Environmental Monitoring Plan
for the
Portsmouth Gaseous Diffusion Plant
Piketon, Ohio

U.S. Department of Energy
DOE/PPPO/03-0009&D5

April 2017

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for the
Portsmouth Gaseous Diffusion Plant
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April 2017

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

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ACRONYMS

ACP	American Centrifuge Plant
ALARA	as low as reasonably achievable
ASER	Annual Site Environmental Report
CAS	cleanup alternatives study
CFR	Code of Federal Regulations
CMS	corrective measures study
D&D	decontamination and decommissioning
DCS	derived concentration standard
DOE	U.S. Department of Energy
DQO	data quality objective
DUF6	depleted uranium hexafluoride
EMP	Environmental Monitoring Plan
EOC	Emergency Operations Center
FBP	Fluor-BWXT Portsmouth LLC
ft/d	feet per day
IGWMP	Integrated Groundwater Monitoring Plan
ISMS	Integrated Safety Management System
MARLAP	*Multi-Agency Radiological Laboratory Analytical Protocols Manual* (NRC 2004)
MCS	Mid-America Conversion Services, LLC
mg/L	milligram per liter
mrem	millirem
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
Ohio EPA	Ohio Environmental Protection Agency
OVEC	Ohio Valley Electric Corporation
PCB	polychlorinated biphenyl
pCi/g	picocurie per gram
PEMS	Project Environmental Measurements System
PMA	Portsmouth Mission Alliance, LLC
PORTS	Portsmouth Gaseous Diffusion Plant
QA	quality assurance
QAP	Quality Assurance Plan
QC	quality control
QSAS	*Quality Systems for Analytical Services Document* (DOE 2013b, or latest revision)
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SADQ	*Sample Analysis Data Quality Assurance Project Plan* (DOE 2014b, or latest revision)
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SOW	statement of work
U.S. EPA	U.S. Environmental Protection Agency
USEC	United States Enrichment Corporation

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1. INTRODUCTION

1.1 PURPOSE

This Environmental Monitoring Plan (EMP) defines and documents the requirements for environmental monitoring at the Portsmouth Gaseous Diffusion Plant (PORTS). The EMP is prepared to comply with U.S. Department of Energy (DOE) Order 458.1, *Radiation Protection of the Public and the Environment* (DOE 2013c), and DOE Order 436.1, *Departmental Sustainability* (DOE 2011b).

The DOE Handbook *Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015b) was used to prepare the EMP (called the DOE Handbook in the remainder of this EMP). As stated in the DOE Handbook, the handbook is not a requirements document and may not be construed as requirements in any audit or assessment of compliance with the associated Policy, Order, Notice, or Manual. The DOE Handbook provides lines of inquiry and an approach for conducting a performance assessment of an environmental monitoring and surveillance program. Appendix A of this EMP provides the completed self-assessment for the PORTS environmental monitoring and surveillance program using the lines of inquiry provided in the handbook.

The PORTS EMP is designed to conduct environmental monitoring as follows:

- to support the site's Integrated Safety Management System (ISMS),
- to detect and characterize releases from DOE activities,
- assess impacts of DOE activities,
- estimate the dispersal patterns in the environment,
- characterize the pathways of exposure to members of the public,
- characterize the exposures and doses to individuals and the population around the plant,
- evaluate the potential impacts to the biota, and
- provide information for preoperational characterization and assessment (as applicable).

Three companies are responsible for environmental monitoring at PORTS: Fluor-BWXT Portsmouth LLC (FBP), Mid-America Conversion Services, LLC (MCS), and Centrus Energy Corp (formerly USEC, Inc.). FBP and MCS are DOE contractors. Centrus is a private company responsible for the American Centrifuge Plant (ACP) and is regulated by the Nuclear Regulatory Commission. This EMP, and most of the environmental monitoring at PORTS is the responsibility of FBP. Chapter 2 discusses MCS and/or Centrus environmental monitoring at National Pollutant Discharge Elimination System (NPDES) outfalls, radiological air emission point sources, and cylinder storage yards. However, the remaining chapters of this EMP apply to FBP only. MCS and Centrus are responsible for collection, reporting, management, and quality assurance of their environmental monitoring data.

1.2 SITE DESCRIPTION

PORTS is located in a rural area of Pike County in south central Ohio, approximately 80 miles south of Columbus, 20 miles north of Portsmouth, and 1 mile east of U.S. Route 23, near Piketon (Figure 1.1). The terrain surrounding the plant, except for the Scioto River floodplain, consists of marginal farmland and densely forested hills. The Scioto River floodplain is farmed extensively, particularly with grain crops.

PORTS is one of only three uranium enrichment facilities that have been operated in the United States (the other two are gaseous diffusion plants at Oak Ridge, Tennessee, and Paducah, Kentucky). The gaseous diffusion uranium enrichment facilities at PORTS operated from 1954 through 2001 supplying enriched uranium for government and commercial use. Initially, PORTS provided uranium-235 for national security at assays above those of the other production facilities at Oak Ridge, Tennessee, and

Figure 1.1. PORTS site location.

Paducah, Kentucky. In 1991, DOE suspended the production of highly enriched uranium at PORTS. In 1993, DOE leased the uranium production facilities at PORTS to the United States Enrichment Corporation (USEC), which was established by the Energy Policy Act of 1992. USEC enriched uranium at PORTS for use in commercial nuclear power reactors until May 2001. At that time, USEC placed the production facilities at PORTS into a cold standby mode under a contract with DOE. DOE terminated the cold standby program as of September 30, 2005, and replaced it with the cold-shutdown program. In 2010, USEC began the process of returning the gaseous diffusion uranium enrichment facilities and other associated support buildings and areas at PORTS to DOE. This process was completed on September 30, 2011.

DOE is responsible for decontamination and decommissioning (D&D) of the gaseous diffusion process buildings and associated facilities and areas, environmental restoration, waste disposal, and uranium management (including the depleted uranium hexafluoride [DUF_6] Conversion Facility). FBP, Portsmouth Mission Alliance, LLC (PMA), and MCS are the contractors responsible for DOE activities at PORTS.

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

PMA provides 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.

MCS is responsible for operation of the DUF_6 Conversion Facility at PORTS, 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 hydrogen fluoride, which are shipped off site. The uranium oxide is made available for beneficial reuse, storage, or disposal, and the hydrogen fluoride is sold for reuse. MCS is responsible for sampling required by the MCS NPDES permit, continuous monitoring of the radiological air emission point source associated with the DUF_6 Conversion Facility, and environmental sampling associated with the X-745C, X-745E, and X-745G cylinder storage yards.

