site #4 peppers	*Off-site #4 tomatoes*	*Off-site #5 blackberries*
Americium-241	pCi/g	0.00245UJ	0U	0.00116U
Neptunium-237	pCi/g	0.000317U	0U	0.00064U
Plutonium-238	pCi/g	0.00143U	0.000294U	-0.000907U
Plutonium-239/240	pCi/g	0U	-0.000884U	0U
Technetium-99	pCi/g	-0.00206U	0.00678U	0.0321U
Uranium	µg/g	0.00121U	0.000329U	-0.000333U
Uranium-233/234	pCi/g	0.000587U	0.000286U	-0.00029U
Uranium-235/236	pCi/g	0.00073U	0.000711U	-0.00072U
Uranium-238	pCi/g	0.000293U	0U	0U
		Off-site #5 blackberries (duplicate sample)	*Off-site #5 tomatoes*	*Off-site #5 tomatoes (duplicate sample)*
Americium-241	pCi/g	0.00114U	0U	0.00062U
Neptunium-237	pCi/g	-0.000333U	0.000657U	-0.0007U
Plutonium-238	pCi/g	-0.00113U	-0.000584U	0.000304U
Plutonium-239/240	pCi/g	0U	0.000585U	0.000304U
Technetium-99	pCi/g	0.0356U	0.0726U	0.0491U
Uranium	µg/g	0.0017U	0.00305U	0.000158U
Uranium-233/234	pCi/g	0.00057U	0.00121U	0U
Uranium-235/236	pCi/g	0U	0.000754U	0.000341U
Uranium-238	pCi/g	0.00057U	0.000909U	0U

Table 2.16. Biota (crops) monitoring program results – 2013 (continued)

Parameter	Unit	Location/results[a,b]		
		Off-site #6 corn	*Off-site #6 cucumbers*	*Off-site #6 red peppers*
Americium-241	pCi/g	0.00179U	0.00146U	0.00152U
Neptunium-237	pCi/g	-0.000322U	0U	-0.000964U
Plutonium-238	pCi/g	0.000945U	0.000566U	-0.000295U
Plutonium-239/240	pCi/g	0.000315U	0.000283U	-0.000295U
Technetium-99	pCi/g	-0.0145U	0.0875U	0.0656U
Uranium	µg/g	0.0000000906U	0.00201U	0.00249U
Uranium-233/234	pCi/g	0.000564U	0.000283U	-0.00111U
Uranium-235/236	pCi/g	0U	0.000704U	0U
Uranium-238	pCi/g	0U	0.000566U	0.000836U
		Off-site #6 tomatoes		
Americium-241	pCi/g	0.000582U		
Neptunium-237	pCi/g	0.000982U		
Plutonium-238	pCi/g	0U		
Plutonium-239/240	pCi/g	0U		
Technetium-99	pCi/g	0.015U		
Uranium	µg/g	0U		
Uranium-233/234	pCi/g	0U		
Uranium-235/236	pCi/g	0U		
Uranium-238	pCi/g	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.

Table 2.17. Off-site dairy monitoring – 2013

Parameter	Units	Milk[a,b]	Eggs[a,b] (March 2013)	Eggs[a,b] (December 2013)
Americium-241	pCi/g	0.00179U	0.00573U	0.00448U
Neptunium-237	pCi/g	0.00134U	0.000717U	-0.000481U
Plutonium-238	pCi/g	0.000846U	0.000714U	0U
Plutonium-239/240	pCi/g	0.00338U	0.00214U	0.000769U
Technetium-99	pCi/g	1.09E-16U[c]	-0.0127U	-0.0347U
Uranium	µg/g	0.000245U	-0.000375U	0.00257U
Uranium-233/234	pCi/g	0.00127U	-0.000651U	0U
Uranium-235/236	pCi/g	0.000528U	-0.000809U	0U
Uranium-238	pCi/g	0U	0U	0.000865U

[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.
[c]The result, reported in scientific notation, is undetected at 0.000000000000000109 pCi/g.

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 – 2013
- Table 3.2. Predicted radiation doses from airborne releases at PORTS – 2013
- Table 3.3. Dose calculations for ambient air monitoring stations – 2013.

Table 3.1. Emissions (Ci/year) from DOE air emission sources – 2013

Radionuclide	Group 1[a]	Group 2[b]	Group 3[c]	DUF_6 facility[d]
Americium-241	4.456E-07	-	7.109E-06	-
Neptunium-237	4.878E-08	-	5.158E-05	-
Plutonium-238	1.039E-07	-	7.807E-07	-
Plutonium-239/240	3.768E-07	-	5.057E-05	-
Technetium-99	4.273E-03	1.586E-03	1.468E-02	-
Uranium-233/234	4.230E-05	7.504E-05	5.692E-03	1.18E-06
Uranium-235	1.275E-05	4.569E-06	2.630E-04	5.39E-08
Uranium-238	4.170E-05	5.654E-05	9.977E-04	2.89E-06
Thorium-228	3.740E-08	2.996E-08	3.393E-10	-
Thorium-230	3.750E-08	2.732E-06	3.399E-10	-
Thorium-231	1.267E-05	4.569E-06	1.915E-04	2.01E-07
Thorium-232	2.290E-09	0	2.074E-11	-
Thorium-234	4.160E-05	5.654E-05	6.203E-04	1.83E-05
Protactinium-234m	4.106E-05	5.654E-05	6.203E-04	1.83E-05
Total	4.466E-03	1.843E-03	2.317E-02	4.09E-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 – 2013

Effective dose to:	DOE releases	All PORTS releases (DOE and USEC, Inc.)
Maximally exposed individual (mrem/year)	0.047	0.047
Population[a] (person-rem/year)	0.256	0.256

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

Table 3.3. Dose calculations for ambient air monitoring stations – 2013

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A3	Americium-241	2.7E-09		
	Neptunium-237	7.3E-10		
	Plutonium-238	6.6E-10		
	Plutonium-239/240	2.4E-09		
	Technetium-99	2.7E-03		
	Uranium-233/234	2.0E-06		
	Uranium-235/236	3.7E-08	(0.0027)	(0.00050)
	Uranium-238	5.2E-07	2.7E-03	5.0E-04
A6	Americium-241	4.1E-09		
	Neptunium-237	1.6E-09		
	Plutonium-238	1.3E-09		
	Plutonium-239/240	3.0E-09		
	Technetium-99	1.4E-03		
	Uranium-233/234	6.0E-07		
	Uranium-235/236	2.1E-08	(0.0014)	
	Uranium-238	5.3E-07	1.4E-03	0
A8	Americium-241	2.6E-09		
	Neptunium-237	0		
	Plutonium-238	1.6E-09		
	Plutonium-239/240	1.5E-09		
	Technetium-99	3.3E-03		
	Uranium-233/234	1.7E-06		
	Uranium-235/236	3.8E-08	(0.0033)	(0.0011)
	Uranium-238	3.6E-07	3.3E-03	1.1E-03
A9	Americium-241	2.8E-09		
	Neptunium-237	0		
	Plutonium-238	9.7E-10		
	Plutonium-239/240	2.8E-09		
	Technetium-99	4.0E-03		
	Uranium-233/234	7.1E-07		
	Uranium-235/236	4.2E-08	(0.0040)	(0.0018)
	Uranium-238	7.0E-07	4.0E-03	1.8E-03

Table 3.3. Dose calculations for ambient air monitoring stations – 2013 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A10	Americium-241	9.2E-06		
	Neptunium-237	5.7E-08		
	Plutonium-238	1.7E-09		
	Plutonium-239/240	8.4E-09		
	Technetium-99	1.8E-03		
	Uranium-233/234	2.5E-06		
	Uranium-235/236	5.8E-08	(0.0018)	
	Uranium-238	2.5E-06	1.8E-03	0
A12	Americium-241	5.5E-06		
	Neptunium-237	1.4E-08		
	Plutonium-238	9.5E-10		
	Plutonium-239/240	4.6E-09		
	Technetium-99	2.3E-03		
	Uranium-233/234	3.0E-06		
	Uranium-235/236	5.5E-08	(0.0023)	(0.00010)
	Uranium-238	4.3E-07	2.3E-03	1.0E-04
A15	Americium-241	3.1E-06		
	Neptunium-237	2.7E-08		
	Plutonium-238	1.9E-09		
	Plutonium-239/240	7.8E-09		
	Technetium-99	2.0E-03		
	Uranium-233/234	1.1E-06		
	Uranium-235/236	2.8E-08	(0.0020)	
	Uranium-238	3.5E-07	2.0E-03	0
A23	Americium-241	5.5E-06		
	Neptunium-237	3.7E-08		
	Plutonium-238	1.7E-09		
	Plutonium-239/240	6.3E-09		
	Technetium-99	1.5E-03		
	Uranium-233/234	3.1E-06		
	Uranium-235/236	6.9E-08	(0.0015)	
	Uranium-238	5.0E-07	1.5E-03	0
A24	Americium-241	3.2E-06		
	Neptunium-237	4.8E-08		
	Plutonium-238	2.6E-09		
	Plutonium-239/240	5.7E-09		
	Technetium-99	1.6E-03		
	Uranium-233/234	1.9E-06		
	Uranium-235/236	3.8E-08	(0.0016)	
	Uranium-238	7.4E-07	1.6E-03	0

Table 3.3. Dose calculations for ambient air monitoring stations – 2013 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
A28	Americium-241	5.0E-06		
	Neptunium-237	1.6E-08		
	Plutonium-238	1.1E-09		
	Plutonium-239/240	6.3E-09		
	Technetium-99	2.0E-03		
	Uranium-233/234	4.2E-07		
	Uranium-235/236	3.0E-08	(0.0020)	
	Uranium-238	3.2E-07	2.0E-03	0
A29	Americium-241	1.2E-06		
	Neptunium-237	2.4E-08		
	Plutonium-238	2.5E-09		
	Plutonium-239/240	9.4E-09		
	Technetium-99	2.4E-03		
	Uranium-233/234	1.3E-06		
	Uranium-235/236	4.0E-08	(0.0024)	(0.00020)
	Uranium-238	6.1E-07	2.4E-03	2.0E-04
A36	Americium-241	4.5E-09		
	Neptunium-237	2.0E-09		
	Plutonium-238	9.8E-10		
	Plutonium-239/240	2.3E-09		
	Technetium-99	2.1E-03		
	Uranium-233/234	5.4E-06		
	Uranium-235/236	2.1E-07	(0.0021)	
	Uranium-238	3.2E-07	2.1E-03	0
A37	Americium-241	4.1E-09		
	Neptunium-237	8.1E-10		
	Plutonium-238	1.1E-09		
	Plutonium-239/240	1.8E-09		
	Technetium-99	2.2E-03		
	Uranium-233/234	3.0E-07		
	Uranium-235/236	2.9E-08	(0.0022)	
	Uranium-238	3.5E-07	2.2E-03	-

Table 3.3. Dose calculations for ambient air monitoring stations – 2013 (continued)

Station	Parameter[a]	Dose[b] (mrem/year)	Total dose for station[c]	Net dose for station[d]
T7	Americium-241	2.7E-09		
	Neptunium-237	3.0E-09		
	Plutonium-238	1.0E-09		
	Plutonium-239/240	2.5E-09		
	Technetium-99	1.3E-03		
	Uranium-233/234	6.9E-07		
	Uranium-235/236	5.4E-08	(0.0013)	
	Uranium-238	4.4E-07	1.3E-03	0

[a]Parameters listed in **bold** type were detected at least once in the samples collected in 2013 (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 2013 at the following locations:

- X-749/X-120/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 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 2013. Sampling for radionuclides is not part of the monitoring programs for the 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 2013. 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. Trichloroethene was also detected in at least one laboratory blank associated with the routine groundwater monitoring samples collected during 2013.

Other VOCs, including trichloroethene, chloromethane, and toluene were detected in trip and/or field blanks during 2013. 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, as stated in the *Quality Assurance Project Plan,* is to determine the nature and extent of contamination in groundwater and associated surface water at PORTS. Data collected in 2013 meet this purpose.

Complete groundwater monitoring results for sampling completed as required by the *Integrated Groundwater Monitoring Plan* are provided in the *2013 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant*. The *2013 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* also provides data for the interim remedial measures and other non-routine sampling conducted during 2013 at the Quadrant II Groundwater Investigative (7-Unit) Area, X-701B Holding Pond, X-630 and X-633 Former Recirculating Cooling Water Complexes, and X-740 Former Waste Oil Handling Facility.

Duplicate samples (samples collected from the same location, at the same time, and from the same sampling device as the regular sample) 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. Results for duplicate samples, when collected, are provided in the *2013 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant*. Additionally, three wells that monitor the X-616 Former Chromium Sludge Surface Impoundments were sampled in both February and March of 2013 due to anomalies in the analytical results for the February 2013 samples. Table 4.10 includes only the results for the samples collected in March 2013. The *2013 Groundwater Monitoring Report for the Portsmouth Gaseous Diffusion Plant* provides the results for the samples collected in February 2013.

The following tables are included in this section:

- Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013
- Table 4.2. Results for radionuclides at the X-749/X-120/PK Landfill – 2013
- Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013
- Table 4.4. Results for radionuclides at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013
- Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2013
- Table 4.6. Results for radionuclides at the Quadrant II Groundwater Investigative (7-Unit) Area – 2013
- Table 4.7. VOCs detected at the X-701B Holding Pond – 2013
- Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013
- Table 4.9. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2013
- Table 4.10. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2013
- Table 4.11. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2013

- Table 4.12. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2013
- Table 4.13. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2013
- Table 4.14. VOCs detected at the X-735 Landfills – 2013
- Table 4.15. Results for radionuclides at the X-735 Landfills – 2013
- Table 4.16. VOCs detected at the X-734 Landfills – 2013
- Table 4.17. Results for radionuclides at the X-734 Landfills – 2011
- Table 4.18. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2013
- Table 4.19. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2013
- Table 4.20. VOCs detected at surface water monitoring locations – 2013
- Table 4.21. Results for radionuclides at surface water monitoring locations – 2013
- Table 4.22. Results for radionuclides at exit pathway monitoring locations – 2013.

A table for VOCs detected at exit pathway monitoring locations is not provided because none were detected in the sample collected from well F-29B. Results for other exit pathway monitoring locations sampled during 2013 (that are part of the monitoring programs for other areas) are provided in the tables for their respective monitoring areas as follows:

- Tables 4.1 and 4.2: VOCs and radionuclides detected at the X-749/X-120/PK Landfill (wells X749-14B, X749-44G, X749-45G, X749-64B, X749-68G, X749-96G, X749-97G, and X749-98G).
- Tables 4.7 and 4.8: VOCs and radionuclides detected at X-701B Holding Pond area well X701-48G.
- Tables 4.20 and 4.21: 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.
E	Organics (VOCs): the reported result exceeds the calibration range.
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/X-120/PK Landfill – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-27G	1,1-Dichloroethane	µg/L			0.68 J	
	cis-1,2-Dichloroethene	µg/L			0.41 J	
MH GW-4	1,1-Dichloroethane	µg/L			0.24 J	
	Chlorobenzene	µg/L			0.36 J	
	cis-1,2-Dichloroethene	µg/L			0.95 J	
MH GW-5	1,1-Dichloroethane	µg/L			0.96 J	
	cis-1,2-Dichloroethene	µg/L			2	
PK-08G	Acetone	µg/L			2.7 J	
	cis-1,2-Dichloroethene	µg/L			0.27 J	
	Trichloroethene	µg/L			7.4	
PK-09G	Acetone	µg/L			14	
	Chloroform	µg/L			0.26 J	
	cis-1,2-Dichloroethene	µg/L			4.5	
	Trichloroethene	µg/L			230	
PK-10G	Methylene chloride	µg/L		0.38 J		0.32 U
PK-14G	Acetone	µg/L		1.9 U		19 B
PK-15B	Acetone	µg/L		1.9 U		19 B
	cis-1,2-Dichloroethene	µg/L		0.16 J		0.15 U
	Methylene chloride	µg/L		0.43 BJ		0.32 U
	Vinyl chloride	µg/L		0.32 J		0.26 J
PK-16G	Acetone	µg/L		1.9 U		23 B
	cis-1,2-Dichloroethene	µg/L		0.25 J		0.39 J
	Methylene chloride	µg/L		0.34 BJ		0.32 U
PK-17B	1,1-Dichloroethane	µg/L		3.3		3.4
	1,1-Dichloroethene	µg/L		0.53 J		0.25 J
	Acetone	µg/L		1.9 U		44 B
	Benzene	µg/L		0.22 J		0.17 J
	Chlorobenzene	µg/L		0.64 J		0.5 J
	cis-1,2-Dichloroethene	µg/L		47		45
	Methylene chloride	µg/L		0.32 BJ		0.32 U
	trans-1,2-Dichloroethene	µg/L		1.6		1.3
	Trichloroethene	µg/L		1.4		0.59 J
	Vinyl chloride	µg/L		15		17
PK-18B	Acetone	µg/L		1.9 U		4.3 BJ
PK-19B	1,1-Dichloroethane	µg/L		0.58 J		0.67 J
	Acetone	µg/L		41		19 B
	Chloroethane	µg/L		2		1.9 J
	Vinyl chloride	µg/L		0.1 U		0.21 J
PK-21B	1,1-Dichloroethane	µg/L		140		110
	1,1-Dichloroethene	µg/L		1.2		1.4
	1,2-Dichloroethane	µg/L		0.75 J		0.62 J
	Benzene	µg/L		0.67 J		0.67 J
	cis-1,2-Dichloroethene	µg/L		11		11
	Trichloroethene	µg/L		0.34 J		0.34 J
	Vinyl chloride	µg/L		17		14 J
PK-PL6	1,1,1-Trichloroethane	µg/L	0.19 J	0.27 J	0.16 U	0.16 U
	1,1-Dichloroethane	µg/L	0.72 J	1.1	0.6 J	0.94 J
	Acetone	µg/L	1.9 U	1.9 U	1.9 U	11
	Chlorobenzene	µg/L	0.17 U	0.17 U	0.17 U	0.2 J
	cis-1,2-Dichloroethene	µg/L	1.7	2.7	1.7	2.9

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
PK-PL6	Trichloroethene	µg/L	0.19 J	3.7	1	0.48 J
	Vinyl chloride	µg/L	0.1 U	0.1 U	0.1 U	0.17 J
PK-PL6A	1,1,1-Trichloroethane	µg/L	5.4	9.8	1.3	2.7
	1,1-Dichloroethane	µg/L	14	18	14	17
	1,1-Dichloroethene	µg/L	3.4	6	2	3
	cis-1,2-Dichloroethene	µg/L	1.9	2.6	3.1	3.8
	Trichloroethene	µg/L	2.1	4.6	2.1	2.6
	Vinyl chloride	µg/L	0.28 J	0.56 J	0.9 J	1.4
STSW-101G	1,1,1-Trichloroethane	µg/L		12		11
	1,1,2-Trichloroethane	µg/L		0.97 J		0.89 J
	1,1-Dichloroethane	µg/L		27		24
	1,1-Dichloroethene	µg/L		55		60
	1,2-Dichloroethane	µg/L		6.1		5.1
	Chloroform	µg/L		2.4		2.1
	cis-1,2-Dichloroethene	µg/L		20		19
	Tetrachloroethene	µg/L		1.1		0.99 J
	Trichloroethene	µg/L		66		60
STSW-102G	1,1,1-Trichloroethane	µg/L		14		12
	1,1,2-Trichloroethane	µg/L		0.58 J		0.27 U
	1,1-Dichloroethane	µg/L		120		94
	1,1-Dichloroethene	µg/L		52		57
	1,2-Dichloroethane	µg/L		46		35
	Benzene	µg/L		0.23 J		0.16 U
	Chloroethane	µg/L		0.41 U		0.92 J
	Chloroform	µg/L		5		4.2
	cis-1,2-Dichloroethene	µg/L		36		34
	Tetrachloroethene	µg/L		0.22 J		0.2 J
	trans-1,2-Dichloroethene	µg/L		0.28 J		0.43 J
	Trichloroethene	µg/L		250		230
	Vinyl chloride	µg/L		0.1 U		0.26 J
WP-07G	Acetone	µg/L	1.9 U	1.9 U	4.4 J	1.9 U
X120-03G	Chloroform	µg/L			1.3	
X120-05G	Trichloroethene	µg/L			2.7	
X120-08G	1,1,1-Trichloroethane	µg/L			4.4	
	1,1,2-Trichloroethane	µg/L			0.38 J	
	1,1-Dichloroethane	µg/L			4.8	
	1,1-Dichloroethene	µg/L			18	
	1,2-Dichloroethane	µg/L			0.66 J	
	Chloroform	µg/L			0.73 J	
	cis-1,2-Dichloroethene	µg/L			0.35 J	
	Trichloroethene	µg/L			11	
X120-09G	1,1,1-Trichloroethane	µg/L			7.8	
	1,1,2-Trichloroethane	µg/L			0.92 J	
	1,1-Dichloroethane	µg/L			12	
	1,1-Dichloroethene	µg/L			42	
	1,2-Dichloroethane	µg/L			1.2	
	Chloroform	µg/L			1.3	
	cis-1,2-Dichloroethene	µg/L			1.2	
	Tetrachloroethene	µg/L			0.42 J	
	Trichloroethene	µg/L			25	