Centrus Energy Corp., formerly USEC, Inc. (the parent company of USEC), is a private company regulated by the Nuclear Regulatory Commission that was developing gaseous centrifuge uranium enrichment technology at PORTS including construction of both a small scale demonstration facility (the Lead Cascade) and a commercial scale uranium enrichment facility (the ACP). The Lead Cascade operated from 2006 until June 2016. The commercial scale ACP was under development. Operation or development of both of these facilities is currently on hold due to lack of funding. 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. Centrus is responsible for sampling required by the Centrus NPDES permit and monitoring of radiological air emission point sources (when operating). DOE obtains results of this sampling from Centrus for annual reporting purposes.

Effluent streams from PORTS containing primarily stormwater runoff and water used for once-through cooling purposes discharge into Little Beaver Creek, which flows to Big Beaver Creek, Big Run Creek, the West Drainage Ditch, and the Southwestern Drainage Ditch, all of which ultimately flow into the Scioto River. Two pipelines discharge effluent from the sewage treatment plant and treated blowdown from the recirculating cooling water system to the Scioto River. Sludge from the wastewater treatment plant is discharged into drying beds, and after drying, the sludge is placed in storage containers for disposition.

1.3 OBJECTIVES

Environmental monitoring is completed to determine one or more of the following:

- comply with applicable environmental quality standards and public exposure limits; federal, state, and local regulations; DOE Orders; and other environmental commitments;
- identify background levels and site contributions of radioactive and chemical materials in the environment;
- support the assessment of radiological doses to the public and biota from DOE operations;
- provide data to support preparation of the Annual Site Environmental Report (ASER);
- evaluate the effectiveness of effluent treatment and controls in reducing effluents and emissions;
- evaluate the validity and effectiveness of models to predict the concentrations or activities of pollutants in the environment;

- determine the long-term buildup of site-related radionuclides and chemicals in the environment and trends in these contaminants;
- detect and quantify unplanned releases; and
- identify and quantify existing or new environmental concerns.

Environmental monitoring is conducted in support of the ISMS and Environmental Management System. The methods and protocols described in this plan meet the intent of the following FBP documents:

- *Integrated Safety Management System* (FBP 2016c, or latest revision)
- *Environmental Management System Description* (FBP 2016a, or latest revision)

1.4 SCOPE

Environmental monitoring consists of two components: effluent monitoring and environmental surveillance. As defined in DOE Order 458.1(DOE 2013c), effluent monitoring is the collection and analysis of samples of liquid and gaseous effluents or measurements of liquid and gaseous effluents performed to characterize and quantify radiological contaminants and process stream characteristics, assess radiation exposures of members of the public, and demonstrate compliance with applicable standards. Environmental surveillance is the collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media at the DOE site and surrounding environs and the measurement of external radiation to demonstrate compliance with applicable standards, assess radiation exposure of members of the public, and assess effects, if any, on the environment.

The following PORTS monitoring programs are discussed in this EMP in Chapter 2, Effluent Monitoring, or Chapter 4, Environmental Surveillance:

- Effluent Monitoring (Chapter 2)
  - NPDES locations
  - Cylinder storage yards (surface water and sediment)
  - Settleable solids
  - Air
- Environmental Surveillance (Chapter 4)
  - Ambient air
  - External radiation
  - Groundwater (including exit pathway and water supply [drinking water wells])
  - Local surface water
  - Surface water required by the Integrated Groundwater Monitoring Program
  - Sediment
  - Soil
  - Biota (vegetation, crops, fish, deer, and dairy products [milk and eggs]).

Table 1.1 provides a summary of the environmental monitoring programs, including number of monitoring locations, parameters, and monitoring frequency, as practical. The *Integrated Groundwater Monitoring Plan* (IGWMP) (DOE 2015c, or latest revision) provides the requirements for groundwater monitoring, associated surface water monitoring, and water supply monitoring at PORTS. The EMP provides only a brief summary of these programs. FBP, MCS, and Centrus NPDES permits provide the requirements for monitoring at NPDES monitoring locations and should be consulted for specific monitoring requirements for each NPDES monitoring location. Monitoring at the cylinder storage yards

is conducted in accordance with agreements between DOE and the U.S. Environmental Protection Agency (U.S. EPA) or the Ohio Environmental Protection Agency (Ohio EPA).

The remaining chapters of the EMP describe the elements that support the PORTS environmental monitoring programs as follows:

- Chapter 3 describes the meteorological monitoring program.
- Chapter 5 describes sample handling, preparation, and analysis procedures.
- Chapter 6 discusses data analysis and statistical treatment.
- Chapter 7 describes dose calculations.
- Chapter 8 discusses records, retention, and reporting requirements.
- Chapter 9 describes quality assurance (QA) applicable to environmental monitoring.

Monitoring required by the EMP may also be used to assess the environmental impacts associated with an unplanned release. In general, unplanned releases may be quantified via existing monitoring, if possible, or by mass balance. Predictions of environmental impacts associated with unplanned releases may be initially estimated by dispersion and transport modeling and confirmed by special environmental sampling as appropriate to the release. In general, procedures for monitoring associated with an unplanned release will be the same as those for routine environmental surveillance, as appropriate to the release.

The EMP documents the environmental monitoring program for PORTS. The program is reviewed 1) annually as part of the production of the ASER, 2) when trending data collected in accordance with the EMP, and 3) during assessment/oversight activities. The EMP is updated periodically as needed as a result of these activities and or other site changes.

Table 1.1 EMP summary

Program	No. of locations	Parameters	Frequency
DOE (FBP) NPDES	18	chemicals or other parameters: see FBP NPDES permit	see NPDES permit
	12	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly
	12	radionuclides: Tc-99, U, U-233/234, U-235/236, U-238	monthly
DOE (MCS) NPDES	2	parameters: see MCS NPDES permit	see NPDES permit
Centrus NPDES	3	chemicals: see Centrus NPDES permit	see NPDES permit
	2	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly[a]
	2	radionuclides: Tc-99, U	weekly[a]

Table 1.1 EMP summary (continued)

Program	No. of locations	Parameters	Frequency
Cylinder yards (FBP)			
surface water	7	U, alpha activity, beta activity	monthly[b]
Cylinder yards (MCS)			
surface water	7	U, alpha activity, beta activity	monthly[b]
surface water	4	polychlorinated biphenyls (PCBs)	quarterly[b]
sediment	4	PCBs	quarterly[b]
Settleable solids	12	Settleable solids Alpha activity and beta-gamma activity in the settleable solids portion of the sample (only if settleable solids are detected at 40 milligrams per liter [mg/L] or more)	semiannual
Air (FBP process vents)	9	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly
	9	radionuclides: Tc-99, U, U-233/234, U-235, U-238	weekly[c]
	2	radionuclides: Th-228, Th-230, Th-232	weekly[c]
Air (MCS process vent)	1	radionuclides: U-234, U-235, U-238	weekly
External radiation	24	deep dose, eye dose, shallow dose	quarterly
Exit pathway groundwater	10	see Section 4.3 and IGWMP	see IGWMP (minimum biennial)
Groundwater	-	see IGWMP	see IGWMP
Ambient air	15	radionuclides: Am-241, Np-237, Pu-238, Pu-239/240	quarterly
	15	radionuclides: Tc-99, U, U-233/234, U-235/236, U-238	monthly
	15	chemicals: Fl	weekly
Water supply	-	see IGWMP	see IGWMP
IGWMP surface water	-	see IGWMP	see IGWMP
Local surface water	14	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	semiannual

Table 1.1 EMP summary (continued)

Program	No. of locations	Parameters	Frequency
Sediment	18	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual
	18	PCBs, Al, Sb, As, Ba, Be, Cd, Ca, Cr, Cu, Fe, Pb, Mg, Mn, Hg, Ni, Se, Si, Ag, Tl, Zn	annual
Soil	15	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual
Biota			
vegetation	15	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual
crops	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)
fish	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)
		PCBs	annual (as available)
deer	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)
dairy	variable	Am-241, Np-237, Pu-238, Pu-239/240, Tc-99, U, U-233/234, U-235/236, U-238	annual (as available)

[a]Monitoring for radionuclides at Centrus NPDES outfalls is conducted in accordance with the Centrus Safety Analysis Report. Current monitoring parameters and frequencies are included in this EMP as information only. Any changes to this monitoring are automatically included in this EMP.
[b]Monitoring at cylinder yards is conducted in accordance with agreements between DOE and U.S EPA or Ohio EPA. Current monitoring parameters and frequencies are included in this EMP as information only. Any changes to this monitoring are automatically included in this EMP.
[c]Samples are normally collected weekly; however, the sampling period may be extended provided that the sampler is operating at all times that the vent is operating.

1.5 HISTORY

Table 1.2 provides a history of EMP changes beginning in 2001, including the DOE document number and date, the effective dates of each plan, and a summary of major changes.

Table 1.2. EMP history change table

DOE document number and document date	Effective dates	Summary of monitoring changes in revision[a]
DOE/PPPO/03-0009&D4 February 2013	January 1, 2013 –	Added former USEC NPDES monitoring points and continuously monitored air emission vents to DOE (FBP) monitoring. Added FBP cylinder yard monitoring locations (X-745B, X-745D, and X-745F yards). Updated settleable solids monitoring program. Replaced ambient air monitoring stations A40 and A41 with A40A and A41A. Added DOE Order 458.1 (DOE 2013c) requirements.
DOE/PPPO/03-0009&D3 September 2009	January 1, 2010 – December 31, 2012	Added DUF_6 facility NPDES Outfall 001.
DOE/PPPO/03-0009&D2 November 2008	January 1, 2009 – December 31, 2009	Transferred DOE NPDES Outfalls 012, 013, and 613 to USEC.
DOE/PPPO/03-0009&D1 July 2007	October 1, 2007 – December 31, 2008	Modified settleable solids monitoring program. Changed monitoring frequency from monthly to quarterly for transuranics at ambient air monitoring stations. Deleted quarterly monitoring for metals and PCBs from surface water monitoring locations on the Scioto River (RW-1 and RW-6). Deleted semiannual monitoring for fluoride and total phosphate as phosphorus from surface water monitoring locations on the Scioto River (RW-1 and RW-6). Deleted monitoring for chromium from fish sampling program.
DOE/OR/11-3071&D3 September 2004	October 16, 2004 – September 30, 2007	Added settleable solids monitoring program to EMP.
DOE/OR/11-3071&D2 June 2001	June 1, 2001 – October 15, 2004	Initiated sampling programs for soil and biota (vegetation, crops, deer, and dairy [milk and eggs]).

[a]Administrative changes are not included in the table. These changes include, but not limited to updates to plant information, minor changes in monitoring parameters, deletion of outdated or unnecessary information, changes in document formats, etc.

This EMP revision will replace the EMP dated February 2013 and implemented on January 1, 2013. This revision includes the following changes:

- Updates the guidance document used to prepare the EMP — DOE Handbook *Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015b),
- Removes information related to sampling/analyses and references the *Sample Analysis Data Quality Assurance Project Plan (SADQ)* (DOE 2014b, or latest revision),
- Updates information about the X-120 Meteorological Tower due to the upgrade of the tower in 2016,
- Updates the MCS NPDES outfalls,
- Adds an additional monitoring location on Big Beaver Creek (RM-15) to the sediment monitoring program, and
- Makes other facility updates and administrative changes.

2. EFFLUENT MONITORING

As defined in DOE Order 458.1 (DOE 2013c), effluent monitoring is the collection and analysis of samples of liquid and gaseous effluents, or measurements of liquid and gaseous effluents, performed to characterize and quantify radiological contaminants and process stream characteristics, assess radiation exposures of members of the public, and demonstrate compliance with applicable standards.

Effluent monitoring at PORTS includes surface water, sediment, and air. The following monitoring programs are discussed in this chapter:

- NPDES locations
- Cylinder storage yards (surface water and sediment)
- Settleable solids monitoring
- Air.

2.1 NPDES

Surface waters leaving PORTS consist of treated process wastewater, treated groundwater, groundwater discharge, non-contact once-through cooling water, sewage treatment plant effluent, and stormwater runoff.

Surface water monitoring of non-radiological constituents at NPDES outfalls is mandated by permits issued to current DOE contractors (FBP and MCS) and Centrus. The permits identify monitoring parameters (e.g., pH, trichloroethene, chromium, and/or oil and grease, etc.), monitoring frequency (daily, weekly, etc.), and discharge limits for each monitoring parameter (as applicable). The permits also require biotoxicity monitoring at two FBP NPDES outfalls and at one monitoring station in the Scioto River.

Radiological monitoring data from FBP NPDES outfalls are collected in accordance with the EMP. Radiological monitoring is not required at the MCS NPDES outfalls. Centrus radiological monitoring data from NPDES outfalls are collected in accordance with the Safety Analysis Report.

2.1.1 Rationale and Design Criteria

NPDES effluent monitoring program objectives include:

- verifying compliance with applicable federal, state, and local regulations, and DOE Orders;
- evaluating the effectiveness of effluent treatment and control;
- identifying potential environmental problems and evaluating the need for remedial actions or mitigation measures;
- supporting permit revision and/or reissuance;
- detecting, characterizing, and reporting unplanned releases; and
- reviewing radiological data and conducting environmental assessments per the as low as reasonably achievable (ALARA) policy.

The Clean Water Act, which requires the issuance of NPDES permits, governs the monitoring of non-radiological effluents to surface water. Monitoring and reporting requirements for NPDES outfalls are outlined in the most recent permits issued by Ohio EPA.

The *Environmental Radiation Protection Program* (FBP 2016b, or latest revision) provides information about FBP ALARA policies and compliance with DOE Order 458.1 (DOE 2013c). 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/or isotopic uranium because of the uranium enrichment process. Samples may be 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 during the Cold War.