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X120-10G	1,1,1-Trichloroethane	µg/L			3.8	
	1,1,2-Trichloroethane	µg/L			0.76 J	
	1,1-Dichloroethane	µg/L			8.3	
	1,1-Dichloroethene	µg/L			30	
	1,2-Dichloroethane	µg/L			0.77 J	
	Acetone	µg/L			4.4 J	
	Chloroform	µg/L			0.96 J	
	cis-1,2-Dichloroethene	µg/L			0.28 J	
	Trichloroethene	µg/L			6	
X120-11G	1,1-Dichloroethene	µg/L		0.53 J		0.56 J
	Acetone	µg/L		18		1.9 U
	cis-1,2-Dichloroethene	µg/L		5.8		12
	trans-1,2-Dichloroethene	µg/L		0.18 J		0.2 J
	Trichloroethene	µg/L		290		200
	Vinyl chloride	µg/L		0.2 U		0.12 J
X749-04G	Acetone	µg/L			27 J	
	Tetrachloroethene	µg/L			2.3 J	
	Trichloroethene	µg/L			630	
X749-05G	1,1-Dichloroethane	µg/L			0.41 J	
	Acetone	µg/L			1.9 BJ	
	Carbon tetrachloride	µg/L			0.28 J	
	Chloroform	µg/L			0.83 J	
	cis-1,2-Dichloroethene	µg/L			0.96 J	
	Tetrachloroethene	µg/L			2.7	
	Trichloroethene	µg/L			74	
X749-06G	1,1,1-Trichloroethane	µg/L		59		43
	1,1,2-Trichloroethane	µg/L		5.9		4.8
	1,1-Dichloroethane	µg/L		290		270
	1,1-Dichloroethene	µg/L		270		210
	1,2-Dichloroethane	µg/L		5.9		4.7
	Acetone	µg/L		31 J		11 J
	Benzene	µg/L		0.64 U		0.43 J
	Chloroform	µg/L		24		19
	cis-1,2-Dichloroethene	µg/L		58		62
	Tetrachloroethene	µg/L		20		21
	trans-1,2-Dichloroethene	µg/L		0.6 U		0.39 J
	Trichloroethene	µg/L		840		850
	Vinyl chloride	µg/L		1.8 J		2.3
X749-07G	1,1,1-Trichloroethane	µg/L		21		17
	1,1,2-Trichloroethane	µg/L		0.38 J		0.42 J
	1,1-Dichloroethane	µg/L		36		69
	1,1-Dichloroethene	µg/L		38		32
	1,2-Dichloroethane	µg/L		15		37
	Acetone	µg/L		3.4 J		2.7 J
	Chloroform	µg/L		2		2.4
	cis-1,2-Dichloroethene	µg/L		7.7		15
	Tetrachloroethene	µg/L		0.79 J		0.69 J
	Trichloroethene	µg/L		110		120
	Vinyl chloride	µg/L		0.53 J		0.55 J
X749-08G	1,1,1-Trichloroethane	µg/L		11		7.8

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-08G	1,1-Dichloroethane	µg/L		3.6		2.9
	1,1-Dichloroethene	µg/L		18		12
	1,2-Dichloroethane	µg/L		0.66 J		0.59 J
	Chloroform	µg/L		0.31 J		0.31 J
	cis-1,2-Dichloroethene	µg/L		4.3		3
	Trichloroethene	µg/L		25		19
X749-09GA	1,1,1-Trichloroethane	µg/L		8.5		9.3
	1,1-Dichloroethane	µg/L		2		3.3
	1,1-Dichloroethene	µg/L		5.9		9
	1,2-Dichloroethane	µg/L		0.23 J		0.43 J
	Chloroform	µg/L		0.16 U		0.27 J
	cis-1,2-Dichloroethene	µg/L		1.2		2.3
	Trichloroethene	µg/L		6.8		8.4
X749-10GA	1,1-Dichloroethane	µg/L		4.2		4.4
	1,1-Dichloroethene	µg/L		13		11
	Acetone	µg/L		2.7 J		1.9 U
	Chloroethane	µg/L		0.5 J		0.51 J
	cis-1,2-Dichloroethene	µg/L		2.7		3.1
	Trichloroethene	µg/L		0.34 J		0.37 J
	Vinyl chloride	µg/L		1.5		1.5
X749-13G	1,1,1-Trichloroethane	µg/L		6.5		6.1
	1,1-Dichloroethane	µg/L		2.4		2.3
	1,1-Dichloroethene	µg/L		13		15
	1,2-Dichloroethane	µg/L		0.13 U		0.33 J
	Acetone	µg/L		1.9 U		2.1 J
	Chloroform	µg/L		0.44 J		0.46 J
	cis-1,2-Dichloroethene	µg/L		2.1		2.5
	Trichloroethene	µg/L		17		18
X749-14B	Acetone	µg/L		23		1.9 U
	Trichloroethene	µg/L		1.2		0.16 U
X749-20G	1,1,1-Trichloroethane	µg/L			1.1	
	1,1-Dichloroethane	µg/L			2.5	
	1,1-Dichloroethene	µg/L			3	
	1,2-Dichloroethane	µg/L			0.54 J	
	Acetone	µg/L			3.6 J	
	Chloroform	µg/L			0.2 J	
	cis-1,2-Dichloroethene	µg/L			1.5	
	Trichloroethene	µg/L			22	
X749-21G	1,1,1-Trichloroethane	µg/L		0.55 J		2.8
	1,1-Dichloroethane	µg/L		0.22 U		0.84 J
	1,1-Dichloroethene	µg/L		0.28 J		2.1
	cis-1,2-Dichloroethene	µg/L		0.15 U		0.33 J
	Trichloroethene	µg/L		2.5		3.4
X749-22G	1,1-Dichloroethane	µg/L		1.7		1.5
	1,1-Dichloroethene	µg/L		1.5		1.8
	cis-1,2-Dichloroethene	µg/L		0.33 J		0.41 J
	Vinyl chloride	µg/L		0.39 J		0.1 U
X749-23G	Acetone	µg/L		6.5 J		1.9 U
X749-26G	1,1,1-Trichloroethane	µg/L		3.1		1.8
	1,1-Dichloroethane	µg/L		6.5		3.1

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-26G	1,1-Dichloroethene	µg/L		8.8		3.9
	1,2-Dichloroethane	µg/L		3.4		1.4
	Chloroform	µg/L		0.54 J		0.31 J
	cis-1,2-Dichloroethene	µg/L		1.3		0.6 J
	Trichloroethene	µg/L		18		8.1
X749-27G	1,1,1-Trichloroethane	µg/L		28		19
	1,1,2-Trichloroethane	µg/L		1.1		0.83 J
	1,1-Dichloroethane	µg/L		72		27
	1,1-Dichloroethene	µg/L		130		53
	1,2-Dichloroethane	µg/L		36		10
	Acetone	µg/L		7.5 J		4.2 J
	Chloroethane	µg/L		2		0.67 J
	Chloroform	µg/L		7.9		3.7
	cis-1,2-Dichloroethene	µg/L		32		11
	Tetrachloroethene	µg/L		1.5		1.3
	trans-1,2-Dichloroethene	µg/L		0.19 J		0.15 U
	Trichloroethene	µg/L		150		92
	Vinyl chloride	µg/L		0.4 J		0.15 J
X749-28G	1,1,1-Trichloroethane	µg/L			8.7	
	1,1,2-Trichloroethane	µg/L			0.31 J	
	1,1-Dichloroethane	µg/L			6.6	
	1,1-Dichloroethene	µg/L			25	
	Chloroform	µg/L			1.2	
	cis-1,2-Dichloroethene	µg/L			0.88 J	
	Tetrachloroethene	µg/L			0.43 J	
	Trichloroethene	µg/L			39	
X749-29G	Trichloroethene	µg/L			4.6	
X749-30G	1,1-Dichloroethene	µg/L			1.3	
	Acetone	µg/L			2.3 J	
	Chloroform	µg/L			0.39 J	
	cis-1,2-Dichloroethene	µg/L			0.65 J	
	Trichloroethene	µg/L			25	
X749-33G	1,1,1-Trichloroethane	µg/L		20		14
	1,1,2-Trichloroethane	µg/L		0.89 J		1.1
	1,1-Dichloroethane	µg/L		42		25
	1,1-Dichloroethene	µg/L		90		63
	1,2-Dichloroethane	µg/L		24		7.6
	Acetone	µg/L		2.5 J		1.9 U
	Chloroform	µg/L		4.9		3.3
	cis-1,2-Dichloroethene	µg/L		7.6		10
	Methylene chloride	µg/L		0.61 BJ		0.32 U
	Tetrachloroethene	µg/L		1.2		1.4
	Trichloroethene	µg/L		120		93
	Vinyl chloride	µg/L		0.1 U		0.13 J
X749-35G	1,1,1-Trichloroethane	µg/L			52	
	1,1,2-Trichloroethane	µg/L			0.33 J	
	1,1-Dichloroethane	µg/L			7.7	
	1,1-Dichloroethene	µg/L			22	
	Chloroform	µg/L			0.28 J	
	cis-1,2-Dichloroethene	µg/L			5.1	

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-35G	Tetrachloroethene	µg/L			0.2 J	
	trans-1,2-Dichloroethene	µg/L			0.18 J	
	Trichloroethene	µg/L			72	
	Vinyl chloride	µg/L			0.54 J	
X749-36G	1,1,1-Trichloroethane	µg/L			0.77 J	
	1,1-Dichloroethane	µg/L			1.1	
	1,1-Dichloroethene	µg/L			4	
	Chloroform	µg/L			0.16 J	
	Trichloroethene	µg/L			2.7	
X749-37G	1,1,1-Trichloroethane	µg/L		7.6		5.5
	1,1,2-Trichloroethane	µg/L		0.53 J		0.43 J
	1,1-Dichloroethane	µg/L		12		9
	1,1-Dichloroethene	µg/L		35		26
	1,2-Dichloroethane	µg/L		1.1		0.81 J
	Chloroform	µg/L		1.1		0.73 J
	cis-1,2-Dichloroethene	µg/L		5.9		4
	Tetrachloroethene	µg/L		0.62 J		0.55 J
	Trichloroethene	µg/L		29		25
X749-38G	1,1,1-Trichloroethane	µg/L		15		21
	1,1,2-Trichloroethane	µg/L		1.2		1.3
	1,1-Dichloroethane	µg/L		28		33
	1,1-Dichloroethene	µg/L		73		83
	1,2-Dichloroethane	µg/L		3.4		3.9
	Acetone	µg/L		6.7 J		1.9 U
	Chloroform	µg/L		2.5		3.4
	cis-1,2-Dichloroethene	µg/L		24		26
	Tetrachloroethene	µg/L		1.3		2.2
	Trichloroethene	µg/L		71		92
	Vinyl chloride	µg/L		0.1 U		0.16 J
X749-40G	Acetone	µg/L			2.6 J	
	Chloroform	µg/L			0.36 J	
	Trichloroethene	µg/L			0.17 J	
X749-41G	Acetone	µg/L		19 J		1.9 U
	Chloroform	µg/L		0.32 U		0.25 J
	cis-1,2-Dichloroethene	µg/L		2.3		2
	Methylene chloride	µg/L		1.8 J		0.32 U
	trans-1,2-Dichloroethene	µg/L		0.68 J		0.64 J
	Trichloroethene	µg/L		550		360
X749-42G	1,1,1-Trichloroethane	µg/L		0.16 U		0.21 J
	1,1-Dichloroethane	µg/L		0.22 U		0.36 J
	1,1-Dichloroethene	µg/L		0.23 U		0.87 J
	Acetone	µg/L		3.3 J		10
	Trichloroethene	µg/L		2.2		6.9
X749-43G	1,1-Dichloroethene	µg/L			0.23 J	
	Acetone	µg/L			9.7 J	
	Trichloroethene	µg/L			0.2 J	
X749-44G	1,1-Dichloroethane	µg/L	0.35 J	0.28 J	0.38 J	0.4 J
	Acetone	µg/L	3.2 J	1.9 U	1.9 U	1.9 U
	Trichloroethene	µg/L	0.61 J	0.5 J	0.78 J	0.74 J
X749-45G	1,1-Dichloroethane	µg/L	0.81 J	1.3	0.22 U	0.22 U

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-45G	1,1-Dichloroethene	µg/L	0.59 J	0.87 J	0.23 U	0.23 U
	1,2-Dichloroethane	µg/L	0.13 U	0.36 J	0.13 U	0.13 U
	cis-1,2-Dichloroethene	µg/L	0.86 J	1.4	0.15 U	0.15 U
	Trichloroethene	µg/L	1.6	2.5	0.55 J	0.3 J
X749-50B	1,1-Dichloroethane	µg/L			0.82 J	
	1,2-Dichloroethane	µg/L			0.26 J	
	Trichloroethene	µg/L			0.17 J	
X749-51B	Trichloroethene	µg/L			1.2	
X749-54B	1,1-Dichloroethane	µg/L		1.4		1.6
	Trichloroethene	µg/L		0.97 J		9.6
	Vinyl chloride	µg/L		0.1 U		0.22 J
X749-64B	Trichloroethene	µg/L			1.1	
X749-67G	1,1,1-Trichloroethane	µg/L	15	13	13	14
	1,1,2-Trichloroethane	µg/L	1.1 J	0.91 J	0.85 J	1 J
	1,1-Dichloroethane	µg/L	130	140	110	140
	1,1-Dichloroethene	µg/L	140	130	100	120
	1,2-Dichloroethane	µg/L	45	42	34	42
	1,4-Dichlorobenzene	µg/L	0.32 U	0.32 U	0.19 J	0.32 U
	Acetone	µg/L	3.8 U	3.8 U	5.9 J	3.8 U
	Benzene	µg/L	0.66 J	0.6 J	0.52 J	0.55 J
	Chloroethane	µg/L	2.9 J	2.8 J	2.1	1.6 J
	Chloroform	µg/L	6.3	6.1	5.4	6
	cis-1,2-Dichloroethene	µg/L	87	87	69	77
	Tetrachloroethene	µg/L	0.52 J	0.4 J	0.52 J	0.42 J
	trans-1,2-Dichloroethene	µg/L	0.81 J	0.8 J	0.49 J	0.56 J
	Trichloroethene	µg/L	430	450	400	400
	Vinyl chloride	µg/L	0.1 U	0.2 U	0.63 J	0.77 J
X749-96G	Acetone	µg/L		50		1.9 U
X749-97G	Acetone	µg/L	1.9 U	8.6 J	1.9 U	1.9 U
	Trichloroethene	µg/L	0.16 U	2.8	0.16 U	0.16 U
X749-98G	Acetone	µg/L		9 J		1.9 U
X749-99M	Trichloroethene	µg/L			0.2 J	
X749-102G	Acetone	µg/L	2.2 J	1.9 U	1.9 U	1.9 U
	Trichloroethene	µg/L	0.17 J	0.19 J	0.16 U	0.16 U
X749-105G	Acetone	µg/L		24		1.9 U
X749-106G	1,1,1-Trichloroethane	µg/L		22		23
	1,1,2-Trichloroethane	µg/L		2.2		2.3
	1,1-Dichloroethane	µg/L		32		34
	1,1-Dichloroethene	µg/L		110		120
	1,2-Dichloroethane	µg/L		3.4		3.5
	Chloroform	µg/L		3.4		3.6
	cis-1,2-Dichloroethene	µg/L		3.3		3.4
	Tetrachloroethene	µg/L		1.1		0.93 J
	Trichloroethene	µg/L		73		73
	Vinyl chloride	µg/L		0.1 U		0.15 J
X749-107G	1,1,1-Trichloroethane	µg/L		25		25
	1,1,2-Trichloroethane	µg/L		2.6		2.7
	1,1-Dichloroethane	µg/L		38		38
	1,1-Dichloroethene	µg/L		150		140
	1,2-Dichloroethane	µg/L		3.9		3.9

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-107G	Chloroform	µg/L		4.1		4.2
	cis-1,2-Dichloroethene	µg/L		4.3		3.7
	Tetrachloroethene	µg/L		1.1		0.87 J
	Trichloroethene	µg/L		100		88
X749-108G	1,1,1-Trichloroethane	µg/L		48		57
	1,1,2-Trichloroethane	µg/L		3.1		3.3
	1,1-Dichloroethane	µg/L		53		54
	1,1-Dichloroethene	µg/L		160		170
	1,2-Dichloroethane	µg/L		4.7		5.2
	Chloroform	µg/L		5.7		6.3
	cis-1,2-Dichloroethene	µg/L		5.7		5.7
	Tetrachloroethene	µg/L		1.5		1.6
	Trichloroethene	µg/L		140		120
	Vinyl chloride	µg/L		0.1 U		0.39 J
X749-109G	1,1,1-Trichloroethane	µg/L		5.8		6.8
	1,1,2-Trichloroethane	µg/L		0.63 J		0.79 J
	1,1-Dichloroethane	µg/L		15		17
	1,1-Dichloroethene	µg/L		29		41
	1,2-Dichloroethane	µg/L		2.3		2.3
	Acetone	µg/L		1.9 U		5.3 J
	Chloroform	µg/L		1.3		1.5
	cis-1,2-Dichloroethene	µg/L		5		5.9
	Tetrachloroethene	µg/L		0.29 J		0.29 J
	Trichloroethene	µg/L		34		35
X749-110G	1,1,1-Trichloroethane	µg/L		2.4		3.2
	1,1-Dichloroethane	µg/L		10		10
	1,1-Dichloroethene	µg/L		15		16
	1,2-Dichloroethane	µg/L		3.5		3.1
	Chloroethane	µg/L		1.1 J		0.83 J
	Chloroform	µg/L		0.79 J		0.71 J
	cis-1,2-Dichloroethene	µg/L		13		14
	trans-1,2-Dichloroethene	µg/L		0.21 J		0.4 J
	Trichloroethene	µg/L		40		46
	Vinyl chloride	µg/L		0.41 J		0.27 J
X749-112G	Acetone	µg/L		25		1.9 U
	Trichloroethene	µg/L		0.16 U		0.17 J
X749-113G	1,1,1-Trichloroethane	µg/L		15		18
	1,1,2-Trichloroethane	µg/L		0.35 J		0.45 J
	1,1-Dichloroethane	µg/L		19		24
	1,1-Dichloroethene	µg/L		35		42
	1,2-Dichloroethane	µg/L		9.7		14
	Acetone	µg/L		7.5 J		1.9 U
	Chloroform	µg/L		2		2.5
	cis-1,2-Dichloroethene	µg/L		2.5		4
	Tetrachloroethene	µg/L		0.59 J		0.59 J
	Trichloroethene	µg/L		51		60 E
X749-114G	1,1,1-Trichloroethane	µg/L			0.19 J	
	1,1-Dichloroethane	µg/L			0.28 J	
	Benzene	µg/L			0.2 J	
	cis-1,2-Dichloroethene	µg/L			0.92 J	

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-114G	Trichloroethene	µg/L			0.35 J	
X749-115G	Acetone	µg/L			2.7 J	
	Chloroform	µg/L			0.27 J	
	cis-1,2-Dichloroethene	µg/L			5.8	
	Trichloroethene	µg/L			260	
X749-117G	1,1-Dichloroethane	µg/L			0.22 J	
	Chloroform	µg/L			1.8	
	cis-1,2-Dichloroethene	µg/L			0.51 J	
	Tetrachloroethene	µg/L			0.45 J	
	Trichloroethene	µg/L			28	
X749-118G	1,1-Dichloroethane	µg/L			1.2	
	Carbon tetrachloride	µg/L			0.22 J	
	Chloroform	µg/L			0.42 J	
	cis-1,2-Dichloroethene	µg/L			1	
	Tetrachloroethene	µg/L			3	
	Trichloroethene	µg/L			72	
X749-119G	Chloroform	µg/L			1	
	cis-1,2-Dichloroethene	µg/L			0.63 J	
	Trichloroethene	µg/L			11	
X749-120G	1,1,1-Trichloroethane	µg/L			630	
	1,1,2-Trichloroethane	µg/L			87 J	
	1,1-Dichloroethane	µg/L			4400	
	1,1-Dichloroethene	µg/L			1800	
	1,2-Dichloroethane	µg/L			74 J	
	Chloroform	µg/L			360	
	cis-1,2-Dichloroethene	µg/L			1700	
	Methylene chloride	µg/L			110 J	
	Tetrachloroethene	µg/L			390	
	Trichloroethene	µg/L			15000	
	Vinyl chloride	µg/L			48 J	
X749-121G	1,1,1-Trichloroethane	µg/L			34	
	1,1,2-Trichloroethane	µg/L			0.73 J	
	1,1-Dichloroethane	µg/L			23	
	1,1-Dichloroethene	µg/L			140	
	1,2-Dichloroethane	µg/L			0.92 J	
	Chloroethane	µg/L			6.5	
	Chloroform	µg/L			1	
	cis-1,2-Dichloroethene	µg/L			14	
	Tetrachloroethene	µg/L			0.42 J	
	Trichloroethene	µg/L			85	
	Vinyl chloride	µg/L			2.1	
X749-122G	1,1,1-Trichloroethane	µg/L			350	
	1,1,2-Trichloroethane	µg/L			3.2 J	
	1,1-Dichloroethane	µg/L			84	
	1,1-Dichloroethene	µg/L			370	
	1,2-Dichloroethane	µg/L			5	
	Benzene	µg/L			1.2 J	
	Chloroform	µg/L			3.9 J	
	cis-1,2-Dichloroethene	µg/L			55	
	trans-1,2-Dichloroethene	µg/L			0.89 J	

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-122G	Trichloroethene	µg/L			770	
	Vinyl chloride	µg/L			4.1 J	
X749-BG9G	Carbon disulfide	µg/L		0.74 J		0.45 U
	Trichloroethene	µg/L		0.22 J		0.33 J
X749-PZ02G	Acetone	µg/L		1.9 U		2.1 J
	Trichloroethene	µg/L		0.36 J		0.5 J
X749-PZ03G	Acetone	µg/L		1.9 U		3.3 J
X749-PZ04G	1,1-Dichloroethane	µg/L	0.6 J	0.62 J	0.44 J	0.3 J
	1,1-Dichloroethene	µg/L	0.31 J	0.31 J	0.23 U	0.23 U
	1,2-Dichloroethane	µg/L	0.2 J	0.13 U	0.13 U	0.13 U
	Acetone	µg/L	1.9 U	10	1.9 U	1.9 J
	cis-1,2-Dichloroethene	µg/L	0.26 J	0.23 J	0.17 J	0.15 U
	Trichloroethene	µg/L	1.7	1.6	1.3	0.82 J
X749-PZ05G	Acetone	µg/L	1.9 U	23	1.9 U	1.9 U
	Trichloroethene	µg/L	0.16 U	0.16 U	0.16 U	0.18 J
X749-PZ06G	1,1,1-Trichloroethane	µg/L		14		14
	1,1,2-Trichloroethane	µg/L		1.4		1.3
	1,1-Dichloroethane	µg/L		25		25
	1,1-Dichloroethene	µg/L		71		73
	1,2-Dichloroethane	µg/L		2.4		2.4
	Acetone	µg/L		1.9 U		3.1 J
	Chloroform	µg/L		2.5		2.4
	cis-1,2-Dichloroethene	µg/L		3.6		3.5
	Tetrachloroethene	µg/L		0.36 J		0.4 J
	Trichloroethene	µg/L		52		50
X749-PZ07G	1,1,1-Trichloroethane	µg/L			0.38 J	
	1,1-Dichloroethane	µg/L			0.39 J	
	1,1-Dichloroethene	µg/L			1.4	
	Trichloroethene	µg/L			1.8	
X749-PZ08G	1,1-Dichloroethane	µg/L			0.26 J	
	Acetone	µg/L			3.6 J	
	cis-1,2-Dichloroethene	µg/L			0.52 J	
	Trichloroethene	µg/L			0.95 J	
X749-PZ09G	1,1,1-Trichloroethane	µg/L			1.8	
	1,1-Dichloroethane	µg/L			2.5	
	1,1-Dichloroethene	µg/L			6.1	
	Chloroform	µg/L			0.16 J	
	cis-1,2-Dichloroethene	µg/L			19	
	trans-1,2-Dichloroethene	µg/L			0.38 J	
	Trichloroethene	µg/L			50	
	Vinyl chloride	µg/L			0.67 J	
X749-PZ10G	1,1,1-Trichloroethane	µg/L		13		13
	1,1,2-Trichloroethane	µg/L		0.37 J		0.54 U
	1,1-Dichloroethane	µg/L		0.55 J		0.69 J
	1,1-Dichloroethene	µg/L		110		140
	1,2-Dichloroethane	µg/L		0.38 J		0.48 J
	Acetone	µg/L		44		59
	Chloroform	µg/L		24		27
	cis-1,2-Dichloroethene	µg/L		0.51 J		0.55 J
	Trichloroethene	µg/L		460		490

Table 4.1. VOCs detected at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-PZ11G	1,1,1-Trichloroethane	µg/L			19	
	1,1-Dichloroethane	µg/L			6.3	
	1,1-Dichloroethene	µg/L			7.4	
	Benzene	µg/L			0.2 J	
	Chloroform	µg/L			0.22 J	
	cis-1,2-Dichloroethene	µg/L			17	
	trans-1,2-Dichloroethene	µg/L			0.61 J	
	Trichloroethene	µg/L			95	
	Vinyl chloride	µg/L			1.9	
X749-PZ12G	1,1,1-Trichloroethane	µg/L			5.4	
	1,1-Dichloroethane	µg/L			38	
	1,1-Dichloroethene	µg/L			29	
	Benzene	µg/L			2.1	
	cis-1,2-Dichloroethene	µg/L			8.1	
	trans-1,2-Dichloroethene	µg/L			0.45 J	
	Trichloroethene	µg/L			6.2	
	Vinyl chloride	µg/L			1.6	
X749-PZ13G	1,1,1-Trichloroethane	µg/L			34	
	1,1,2-Trichloroethane	µg/L			0.44 J	
	1,1-Dichloroethane	µg/L			52	
	1,1-Dichloroethene	µg/L			82	
	1,2-Dichloroethane	µg/L			2.2	
	Benzene	µg/L			2.9	
	Chloroethane	µg/L			1.4 J	
	Chloroform	µg/L			0.87 J	
	cis-1,2-Dichloroethene	µg/L			21	
	trans-1,2-Dichloroethene	µg/L			0.87 J	
	Trichloroethene	µg/L			69	
	Vinyl chloride	µg/L			1.7	
X749-WPW	1,1,1-Trichloroethane	µg/L		79		97
	1,1,2-Trichloroethane	µg/L		1.4 J		1.6 J
	1,1-Dichloroethane	µg/L		81		80
	1,1-Dichloroethene	µg/L		160		200
	1,2-Dichloroethane	µg/L		9.4		17
	Benzene	µg/L		12		1.4 J
	Chloroform	µg/L		7.1		19
	cis-1,2-Dichloroethene	µg/L		110		61
	Tetrachloroethene	µg/L		2.3 J		3.9 J
	trans-1,2-Dichloroethene	µg/L		0.79 J		0.6 U
	Trichloroethene	µg/L		850		830
	Vinyl chloride	µg/L		2.4 J		9.6

Table 4.2. Results for radionuclides at the X-749/X-120/PK Landfill – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
STSW-101G	Technetium-99	pCi/L		6.59 U		
	Uranium	µg/L		0.118 U		
	Uranium-233/234	pCi/L		0.0554 U		
	Uranium-235/236	pCi/L		0.0172 U		
	Uranium-238	pCi/L		0.0369 U		
STSW-102G	Technetium-99	pCi/L		52.5		
	Uranium	µg/L		1.49		
	Uranium-233/234	pCi/L		0.717		
	Uranium-235/236	pCi/L		0.0381 U		
	Uranium-238	pCi/L		0.494		
WP-01G	Technetium-99	pCi/L		1.08 U		
	Uranium	µg/L		0.0422 U		
	Uranium-233/234	pCi/L		0.0222 U		
	Uranium-235/236	pCi/L		0.00552 U		
	Uranium-238	pCi/L		0.0133 U		
WP-02G	Technetium-99	pCi/L		0.441 U		
	Uranium	µg/L		0.115 U		
	Uranium-233/234	pCi/L		0.0265 U		
	Uranium-235/236	pCi/L		0.0219 U		
	Uranium-238	pCi/L		0.0353 U		
WP-03G	Technetium-99	pCi/L		1.19 U		
	Uranium	µg/L		0.0805 U		
	Uranium-233/234	pCi/L		0.0496 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0271 U		
WP-04G	Technetium-99	pCi/L		3.51 U		
	Uranium	µg/L		0.0235 U		
	Uranium-233/234	pCi/L		0.0178 U		
	Uranium-235/236	pCi/L		0.0221 U		
	Uranium-238	pCi/L		0.00444 U		
WP-05G	Technetium-99	pCi/L		0.102 U		
	Uranium	µg/L		0.387 J		
	Uranium-233/234	pCi/L		0.0852 J		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.13 J		
WP-06G	Technetium-99	pCi/L		-0.779 U		
	Uranium	µg/L		5.21		
	Uranium-233/234	pCi/L		1.38		
	Uranium-235/236	pCi/L		0.106 U		
	Uranium-238	pCi/L		1.73		
WP-07G	Technetium-99	pCi/L		-0.734 U		
	Uranium	µg/L		0.113 U		
	Uranium-233/234	pCi/L		0.0136 U		
	Uranium-235/236	pCi/L		0.0113 U		
	Uranium-238	pCi/L		0.0362 U		
X120-08G	Technetium-99	pCi/L			0.43 U	
	Uranium	µg/L			0.126 U	
	Uranium-233/234	pCi/L			0.0476 U	
	Uranium-235/236	pCi/L			-0.00538 U	
	Uranium-238	pCi/L			0.0433 U	

Table 4.2. Results for radionuclides at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-06G	Technetium-99	pCi/L		20.5		
	Uranium	µg/L		0.201 U		
	Uranium-233/234	pCi/L		0.0658 U		
	Uranium-235/236	pCi/L		0.0117 U		
	Uranium-238	pCi/L		0.0658 U		
X749-07G	Americium-241	pCi/L		0.037 U		
	Neptunium-237	pCi/L		0.0049 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.0138 U		
	Technetium-99	pCi/L		33.4		
	Uranium	µg/L		0.198 U		
	Uranium-233/234	pCi/L		0.0787 U		
	Uranium-235/236	pCi/L		0.00544 U		
	Uranium-238	pCi/L		0.0656 U		
X749-08G	Americium-241	pCi/L		0.0194 U		
	Neptunium-237	pCi/L		0.0358 U		
	Plutonium-238	pCi/L		-0.0045 U		
	Plutonium-239/240	pCi/L		0.0136 U		
	Technetium-99	pCi/L		12.5		
	Uranium	µg/L		0.115 U		
	Uranium-233/234	pCi/L		0.0859 J		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0387 U		
X749-10GA	Americium-241	pCi/L		0.00945 U		
	Neptunium-237	pCi/L		0.011 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.0177 U		
	Technetium-99	pCi/L		0.124 U		
	Uranium	µg/L		0.0945 U		
	Uranium-233/234	pCi/L		0.0265 U		
	Uranium-235/236	pCi/L		0.00549 U		
	Uranium-238	pCi/L		0.0309 U		
X749-13G	Technetium-99	pCi/L		2.3 U		
	Uranium	µg/L		0.602 J		
	Uranium-233/234	pCi/L		0.308		
	Uranium-235/236	pCi/L		0.0169 U		
	Uranium-238	pCi/L		0.2 J		
X749-14B	Americium-241	pCi/L		0.00954 U		
	Neptunium-237	pCi/L		0.00468 U		
	Plutonium-238	pCi/L		0.0177 U		
	Plutonium-239/240	pCi/L		0.0133 U		
	Technetium-99	pCi/L		-0.61 U		
	Uranium	µg/L		0.046 U		
	Uranium-233/234	pCi/L		0.0216 U		
	Uranium-235/236	pCi/L		0.0161 U		
	Uranium-238	pCi/L		0.013 U		
X749-20G	Technetium-99	pCi/L			24.8	
	Uranium	µg/L			0.902 J	
	Uranium-233/234	pCi/L			0.33	
	Uranium-235/236	pCi/L			0.0342 U	

Table 4.2. Results for radionuclides at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-20G	Uranium-238	pCi/L			0.298	
X749-26G	Technetium-99	pCi/L		5.57 U		
	Uranium	µg/L		0.0226 U		
	Uranium-233/234	pCi/L		0.048 U		
	Uranium-235/236	pCi/L		0.0179 U		
	Uranium-238	pCi/L		0.0048 U		
X749-27G	Technetium-99	pCi/L		44.2		
	Uranium	µg/L		0.124 U		
	Uranium-233/234	pCi/L		0.0511 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0418 U		
X749-28G	Technetium-99	pCi/L			2.53 U	
	Uranium	µg/L			0.148 U	
	Uranium-233/234	pCi/L			0.0178 U	
	Uranium-235/236	pCi/L			0.00554 U	
	Uranium-238	pCi/L			0.049 U	
X749-33G	Technetium-99	pCi/L		19.2		
	Uranium	µg/L		0.0435 U		
	Uranium-233/234	pCi/L		0.0277 U		
	Uranium-235/236	pCi/L		0.0345 U		
	Uranium-238	pCi/L		0.00924 U		
X749-37G	Technetium-99	pCi/L		2.39 U		
	Uranium	µg/L		0.0976 U		
	Uranium-233/234	pCi/L		0.0565 U		
	Uranium-235/236	pCi/L		0.0128 U		
	Uranium-238	pCi/L		0.0308 U		
X749-44G	Americium-241	pCi/L		0.0317 U		
	Neptunium-237	pCi/L		-0.0045 U		
	Plutonium-238	pCi/L		-0.0088 U		
	Plutonium-239/240	pCi/L		0.0221 U		
	Technetium-99	pCi/L		0.452 U		
	Uranium	µg/L		0.438 J		
	Uranium-233/234	pCi/L		0.141 J		
	Uranium-235/236	pCi/L		0.0113 U		
	Uranium-238	pCi/L		0.145 J		
X749-45G	Americium-241	pCi/L		0.045 U		
	Neptunium-237	pCi/L		-0.0044 U		
	Plutonium-238	pCi/L		-0.014 U		
	Plutonium-239/240	pCi/L		0.00468 U		
	Technetium-99	pCi/L		1.24 U		
	Uranium	µg/L		0.0175 U		
	Uranium-233/234	pCi/L		0.0148 U		
	Uranium-235/236	pCi/L		0.00613 U		
	Uranium-238	pCi/L		0.00493 U		
X749-54B	Technetium-99	pCi/L		0.722 U		
	Uranium	µg/L		0.00815 U		
	Uranium-233/234	pCi/L		0.0189 U		
	Uranium-235/236	pCi/L		0.0176 U		
	Uranium-238	pCi/L		0 U		
X749-64B	Americium-241	pCi/L			0.0171 U	

Table 4.2. Results for radionuclides at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-64B	Neptunium-237	pCi/L			0.00563 U	
	Plutonium-238	pCi/L			0.00473 U	
	Plutonium-239/240	pCi/L			0.00946 U	
	Technetium-99	pCi/L			3.27 U	
	Uranium	µg/L			1.33	
	Uranium-233/234	pCi/L			1.97	
	Uranium-235/236	pCi/L			0.0801 U	
	Uranium-238	pCi/L			0.436	
X749-67G	Technetium-99	pCi/L		15.6		
	Uranium	µg/L		0.372 J		
	Uranium-233/234	pCi/L		0.0808 U		
	Uranium-235/236	pCi/L		0.0251 U		
	Uranium-238	pCi/L		0.121 J		
X749-68G	Americium-241	pCi/L			0.0221 U	
	Neptunium-237	pCi/L			0.00927 U	
	Plutonium-238	pCi/L			0.00439 U	
	Plutonium-239/240	pCi/L			0.0132 U	
	Technetium-99	pCi/L			-2.03 U	
	Uranium	µg/L			0.0635 U	
	Uranium-233/234	pCi/L			0.0288 U	
	Uranium-235/236	pCi/L			0.00511 U	
	Uranium-238	pCi/L			0.0206 U	
X749-96G	Americium-241	pCi/L		0.00985 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		-0.0092 U		
	Plutonium-239/240	pCi/L		0.00923 U		
	Technetium-99	pCi/L		1.22 U		
	Uranium	µg/L		0.0642 U		
	Uranium-233/234	pCi/L		0.0135 U		
	Uranium-235/236	pCi/L		-0.0056 U		
	Uranium-238	pCi/L		0.0224 U		
X749-97G	Americium-241	pCi/L		0 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.0298 U		
	Technetium-99	pCi/L		0.136 U		
	Uranium	µg/L		0.211 U		
	Uranium-233/234	pCi/L		0.054 U		
	Uranium-235/236	pCi/L		0.0224 U		
	Uranium-238	pCi/L		0.0675 U		
X749-98G	Americium-241	pCi/L		0.00909 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		-0.029 U		
	Plutonium-239/240	pCi/L		0.00968 U		
	Technetium-99	pCi/L		-0.723 U		
	Uranium	µg/L		0.167 U		
	Uranium-233/234	pCi/L		0.0438 U		
	Uranium-235/236	pCi/L		-0.0055 U		
	Uranium-238	pCi/L		0.0569 U		
X749-106G	Technetium-99	pCi/L		4.83 U		

Table 4.2. Results for radionuclides at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-106G	Uranium	µg/L		0.0999 U		
	Uranium-233/234	pCi/L		0 U		
	Uranium-235/236	pCi/L		-0.0126 U		
	Uranium-238	pCi/L		0.0356 U		
X749-108G	Technetium-99	pCi/L		8.63		
	Uranium	µg/L		0.0318 U		
	Uranium-233/234	pCi/L		0.0293 U		
	Uranium-235/236	pCi/L		0.00607 U		
	Uranium-238	pCi/L		0.00975 U		
X749-109G	Technetium-99	pCi/L		4.11 U		
	Uranium	µg/L		0.269 U		
	Uranium-233/234	pCi/L		0.0554 U		
	Uranium-235/236	pCi/L		0.0172 U		
	Uranium-238	pCi/L		0.0877 U		
X749-110G	Technetium-99	pCi/L		0.953 U		
	Uranium	µg/L		2.66		
	Uranium-233/234	pCi/L		1.03		
	Uranium-235/236	pCi/L		0.0543 U		
	Uranium-238	pCi/L		0.886		
X749-113G	Technetium-99	pCi/L		15.2		
	Uranium	µg/L		0.0708 U		
	Uranium-233/234	pCi/L		0.0571 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0238 U		
X749-120G	Technetium-99	pCi/L			180	
	Uranium	µg/L			0.373 J	
	Uranium-233/234	pCi/L			0.117 J	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.125 J	
X749-121G	Technetium-99	pCi/L			852	
	Uranium	µg/L			0.431 J	
	Uranium-233/234	pCi/L			0.143 J	
	Uranium-235/236	pCi/L			0.0105 U	
	Uranium-238	pCi/L			0.143 J	
X749-PZ02G	Technetium-99	pCi/L		-0.0678 U		
	Uranium	µg/L		0.0726 U		
	Uranium-233/234	pCi/L		0.0295 U		
	Uranium-235/236	pCi/L		0.0305 U		
	Uranium-238	pCi/L		0.0196 U		
X749-PZ04G	Technetium-99	pCi/L		0.344 U		
	Uranium	µg/L		0.17 U		
	Uranium-233/234	pCi/L		0.0475 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.057 U		
X749-PZ09G	Technetium-99	pCi/L			531	
	Uranium	µg/L			1.59	
	Uranium-233/234	pCi/L			0.548	
	Uranium-235/236	pCi/L			0.026 U	
	Uranium-238	pCi/L			0.531	
X749-PZ10G	Technetium-99	pCi/L		26.4		

Table 4.2. Results for radionuclides at the X-749/X-120/PK Landfill – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749-PZ10G	Uranium	µg/L		0.139 U		
	Uranium-233/234	pCi/L		0.0765 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0468 U		
X749-PZ11G	Technetium-99	pCi/L			2.62 U	
	Uranium	µg/L			1.18	
	Uranium-233/234	pCi/L			0.408	
	Uranium-235/236	pCi/L			0.011 U	
	Uranium-238	pCi/L			0.394	
X749-PZ12G	Technetium-99	pCi/L			-0.52 U	
	Uranium	µg/L			3.15	
	Uranium-233/234	pCi/L			0.899	
	Uranium-235/236	pCi/L			0.108 U	
	Uranium-238	pCi/L			1.04	
X749-PZ13G	Technetium-99	pCi/L			0.0594 U	
	Uranium	µg/L			1.52	
	Uranium-233/234	pCi/L			0.79	
	Uranium-235/236	pCi/L			0.0492 U	
	Uranium-238	pCi/L			0.504	
X749-WPW	Americium-241	pCi/L		0.00929 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		-0.0046 U		
	Plutonium-239/240	pCi/L		0.0138 U		
	Technetium-99	pCi/L		72.2		
	Uranium	µg/L		0.555 J		
	Uranium-233/234	pCi/L		0.209 J		
	Uranium-235/236	pCi/L		0.0259 U		
	Uranium-238	pCi/L		0.182 J		