In addition, the DOE Handbook recommends that the EMP document:

- sampling locations used for providing quantitative effluent release data for each outfall,
- procedures and equipment used to perform the sampling and measurement (see Chapter 5),
- frequency and analyses required for each continuous monitoring and/or sampling location,
- minimum detectable activity and uncertainty for equipment used for measurements (see Chapter 5),
- QA components (see Chapter 9), and
- effluent outfall alarm settings and technical bases.

Sampling/monitoring equipment used to collect data at the NPDES outfalls meets the following performance criteria:

- Any device or process meeting Ohio EPA-approved standards may be used to determine the instantaneous flow rate, to take automatic samples, or to continuously monitor conditions (i.e. flow or pH) at NPDES locations.
- Operating manual instructions and requirements for automatic samplers are incorporated into the contractor quality assurance plans (QAPs) for NPDES sampling.
- Automatic samplers are installed at all permitted outfalls requiring 24-hour composite samples.
- Automatic samplers are installed following manufacturer guidelines for proper operation. All sampler parts that contact the water sample (e.g., sample lines, sample bottles) are compatible with the expected composition of the sample.
- Continuous monitors are installed following manufacturer guidelines for proper operation. All monitor parts that contact the effluent water (e.g., monitor electrodes, electrical cables) are compatible with the expected composition of the sample.

Effluent samples for radiological analyses are collected using the same types of sampling equipment used for the NPDES program. There are no continuous monitors for radiological parameters.

All of the FBP external NPDES outfalls (except Outfall 005) are equipped with continuous flow monitors. FBP Outfalls 001, 010, and 011 have continuous pH monitors with alarms tied to the Plant Shift Superintendent's office. No alarms are associated with the flow monitors.

2.1.2 Monitoring Locations

PORTS has a total of 23 NPDES monitoring locations regulated by the site NPDES permits (Figure 2.1). Of these, FBP has 18 monitoring locations. Nine outfalls discharge directly to surface water and six outfalls discharge to another outfall before leaving the site. FBP also monitors three additional locations that are not discharge points.

MCS has two NPDES outfalls. NPDES Outfall 001, which requires monitoring only when process wastewater is being discharged through the outfall, flows to the X-230J5 Northwest Holding Pond (FBP NPDES Outfall 010) prior to discharge from the site. NPDES Outfall 602, which requires monitoring only when process wastewater is being discharged, flows through the PORTS sanitary sewer system to the X-6619 Sewage Treatment Plant (FBP Outfall 003).

Centrus is responsible for three NPDES outfalls. Two outfalls discharge directly to surface water, and one discharges to another outfall before leaving the site. The outfalls/sampling locations are shown on Figure 2.1, and all are described briefly below.

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

MCS NPDES Outfall 001 – This outfall is located northwest of the DUF_6 facility. The outfall is permitted for liquid effluents generated by the deionized water system, and boiler and cooling tower blowdown from the DUF_6 Conversion Facility. The MCS Outfall 001 requires monitoring only when in use for the discharge of process effluents. The outfall currently discharges only precipitation run-off, which flows to the West Drainage Ditch and the X-230J5 Northwest Holding Pond (FBP Outfall 010) and the Scioto River.

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

FBP NPDES Outfall 003 (X-6619 Sewage Treatment Plant) – The X-6619 Sewage Treatment Plant treats PORTS sewage, some of Pike County sewage, and process wastewater from MCS as well as water discharged from DOE groundwater treatment facilities, the X-700 Biodenitrification Facility, the X-705 Decontamination Microfiltration System, and miscellaneous waste streams. The X-6619 Sewage Treatment Plant uses screening, aeration, clarification, and filtering followed by disinfection to treat wastewater prior to release to the Scioto River.

FBP NPDES Outfall 004 (Cooling Tower Blowdown) – Outfall 004 is located within the X-680 Blowdown Sample and Treatment Building at PORTS. It monitors blowdown water from cooling towers on site prior to being discharged to the Scioto River.

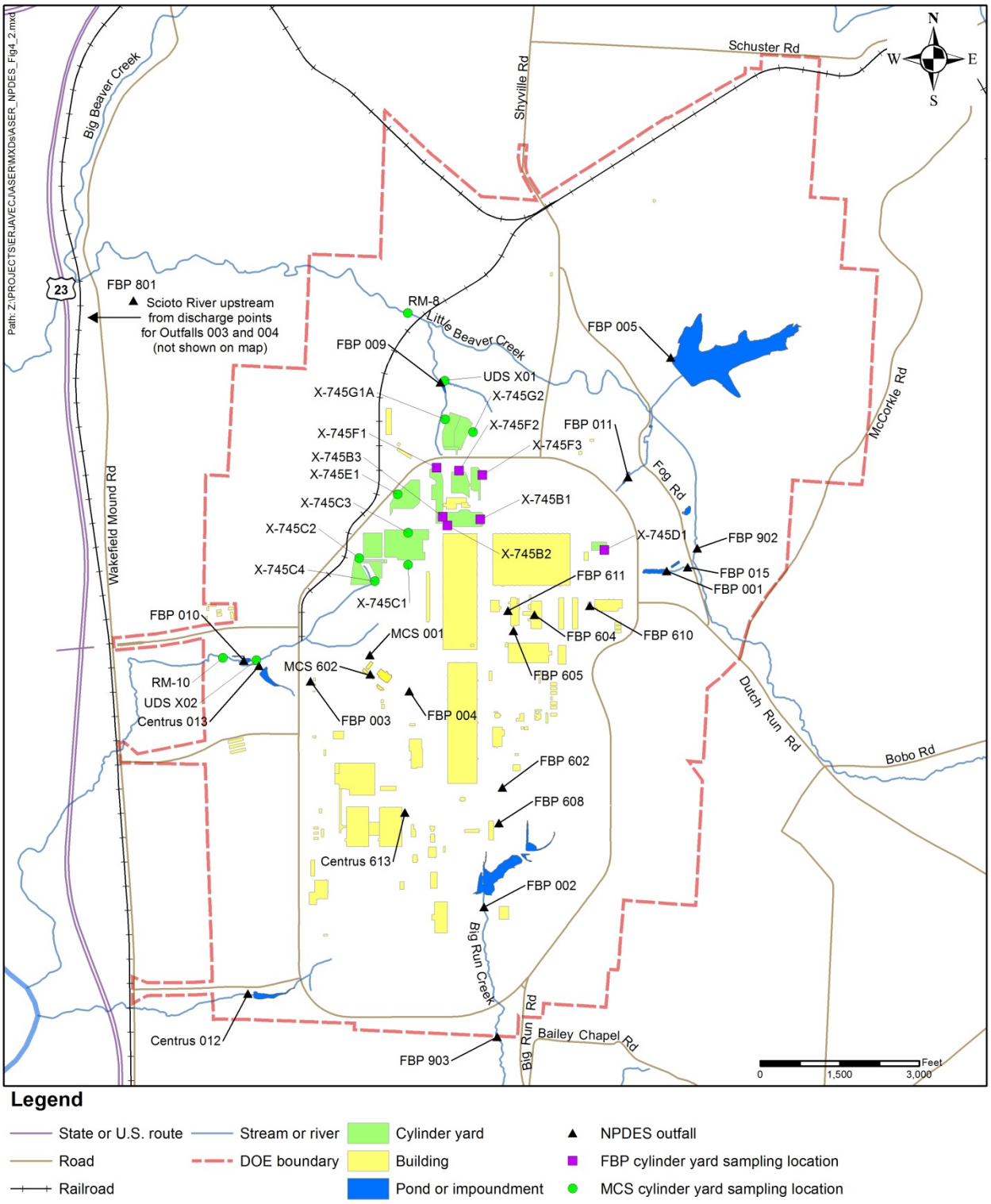

Figure 2.1. PORTS NPDES outfalls/monitoring points and cylinder storage yards monitoring locations.

FBP NPDES Outfall 005 (X-611B Lime Sludge Lagoon) – The X-611B Lime Sludge Lagoon is used to settle lime sludge used in a water-softening process. The X-611B also receives rainwater runoff. Currently the lagoon only discharges during periods of excess precipitation.

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

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

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

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

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

FBP NPDES Outfall 015 (X-624 Groundwater Treatment Facility) – The X-624 Groundwater Treatment Facility removes volatile organic compounds 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 volatile organic compounds toward Little Beaver Creek. Treated water is released to a tributary that flows to Little Beaver Creek.

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

MCS Outfall 602 – This outfall is within the MCS X-1320 Building prior to discharge to the FBP sewer system (X-6619 Sewage Treatment Plant – FBP NPDES Outfall 003). The outfall is permitted for cooling water blowdown from the heating/cooling system, deionized water blowdown, boiler and cooling tower blowdown, and potable water supply filter blowdown from the DUF_6 Conversion Facility.

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 volatile organic compounds from contaminated groundwater originating from site remediation activities in the southern portion of the site, which is Quadrant I in the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. 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 volatile organic compounds 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 volatile organic compounds 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.

Centrus NPDES Outfall 613 (X-6002 Particulate Separator) – This unit removes suspended solids from water used in the X-6002 Recirculating Hot Water Plant, which provides heat to the X-7725 and other buildings at PORTS, and may occasionally treat discharges of heating water for maintenance activities. Treated water is discharged to the sanitary sewer to the X-6619 Sewage Treatment Plant (FBP NPDES Outfall 003).

FBP Station 801 – This location is a monitoring site in the Scioto River, upstream from the discharge point of Outfalls 003 and 004 and outside the zone of effluent and receiving water interaction used for biotoxicity studies.

FBP Station 902 – This location is a temperature monitoring site in Little Beaver Creek, downstream from FBP NPDES Outfall 001 and outside the mixing zone.

FBP Station 903 – This location is a temperature monitoring site in Big Run Creek, downstream from FBP NPDES Outfall 002 and outside the mixing zone.

2.1.3 Monitoring Frequency and Parameters

Both radiological and non-radiological parameters are monitored at the PORTS NPDES outfalls. The following sections discuss monitoring frequency and parameters for radionuclides and non-radionuclides.

2.1.3.1 Radionuclides

Twelve of the FBP NPDES outfalls (Outfalls 001, 002, 003, 004, 005, 009, 010, 011, 015, 608, 610, and 611) are sampled as follows for radionuclides:

- Quarterly: transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), and

- Monthly: technetium-99, uranium, and isotopic uranium (uranium-233/234, uranium-235/236, and uranium-238).

Samples are collected from FBP Outfalls 005 and 610 only when the outfalls are in use. Radiological monitoring is not required at the MCS NPDES outfalls.

Centrus NPDES Outfalls 012 and 013 are sampled as follows:

- Quarterly: transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), and

- Weekly: technetium-99 and uranium.

Radiological monitoring is not required at the Centrus NPDES Outfall 613. This sampling is conducted in accordance with the Centrus Safety Analysis Report. Current monitoring parameters and frequencies are included in this EMP as information only. Any changes to Centrus NPDES monitoring required by the Safety Analysis Report are included automatically in this EMP.

2.1.3.2 Non-radiological parameters

The current FBP, MCS, and Centrus NPDES permits list the non-radiological monitoring parameters and sampling frequencies for each monitoring location. Sampling frequencies for non-radiological parameters vary from daily to quarterly. Table 2.1 lists examples of the non-radiological monitoring parameters for the PORTS NPDES outfalls.

Table 2.1 does not include all monitoring parameters for all NPDES outfalls. The current FBP, MCS, and Centrus NPDES permits should be consulted for all monitoring parameters and current monitoring frequencies for each monitoring location.

Table 2.1. NPDES non-radiological parameters[a]

Acute Toxicity (*Pimephales promelas*)	Nitrogen Kjeldahl, total
Acute Toxicity (*Ceriodaphnia dubia*)	Nitrogen, ammonia (NH_3)
Barium, total recoverable	Nitrogen, nitrate (NO_3)
Carbonaceous Biochemical Oxygen Demand	Nitrogen, nitrite (NO_2)
Cadmium, total recoverable	Nitrogen, nitrite + nitrate
Chlorine, total residual	Oil and Grease
Chromium, hexavalent	PCBs
Chromium, total	pH
Copper, total	Selenium, total recoverable
Copper, total recoverable	Silver, total recoverable
1,2-trans-dichloroethylene	Solids, dissolved-sum of
Fecal coliform	Sulfate
Flow rate	Trichloroethene
Fluoride, total	Thallium, total recoverable
Iron, total	Total precipitation
Lead, total recoverable	Total suspended solids
Manganese, total	Water temperature
Mercury, total	Zinc, total
Nickel, total	Zinc, total recoverable

[a]See NPDES permits for applicable outfalls and sampling frequencies.

2.2 CYLINDER STORAGE YARDS

As required by Ohio EPA, FBP and MCS collect surface water samples from the X-745B, X-745C, X-745D, X-745E, X-745F, and X-745G Cylinder Storage Yards. In addition, U.S. EPA requires quarterly sampling of surface water and sediment at four locations downstream from the cylinder yards.

The surface water runoff from the cylinder storage yards flows through NPDES outfalls prior to discharge from PORTS.

2.2.1 Rationale and Design Criteria

Ohio EPA requires monthly monitoring of surface water run-off from DUF_6 cylinder storage yards for alpha activity, beta activity, and uranium. Monitoring of the X-745C and X-745E Cylinder Storage Yards began in 1998. The X-745G yard was added to the monitoring program in 2004. The X-745B, X-745D, and X-745F yards were added to the monitoring program in 2012. Although Ohio EPA only requires monitoring for alpha activity, beta activity, and uranium, monitoring parameters over the years have also included PCBs and the specific radionuclides typically monitored at PORTS (americium-241, neptunium-237, plutonium-238, plutonium-239/240, technetium-99, uranium, uranium-233/234, uranium-235/236, and uranium-238).