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X230K-14G	cis-1,2-Dichloroethene	µg/L			0.32 J	
	Trichloroethene	µg/L			3.2	
X230K-15G	Trichloroethene	µg/L			0.69 J	
X231A-01G	1,1-Dichloroethane	µg/L			1.6	
	1,1-Dichloroethene	µg/L			0.27 J	
	Benzene	µg/L			0.17 J	
	cis-1,2-Dichloroethene	µg/L			0.82 J	
	Trichloroethene	µg/L			13	
X231A-02G	1,1,1-Trichloroethane	µg/L			5.8	
	1,1,2-Trichloroethane	µg/L			0.56 J	
	1,1-Dichloroethane	µg/L			7.5	
	1,1-Dichloroethene	µg/L			64	
	1,2-Dichloroethane	µg/L			0.34 J	
	Benzene	µg/L			0.18 J	
	Chloroform	µg/L			2.4	
	cis-1,2-Dichloroethene	µg/L			15	
	Tetrachloroethene	µg/L			0.45 J	
	trans-1,2-Dichloroethene	µg/L			0.16 J	
	Trichloroethene	µg/L			280	
X231A-04G	1,1-Dichloroethene	µg/L			1.1	
	Acetone	µg/L			22	
	Chloroform	µg/L			0.24 J	
	cis-1,2-Dichloroethene	µg/L			0.58 J	
	Trichloroethene	µg/L			9.6	
X231B-02G	1,1,1-Trichloroethane	µg/L	0.61 J		0.28 J	
	1,1-Dichloroethane	µg/L	0.38 J		0.48 J	
	1,1-Dichloroethene	µg/L	45		20	
	Acetone	µg/L	1.9 U		41	
	Chloroform	µg/L	1.1		1.2	
	cis-1,2-Dichloroethene	µg/L	8.1		11	
	trans-1,2-Dichloroethene	µg/L	0.97 J		0.41 J	
	Trichloroethene	µg/L	150		210	
X231B-03G	1,1,1-Trichloroethane	µg/L	18		9.9	
	1,1,2-Trichloroethane	µg/L	1 J		0.69 J	
	1,1-Dichloroethane	µg/L	17		9.6	
	1,1-Dichloroethene	µg/L	120		63	
	1,2-Dichloroethane	µg/L	0.52 J		0.32 J	
	Acetone	µg/L	3.8 U		12 J	
	Benzene	µg/L	0.42 J		0.41 J	
	Chloroform	µg/L	1.7 J		0.81 J	
	cis-1,2-Dichloroethene	µg/L	23		16	
	Tetrachloroethene	µg/L	1.1 J		0.5 J	
	trans-1,2-Dichloroethene	µg/L	0.61 J		0.35 J	
	Trichloroethene	µg/L	800		670	
X231B-06G	1,1,1-Trichloroethane	µg/L	28		14	
	1,1,2-Trichloroethane	µg/L	0.34 J		0.31 J	
	1,1-Dichloroethane	µg/L	12		7.5	
	1,1-Dichloroethene	µg/L	62		57	
	1,2-Dichloroethane	µg/L	0.33 J		0.13 U	
	Acetone	µg/L	6.4 J		1.9 U	

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231B-06G	Chloroform	µg/L	0.21 J		0.25 J	
	cis-1,2-Dichloroethene	µg/L	1.1		2.4	
	Tetrachloroethene	µg/L	0.33 J		0.33 J	
	Trichloroethene	µg/L	56		120	
	Vinyl chloride	µg/L	0.15 J		0.1 U	
X231B-07G	Acetone	µg/L	35 B			
	Chloroform	µg/L	8			
	cis-1,2-Dichloroethene	µg/L	2			
	Trichloroethene	µg/L	24			
X231B-11G	1,1,1-Trichloroethane	µg/L	1			
	1,1-Dichloroethene	µg/L	3.6			
	cis-1,2-Dichloroethene	µg/L	0.16 J			
	Trichloroethene	µg/L	1.1			
X231B-12G	1,1,1-Trichloroethane	µg/L			0.53 J	
	1,1-Dichloroethene	µg/L			1.6	
	Chloroform	µg/L			0.18 J	
	Trichloroethene	µg/L			2.6	
X231B-14G	1,1,1-Trichloroethane	µg/L			1.8	
	1,1-Dichloroethane	µg/L			1.2	
	1,1-Dichloroethene	µg/L			22	
	Chloroform	µg/L			1.1	
	cis-1,2-Dichloroethene	µg/L			6.6	
	Trichloroethene	µg/L			130	
X231B-15G	cis-1,2-Dichloroethene	µg/L			0.25 J	
	Trichloroethene	µg/L			1.4	
X231B-16G	1,1,1-Trichloroethane	µg/L			0.42 J	
	1,1-Dichloroethene	µg/L			2.1	
	Acetone	µg/L			29	
	Chloroform	µg/L			2	
	Trichloroethene	µg/L			0.23 J	
X231B-20G	1,1,1-Trichloroethane	µg/L			0.25 J	
	1,1-Dichloroethene	µg/L			7.2	
	Chloroform	µg/L			0.75 J	
	cis-1,2-Dichloroethene	µg/L			0.32 J	
	Trichloroethene	µg/L			48	
	Trichlorofluoromethane	µg/L			0.3 J	
X231B-23G	1,1-Dichloroethene	µg/L			0.39 J	
	Acetone	µg/L			12	
	Chloroform	µg/L			0.21 J	
	Trichloroethene	µg/L			1.5	
X231B-29G	Acetone	µg/L	51 B			
	cis-1,2-Dichloroethene	µg/L	0.19 J			
	Trichloroethene	µg/L	5.2			
X231B-32B	Trichloroethene	µg/L			0.65 J	
X231B-36G	Chloroform	µg/L			0.46 J	
	cis-1,2-Dichloroethene	µg/L			1.2	
	Trichloroethene	µg/L			120	
X231B-37G	1,1-Dichloroethane	µg/L			1.3	
	1,1-Dichloroethene	µg/L			1.4	
	Acetone	µg/L			4.6 J	

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231B-37G	Benzene	µg/L			0.21 J	
	cis-1,2-Dichloroethene	µg/L			8.3	
	trans-1,2-Dichloroethene	µg/L			1.2	
	Trichloroethene	µg/L			11	
	Vinyl chloride	µg/L			0.37 J	
X231B-38G	1,1,1-Trichloroethane	µg/L	0.39 J			
	1,1-Dichloroethene	µg/L	0.9 J			
	1,2-Dichlorobenzene	µg/L	0.3 J			
	Acetone	µg/L	14 B			
	Trichloroethene	µg/L	0.66 J			
X326-09G	1,1-Dichloroethene	µg/L	440		190	
	Acetone	µg/L	720 BJ		2200	
	Chloroform	µg/L	130		300	
	cis-1,2-Dichloroethene	µg/L	110		140	
	Trichloroethene	µg/L	23000		24000	
X326-10G	1,1-Dichloroethene	µg/L			0.93 J	
	cis-1,2-Dichloroethene	µg/L			0.95 J	
	Trichloroethene	µg/L			8.4	
X626-07G	1,1,1-Trichloroethane	µg/L	3.9		3.7	
	1,1,2-Trichloroethane	µg/L	2		1.4	
	1,1-Dichloroethane	µg/L	1.6 J		1.6	
	1,1-Dichloroethene	µg/L	340		270	
	1,2-Dichloroethane	µg/L	0.99 J		1.1	
	Acetone	µg/L	17 BJ		1.9 U	
	Benzene	µg/L	0.74 J		0.77 J	
	Chloroform	µg/L	6.9		1.6	
	cis-1,2-Dichloroethene	µg/L	4.8		3.3	
	trans-1,2-Dichloroethene	µg/L	0.3 U		0.37 J	
	Trichloroethene	µg/L	480		220	
	Vinyl chloride	µg/L	0.46 J		0.1 U	
X710-01G	Acetone	µg/L	20 *B			
	cis-1,2-Dichloroethene	µg/L	0.54 J			
	Trichloroethene	µg/L	31			
X749A-09G	Acetone	µg/L			13	
X749A-12G	1,1-Dichloroethane	µg/L		0.22 J		
	cis-1,2-Dichloroethene	µg/L		5.8		
	Trichloroethene	µg/L		2.5		
X749A-18G	cis-1,2-Dichloroethene	µg/L		0.2 J		
	Trichloroethene	µg/L		3.6		
X749A-19G	Acetone	µg/L		3 J		
	cis-1,2-Dichloroethene	µg/L		4.4		
	Trichloroethene	µg/L		18		
X760-02G	Acetone	µg/L	6.3 BJ			
	Trichloroethene	µg/L	0.88 J			
X760-03G	1,1-Dichloroethene	µg/L			0.24 J	
	Acetone	µg/L			26	
	Chloroform	µg/L			0.35 J	
	cis-1,2-Dichloroethene	µg/L			5.1	
	Trichloroethene	µg/L			230	
X760-07G	1,1-Dichloroethene	µg/L			0.56 J	

Table 4.3. VOCs detected at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X760-07G	Acetone	µg/L			29	
	cis-1,2-Dichloroethene	µg/L			11	
	Trichloroethene	µg/L			670	
X770-17GA	Acetone	µg/L	3.6 BJ		1.9 U	
	cis-1,2-Dichloroethene	µg/L	0.58 J		0.87 J	
	Trichloroethene	µg/L	210		240	

Table 4.4. Results for radionuclides at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X231A-01G	Technetium-99	pCi/L			18.4	
	Uranium	µg/L			20.1	
	Uranium-233/234	pCi/L			12.6	
	Uranium-235/236	pCi/L			0.833	
	Uranium-238	pCi/L			6.63	
X231A-02G	Technetium-99	pCi/L			0.317 U	
	Uranium	µg/L			0.424 J	
	Uranium-233/234	pCi/L			0.116 J	
	Uranium-235/236	pCi/L			0.0231 U	
	Uranium-238	pCi/L			0.139 J	
X231A-04G	Technetium-99	pCi/L			-0.575 U	
	Uranium	µg/L			0.259 J	
	Uranium-233/234	pCi/L			0.0598 U	
	Uranium-235/236	pCi/L			0.0106 U	
	Uranium-238	pCi/L			0.0855 J	
X231B-02G	Technetium-99	pCi/L	13.6			
	Uranium	µg/L	0.298 J			
	Uranium-233/234	pCi/L	0.143 J			
	Uranium-235/236	pCi/L	0.0229 U			
	Uranium-238	pCi/L	0.0966 J			
X231B-03G	Americium-241	pCi/L	0.0365 U			
	Neptunium-237	pCi/L	-0.010 U			
	Plutonium-238	pCi/L	0 U			
	Plutonium-239/240	pCi/L	0.0147 U			
	Technetium-99	pCi/L	13.1			
	Uranium	µg/L	0.303 J			
	Uranium-233/234	pCi/L	0.0961 J			
	Uranium-235/236	pCi/L	0.006 U			
	Uranium-238	pCi/L	0.101 J			
X231B-06G	Americium-241	pCi/L	0 U			
	Neptunium-237	pCi/L	0 U			
	Plutonium-238	pCi/L	-0.023 U			
	Plutonium-239/240	pCi/L	0.0186 U			
	Technetium-99	pCi/L	114			
	Uranium	µg/L	5.49			
	Uranium-233/234	pCi/L	7.99			
	Uranium-235/236	pCi/L	0.404			
	Uranium-238	pCi/L	1.78			
X326-09G	Technetium-99	pCi/L	0.102 U			
	Uranium	µg/L	0.216 U			
	Uranium-233/234	pCi/L	0.0953 J			
	Uranium-235/236	pCi/L	0.0215 U			
	Uranium-238	pCi/L	0.0693 U			
X626-07G	Technetium-99	pCi/L	-1.59 U			
	Uranium	µg/L	1.18			
	Uranium-233/234	pCi/L	0.254			
	Uranium-235/236	pCi/L	0.0298 U			
	Uranium-238	pCi/L	0.393			
X749A-02G	Technetium-99	pCi/L		3.47 U		
	Uranium	µg/L		0.182 U		

Table 4.4. Results for radionuclides at the Quadrant I Groundwater Investigative (5-Unit) Area – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X749A-02G	Uranium-233/234	pCi/L		0.0729 U		
	Uranium-235/236	pCi/L		0.0181 U		
	Uranium-238	pCi/L		0.0583 U		
X749A-03G	Technetium-99	pCi/L		2.09 U		
	Uranium	µg/L		0.158 U		
	Uranium-233/234	pCi/L		0.117 J		
	Uranium-235/236	pCi/L		0.0116 U		
	Uranium-238	pCi/L		0.0515 U		
X749A-04G	Technetium-99	pCi/L		2.16 U		
	Uranium	µg/L		0.027 U		
	Uranium-233/234	pCi/L		0.0181 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.00907 U		
X749A-07G	Technetium-99	pCi/L		-1.21 U		
	Uranium	µg/L		7.86		
	Uranium-233/234	pCi/L		2.81		
	Uranium-235/236	pCi/L		0.215 J		
	Uranium-238	pCi/L		2.61		
X749A-12G	Technetium-99	pCi/L		-1.3 U		
	Uranium	µg/L		0.105 U		
	Uranium-233/234	pCi/L		0.0753 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0354 U		
X749A-14G	Technetium-99	pCi/L		-0.914 U		
	Uranium	µg/L		0.141 U		
	Uranium-233/234	pCi/L		0.0676 U		
	Uranium-235/236	pCi/L		-0.006 U		
	Uranium-238	pCi/L		0.0483 U		
X749A-16G	Technetium-99	pCi/L		6.76 U		
	Uranium	µg/L		0.232 U		
	Uranium-233/234	pCi/L		0.0994 J		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0778 U		
X749A-17G	Technetium-99	pCi/L		0.892 U		
	Uranium	µg/L		0.129 U		
	Uranium-233/234	pCi/L		0.0507 U		
	Uranium-235/236	pCi/L		0.0115 U		
	Uranium-238	pCi/L		0.0415 U		
X749A-18G	Technetium-99	pCi/L		-1.3 U		
	Uranium	µg/L		0.289 J		
	Uranium-233/234	pCi/L		0.091 U		
	Uranium-235/236	pCi/L		0.00629 U		
	Uranium-238	pCi/L		0.0961 J		
X749A-19G	Technetium-99	pCi/L		1.69 U		
	Uranium	µg/L		0.322 J		
	Uranium-233/234	pCi/L		0.106 J		
	Uranium-235/236	pCi/L		0.0164 U		
	Uranium-238	pCi/L		0.106 J		

Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X700-02G	1,1,1-Trichloroethane	µg/L	13 J			
	1,1-Dichloroethane	µg/L	15 J			
	1,1-Dichloroethene	µg/L	150			
	1,2-Dichloroethane	µg/L	5.2 J			
	cis-1,2-Dichloroethene	µg/L	1600			
	trans-1,2-Dichloroethene	µg/L	4.2 J			
	Trichloroethene	µg/L	6600			
	Vinyl chloride	µg/L	76			
X700-03G	cis-1,2-Dichloroethene	µg/L	0.16 J			
X701-26G	1,1-Dichloroethene	µg/L	0.79 J			
	Chloroform	µg/L	0.87 J			
	Tetrachloroethene	µg/L	3.8			
	Trichloroethene	µg/L	1.2			
X701-27G	1,1-Dichloroethane	µg/L	0.52 J			
	1,1-Dichloroethene	µg/L	2.4			
	cis-1,2-Dichloroethene	µg/L	0.33 J			
	Trichloroethene	µg/L	4.6			
X701-28GA	Trichloroethene	µg/L	0.26 J			
X701-45G	1,1-Dichloroethene	µg/L	0.37 J			
	cis-1,2-Dichloroethene	µg/L	0.27 J			
	Trichloroethene	µg/L	2.9			
X701-68G	1,1,1-Trichloroethane	µg/L	0.27 J			
	1,1-Dichloroethane	µg/L	0.34 J			
	1,1-Dichloroethene	µg/L	2.3			
	Chloroform	µg/L	0.24 J			
	cis-1,2-Dichloroethene	µg/L	2			
	Trichloroethene	µg/L	76			
	Trichlorofluoromethane	µg/L	0.76 J			
X701-69G	1,1-Dichloroethene	µg/L	1.8 J			
	cis-1,2-Dichloroethene	µg/L	280			
	trans-1,2-Dichloroethene	µg/L	7.9			
	Trichloroethene	µg/L	1100			
X701-70G	1,1-Dichloroethene	µg/L	4 J			
	cis-1,2-Dichloroethene	µg/L	880			
	Trichloroethene	µg/L	2000			
X701-117GA	1,1,1-Trichloroethane	µg/L	0.35 J			
	1,1-Dichloroethene	µg/L	1.4			
	Chloroform	µg/L	0.37 J			
	cis-1,2-Dichloroethene	µg/L	31			
	trans-1,2-Dichloroethene	µg/L	0.24 J			
	Trichloroethene	µg/L	320			
	Trichlorofluoromethane	µg/L	0.47 J			
X705-01GA	1,1,1-Trichloroethane	µg/L	0.17 J			
	1,1-Dichloroethene	µg/L	0.48 J			
	Bromodichloromethane	µg/L	0.18 J			
	Carbon tetrachloride	µg/L	0.86 J			
	Chloroform	µg/L	26			
	cis-1,2-Dichloroethene	µg/L	0.26 J			
	Tetrachloroethene	µg/L	0.41 J			
	Trichloroethene	µg/L	84			

Table 4.5. VOCs detected at the Quadrant II Groundwater Investigative (7-Unit) Area – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X705-02G	1,1-Dichloroethene	µg/L	1.5			
	cis-1,2-Dichloroethene	µg/L	1.1			
	Trichloroethene	µg/L	77			
X705-03G	1,1-Dichloroethane	µg/L	1.2			
	1,1-Dichloroethene	µg/L	2.4			
	cis-1,2-Dichloroethene	µg/L	4.8			
	Tetrachloroethene	µg/L	0.39 J			
	trans-1,2-Dichloroethene	µg/L	0.41 J			
	Trichloroethene	µg/L	25			
X705-04G	1,1,2-Trichloroethane	µg/L	0.27 J			
	1,1-Dichloroethane	µg/L	0.23 J			
	1,1-Dichloroethene	µg/L	0.41 J			
	Bromodichloromethane	µg/L	0.63 J			
	Carbon tetrachloride	µg/L	12			
	Chloroform	µg/L	330			
	Tetrachloroethene	µg/L	2.2			
	Trichloroethene	µg/L	12			
X705-06G	1,1-Dichloroethane	µg/L	0.29 J			
	1,1-Dichloroethene	µg/L	1.7			
	Chloroform	µg/L	0.91 J			
	cis-1,2-Dichloroethene	µg/L	3.1			
	Tetrachloroethene	µg/L	3.9			
	Trichloroethene	µg/L	30			
X705-07G	Chloroform	µg/L	0.85 J			
	cis-1,2-Dichloroethene	µg/L	0.49 J			
	Trichloroethene	µg/L	8.1			
X705-08G	1,1-Dichloroethene	µg/L	8.3			
	Chloroform	µg/L	0.19 J			
	Trichlorofluoromethane	µg/L	14			
X720-01G	1,1,1-Trichloroethane	µg/L	51 J			
	1,1-Dichloroethane	µg/L	110			
	1,1-Dichloroethene	µg/L	170			
	cis-1,2-Dichloroethene	µg/L	14000			
	trans-1,2-Dichloroethene	µg/L	27 J			
	Trichloroethene	µg/L	5400			
	Vinyl chloride	µg/L	2800			
X720-08G	1,1-Dichloroethene	µg/L	43			
	cis-1,2-Dichloroethene	µg/L	7.8			
	Tetrachloroethene	µg/L	5.1			
	Trichloroethene	µg/L	2200			