The U.S. EPA requires monitoring for PCBs in surface water and sediment in drainage basins downstream from the MCS cylinder storage yards because the DUF_6 Conversion Facility stores and processes cylinders containing DUF_6 that may have paint containing greater than 50 parts per million 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. This monitoring began in the third quarter of 2005.

2.2.2 Monitoring Locations

Figure 2.1 shows the surface water runoff locations monitored at the X-745B, X-745C, X-745D, X-745E, X-745F, and X-745G cylinder storage yards and the downstream surface water and sediment monitoring locations for the cylinder yards. A description and the DOE contractor responsible for each location are provided below.

MCS monitoring locations (radionuclides):

- Locations X-745C1, X-745C2, X-745C3, and X-745C4 monitor surface water runoff from the X-745C cylinder storage yard.
- Location X-745E1 monitors surface water runoff from the X-745E cylinder storage yard.
- Location X-745G1A and X-745G2 monitor surface water runoff from the X-745G cylinder storage yard.

MCS monitoring locations (PCBs):

- Location UDS X01 monitors surface water and sediment within the storm water drainage system prior to the outfall associated with the X-230L North Holding Pond.
- Location RM-8 monitors surface water and sediment in the North Drainage Ditch downstream from the X-230L North Holding Pond.
- Location UDS X02 monitors surface water and sediment within the storm water drainage system prior to the outfall associated with the X-230J5 Northwest Holding Pond.
- Location RM-10 monitors surface water and sediment in the West Drainage Ditch downstream from the X-230J5 Northwest Holding Pond.

FBP monitoring locations (radionuclides):

- Locations X-745B1, X-745B2, and X-745B3 monitor surface water runoff from the X-745B cylinder storage yard.
- Location X-745D1 monitors surface water runoff from the X-745D cylinder storage yard.
- Locations X-745F1, X-745F2, and X-745F3 monitor surface water runoff from the X-745F cylinder storage yard.

2.2.3 Monitoring Frequency and Parameters

MCS collects monthly surface water samples from monitoring locations at the X-745C, X-745E, and X-745G cylinder storage yards (X-745C1, X-745C2, X-745C3, X-745C4, X-745E1, X-745G1A, and X-745G2) when water is available. The samples are analyzed for the following parameters:

- alpha activity
- beta activity
- uranium.

MCS collects quarterly surface water (both filtered and unfiltered) and sediment samples from four locations downstream from the cylinder yards (UDS X01, RM-8, UDS X02, and RM-10) for PCBs.

FBP collects monthly surface water samples from monitoring locations at the X-745B, X-745D, and X-745F cylinder storage yards (X-745B1, X-745B2, X-745B3, X-745D1, X-745F1, X-745F2, and X-745F3) for alpha activity, beta activity, and uranium, when water is available. The samples are analyzed for the following parameters:

- alpha activity
- beta activity
- uranium.

2.3 SETTLEABLE SOLIDS

FBP collects samples at 12 locations to determine the activity of radioactive material that is present in the sediment suspended in the water samples (settleable solids monitoring). The data from this sampling are used to determine compliance with DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE 2013c).

2.3.1 Rationale and Design Criteria

DOE Order 458.1, *Radiation Protection of the Public and the Environment*, Section 4, paragraph g(4), (DOE 2013c) 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 picocuries per gram (pCi/g) above background of settleable solids for alpha-emitting radionuclides, and

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

Settleable solids monitoring began in 2001. The monitoring has been periodically revised and was revised in 2013 to demonstrate compliance with DOE Order 458.1 (DOE 2013c).

2.3.2 Monitoring Locations

Samples for the settleable solids monitoring program are collected from seven NPDES outfalls, two IGWMP surface water monitoring locations, and three background locations as listed below:

- FBP NPDES Outfall 002, which discharges to Big Run Creek;

- FBP NPDES Outfall 003, which discharges to the Scioto River;

- FBP NPDES Outfall 004, which discharges to the Scioto River;

- FBP NPDES Outfall 005, which discharges to the Little Beaver Creek;

- FBP NPDES Outfall 009, which discharges to the Little Beaver Creek;

- FBP NPDES Outfall 011, which discharges to the Little Beaver Creek;

- Centrus NPDES Outfall 012, which discharges to the Southwestern Drainage Ditch (and then to the Scioto River;

- EDD-SW01, which monitors discharges from FBP NPDES Outfalls 001 and 015;

- WDD-SW03, which monitors discharges from FBP NPDES Outfall 010 and Centrus NPDES Outfall 013;
- Background location RW-6, a local surface water monitoring point on the Scioto River in Piketon;
- Background location RW-5, a local surface water monitoring point on the Big Beaver Creek north of PORTS; and
- Background location LBC-SW12, a monitoring point on Little Beaver Creek upstream from PORTS NPDES discharges and potential groundwater discharges.

These locations were selected because they meet the definition of a "liquid discharge containing radionuclides from DOE activities" as stated in the DOE Order 458.1 requirement for settleable solids monitoring (see Section 2.3.1) (DOE 2013c). Figure 2.2 shows the settleable solids monitoring locations.

2.3.3 Monitoring Frequency and Parameters

Settleable solids samples are collected semiannually, with the possible exception of FBP Outfall 005. Because FBP NPDES Outfall 005 only discharges during periods of excessive rain, this outfall is only sampled when in use, and only once in each six month period (i.e., once in January through June, if the outfall is in use, and once in July through December, if in use). Samples are analyzed for total suspended solids (which includes settleable solids and non-settleable solids) and settleable solids.

When a low concentration of settleable solids is detected in a water sample, accurate measurement of the alpha and beta-gamma activity in the settleable solids portion of the sample is not practical due to the small sample size. A DOE memo (DOE 1995) states that settleable solids of less than 40 mg/L are in *de facto* compliance with the DOE Order 5400.5 limits: 5 pCi/g above background for alpha activity and 50 pCi/g above background for beta activity (DOE Order 458.1 [DOE 2013c] has replaced DOE Order 5400.5; however, the limits remain the same). Based on this memo, if settleable solids are not detected in the sample at a concentration of 40 mg/L or more, the sample is considered in compliance with the DOE Order limits. The settleable solids portion of the sample is not analyzed for alpha and beta-gamma activity.

If settleable solids are detected in the sample at a concentration of 40 mg/L or more, the settleable solids portion of the sample is analyzed for alpha and beta-gamma activity. The background activity, if any, is then subtracted from the result. After the second semiannual sampling event, the results for each sampling location are averaged and compared to the limits set in DOE Order 458.1 (DOE 2013c). Analytical results reported as undetected are assumed to be zero.

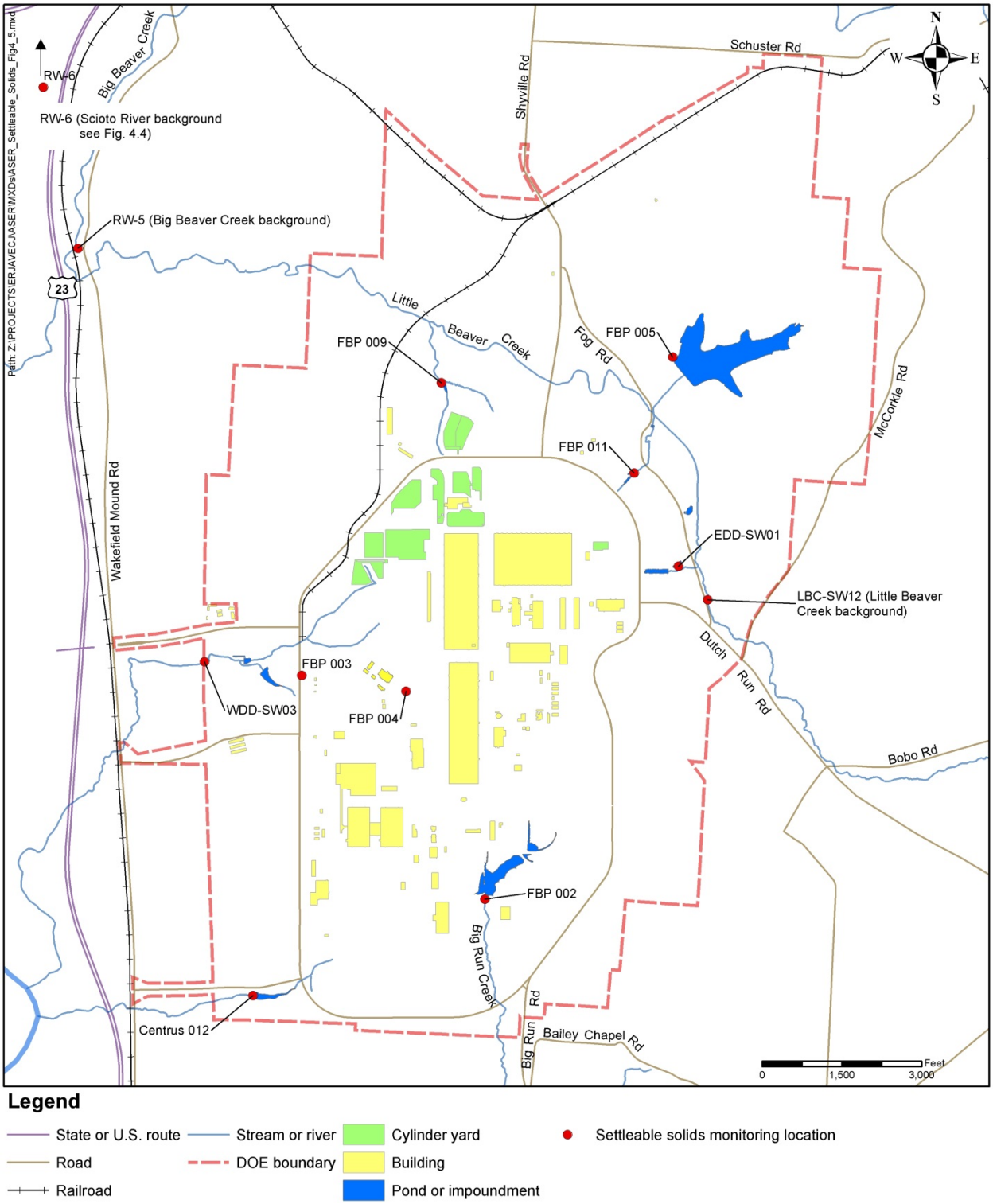

Figure 2.2 Settleable solids monitoring locations.

2.4 AIR

A monitoring system provides data to characterize an emission, determine the performance of equipment, establish trends, support environmental management decisions, and demonstrate compliance with existing legal and regulatory requirements. A monitoring system may also alert personnel to excessive emissions during an abnormal occurrence.

This section discusses requirements for monitoring systems installed at sources of emissions that are designed to measure contaminants from those sources. The PORTS ambient air monitoring program measures ambient concentrations or activities of radionuclides and fluoride at on-site and off-site locations. Because these ambient air monitors are not associated with a specific source of air emissions, the ambient air monitoring program is discussed in Chapter 4, Section 4.1.

2.4.1 Rationale and Design Criteria

PORTS currently has specific sources of air emissions that have operating permits and registrations (a sub-permit for small sources). Emissions from these sources include radionuclides and standard industrial pollutants such as particulates from fossil fuel combustion activities, sulfur dioxide, gaseous fluorides, water treatment chemicals, gasoline and diesel fuel vapors, cleaning solvent vapors, and process coolants.

Airborne radionuclides are one of the sources of potential radiation dose to the public from plant operations. The predominant radionuclides emitted from PORTS operations are uranium, technetium-99 and small amounts of transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240). PORTS maintains and uses gaseous emission controls, as appropriate, to maintain releases of radioactive material in gaseous emissions to unrestricted areas below the limits specified in National Emission Standards for Hazardous Air Pollutants (NESHAP) (Title 40 of the Code of Federal Regulations [CFR] Part 61 Subpart H), and in accordance with the plant's ALARA policy. Unrestricted areas are those areas beyond the DOE reservation boundary and to which any member of the public has unrestricted access.

Based on the U.S. EPA dose assessment model, CAP88-PC, the effective dose to the most exposed individual in proximity to PORTS has consistently been significantly less than the U.S. EPA standard of 10 millirems (mrem)/year in NESHAP regulations (40 CFR Part 61.92).

For purposes of compliance, a major source is a release point that has the potential to emit, during one year, radionuclides that can cause an individual member of the public offsite, or who abides on DOE property where DOE no longer maintains a physical access control barrier, to receive an annual effective dose of 0.1 mrem or more. A minor source is a release point or group of release points that have the potential to emit radionuclides that produce a dose less than 0.1 mrem/year. Potential to emit is calculated using either stack sampling data or other estimation methods. When calculating “potential emissions,” it is assumed that pollution abatement equipment does not exist, but the facility or process operations are otherwise normal, which is consistent with 40 CFR Part 61.93 (b)(4)(ii). Equipment integral to the proper operation of the process is not considered abatement even though radionuclides may be removed by this equipment. In other words, if the process could not function as intended without the equipment, it is considered integral to the process and is not considered abatement equipment. NESHAP regulations require continuous sampling of all emission points with potential doses of 0.1 mrem/year or more.

The development of an airborne effluent monitoring program for airborne emissions of radionuclides has been established under guidelines set by the U.S. EPA and DOE. Specifically, standards established by U.S. EPA for radionuclides are found in NESHAP regulations at 40 CFR Part 61, Subpart H. The guidelines set by DOE are noted in DOE Order 458.1 (DOE 2013c) and in the DOE Handbook.