Table 4.6. Results for radionuclides at the Quadrant II Groundwater Investigative (7-Unit) Area – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X700-02G	Technetium-99	pCi/L	33.4			
	Uranium	µg/L	2.01			
	Uranium-233/234	pCi/L	0.643			
	Uranium-235/236	pCi/L	0.0384 U			
	Uranium-238	pCi/L	0.67			
X701-26G	Technetium-99	pCi/L	35.5			
	Uranium	µg/L	5.07			
	Uranium-233/234	pCi/L	2.62			
	Uranium-235/236	pCi/L	0.109 J			
	Uranium-238	pCi/L	1.69			
X701-68G	Technetium-99	pCi/L	17.4			
	Uranium	µg/L	3.11			
	Uranium-233/234	pCi/L	1.39			
	Uranium-235/236	pCi/L	0.0509 U			
	Uranium-238	pCi/L	1.04			
X701-69G	Technetium-99	pCi/L	1.1 U			
	Uranium	µg/L	6.37			
	Uranium-233/234	pCi/L	3.32			
	Uranium-235/236	pCi/L	0.132 J			
	Uranium-238	pCi/L	2.12			
X701-70G	Technetium-99	pCi/L	16.6			
	Uranium	µg/L	2.22			
	Uranium-233/234	pCi/L	0.922			
	Uranium-235/236	pCi/L	0.0264 U			
	Uranium-238	pCi/L	0.743			
X705-01GA	Americium-241	pCi/L	0 U			
	Neptunium-237	pCi/L	0 U			
	Plutonium-238	pCi/L	0.0092 U			
	Plutonium-239/240	pCi/L	0.0139 U			
	Technetium-99	pCi/L	196			
	Uranium	µg/L	0.991 J			
	Uranium-233/234	pCi/L	0.307			
	Uranium-235/236	pCi/L	0.0222 U			
	Uranium-238	pCi/L	0.33			
X705-02G	Technetium-99	pCi/L	-1.73 U			
	Uranium	µg/L	4.59			
	Uranium-233/234	pCi/L	1.71			
	Uranium-235/236	pCi/L	0.0602 U			
	Uranium-238	pCi/L	1.53			
X705-07G	Technetium-99	pCi/L	116			
	Uranium	µg/L	1.69			
	Uranium-233/234	pCi/L	0.881			
	Uranium-235/236	pCi/L	0.051 U			
	Uranium-238	pCi/L	0.559			
X720-01G	Technetium-99	pCi/L	3.85 U			
	Uranium	µg/L	97			
	Uranium-233/234	pCi/L	31.1			
	Uranium-235/236	pCi/L	1.59			
	Uranium-238	pCi/L	32.3			
X720-08G	Technetium-99	pCi/L	74			

Table 4.6. Results for radionuclides at the Quadrant II Groundwater Investigative (7-Unit) Area – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X720-08G	Uranium	µg/L	18			
	Uranium-233/234	pCi/L	51			
	Uranium-235/236	pCi/L	3.13			
	Uranium-238	pCi/L	5.56			

Table 4.7. VOCs detected at the X-701B Holding Pond – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ03G	Acetone	µg/L	1.9 U		1.9 J	
	cis-1,2-Dichloroethene	µg/L	29		85	
	trans-1,2-Dichloroethene	µg/L	0.57 J		1.3	
	Trichloroethene	µg/L	45		71	
	Vinyl chloride	µg/L	0.1 U		0.39 J	
LBC-PZ06G	Acetone	µg/L	1.9 U		5.3 J	
	Trichloroethene	µg/L	3.7		0.43 J	
X230J7-01GA	1,1,2-Trichloroethane	µg/L	0.29 J		0.54 U	
	1,1-Dichloroethene	µg/L	0.35 J		0.46 U	
	Chloroform	µg/L	0.23 J		0.32 U	
	cis-1,2-Dichloroethene	µg/L	0.99 J		0.73 J	
	Trichloroethene	µg/L	290		280	
X230J7-02GA	1,1,2-Trichloroethane	µg/L	0.67 J		0.54 U	
	Acetone	µg/L	5.5 J		3.8 U	
	Chloroform	µg/L	0.38 J		0.32 U	
	cis-1,2-Dichloroethene	µg/L	2.2		1.7 J	
	Trichloroethene	µg/L	440		460	
X230J7-03GA	1,1,2-Trichloroethane	µg/L	2.9 J		6.8 U	
	Acetone	µg/L	21 J		48 U	
	cis-1,2-Dichloroethene	µg/L	360		400	
	Methylene chloride	µg/L	3.6 BJ		8 U	
	Tetrachloroethene	µg/L	2 J		5 U	
	trans-1,2-Dichloroethene	µg/L	7.4 J		10 J	
	Trichloroethene	µg/L	3000		4400	
	Vinyl chloride	µg/L	11		5.6 J	
X701-01G	1,1-Dichloroethene	µg/L	0.27 J		0.61 J	
	cis-1,2-Dichloroethene	µg/L	2.9		13	
	trans-1,2-Dichloroethene	µg/L	0.15 U		0.38 J	
	Trichloroethene	µg/L	16		69	
	Vinyl chloride	µg/L	0.1 U		0.24 J	
X701-02G	1,1-Dichloroethene	µg/L	0.44 J		0.24 J	
	Acetone	µg/L	1.9 U		2.6 J	
	cis-1,2-Dichloroethene	µg/L	6		5	
	trans-1,2-Dichloroethene	µg/L	0.2 J		0.15 U	
	Trichloroethene	µg/L	16		13	
X701-06G	1,1-Dichloroethane	µg/L	1.3		1.2 J	
	1,1-Dichloroethene	µg/L	11		9.8	
	Acetone	µg/L	1.9 U		7.2 J	
	Chloroform	µg/L	0.49 J		0.5 J	
	cis-1,2-Dichloroethene	µg/L	16		23	
	trans-1,2-Dichloroethene	µg/L	0.39 J		0.33 J	
	Trichloroethene	µg/L	330		340	
	Vinyl chloride	µg/L	0.28 J		0.5 J	
X701-15G	cis-1,2-Dichloroethene	µg/L	32		230	
	trans-1,2-Dichloroethene	µg/L	1.4		7.1	
	Trichloroethene	µg/L	3.8		6.7	
X701-16G	Acetone	µg/L	1.9 U		3 J	
	cis-1,2-Dichloroethene	µg/L	0.15 U		0.17 J	
	Trichloroethene	µg/L	0.91 J		1.3	
X701-19G	Acetone	µg/L	37 B		1.9 U	

Table 4.7. VOCs detected at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-19G	Trichloroethene	µg/L	3		0.16 U	
X701-20G	1,1,2-Trichloroethane	µg/L	120 J		85 J	
	Acetone	µg/L	14000 B		380 U	
	cis-1,2-Dichloroethene	µg/L	2200		2200	
	Tetrachloroethene	µg/L	88 J		82 J	
	Trichloroethene	µg/L	120000		78000	
X701-21G	1,2-Dichlorobenzene	µg/L	0.2 J		0.31 J	
	Acetone	µg/L	33 B		3.3 J	
	Chloroform	µg/L	0.18 J		0.2 J	
	cis-1,2-Dichloroethene	µg/L	7		13	
	Trichloroethene	µg/L	11		15	
	Vinyl chloride	µg/L	0.27 J		0.56 J	
X701-23G	Trichloroethene	µg/L			0.95 J	
X701-24G	1,1,2-Trichloroethane	µg/L	12 J		8 J	
	1,1-Dichloroethene	µg/L	6.9 J		4.6 U	
	cis-1,2-Dichloroethene	µg/L	1300		1000	
	Methylene chloride	µg/L	9.5 BJ		6.4 U	
	trans-1,2-Dichloroethene	µg/L	16 J		14 J	
	Trichloroethene	µg/L	6700		5700	
	Vinyl chloride	µg/L	24		35	
X701-25G	Acetone	µg/L	1.9 U		10	
	Trichloroethene	µg/L	0.45 BJ		0.32 J	
X701-30G	cis-1,2-Dichloroethene	µg/L	0.17 J		0.15 U	
	Trichloroethene	µg/L	3.9		4.1	
	Trichlorofluoromethane	µg/L	0.52 J		0.91 J	
X701-31G	Acetone	µg/L			5.6 J	
X701-38G	1,2-Dichlorobenzene	µg/L			0.28 J	
	Chloroform	µg/L			0.17 J	
X701-42G	1,2-Dichlorobenzene	µg/L			0.39 J	
	cis-1,2-Dichloroethene	µg/L			23	
	trans-1,2-Dichloroethene	µg/L			0.31 J	
	Trichloroethene	µg/L			3.6	
	Vinyl chloride	µg/L			1.3	
X701-58B	Acetone	µg/L			2.2 J	
	Benzene	µg/L			0.45 J	
X701-61B	1,1-Dichloroethene	µg/L			0.47 J	
	1,2-Dimethylbenzene	µg/L			0.21 J	
	M + P Xylene	µg/L			2.8	
	Trichloroethene	µg/L			4	
X701-66G	Acetone	µg/L	95 U		390 J	
	Chloroform	µg/L	27 J		37 J	
	cis-1,2-Dichloroethene	µg/L	380		340	
	Tetrachloroethene	µg/L	17 J		20 U	
	Trichloroethene	µg/L	14000		15000	
	Vinyl chloride	µg/L	3.2			
X701-77G	1,1,1-Trichloroethane	µg/L			9.1 J	
	Acetone	µg/L			220 J	
	cis-1,2-Dichloroethene	µg/L			140	
	Methylene chloride	µg/L			36 BJ	
	Tetrachloroethene	µg/L			40 J	

Table 4.7. VOCs detected at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-77G	Trichloroethene	µg/L			12000	
X701-79G	cis-1,2-Dichloroethene	µg/L			5.2	
	Trichloroethene	µg/L			32	
X701-127G	1,1,1-Trichloroethane	µg/L	7		32 U	
	1,1,2,2-Tetrachloroethane	µg/L	0.72 J		42 U	
	1,1,2-Trichloroethane	µg/L	56		54 U	
	1,1-Dichloroethane	µg/L	1.4		44 U	
	1,1-Dichloroethene	µg/L	16		46 U	
	1,2-Dichloroethane	µg/L	1.5		26 U	
	Acetone	µg/L	25 B		380 U	
	Benzene	µg/L	0.23 J		32 U	
	Bromodichloromethane	µg/L	0.29 J		34 U	
	Bromoform	µg/L	0.62 J		38 U	
	Carbon tetrachloride	µg/L	1.4		38 U	
	Chloroform	µg/L	4.7		32 U	
	cis-1,2-Dichloroethene	µg/L	860 J		910	
	Tetrachloroethene	µg/L	33		40 U	
	Toluene	µg/L	0.49 J		34 U	
	trans-1,2-Dichloroethene	µg/L	1.8		30 U	
	Trichloroethene	µg/L	42000		40000	
	Vinyl chloride	µg/L	5.9		0.1 U	
X701-128G	1,1,2-Trichloroethane	µg/L	19 J		27 U	
	1,1-Dichloroethene	µg/L	10 J		23 U	
	cis-1,2-Dichloroethene	µg/L	140		200	
	Tetrachloroethene	µg/L	14 J		20 U	
	Trichloroethene	µg/L	16000		18000	
	Vinyl chloride	µg/L	3.6		10 U	
X701-130G	Acetone	µg/L			4600 B	
	cis-1,2-Dichloroethene	µg/L			1200	
	Methylene chloride	µg/L			170 BJ	
	Tetrachloroethene	µg/L			120 J	
	Trichloroethene	µg/L			62000	
	Vinyl chloride	µg/L			76 J	
X701-BW2G	1,1-Dichloroethene	µg/L			67 J	
	Acetone	µg/L			870 J	
	Chloroform	µg/L			210	
	cis-1,2-Dichloroethene	µg/L			280	
	Trichloroethene	µg/L			26000	
X701-BW3G	1,1-Dichloroethane	µg/L			0.59 J	
	1,1-Dichloroethene	µg/L			2.1	
	Acetone	µg/L			25	
	Chloroform	µg/L			0.25 J	
	cis-1,2-Dichloroethene	µg/L			120	
	Tetrachloroethene	µg/L			0.27 J	
	trans-1,2-Dichloroethene	µg/L			0.33 J	
	Trichloroethene	µg/L			140	
	Vinyl chloride	µg/L			10	
X701-BW4G	cis-1,2-Dichloroethene	µg/L	4.2		5.7	
	trans-1,2-Dichloroethene	µg/L	0.21 J		0.49 J	
	Trichloroethene	µg/L	1.7 B		1.5	

Table 4.7. VOCs detected at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-BW4G	Vinyl chloride	µg/L	0.1 U		0.17 J	
X701-EW121G	1,1,2-Trichloroethane	µg/L	240 J		150 J	
	cis-1,2-Dichloroethene	µg/L	7400		4200	
	Tetrachloroethene	µg/L	210 J		180 J	
	trans-1,2-Dichloroethene	µg/L	130 J		150 J	
	Trichloroethene	µg/L	200000		140000	
	Vinyl chloride	µg/L	92		46 J	
X701-EW122G	1,1,2,2-Tetrachloroethane	µg/L	63		160 J	
	1,1,2-Trichloroethane	µg/L	30 J		54 U	
	Acetone	µg/L	95 U		830 J	
	cis-1,2-Dichloroethene	µg/L	320		380	
	Methylene chloride	µg/L	16 U		160 BJ	
	Tetrachloroethene	µg/L	84		140 J	
	trans-1,2-Dichloroethene	µg/L	32 J		42 J	
	Trichloroethene	µg/L	24000		36000	
	Vinyl chloride	µg/L	1.6		10 U	
X701-IRMPZ03G	1,1,2-Trichloroethane	µg/L	3.3 J		1.4 U	
	1,1-Dichloroethene	µg/L	0.92 U		2.1 J	
	cis-1,2-Dichloroethene	µg/L	320		780	
	trans-1,2-Dichloroethene	µg/L	4.3		4.8 J	
	Trichloroethene	µg/L	940		1400	
	Vinyl chloride	µg/L	0.4 U		1.3 J	
X701-IRMPZ08G	Acetone	µg/L	27 B		1.9 U	
	cis-1,2-Dichloroethene	µg/L	83		65	
	trans-1,2-Dichloroethene	µg/L	0.53 J		0.46 J	
	Trichloroethene	µg/L	110		83	
	Vinyl chloride	µg/L	0.16 J		0.39 J	
X701-TC01G	1,1,1-Trichloroethane	µg/L	210		250 J	
	1,1,2,2-Tetrachloroethane	µg/L	180 J		130 J	
	Acetone	µg/L	380 U		2600 BJ	
	Chloromethane	µg/L	65 J		120 U	
	cis-1,2-Dichloroethene	µg/L	3200		5600	
	Methylene chloride	µg/L	64 U		210 BJ	
	Tetrachloroethene	µg/L	110 J		130 J	
	trans-1,2-Dichloroethene	µg/L	380		260 J	
	Trichloroethene	µg/L	46000 B		60000	
	Vinyl chloride	µg/L	76		130 J	
X701-TC03G	1,1,1-Trichloroethane	µg/L	110		98 J	
	1,1,2,2-Tetrachloroethane	µg/L	290		280	
	Acetone	µg/L	550 J		760 BJ	
	Chloromethane	µg/L	120 J		79 J	
	cis-1,2-Dichloroethene	µg/L	2100		3000	
	Methylene chloride	µg/L	32 U		51 BJ	
	Tetrachloroethene	µg/L	69 J		53 J	
	trans-1,2-Dichloroethene	µg/L	340		500	
	Trichloroethene	µg/L	17000 B		19000	
	Vinyl chloride	µg/L	22		45 J	
X701-TC05G	1,1,1-Trichloroethane	µg/L	47 J		80 J	
	1,1,2,2-Tetrachloroethane	µg/L	180		250	
	1,1,2-Trichloroethane	µg/L	19 J		32 J	

Table 4.7. VOCs detected at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC05G	Acetone	µg/L	260 J		980 J	
	Chloromethane	µg/L	140		130 J	
	cis-1,2-Dichloroethene	µg/L	930		1600	
	Methylene chloride	µg/L	16 U		64 BJ	
	Tetrachloroethene	µg/L	36 J		38 J	
	trans-1,2-Dichloroethene	µg/L	150		240	
	Trichloroethene	µg/L	14000		25000	
	Vinyl chloride	µg/L	10 U		16 J	
X701-TC10G	1,1,1-Trichloroethane	µg/L	42 J		26 J	
	1,1,2,2-Tetrachloroethane	µg/L	120		78	
	1,1,2-Trichloroethane	µg/L	21 J		14 U	
	Acetone	µg/L	95 U		140 J	
	Chloromethane	µg/L	15 U		110	
	cis-1,2-Dichloroethene	µg/L	960		910	
	Tetrachloroethene	µg/L	37 J		27 J	
	trans-1,2-Dichloroethene	µg/L	160		140	
	Trichloroethene	µg/L	12000 B		8100	
	Vinyl chloride	µg/L	4.6		10 U	
X701-TC17G	1,1,1-Trichloroethane	µg/L	16 U		15 J	
	1,1,2,2-Tetrachloroethane	µg/L	21 U		25 J	
	Acetone	µg/L	510 J		1100	
	Chloroform	µg/L	16 U		12 J	
	Chloromethane	µg/L	140 J		210	
	cis-1,2-Dichloroethene	µg/L	190		76	
	Tetrachloroethene	µg/L	52 J		24 J	
	trans-1,2-Dichloroethene	µg/L	15 U		8.1 J	
	Trichloroethene	µg/L	18000 B		7800	
	Vinyl chloride	µg/L	0.86 J		5 U	
X701-TC22G	1,1,1-Trichloroethane	µg/L	19 J		32 J	
	1,1,2,2-Tetrachloroethane	µg/L	140		140	
	1,1,2-Trichloroethane	µg/L	42 J		27 U	
	Acetone	µg/L	120 J		990 BJ	
	Chloromethane	µg/L	28 J		30 U	
	cis-1,2-Dichloroethene	µg/L	110		460	
	Methylene chloride	µg/L	16 U		60 BJ	
	Tetrachloroethene	µg/L	40 J		44 J	
	trans-1,2-Dichloroethene	µg/L	19 J		74 J	
	Trichloroethene	µg/L	14000		18000	
X701-TC28G	1,1,1-Trichloroethane	µg/L	230 J		250 J	
	1,1,2,2-Tetrachloroethane	µg/L	600 J		210 U	
	cis-1,2-Dichloroethene	µg/L	630 J		750 J	
	Tetrachloroethene	µg/L	600 J		770 J	
	Trichloroethene	µg/L	220000		180000	
X701-TC48G	1,1,1-Trichloroethane	µg/L	0.8 J		0.79 J	
	1,1,2,2-Tetrachloroethane	µg/L	3.1		3.2 J	
	1,1,2-Trichloroethane	µg/L	19		16	
	1,1-Dichloroethane	µg/L	0.3 J		0.88 U	
	1,2-Dichloroethane	µg/L	0.95 J		0.52 U	
	2-Butanone	µg/L	120		110	
	4-Methyl-2-pentanone	µg/L	4 J		5 J	

Table 4.7. VOCs detected at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC48G	Acetone	µg/L	1100		1100	
	Benzene	µg/L	4.4		5.8	
	Bromomethane	µg/L	15		6.5 J	
	Carbon disulfide	µg/L	0.7 J		1.8 U	
	Chloroethane	µg/L	0.81 J		1.6 U	
	Chloroform	µg/L	6.4		5.8	
	Chloromethane	µg/L	180		110	
	cis-1,2-Dichloroethene	µg/L	13		20	
	Methylene chloride	µg/L	3.2		1.9 J	
	Tetrachloroethene	µg/L	4.5		4.1	
	trans-1,2-Dichloroethene	µg/L	1.6		2.6 J	
	Trichloroethene	µg/L	480		270	
X701-TC54G	1,1,1-Trichloroethane	µg/L	150 J		210 J	
	1,1,2,2-Tetrachloroethane	µg/L	1300		1800	
	Acetone	µg/L	630 U		2800 J	
	cis-1,2-Dichloroethene	µg/L	170 J		170 J	
	Tetrachloroethene	µg/L	400		460 J	
	Trichloroethene	µg/L	170000 B		270000	
	Vinyl chloride	µg/L	2.4		100 U	
X701-TC61G	1,1,1-Trichloroethane	µg/L	87 J		64 U	
	1,1,2,2-Tetrachloroethane	µg/L	730		840	
	Acetone	µg/L	380 U		1900 J	
	cis-1,2-Dichloroethene	µg/L	650		600	
	Tetrachloroethene	µg/L	650		540	
	trans-1,2-Dichloroethene	µg/L	76 J		71 J	
	Trichloroethene	µg/L	98000		100000	
	Vinyl chloride	µg/L	5.7		50 U	
X701-TC67G	1,1,1-Trichloroethane	µg/L	32 J		32 U	
	1,1,2,2-Tetrachloroethane	µg/L	50 J		59 J	
	Acetone	µg/L	190 U		690 J	
	cis-1,2-Dichloroethene	µg/L	480		280	
	Tetrachloroethene	µg/L	140		110 J	
	trans-1,2-Dichloroethene	µg/L	25 J		30 U	
	Trichloroethene	µg/L	42000		38000	
	Vinyl chloride	µg/L	6.1		20 U	
X744G-01G	Acetone	µg/L	1.9 U		21	
	Trichloroethene	µg/L	0.35 BJ		0.16 U	
X744G-02G	Acetone	µg/L	1.9 U		2.1 J	
	cis-1,2-Dichloroethene	µg/L	1.6		1.6	
	Trichloroethene	µg/L	23		27	
	Trichlorofluoromethane	µg/L	3.4		3.3	
X744G-03G	cis-1,2-Dichloroethene	µg/L	0.28 J		0.19 J	
	Trichloroethene	µg/L	3.2		2.7	

Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-PZ03G	Technetium-99	pCi/L	0.622 U			
	Uranium	µg/L	0.0949 U			
	Uranium-233/234	pCi/L	0.0504 U			
	Uranium-235/236	pCi/L	0.0285 U			
	Uranium-238	pCi/L	0.0275 U			
LBC-PZ06G	Technetium-99	pCi/L	1.25 U			
	Uranium	µg/L	0.15 U			
	Uranium-233/234	pCi/L	0.0899 J			
	Uranium-235/236	pCi/L	0.0056 U			
	Uranium-238	pCi/L	0.0494 U			
X230J7-01GA	Technetium-99	pCi/L	3.72 U			
	Uranium	µg/L	0.167 U			
	Uranium-233/234	pCi/L	0.0656 U			
	Uranium-235/236	pCi/L	0 U			
	Uranium-238	pCi/L	0.0562 U			
X230J7-02GA	Technetium-99	pCi/L	53.7			
	Uranium	µg/L	0.268 J			
	Uranium-233/234	pCi/L	0.0656 U			
	Uranium-235/236	pCi/L	0.0163 U			
	Uranium-238	pCi/L	0.0875 J			
X230J7-03GA	Americium-241	pCi/L	0.0389 U			
	Neptunium-237	pCi/L	0.0102 U			
	Plutonium-238	pCi/L	0 U			
	Plutonium-239/240	pCi/L	0.0329 U			
	Technetium-99	pCi/L	28.2			
	Uranium	µg/L	0.367 J			
	Uranium-233/234	pCi/L	0.134 J			
	Uranium-235/236	pCi/L	0.0238 U			
	Uranium-238	pCi/L	0.12 J			
X230J7-04GA	Technetium-99	pCi/L			1.64 U	
	Uranium	µg/L			0.192 U	
	Uranium-233/234	pCi/L			0.0208 U	
	Uranium-235/236	pCi/L			0.0129 U	
	Uranium-238	pCi/L			0.0625 U	
X701-01G	Technetium-99	pCi/L	-0.509 U			
	Uranium	µg/L	2.04			
	Uranium-233/234	pCi/L	0.944			
	Uranium-235/236	pCi/L	0.0411 U			
	Uranium-238	pCi/L	0.68			
X701-02G	Technetium-99	pCi/L	3.74 U			
	Uranium	µg/L	0.653 J			
	Uranium-233/234	pCi/L	0.279			
	Uranium-235/236	pCi/L	0.0118 U			
	Uranium-238	pCi/L	0.218 J			
X701-06G	Technetium-99	pCi/L	51.2			
	Uranium	µg/L	1.06			
	Uranium-233/234	pCi/L	0.565			
	Uranium-235/236	pCi/L	0.0397 U			
	Uranium-238	pCi/L	0.351			
X701-15G	Technetium-99	pCi/L	0.0113 U			

Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-15G	Uranium	µg/L	0.066 U			
	Uranium-233/234	pCi/L	0.0266 U			
	Uranium-235/236	pCi/L	0 U			
	Uranium-238	pCi/L	0.0222 U			
X701-16G	Technetium-99	pCi/L	-0.305 U			
	Uranium	µg/L	0.127 U			
	Uranium-233/234	pCi/L	0.0342 U			
	Uranium-235/236	pCi/L	0 U			
	Uranium-238	pCi/L	0.0427 U			
X701-18G	Technetium-99	pCi/L			-0.624 U	
	Uranium	µg/L			-0.00795 U	
	Uranium-233/234	pCi/L			0.0218 U	
	Uranium-235/236	pCi/L			0.0108 U	
	Uranium-238	pCi/L			-0.00436 U	
X701-19G	Technetium-99	pCi/L	-2.9 U			
	Uranium	µg/L	0.0372 U			
	Uranium-233/234	pCi/L	0.0134 U			
	Uranium-235/236	pCi/L	-0.006 U			
	Uranium-238	pCi/L	0.0134 U			
X701-20G	Americium-241	pCi/L	0.033 U		-0.0047 U	
	Neptunium-237	pCi/L	0.0051 U		-0.00502 U	
	Plutonium-238	pCi/L	0.0143 U		-0.0157 U	
	Plutonium-239/240	pCi/L	0.0191 U		0.00523 U	
	Technetium-99	pCi/L	97.3		129	
	Uranium	µg/L	0.0525 U		0.0956 U	
	Uranium-233/234	pCi/L	0.0353 U		0.0491 U	
	Uranium-235/236	pCi/L	0 U		0.00555 U	
	Uranium-238	pCi/L	0.0176 U		0.0313 U	
X701-21G	Technetium-99	pCi/L	282			
	Uranium	µg/L	0.158 U			
	Uranium-233/234	pCi/L	0.0575 U			
	Uranium-235/236	pCi/L	0 U			
	Uranium-238	pCi/L	0.0531 U			
X701-23G	Technetium-99	pCi/L			3.94 U	
	Uranium	µg/L			0.0451 U	
	Uranium-233/234	pCi/L			0.0296 U	
	Uranium-235/236	pCi/L			0.0158 U	
	Uranium-238	pCi/L			0.0127 U	
X701-24G	Americium-241	pCi/L	0.0568 U			
	Neptunium-237	pCi/L	0.0103 U			
	Plutonium-238	pCi/L	0 U			
	Plutonium-239/240	pCi/L	0 U			
	Technetium-99	pCi/L	1.74 U			
	Uranium	µg/L	0.48 J			
	Uranium-233/234	pCi/L	0.154 J			
	Uranium-235/236	pCi/L	0.0179 U			
	Uranium-238	pCi/L	0.158 J			
X701-25G	Technetium-99	pCi/L	2.33 U			
	Uranium	µg/L	0.0178 U			
	Uranium-233/234	pCi/L	0.01 U			

Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-25G	Uranium-235/236	pCi/L	0.0062 U			
	Uranium-238	pCi/L	0.005 U			
X701-30G	Technetium-99	pCi/L	5.08 U			
	Uranium	µg/L	0.256 U			
	Uranium-233/234	pCi/L	0.106 J			
	Uranium-235/236	pCi/L	0 U			
	Uranium-238	pCi/L	0.086 U			
X701-31G	Technetium-99	pCi/L			1.19 U	
	Uranium	µg/L			0.128 U	
	Uranium-233/234	pCi/L			0.0655 U	
	Uranium-235/236	pCi/L			0.00582 U	
	Uranium-238	pCi/L			0.0421 U	
X701-38G	Technetium-99	pCi/L			0.938 U	
	Uranium	µg/L			0.0313 U	
	Uranium-233/234	pCi/L			0.00961 U	
	Uranium-235/236	pCi/L			0.00597 U	
	Uranium-238	pCi/L			0.00961 U	
X701-42G	Technetium-99	pCi/L			493	
	Uranium	µg/L			0.5 J	
	Uranium-233/234	pCi/L			0.137 J	
	Uranium-235/236	pCi/L			0.0227 U	
	Uranium-238	pCi/L			0.164 J	
X701-48G	Americium-241	pCi/L			0.0195 U	
	Neptunium-237	pCi/L			0.016 U	
	Plutonium-238	pCi/L			0 U	
	Plutonium-239/240	pCi/L			0.00552 U	
	Technetium-99	pCi/L			1.57 U	
	Uranium	µg/L			0.0552 U	
	Uranium-233/234	pCi/L			0.0187 U	
	Uranium-235/236	pCi/L			0.0291 U	
	Uranium-238	pCi/L			0.014 U	
X701-58B	Technetium-99	pCi/L			1.5 U	
	Uranium	µg/L			0.106 U	
	Uranium-233/234	pCi/L			0.158 J	
	Uranium-235/236	pCi/L			0.00614 U	
	Uranium-238	pCi/L			0.0345 U	
X701-61B	Technetium-99	pCi/L			1.89 U	
	Uranium	µg/L			0.16 U	
	Uranium-233/234	pCi/L			0.0605 U	
	Uranium-235/236	pCi/L			0.0174 U	
	Uranium-238	pCi/L			0.0512 U	
X701-66G	Americium-241	pCi/L	0.0096 U		0.0149 U	
	Neptunium-237	pCi/L	0.0116 U		0.00483 U	
	Plutonium-238	pCi/L	0 U		0.00917 U	
	Plutonium-239/240	pCi/L	0.0049 U		0.0138 U	
	Technetium-99	pCi/L	2760		2590	
	Uranium	µg/L	0.406 J		0.236 U	
	Uranium-233/234	pCi/L	0.117 J		0.0848 U	
	Uranium-235/236	pCi/L	0.0112 U		0.0222 U	
	Uranium-238	pCi/L	0.135 J		0.0759 U	

Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-77G	Technetium-99	pCi/L			92.9	
	Uranium	µg/L			0.168 U	
	Uranium-233/234	pCi/L			0.0512 U	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.0563 U	
X701-79G	Technetium-99	pCi/L			92.4	
	Uranium	µg/L			0.0897 U	
	Uranium-233/234	pCi/L			0.0331 U	
	Uranium-235/236	pCi/L			0.0117 U	
	Uranium-238	pCi/L			0.0283 U	
X701-127G	Americium-241	pCi/L	0.027 U		0 U	
	Neptunium-237	pCi/L	0.0101 U		-0.00525 U	
	Plutonium-238	pCi/L	-0.004 U		-0.00631 U	
	Plutonium-239/240	pCi/L	0.0179 U		0.0126 U	
	Technetium-99	pCi/L	35.3		54.9	
	Uranium	µg/L	0.0921 U		0.0522 U	
	Uranium-233/234	pCi/L	0.0575 U		0.0294 U	
	Uranium-235/236	pCi/L	0 U		0.0183 U	
	Uranium-238	pCi/L	0.031 U		0.0147 U	
X701-128G	Americium-241	pCi/L	0.0177 U			
	Neptunium-237	pCi/L	-0.017 U			
	Plutonium-238	pCi/L	0.0046 U			
	Plutonium-239/240	pCi/L	0.0092 U			
	Technetium-99	pCi/L	11.8			
	Uranium	µg/L	0.764 J			
	Uranium-233/234	pCi/L	0.176 J			
	Uranium-235/236	pCi/L	0.0055 U			
	Uranium-238	pCi/L	0.256			
X701-130G	Technetium-99	pCi/L			989	
	Uranium	µg/L			10.5	
	Uranium-233/234	pCi/L			15.8	
	Uranium-235/236	pCi/L			0.999	
	Uranium-238	pCi/L			3.37	
X701-BW1G	Technetium-99	pCi/L			3.96 U	
	Uranium	µg/L			0.0586 U	
	Uranium-233/234	pCi/L			0.00469 U	
	Uranium-235/236	pCi/L			0.00584 U	
	Uranium-238	pCi/L			0.0188 U	
X701-BW2G	Technetium-99	pCi/L			653	
	Uranium	µg/L			0.117 U	
	Uranium-233/234	pCi/L			0.0394 U	
	Uranium-235/236	pCi/L			0 U	
	Uranium-238	pCi/L			0.0394 U	
X701-BW3G	Technetium-99	pCi/L			171	
	Uranium	µg/L			0.113 U	
	Uranium-233/234	pCi/L			0.057 U	
	Uranium-235/236	pCi/L			0.0296 U	
	Uranium-238	pCi/L			0.0333 U	
X701-BW4G	Technetium-99	pCi/L	205			
	Uranium	µg/L	-0.003 U			

Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-BW4G	Uranium-233/234	pCi/L	0.0375 U			
	Uranium-235/236	pCi/L	0.0233 U			
	Uranium-238	pCi/L	-0.005 U			
X701-EW121G	Technetium-99	pCi/L	138		136	
	Uranium	µg/L	0.254 U		0.319 J	
	Uranium-233/234	pCi/L	0.117 J		0.116 U	
	Uranium-235/236	pCi/L	0 U		0.0131 U	
	Uranium-238	pCi/L	0.0852 U		0.105 J	
X701-EW122G	Technetium-99	pCi/L	173		184	
	Uranium	µg/L	0.241 U		0.274 U	
	Uranium-233/234	pCi/L	0.089 U		0.0908 U	
	Uranium-235/236	pCi/L	0.0123 U		0.00706 U	
	Uranium-238	pCi/L	0.0791 U		0.0908 U	
X701-TC01G	Americium-241	pCi/L	0.0476 U		0.0191 U	
	Neptunium-237	pCi/L	0.0288 U		0.0163 U	
	Plutonium-238	pCi/L	0.0049 U		-0.00502 U	
	Plutonium-239/240	pCi/L	0.0148 U		0.0151 U	
	Technetium-99	pCi/L	2460		1070	
	Uranium	µg/L	5.56		1.93	
	Uranium-233/234	pCi/L	3.8		1.1	
	Uranium-235/236	pCi/L	0.176 J		0.112 U	
	Uranium-238	pCi/L	1.84		0.633	
X701-TC03G	Americium-241	pCi/L	0.0164 U		0.0424 U	
	Neptunium-237	pCi/L	0 U		0.0121 U	
	Plutonium-238	pCi/L	-0.007 U		-0.00593 U	
	Plutonium-239/240	pCi/L	0.0066 U		0.0178 U	
	Technetium-99	pCi/L	3050		2140	
	Uranium	µg/L	15		5.52	
	Uranium-233/234	pCi/L	5.56		1.92	
	Uranium-235/236	pCi/L	0.249		0.161 J	
	Uranium-238	pCi/L	5.01		1.83	
X701-TC05G	Americium-241	pCi/L	0.0319 U		0.0238 U	
	Neptunium-237	pCi/L	0 U		0.0169 U	
	Plutonium-238	pCi/L	-0.015 U		-0.00975 U	
	Plutonium-239/240	pCi/L	0.0205 U		0.00976 U	
	Technetium-99	pCi/L	1503		1560	
	Uranium	µg/L	4.46		3.85	
	Uranium-233/234	pCi/L	1.59		1.74	
	Uranium-235/236	pCi/L	0.113 U		0.0704 U	
	Uranium-238	pCi/L	1.48		1.28	
X701-TC10G	Americium-241	pCi/L	0.0255 U		0.0375 U	
	Neptunium-237	pCi/L	0.0221 U		-0.00626 U	
	Plutonium-238	pCi/L	0 U		0.00555 U	
	Plutonium-239/240	pCi/L	0.0273 U		0.0111 U	
	Technetium-99	pCi/L	1590		687	
	Uranium	µg/L	6.77		31.7	
	Uranium-233/234	pCi/L	2.38		13.5	
	Uranium-235/236	pCi/L	0.124 U		0.776	
	Uranium-238	pCi/L	2.25		10.5	
X701-TC17G	Americium-241	pCi/L	0.0106 U		0.00528 U	

Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC17G	Neptunium-237	pCi/L	0.0125 U		0 U	
	Plutonium-238	pCi/L	0.0126 U		0.0279 U	
	Plutonium-239/240	pCi/L	0.0189 U		0.0279 U	
	Technetium-99	pCi/L	757		587	
	Uranium	µg/L	31.5		42.4	
	Uranium-233/234	pCi/L	13		16.9	
	Uranium-235/236	pCi/L	0.641		0.878	
	Uranium-238	pCi/L	10.5		14.1	
X701-TC22G	Americium-241	pCi/L	-0.005 U		0.0143 U	
	Neptunium-237	pCi/L	-0.005 U		0.0105 U	
	Plutonium-238	pCi/L	0 U		0.0243 U	
	Plutonium-239/240	pCi/L	0.026 U		0.0389 U	
	Technetium-99	pCi/L	873		1170	
	Uranium	µg/L	1.79		2.48	
	Uranium-233/234	pCi/L	0.545		0.87	
	Uranium-235/236	pCi/L	0.0411 U		0.0587 U	
	Uranium-238	pCi/L	0.595		0.823	
X701-TC28G	Americium-241	pCi/L	0.0229 U			
	Neptunium-237	pCi/L	0 U			
	Plutonium-238	pCi/L	-0.005 U			
	Plutonium-239/240	pCi/L	0.0153 U			
	Technetium-99	pCi/L	934		929	
	Uranium	µg/L	17.5		19.1	
	Uranium-233/234	pCi/L	6.57		7.11	
	Uranium-235/236	pCi/L	0.333		0.452	
	Uranium-238	pCi/L	5.82		6.34	
X701-TC48G	Americium-241	pCi/L	0.0104 U		0.0191 U	
	Neptunium-237	pCi/L	-0.012 U		-0.00532 U	
	Plutonium-238	pCi/L	-0.006 U		0.0109 U	
	Plutonium-239/240	pCi/L	0.0166 U		0.0272 U	
	Technetium-99	pCi/L	96.5		101	
	Uranium	µg/L	56.4		51.8	
	Uranium-233/234	pCi/L	19.1		17.8	
	Uranium-235/236	pCi/L	1.04		0.948	
	Uranium-238	pCi/L	18.8		17.3	
X701-TC54G	Americium-241	pCi/L	-0.005 U		0.00938 U	
	Neptunium-237	pCi/L	0.0111 U		0 U	
	Plutonium-238	pCi/L	0.0054 U		-0.0196 U	
	Plutonium-239/240	pCi/L	0.0054 U		0.0147 U	
	Technetium-99	pCi/L	434		590	
	Uranium	µg/L	2.11		2.32	
	Uranium-233/234	pCi/L	0.687		0.784	
	Uranium-235/236	pCi/L	0.0342 U		0.109 U	
	Uranium-238	pCi/L	0.703		0.762	
X701-TC61G	Americium-241	pCi/L	0.0155 U		0.00495 U	
	Neptunium-237	pCi/L	0 U		-0.0115 U	
	Plutonium-238	pCi/L	0 U		0.00972 U	
	Plutonium-239/240	pCi/L	0.0274 U		0.00486 U	
	Technetium-99	pCi/L	327		391	
	Uranium	µg/L	5.75		8.31	

Table 4.8. Results for radionuclides at the X-701B Holding Pond – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X701-TC61G	Uranium-233/234	pCi/L	1.6		2.85	
	Uranium-235/236	pCi/L	0.0882 U		0.181 J	
	Uranium-238	pCi/L	1.92		2.76	
X701-TC67G	Americium-241	pCi/L	0.0185 U		0.0485 U	
	Neptunium-237	pCi/L	-0.024 U		0 U	
	Plutonium-238	pCi/L	-0.005 U		-0.00498 U	
	Plutonium-239/240	pCi/L	0.0159 U		0.0249 U	
	Technetium-99	pCi/L	259		240	
	Uranium	µg/L	2.47		0.561 J	
	Uranium-233/234	pCi/L	0.799		0.128 J	
	Uranium-235/236	pCi/L	0.0241 U		0.0236 U	
	Uranium-238	pCi/L	0.828		0.185 J	

Table 4.9. Results for chromium at the X-633 Former Recirculating Cooling Water Complex – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X633-07G	Chromium	µg/L		640		880
X633-PZ04G	Chromium	µg/L		14		31

Table 4.10. VOCs detected at the X-616 Former Chromium Sludge Surface Impoundments – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-02G	1,1-Dichloroethene	µg/L	0.27 J			
	Trichloroethene	µg/L	0.36 J			
X616-09G	1,1,1-Trichloroethane	µg/L	4			
	1,1-Dichloroethane	µg/L	3.5			
	1,1-Dichloroethene	µg/L	33			
	cis-1,2-Dichloroethene	µg/L	3.1			
	Trichloroethene	µg/L	21			
X616-13G	1,1,1-Trichloroethane	µg/L	2.8			
	1,1-Dichloroethane	µg/L	0.65 J			
	1,1-Dichloroethene	µg/L	17			
	Acetone	µg/L	2.2 J			
	cis-1,2-Dichloroethene	µg/L	0.27 J			
	Trichloroethene	µg/L	7.4			
	Trichlorofluoromethane	µg/L	3.2			
X616-14G	1,1,1-Trichloroethane	µg/L	1.4			
	1,1-Dichloroethane	µg/L	0.28 J			
	1,1-Dichloroethene	µg/L	7.5			
	Trichloroethene	µg/L	3.4			
X616-16G	1,1-Dichloroethene	µg/L	0.57 J			
	cis-1,2-Dichloroethene	µg/L	1.6			
	Trichloroethene	µg/L	1.9			
X616-17G	1,1-Dichloroethene	µg/L	0.3 J			
	Acetone	µg/L	22			
X616-19B	Acetone	µg/L	33			
X616-20B	1,1,1-Trichloroethane	µg/L	0.27 J			
	1,1-Dichloroethane	µg/L	0.58 J			
	1,1-Dichloroethene	µg/L	2.6			
	cis-1,2-Dichloroethene	µg/L	0.48 J			
	Trichloroethene	µg/L	14			
X616-22G	Acetone	µg/L	3.7 J			
X616-25G	cis-1,2-Dichloroethene	µg/L	0.73 J			
	Trichloroethene	µg/L	1.5			
X616-28B	1,1,1-Trichloroethane	µg/L	1.1			
	1,1-Dichloroethene	µg/L	0.76 J			
	Trichloroethene	µg/L	0.4 J			

Table 4.11. Results for chromium at the X-616 Former Chromium Sludge Surface Impoundments – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X616-02G	Chromium	µg/L	0.5 U			
X616-05G	Chromium	µg/L	740			
X616-09G	Chromium	µg/L	10			
X616-10G	Chromium	µg/L	0.97 B			
X616-13G	Chromium	µg/L	1 B			
X616-14G	Chromium	µg/L	1.7 B			
X616-16G	Chromium	µg/L	0.5 U			
X616-17G	Chromium	µg/L	3.8			
X616-19B	Chromium	µg/L	52			
X616-20B	Chromium	µg/L	0.9 B			
X616-21G	Chromium	µg/L	1.3 B			
X616-22G	Chromium	µg/L	0.5 U			
X616-24B	Chromium	µg/L	1.1 B			
X616-25G	Chromium	µg/L	2.3			
X616-26G	Chromium	µg/L	3.5			
X616-28B	Chromium	µg/L	0.69 B			

Table 4.12. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-02G	1,1,1-Trichloroethane	µg/L	4.6	3.9	5.2	3
	1,1-Dichloroethane	µg/L	3.9	3.2	3.4	3.3
	1,1-Dichloroethene	µg/L	6.4	6	6.1	3.8
	Acetone	µg/L	1.9 U	1.9 U	2.2 J	1.9 U
	Trichloroethene	µg/L	7.1	6.3	6.8	5.9
	Trichlorofluoromethane	µg/L	0.29 U	0.29 U	0.38 J	0.29 U
X740-03G	1,1-Dichloroethane	µg/L	14	5.1	14	7.4
	1,1-Dichloroethene	µg/L	230	130	220	130
	1,2-Dichloroethane	µg/L	41	17	46	29
	2-Butanone	µg/L	110	41	26 J	10 U
	Acetone	µg/L	36 J	270	55 J	33 J
	Chloroethane	µg/L	25	18	29	23
	cis-1,2-Dichloroethene	µg/L	1800	1100	1600	1400
	Methylene chloride	µg/L	3.2 U	1.3 U	5.8 J	1.6 U
	Toluene	µg/L	1.7 U	0.68 U	1.7 U	1 J
	trans-1,2-Dichloroethene	µg/L	3.5 J	1.1 J	2.5 J	2.3 J
	Trichloroethene	µg/L	91	24	110	23
	Vinyl chloride	µg/L	18	15	24	21
X740-09B	1,1,1-Trichloroethane	µg/L	9.2	10	19	8.3
	1,1-Dichloroethane	µg/L	20	18	19	14
	1,1-Dichloroethene	µg/L	210	200	180	110
	1,2-Dichloroethane	µg/L	52	41	47	29
	Acetone	µg/L	9.5 U	7.6 U	9.8 J	7.6 U
	Chloroform	µg/L	1.5 J	1.4 J	2.1 J	1.4 J
	cis-1,2-Dichloroethene	µg/L	120	340	270	180
	Methylene chloride	µg/L	1.6 U	1.3 U	1.5 J	1.3 U
	Tetrachloroethene	µg/L	28	25	21	17
	Trichloroethene	µg/L	1300	1000	950	810
	Trichlorofluoromethane	µg/L	1.5 U	1.2 U	1.3 J	1.2 U
	Vinyl chloride	µg/L	0.5 U	0.52 J	0.52 J	0.4 U
X740-10G	1,1,1-Trichloroethane	µg/L	1.9	1.3	3.8	4.1
	1,1-Dichloroethane	µg/L	1.8	1.2	3.4	4.8
	1,1-Dichloroethene	µg/L	19	14	33	42
	1,2-Dichloroethane	µg/L	4	2.6	8.5	9.5
	Acetone	µg/L	1.9 U	4.8 J	1.9 U	2.1 BJ
	Chloroform	µg/L	0.25 J	0.16 J	0.36 J	0.44 J
	cis-1,2-Dichloroethene	µg/L	2.6	2.2	22	43
	Tetrachloroethene	µg/L	2.2	1.7	4	4.3
	trans-1,2-Dichloroethene	µg/L	0.15 U	0.15 U	0.15 U	0.15 J
	Trichloroethene	µg/L	95	71	220	220
X740-18G	1,1-Dichloroethane	µg/L	0.33 J	0.22 U	0.22 U	0.22 U
	1,1-Dichloroethene	µg/L	3.1	2.8	1.7	1.6
	1,2-Dichloroethane	µg/L	2.9	1.3	1.7	0.73 J
	2-Butanone	µg/L	1100	650	230	310
	4-Methyl-2-pentanone	µg/L	2.3 J	0.98 U	0.98 U	1.2 J
	Acetone	µg/L	520	740	210	230 B
	Chloroethane	µg/L	0.41 U	1.3 J	1.8 J	1.2 J
	cis-1,2-Dichloroethene	µg/L	38	28	27	27
	Methylene chloride	µg/L	0.57 BJ	0.32 U	0.32 U	0.32 U
	Toluene	µg/L	0.19 J	0.17 U	0.17 U	0.17 U

Table 4.12. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-18G	trans-1,2-Dichloroethene	µg/L	0.5 J	0.15 U	0.26 J	0.35 J
	Trichloroethene	µg/L	1.7	1.1	1.3	0.8 J
	Vinyl chloride	µg/L	0.94 J	0.75 J	0.9 J	0.74 J
X740-19G	1,1,1-Trichloroethane	µg/L	1.3	0.97 J	1.1	0.9 J
	1,1-Dichloroethane	µg/L	0.7 J	0.52 J	0.42 J	0.49 J
	1,1-Dichloroethene	µg/L	13	8.5	7	6.5
	1,2-Dichloroethane	µg/L	2.8	2.3	2.3	1.8
	Acetone	µg/L	1.9 U	11	1.9 U	1.9 J
	Chloroform	µg/L	0.21 J	0.17 J	0.18 J	0.16 U
	cis-1,2-Dichloroethene	µg/L	2.7	3.2	3.9	4.2
	Tetrachloroethene	µg/L	2.5	1.6	1.6	1.9
	Trichloroethene	µg/L	76	51	69	55
X740-20G	1,1,1-Trichloroethane	µg/L	0.25 J	0.18 J	0.22 J	0.19 J
	1,1-Dichloroethane	µg/L	0.34 J	0.4 J	0.33 J	0.31 J
	1,1-Dichloroethene	µg/L	2.5	2.1	2.3	1.8
	1,2-Dichloroethane	µg/L	0.9 J	1	0.83 J	0.66 J
	Acetone	µg/L	1.9 U	55	1.9 U	1.9 U
	cis-1,2-Dichloroethene	µg/L	0.51 J	1.2	1.2	1.6
	Methylene chloride	µg/L	0.44 BJ	0.32 U	0.32 U	0.32 U
	Trichloroethene	µg/L	16	14	18	18
X740-21G	1,1,1-Trichloroethane	µg/L	0.53 J	0.38 J	0.41 J	0.47 J
	1,1-Dichloroethane	µg/L	0.4 J	0.27 J	0.27 J	0.39 J
	1,1-Dichloroethene	µg/L	6	3.7	3	4.1
	1,2-Dichloroethane	µg/L	1.7	1.1	1.1	1.4
	cis-1,2-Dichloroethene	µg/L	0.26 J	0.28 J	0.26 J	0.49 J
	Methylene chloride	µg/L	0.42 BJ	0.32 U	0.32 U	0.32 U
	Tetrachloroethene	µg/L	0.41 J	0.32 J	0.26 J	0.4 J
	Trichloroethene	µg/L	35	26	25	30
X740-22G	1,1,1-Trichloroethane	µg/L	3.5	3.2	3.1	3.5
	1,1-Dichloroethane	µg/L	1.6 J	1.3	1.3	1.5
	1,1-Dichloroethene	µg/L	32	33	27	27
	1,2-Dichloroethane	µg/L	8	5.3	5.8	6.8
	Acetone	µg/L	3.8 U	1.9 U	1.9 U	2.7 BJ
	Chloroform	µg/L	0.66 J	0.49 J	0.55 J	0.65 J
	cis-1,2-Dichloroethene	µg/L	0.48 J	0.49 J	0.52 J	0.63 J
	Tetrachloroethene	µg/L	3.6	3.9	3.4	3
	Trichloroethene	µg/L	170	170	160	160
X740-23M	1,1-Dichloroethane	µg/L	0.22 U	0.22 U	0.22 U	0.28 J
	Acetone	µg/L	1.9 U	1.9 U	1.9 U	2.8 J
	Toluene	µg/L	0.17 U	0.31 J	0.17 U	0.17 U
	Trichloroethene	µg/L	0.58 J	2.3	0.48 J	0.59 J
X740-PZ04M	Trichloroethene	µg/L	0.26 J	0.26 J	0.42 J	0.4 J
X740-PZ12G	1,1,1-Trichloroethane	µg/L	2.2	1.4	1.8	1.8
	1,1-Dichloroethane	µg/L	0.81 J	0.55 J	0.69 J	0.76 J
	1,1-Dichloroethene	µg/L	12	8	9.2	9.2
	1,2-Dichloroethane	µg/L	4.1	2.9	3	3.7
	Chloroform	µg/L	0.39 J	0.29 J	0.37 J	0.39 J
	cis-1,2-Dichloroethene	µg/L	0.15 U	0.15 U	0.15 U	0.16 J
	Methylene chloride	µg/L	0.47 BJ	0.32 U	0.32 U	0.32 U
	Tetrachloroethene	µg/L	1.2	0.63 J	0.79 J	0.83 J

Table 4.12. VOCs detected at the X-740 Former Waste Oil Handling Facility – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X740-PZ12G	Trichloroethene	µg/L	85	57	69	89

Table 4.13. Results for beryllium and chromium at the X-611A Former Lime Sludge Lagoons – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-07G	Beryllium	µg/L	0.93 B		1.5	
	Chromium	µg/L	6.1		1.3 B	
F-08B	Beryllium	µg/L	0.094 B		0.08 U	
	Chromium	µg/L	0.5 U		0.5 U	
X611-01B	Beryllium	µg/L	0.092 B		0.08 U	
	Chromium	µg/L	57		15	
X611-02BA	Beryllium	µg/L	0.11 B		0.08 U	
	Chromium	µg/L	1.9 B		2.8	
X611-03G	Beryllium	µg/L	0.36 B		0.08 U	
	Chromium	µg/L	2.6		0.5 U	
X611-04BA	Beryllium	µg/L	0.42 B		0.62 B	
	Chromium	µg/L	0.5 U		0.5 U	

Table 4.14. VOCs detected at the X-735 Landfills – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-02GA	1,1-Dichloroethane	µg/L		0.22 J		
X735-16B	Acetone	µg/L		2.1 J		
X735-18B	Acetone	µg/L		2.9 J		
X735-19G	Acetone	µg/L		3.5 J		
X735-20B	Trichloroethene	µg/L		1.6		
X737-08B	Trichloroethene	µg/L		0.3 J		

Table 4.15. Results for radionuclides at the X-735 Landfills – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-01GA	Technetium-99	pCi/L		0.135 U		
	Uranium	µg/L		0.065 U		
	Uranium-233/234	pCi/L		0.0218 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0218 U		
X735-02GA	Technetium-99	pCi/L		-0.215 U		
	Uranium	µg/L		0.051 U		
	Uranium-233/234	pCi/L		0.0129 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0171 U		
X735-03GA	Technetium-99	pCi/L		4.26 U		
	Uranium	µg/L		0.0484 U		
	Uranium-233/234	pCi/L		0.0136 U		
	Uranium-235/236	pCi/L		0.0169 U		
	Uranium-238	pCi/L		0.0136 U		
X735-04GA	Technetium-99	pCi/L		1.5 U		
	Uranium	µg/L		0.0272 U		
	Uranium-233/234	pCi/L		0.0183 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.00914 U		
X735-05GA	Technetium-99	pCi/L		1.95 U		
	Uranium	µg/L		0.117 U		
	Uranium-233/234	pCi/L		0.0335 U		
	Uranium-235/236	pCi/L		0.0104 U		
	Uranium-238	pCi/L		0.0377 U		
X735-06GAA	Technetium-99	pCi/L		0.26 U		
	Uranium	µg/L		0.106 U		
	Uranium-233/234	pCi/L		0.0532 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0355 U		
X735-13GA	Technetium-99	pCi/L		1.03 U		
	Uranium	µg/L		0.187 U		
	Uranium-233/234	pCi/L		0.0436 U		
	Uranium-235/236	pCi/L		0.0109 U		
	Uranium-238	pCi/L		0.0611 U		
X735-16B	Technetium-99	pCi/L		-1.33 U		
	Uranium	µg/L		0.00542 U		
	Uranium-233/234	pCi/L		0.00942 U		
	Uranium-235/236	pCi/L		0.0117 U		
	Uranium-238	pCi/L		0 U		
X735-17B	Technetium-99	pCi/L		-1.1 U		
	Uranium	µg/L		0.222 U		
	Uranium-233/234	pCi/L		0.137 J		
	Uranium-235/236	pCi/L		0.0107 U		
	Uranium-238	pCi/L		0.0729 U		
X735-18B	Technetium-99	pCi/L		-0.666 U		
	Uranium	µg/L		0.0643 U		
	Uranium-233/234	pCi/L		0.00435 U		
	Uranium-235/236	pCi/L		0.027 U		
	Uranium-238	pCi/L		0.0174 U		

Table 4.15. Results for radionuclides at the X-735 Landfills – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X735-19G	Technetium-99	pCi/L		1.07 U		
	Uranium	µg/L		0.0494 U		
	Uranium-233/234	pCi/L		0.0278 U		
	Uranium-235/236	pCi/L		0.0173 U		
	Uranium-238	pCi/L		0.0139 U		
X735-20B	Technetium-99	pCi/L		0.87 U		
	Uranium	µg/L		0.0297 U		
	Uranium-233/234	pCi/L		0.0167 U		
	Uranium-235/236	pCi/L		0.0104 U		
	Uranium-238	pCi/L		0.00836 U		
X735-21G	Technetium-99	pCi/L		0.644 U		
	Uranium	µg/L		0.533 J		
	Uranium-233/234	pCi/L		0.235		
	Uranium-235/236	pCi/L		0.00541 U		
	Uranium-238	pCi/L		0.178 J		
X737-05B	Technetium-99	pCi/L		3.13 U		
	Uranium	µg/L		0.0125 U		
	Uranium-233/234	pCi/L		0.00841 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.00421 U		
X737-06G	Technetium-99	pCi/L		1.16 U		
	Uranium	µg/L		0.127 U		
	Uranium-233/234	pCi/L		0.025 U		
	Uranium-235/236	pCi/L		0.00519 U		
	Uranium-238	pCi/L		0.0417 U		
X737-07B	Technetium-99	pCi/L		0.0791 U		
	Uranium	µg/L		0.00493 U		
	Uranium-233/234	pCi/L		0.00856 U		
	Uranium-235/236	pCi/L		0.0106 U		
	Uranium-238	pCi/L		0 U		
X737-08B	Technetium-99	pCi/L		-0.711 U		
	Uranium	µg/L		0.104 U		
	Uranium-233/234	pCi/L		0.0873 J		
	Uranium-235/236	pCi/L		0.0103 U		
	Uranium-238	pCi/L		0.0333 U		
X737-09G	Technetium-99	pCi/L		0.147 U		
	Uranium	µg/L		0.0515 U		
	Uranium-233/234	pCi/L		0.026 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0173 U		

Table 4.16. VOCs detected at the X-734 Landfills – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
RSY-02B	Trichloroethene	µg/L		0.21 J		0.16 U
X734-01G	Acetone	µg/L		2.7 J		1.9 U
X734-02B	Acetone	µg/L		3.2 J		1.9 U
X734-03G	1,1-Dichloroethane	µg/L		0.22 U		0.31 J
	1,4-Dichlorobenzene	µg/L		0.42 J		1.1
X734-05B	1,2-Dimethylbenzene	µg/L		0.21 J		0.19 U
	Benzene	µg/L		1.4		2.2
	Ethylbenzene	µg/L		0.32 J		0.28 J
	Toluene	µg/L		0.5 J		0.76 J
X734-16G	Acetone	µg/L		1.9 U		10
X734-22G	Acetone	µg/L		2.4 J		1.9 U
X734-23G	cis-1,2-Dichloroethene	µg/L		2.8		2.6
	trans-1,2-Dichloroethene	µg/L		0.19 J		0.15 U
	Vinyl chloride	µg/L		0.8 J		0.3 J

Table 4.17. Results for radionuclides at the X-734 Landfills – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
RSY-02B	Americium-241	pCi/L		0.0411 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.00996 U		
	Plutonium-239/240	pCi/L		0.00498 U		
	Technetium-99	pCi/L		-1.46 U		
	Uranium	µg/L		0.0502 U		
	Uranium-233/234	pCi/L		0.0619 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0169 U		
X734-01G	Americium-241	pCi/L		0.0232 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.00913 U		
	Plutonium-239/240	pCi/L		0.0137 U		
	Technetium-99	pCi/L		-1.22 U		
	Uranium	µg/L		0.187 U		
	Uranium-233/234	pCi/L		0.0772 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0627 U		
X734-02B	Americium-241	pCi/L		0.0514 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.0288 U		
	Plutonium-239/240	pCi/L		0.0288 U		
	Technetium-99	pCi/L		0.475 U		
	Uranium	µg/L		0.0201 U		
	Uranium-233/234	pCi/L		0.00975 U		
	Uranium-235/236	pCi/L		0.0121 U		
	Uranium-238	pCi/L		0.00487 U		
X734-03G	Americium-241	pCi/L		0.0432 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.00978 U		
	Plutonium-239/240	pCi/L		0 U		
	Technetium-99	pCi/L		-1.04 U		
	Uranium	µg/L		1.95		
	Uranium-233/234	pCi/L		1.19		
	Uranium-235/236	pCi/L		0.105 J		
	Uranium-238	pCi/L		0.639		
X734-04G	Americium-241	pCi/L		0.00881 U		
	Neptunium-237	pCi/L		0.00476 U		
	Plutonium-238	pCi/L		-0.009 U		
	Plutonium-239/240	pCi/L		0.00898 U		
	Technetium-99	pCi/L		-2.24 U		
	Uranium	µg/L		2.45		
	Uranium-233/234	pCi/L		0.94		
	Uranium-235/236	pCi/L		0.0562 U		
	Uranium-238	pCi/L		0.813		
X734-05B	Americium-241	pCi/L		0.0147 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0.00481 U		
	Plutonium-239/240	pCi/L		0.0289 U		
	Technetium-99	pCi/L		-1.38 U		

Table 4.17. Results for radionuclides at the X-734 Landfills – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X734-05B	Uranium	µg/L		0.389 J		
	Uranium-233/234	pCi/L		0.372		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.131 J		
X734-06G	Americium-241	pCi/L		0.0188 U		
	Neptunium-237	pCi/L		0.00492 U		
	Plutonium-238	pCi/L		-0.0103 U		
	Plutonium-239/240	pCi/L		0.0309 U		
	Technetium-99	pCi/L		2.31 U		
	Uranium	µg/L		0.0436 U		
	Uranium-233/234	pCi/L		0.0342 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0.0146 U		
X734-10G	Americium-241	pCi/L		0.0427 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.00463 U		
	Technetium-99	pCi/L		-0.995 U		
	Uranium	µg/L		0.522 J		
	Uranium-233/234	pCi/L		0.113 J		
	Uranium-235/236	pCi/L		0.0117 U		
	Uranium-238	pCi/L		0.174 J		
X734-14G	Americium-241	pCi/L		0.0225 U		
	Neptunium-237	pCi/L		0.00517 U		
	Plutonium-238	pCi/L		0.00479 U		
	Plutonium-239/240	pCi/L		0.0144 U		
	Technetium-99	pCi/L		-1.87 U		
	Uranium	µg/L		0.924 J		
	Uranium-233/234	pCi/L		0.355		
	Uranium-235/236	pCi/L		0.0195 U		
	Uranium-238	pCi/L		0.308		
X734-15G	Americium-241	pCi/L		0.0229 U		
	Neptunium-237	pCi/L		0.00465 U		
	Plutonium-238	pCi/L		-0.0088 U		
	Plutonium-239/240	pCi/L		0.0308 U		
	Technetium-99	pCi/L		-2.4 U		
	Uranium	µg/L		0.0863 U		
	Uranium-233/234	pCi/L		0.0511 U		
	Uranium-235/236	pCi/L		-0.0053 U		
	Uranium-238	pCi/L		0.0298 U		
X734-16G	Americium-241	pCi/L		-0.0046 U		
	Neptunium-237	pCi/L		-0.0050 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.00954 U		
	Technetium-99	pCi/L		-1.47 U		
	Uranium	µg/L		4.29		
	Uranium-233/234	pCi/L		1.66		
	Uranium-235/236	pCi/L		0.116 J		
	Uranium-238	pCi/L		1.42		
X734-18G	Americium-241	pCi/L		0.0177 U		

Table 4.17. Results for radionuclides at the X-734 Landfills – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X734-18G	Neptunium-237	pCi/L		-0.0048 U		
	Plutonium-238	pCi/L		-0.0046 U		
	Plutonium-239/240	pCi/L		0.0139 U		
	Technetium-99	pCi/L		-0.95 U		
	Uranium	µg/L		1.94		
	Uranium-233/234	pCi/L		1.06		
	Uranium-235/236	pCi/L		0.0488 U		
	Uranium-238	pCi/L		0.643		
X734-20G	Americium-241	pCi/L		0.00536 U		
	Neptunium-237	pCi/L		0.00992 U		
	Plutonium-238	pCi/L		0.0102 U		
	Plutonium-239/240	pCi/L		0.0205 U		
	Technetium-99	pCi/L		-0.666 U		
	Uranium	µg/L		3.2E-06 U		
	Uranium-233/234	pCi/L		0.0198 U		
	Uranium-235/236	pCi/L		0 U		
	Uranium-238	pCi/L		0 U		
X734-22G	Americium-241	pCi/L		0.0327 U		
	Neptunium-237	pCi/L		0.0233 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.0283 U		
	Technetium-99	pCi/L		2.46 U		
	Uranium	µg/L		0.877 J		
	Uranium-233/234	pCi/L		0.482		
	Uranium-235/236	pCi/L		0.021 U		
	Uranium-238	pCi/L		0.292		
X734-23G	Americium-241	pCi/L		0.0399 U		
	Neptunium-237	pCi/L		0 U		
	Plutonium-238	pCi/L		0 U		
	Plutonium-239/240	pCi/L		0.0301 U		
	Technetium-99	pCi/L		1.9 U		
	Uranium	µg/L		0.0976 U		
	Uranium-233/234	pCi/L		0.013 U		
	Uranium-235/236	pCi/L		0.0161 U		
	Uranium-238	pCi/L		0.0303 U		

Table 4.18. Results for cadmium and nickel at the X-533 Former Switchyard Complex – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-03G	Cadmium	µg/L		46		49
	Nickel	µg/L		560		650
TCP-01G	Cadmium	µg/L		14		11
	Nickel	µg/L		190		140
X533-03G	Cadmium	µg/L		18		22
	Nickel	µg/L		290		310

Table 4.19. VOCs detected at the X-344C Former Hydrogen Fluoride Storage Building – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
X344C-01G	cis-1,2-Dichloroethene	µg/L	2			
	trans-1,2-Dichloroethene	µg/L	0.2 J			
	Trichloroethene	µg/L	0.32 J			
	Vinyl chloride	µg/L	0.12 J			

Table 4.20. VOCs detected at surface water monitoring locations – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Acetone	µg/L	12	14	13 B	1.9 U
	Bromodichloromethane	µg/L	1.7	1	0.33 J	0.17 U
	Bromoform	µg/L	0.62 J	1.4	0.19 U	0.19 U
	Chloroform	µg/L	1.9	1.4	0.41 J	0.16 U
	Dibromochloromethane	µg/L	1.7	1.5	0.7 J	0.17 U
BRC-SW02	Acetone	µg/L	5.8 J	2.5 J	3.3 BJ	1.9 U
BRC-SW05	Acetone	µg/L	7.5 J	1.9 U	4.8 BJ	17
	Bromodichloromethane	µg/L	0.17 U	0.17 U	0.17 U	0.61 J
	Chloroform	µg/L	0.16 U	0.16 U	0.16 U	1
	Dibromochloromethane	µg/L	0.17 U	0.17 U	0.17 U	0.69 J
EDD-SW01	Acetone	µg/L	3.1 J	1.9 U	3.4 J	4.8 BJ
	Bromodichloromethane	µg/L	4.1	1.4	2.2	3.3
	Bromoform	µg/L	1.8	0.66 J	1.3	1.1
	Chloroform	µg/L	3.4	1.7	2.4	3.3
	cis-1,2-Dichloroethene	µg/L	0.46 J	0.58 J	0.39 J	0.98 J
	Dibromochloromethane	µg/L	5.2	2	3.3	3.9
	Trichloroethene	µg/L	1.1	1.3	0.72 J	1.7
LBC-SW01	Acetone	µg/L	2.4 J	1.9 U	2.9 J	1.9 U
	Bromodichloromethane	µg/L	2.3	0.89 J	1.9	2.6
	Bromoform	µg/L	1.1	0.45 J	1.1	0.86 J
	Chloroform	µg/L	1.8	1.1	1.9	2.6
	cis-1,2-Dichloroethene	µg/L	0.4 J	0.75 J	0.29 J	0.87 J
	Dibromochloromethane	µg/L	3.1	1.1	3	3.2
	Trichloroethene	µg/L	0.79 J	0.88 J	0.5 J	1.3
LBC-SW02	Acetone	µg/L	1.9 U	5.2 J	3.9 J	1.9 U
	Bromodichloromethane	µg/L	1.5	0.41 J	0.49 J	0.97 J
	Bromoform	µg/L	0.99 J	0.19 U	0.4 J	0.19 U
	Chloroform	µg/L	1.1	0.54 J	0.5 J	0.92 J
	cis-1,2-Dichloroethene	µg/L	0.25 J	0.2 J	0.15 U	0.28 J
	Dibromochloromethane	µg/L	2.2	0.54 J	0.96 J	1.4
	Trichloroethene	µg/L	0.39 J	0.33 J	0.16 U	0.45 J
LBC-SW03	Acetone	µg/L	1.9 U	1.9 U	5.8 J	1.9 U
	Bromodichloromethane	µg/L	0.6 J	0.17 U	0.17 U	0.17 U
	Bromoform	µg/L	0.66 J	0.19 U	0.19 U	0.19 U
	Chloroform	µg/L	0.36 J	0.16 U	0.16 U	0.16 U
	Dibromochloromethane	µg/L	1.1	0.17 U	0.17 U	0.17 U
	Methylene chloride	µg/L	0.32 U	0.34 BJ	0.32 U	0.32 U
	Trichloroethene	µg/L	0.2 J	0.16 U	0.16 U	0.16 U
LBC-SW04	Acetone	µg/L	1.9 U	1.9 U	20	1.9 U
	Bromodichloromethane	µg/L	0.21 J	0.17 U	0.17 U	0.17 U
	Bromoform	µg/L	0.38 J	0.19 U	0.19 U	0.19 U
	Dibromochloromethane	µg/L	0.44 J	0.17 U	0.17 U	0.17 U
	Methylene chloride	µg/L	0.32 U	0.37 BJ	0.32 U	0.32 U
NHP-SW01	Acetone	µg/L	1.9 U	1.9 U	21	1.9 U
	Bromodichloromethane	µg/L	0.5 J	0.17 U	0.17 U	0.22 J
	Bromoform	µg/L	0.31 J	0.19 U	0.19 U	0.19 U
	Chloroform	µg/L	0.4 J	0.23 J	0.16 U	0.3 J
	Dibromochloromethane	µg/L	0.54 J	0.17 U	0.17 U	0.38 J
UND-SW01	1,1-Dichloroethene	µg/L	0.23 U	0.26 J	0.27 J	0.23 U
	Acetone	µg/L	1.9 U	1.9 U	3.4 J	1.9 U

Table 4.20. VOCs detected at surface water monitoring locations – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
UND-SW01	cis-1,2-Dichloroethene	µg/L	0.15 J	0.26 J	0.54 J	0.15 U
	Trichloroethene	µg/L	2.1	4	6.2	1.1
UND-SW02	Acetone	µg/L	2 J	1.9 U	3.9 J	1.9 U
WDD-SW01	Acetone	µg/L	3.1 J	1.9 U	2.3 J	1.9 U
	Bromodichloromethane	µg/L	0.49 J	0.7 J	0.9 J	0.31 J
	Bromoform	µg/L	0.21 J	0.79 J	0.19 U	0.19 U
	Chloroform	µg/L	0.46 J	1.2	1.3	0.27 J
	Dibromochloromethane	µg/L	0.47 J	1.2	0.94 J	0.43 J
WDD-SW02	Acetone	µg/L	2.5 J	1.9 U	4.1 J	1.9 U
	Bromodichloromethane	µg/L	2.7	0.17 U	0.17 U	0.17 U
	Bromoform	µg/L	0.59 J	0.19 U	0.19 U	0.19 U
	Chloroform	µg/L	2.6	0.16 U	0.16 U	0.16 U
	Dibromochloromethane	µg/L	2.9	0.17 U	0.17 U	0.17 U
WDD-SW03	Acetone	µg/L	1.9 U	1.9 U	2.3 J	1.9 U
	Bromodichloromethane	µg/L	0.17 U	0.2 J	0.17 U	0.17 U
	Bromoform	µg/L	0.19 U	0.28 J	0.19 U	0.19 U
	Chloroform	µg/L	0.16 U	0.33 J	0.22 J	0.16 U
	Dibromochloromethane	µg/L	0.17 U	0.35 J	0.17 J	0.17 U

Table 4.21. Results for radionuclides at surface water monitoring locations – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
BRC-SW01	Americium-241	pCi/L		0.0272 U		0.0174 U
	Neptunium-237	pCi/L		0 U		0 U
	Plutonium-238	pCi/L		0.00921 U		0.00503 U
	Plutonium-239/240	pCi/L		0.0369 U		0.0101 U
	Technetium-99	pCi/L	-0.555 U	5.42 U	2.82 U	-1.88 U
	Uranium	µg/L	3.66	0.983 J	0.361 J	0.568 J
	Uranium-233/234	pCi/L	5.58	2.72	0.285	0.4
	Uranium-235/236	pCi/L	0.335	0.103 U	0.0291 U	0.0241 U
	Uranium-238	pCi/L	1.18	0.314	0.117 J	0.187 J
BRC-SW02	Americium-241	pCi/L		0.0144 U		0.0178 U
	Neptunium-237	pCi/L		0.0465 U		0.0202 U
	Plutonium-238	pCi/L		0.00499 U		0 U
	Plutonium-239/240	pCi/L		0.02 U		0.00507 U
	Technetium-99	pCi/L	1.16 U	0.735 U	2.11 U	-0.0339 U
	Uranium	µg/L	0.897 J	1.14	0.521 J	0.512 J
	Uranium-233/234	pCi/L	0.647	0.889	0.431	0.491
	Uranium-235/236	pCi/L	0.0444 U	0.0626 U	0.0057 U	0.0526 U
	Uranium-238	pCi/L	0.295	0.373	0.174 J	0.164 J
BRC-SW05	Americium-241	pCi/L		0.0179 U		0.0257 U
	Neptunium-237	pCi/L		0 U		0.0175 U
	Plutonium-238	pCi/L		0 U		-0.00508 U
	Plutonium-239/240	pCi/L		0.0186 U		0.0153 U
	Technetium-99	pCi/L	-0.555 U	2.03 U	0.711 U	1.48 U
	Uranium	µg/L	0.978 J	0.697 J	0.422 J	0.366 J
	Uranium-233/234	pCi/L	0.946	0.904	0.38	0.771
	Uranium-235/236	pCi/L	0.0535 U	0.0166 U	0 U	0.0496 U
	Uranium-238	pCi/L	0.32	0.231 J	0.142 J	0.115 J
EDD-SW01	Americium-241	pCi/L		0.0191 U		0.0417 U
	Neptunium-237	pCi/L		0.0159 U		0 U
	Plutonium-238	pCi/L		-0.0046 U		0 U
	Plutonium-239/240	pCi/L		0.0139 U		0.0241 U
	Technetium-99	pCi/L	18.7	5.18 U	-0.339 U	2.5 U
	Uranium	µg/L	1.09	1.03	0.373 J	0.882 J
	Uranium-233/234	pCi/L	2.19	1.41	0.502	1.02
	Uranium-235/236	pCi/L	0.116 U	0.115 J	0.0279 U	0.0307 U
	Uranium-238	pCi/L	0.349	0.328	0.121 J	0.291
LBC-SW01	Americium-241	pCi/L		0.00902 U		0.018 U
	Neptunium-237	pCi/L		0.00946 U		-0.00947 U
	Plutonium-238	pCi/L		0 U		-0.00541 U
	Plutonium-239/240	pCi/L		0.0391 U		0.0216 U
	Technetium-99	pCi/L	15.1	2.98 U	0.411 U	3.11 U
	Uranium	µg/L	0.855 J	0.809 J	0.353 J	0.855 J
	Uranium-233/234	pCi/L	1.35	1.1	0.56	1.12
	Uranium-235/236	pCi/L	0.0643 U	0.0821 U	0.0314 U	0.0888 U
	Uranium-238	pCi/L	0.277	0.259	0.114 J	0.274
LBC-SW02	Americium-241	pCi/L		0.00916 U		0.0211 U
	Neptunium-237	pCi/L		0.00479 U		0.0202 U
	Plutonium-238	pCi/L		0.00478 U		0.0101 U
	Plutonium-239/240	pCi/L		0.00478 U		0.0152 U
	Technetium-99	pCi/L	13.7	3.61 U	0.0317 U	1.39 U

Table 4.21. Results for radionuclides at surface water monitoring locations – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
LBC-SW02	Uranium	µg/L	0.689 J	0.762 J	0.497 J	0.875 J
	Uranium-233/234	pCi/L	1.43	1.2	0.698	1.28
	Uranium-235/236	pCi/L	0.118 J	0.102 U	0.04 U	0.0551 U
	Uranium-238	pCi/L	0.213 J	0.24	0.161 J	0.285
LBC-SW03	Americium-241	pCi/L		0.0366 U		0.0175 U
	Neptunium-237	pCi/L		0.0299 U		-0.00954 U
	Plutonium-238	pCi/L		0.00483 U		0.025 U
	Plutonium-239/240	pCi/L		0.0145 U		0.01 U
	Technetium-99	pCi/L	12	2.19 U	0.602 U	4.19 U
	Uranium	µg/L	0.579 J	0.938 J	0.67 J	1.21
	Uranium-233/234	pCi/L	1.31	1.27	0.979	1.91
	Uranium-235/236	pCi/L	0.0498 U	0.042 U	0.105 U	0.13 J
	Uranium-238	pCi/L	0.187 J	0.309	0.209 J	0.385
LBC-SW04	Americium-241	pCi/L		0.00446 U		0.0187 U
	Neptunium-237	pCi/L		0.0278 U		0.0499 U
	Plutonium-238	pCi/L		0.0138 U		0.0348 U
	Plutonium-239/240	pCi/L		0.0138 U		0.0398 U
	Technetium-99	pCi/L	9.8	5.88 U	0.826 U	4.78 U
	Uranium	µg/L	1.17	1.68	0.763 J	2.2
	Uranium-233/234	pCi/L	1.33	1.74	0.934	2.34
	Uranium-235/236	pCi/L	0.0834 U	0.0914 U	0.125 J	0.101 U
	Uranium-238	pCi/L	0.381	0.551	0.237 J	0.725
NHP-SW01	Americium-241	pCi/L		0.00474 U		0 U
	Neptunium-237	pCi/L		0.0234 U		0.0196 U
	Plutonium-238	pCi/L		-0.0048 U		0.00612 U
	Plutonium-239/240	pCi/L		0.0238 U		0.0184 U
	Technetium-99	pCi/L	1.55 U	1.51 U	0.095 U	0.984 U
	Uranium	µg/L	4.83	5.33	3.54	5.78
	Uranium-233/234	pCi/L	2.02	2.24	1.42	2.19
	Uranium-235/236	pCi/L	0.114 J	0.0982 U	0.0998 U	0.127 J
	Uranium-238	pCi/L	1.6	1.77	1.17	1.92
UND-SW01	Americium-241	pCi/L		0.0276 U		0.0192 U
	Neptunium-237	pCi/L		-0.0049 U		0.00973 U
	Plutonium-238	pCi/L		0.0106 U		0 U
	Plutonium-239/240	pCi/L		0.0212 U		0.0101 U
	Technetium-99	pCi/L	1.14 U	0.802 U	-1.5 U	-1.21 U
	Uranium	µg/L	2	2.36	1.92	0.722 J
	Uranium-233/234	pCi/L	0.982	0.944	0.749	0.501
	Uranium-235/236	pCi/L	0 U	0.052 U	0.0524 U	0.0322 U
	Uranium-238	pCi/L	0.673	0.786	0.637	0.237 J
UND-SW02	Americium-241	pCi/L		0.0266 U		0.0265 U
	Neptunium-237	pCi/L		0.01 U		0.0189 U
	Plutonium-238	pCi/L		0 U		0 U
	Plutonium-239/240	pCi/L		0.0239 U		0.03 U
	Technetium-99	pCi/L	-0.893 U	-2.82 U	-0.782 U	0.282 U
	Uranium	µg/L	1.83	1.87	1.13	1.63
	Uranium-233/234	pCi/L	0.765	0.656	0.457	0.577
	Uranium-235/236	pCi/L	0.0461 U	0.0124 U	0.0421 U	0.0276 U
	Uranium-238	pCi/L	0.607	0.626	0.372	0.542
WDD-SW01	Americium-241	pCi/L		0.0104 U		-0.00897 U

Table 4.21. Results for radionuclides at surface water monitoring locations – 2013 (continued)

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
WDD-SW01	Neptunium-237	pCi/L		-0.0102 U		0 U
	Plutonium-238	pCi/L		0 U		0.0105 U
	Plutonium-239/240	pCi/L		0 U		0.0105 U
	Technetium-99	pCi/L	-0.757 U	-1.32 U	-0.169 U	1.1 U
	Uranium	µg/L	3.57	1.1	0.711 J	1.74
	Uranium-233/234	pCi/L	1.75	0.694	0.337	0.844
	Uranium-235/236	pCi/L	0.0961 U	0.0288 U	0.0209 U	0.0546 U
	Uranium-238	pCi/L	1.19	0.365	0.236 J	0.576
WDD-SW02	Americium-241	pCi/L		0.0434 U		0.0255 U
	Neptunium-237	pCi/L		-0.0112 U		0.0295 U
	Plutonium-238	pCi/L		0.00961 U		-0.0152 U
	Plutonium-239/240	pCi/L		0.00481 U		0.0202 U
	Technetium-99	pCi/L	0.576 U	0.0113 U	2.43 U	1.89 U
	Uranium	µg/L	1.2	2.39	1.3	2.12
	Uranium-233/234	pCi/L	0.691	1.27	0.551	1.08
	Uranium-235/236	pCi/L	0.0396 U	0.0587 U	0.0658 U	0.0442 U
	Uranium-238	pCi/L	0.396	0.793	0.427	0.706
WDD-SW03	Americium-241	pCi/L		0.0315 U		0.0229 U
	Neptunium-237	pCi/L		-0.0050 U		-0.0103 U
	Plutonium-238	pCi/L		0.0274 U		-0.0204 U
	Plutonium-239/240	pCi/L		0.0183 U		0.0255 U
	Technetium-99	pCi/L	1.48 U	-3.34 U	-1.66 U	2.22 U
	Uranium	µg/L	2.58	0.896 J	0.799 J	1.98
	Uranium-233/234	pCi/L	1.38	0.472	0.333	0.815
	Uranium-235/236	pCi/L	0.0795 U	0.0356 U	0.0158 U	0.0271 U
	Uranium-238	pCi/L	0.856	0.296	0.266	0.662

Table 4.22. Results for radionuclides at exit pathway monitoring locations – 2013

Sampling Location	Parameter	Unit	First quarter	Second quarter	Third quarter	Fourth quarter
F-29B	Americium-241	pCi/L			0.0182 U	
	Neptunium-237	pCi/L			0.00537 U	
	Plutonium-238	pCi/L			0 U	
	Plutonium-239/240	pCi/L			0.0431 U	
	Technetium-99	pCi/L			2.04 U	
	Uranium	µg/L			0.0474 U	
	Uranium-233/234	pCi/L			0.0311 U	
	Uranium-235/236	pCi/L			0.0166 U	
	Uranium-238	pCi/L			0.0133 U	

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