The design criteria for an acceptable radionuclide effluent monitor follow documented methodologies as described in the *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013). The compliance plan and the *Quality Assurance Project Plan for Compliance with National Emission Standards for Hazardous Air Pollutants* (FBP 2014) provide additional information on the radiological air emission point sources, stack monitoring system design, analytical methods, and QA/quality control (QC).

A preoperational radionuclide emissions assessment is made for any new source or when source modifications will alter emissions. If any new sources requiring continuous sampling are installed, they will be sampled according to the radionuclide portion of NESHAP.

The design criteria for an acceptable nonradionuclide effluent monitor meets specifications identified in applicable U.S. EPA, DOE, or Ohio regulations and permits. A preoperational assessment is made for any new or modified source of nonradionuclide emissions.

2.4.2 Monitoring Locations, Frequency, and Parameters

All release points that have the potential to emit, during one year, radionuclides that can cause an individual member of the public at any offsite point where there is a residence, school, business, or office, or who abides on DOE property where DOE no longer maintains a physical access control barrier, to receive an annual dose of 0.1 mrem or more are continuously monitored. All systems meet the continuous sampling requirements specified in 40 CFR Part 61, Subpart H.

Continuously sampled emission points meet all applicable design criteria and sampling frequency requirements as specified for each source by regulation or permit condition. All release points that require periodic grab sampling follow sampling frequencies as specified by regulation or permit requirements.

FBP, MCS, and Centrus have emission points that are continuously monitored for compliance with NESHAP requirements (when operating). The monitoring points, analytical parameters, and sampling frequencies for FBP, MCS, and Centrus are provided in the following sections.

2.4.2.1 FBP sources

The following FBP vents are continuously monitored (when in use):

- X-326 SE4 seal exhaust vent (Sampler #14)
- X-326 SE5 seal exhaust vent (Sampler #15)
- X-326 SE6 seal exhaust vent (Sampler #16)
- X-326 top purge after-jet vent (Sampler #6)
- X-326 EJET after-jet vent (Sampler #7)
- X-326 Side Purge Vent (Sampler #5) (inactive)
- X-330 Cold Recovery/Building Wet Air Evacuation Vent (Sampler #1) (inactive)
- X-330 Seal Exhaust Vent (Sampler #12) (inactive)
- X-330 Seal Exhaust Vent (Sampler #13) (inactive)
- X-333 Cold Recovery Vent (Sampler #2) (inactive)
- X-333 Building Wet Air Evacuation Vent (Sampler #3) (inactive)
- X-333 Seal Exhaust Vent (Sampler #9) (inactive)
- X-343 Cold Trap Vent (Sampler #18) (inactive)
- X-344A cold trap vent (Sampler #18)
- X-344A gulper vent (Sampler #8).

Samples from the primary sample traps are normally collected weekly; however, the sampling period may be extended provided that the sampler is operating at all times that the vent is operating. Samples are analyzed for the following radionuclides:

- uranium (total)
- uranium isotopes (uranium-233/234, uranium-235, uranium-238)
- technetium-99
- thorium isotopes (thorium-228, thorium-230, and thorium-232) (Sampler #8 and Sampler #18 only).

The X-344A vents (Sampler #8 and Sampler #18) are sampled for thorium isotopes because thorium was occasionally detected in uranium from the Paducah Gaseous Diffusion Plant, which was processed at the X-344A facility.

Samples from the secondary sample traps are collected quarterly and analyzed for the following radionuclides:

- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240), and
- the weekly sampling parameters listed above (uranium, uranium isotopes, technetium-99, and thorium isotopes [Sampler #8 and Sampler # 18 only]).

2.4.2.2 MCS sources

The vent associated with the three process lines in the DUF_6 Conversion Facility is continuously sampled. Samples are normally collected weekly; however, the sampling period may be extended provided that the sampler is operating at all times that the vent is operating. Samples are analyzed for uranium isotopes (uranium-234, uranium-235, and uranium-238).

2.4.2.3 Centrus sources

The Lead Cascade was shut down in 2016; therefore, there are currently no radiological emissions from point sources controlled by Centrus. If the lead cascade is operating, the vent associated with the Lead Cascade is continuously sampled. Samples are collected over a sampling period determined by Centrus provided that the sampler is operating at all times that the vent is operating. Samples are analyzed for uranium isotopes (uranium-234, uranium-235, and uranium-238).

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3. METEOROLOGICAL MONITORING

Meteorological monitoring acquires information on atmospheric weather phenomena that can be used to forecast atmospheric dispersion of planned and unplanned releases or of events causing environmental concern. This chapter describes the types of weather information that is acquired to support environmental surveillance activities. It also presents the elements of the meteorological monitoring program at PORTS and explains the purpose and the regulatory basis of these specific program components and activities.

3.1 RATIONALE AND SITING CRITERIA

Meteorological information representative of conditions at the facility is essential to assess the transport, diffusion, and deposition of material released to the atmosphere by PORTS. Various air pollutants, as well as airborne radionuclides, are emitted from plant activities. Meteorological data may be used in atmospheric dispersion modeling to determine how discharged radionuclides or chemicals mix with the atmosphere, where they travel, and where they may be deposited. Monitoring data and meteorological data may be used to calculate radiation doses from plant operations received by people living near PORTS and to support other environmental surveillance activities such as air quality monitoring.

A single freestanding meteorological tower is located in the southern portion of PORTS (Figure 3.1). The tower contains instrumentation at 10-m, 30-m, and 60-m heights. The instrumentation packages were selected to provide continuous operation within the normal atmospheric conditions at the plant.

3.2 EXTENT AND FREQUENCY OF MONITORING

Meteorological tower instrument packages located at the 10-m, 30-m, and 60-m levels monitor temperature, wind speed, wind direction, and relative humidity. Relative humidity sensors are located only at the 10-m and 60-m levels. These instrument packages are mounted on booms that are located between three and four tower diameters from the tower in the direction of the prevailing winds, which are generally from the south to southwest. The temperature and relative humidity instruments are located inside housings with forced air ventilation to minimize the effects of direct and reflected radiation. Ground-level instruments measure solar radiation, barometric pressure, and precipitation. Wind stability class is calculated based on meteorological measurements.

The data loggers that record the meteorological data are housed in a climatically controlled environment near the foot of the tower. The data loggers store the data for more than 24 hours. The data are continually transferred to the meteorological database including an active dashboard available on the FBP intranet. The dashboard displays real time data as well as 15-minute and 60-minute averages. The database is backed up at rolling 8-hour increments with a complete back-up of the meteorological database completed daily.

In the event that the data link between the tower and the meteorological database system computer fails, data can be retrieved directly from the data loggers with a laptop computer. These data are then transferred to the system computer.

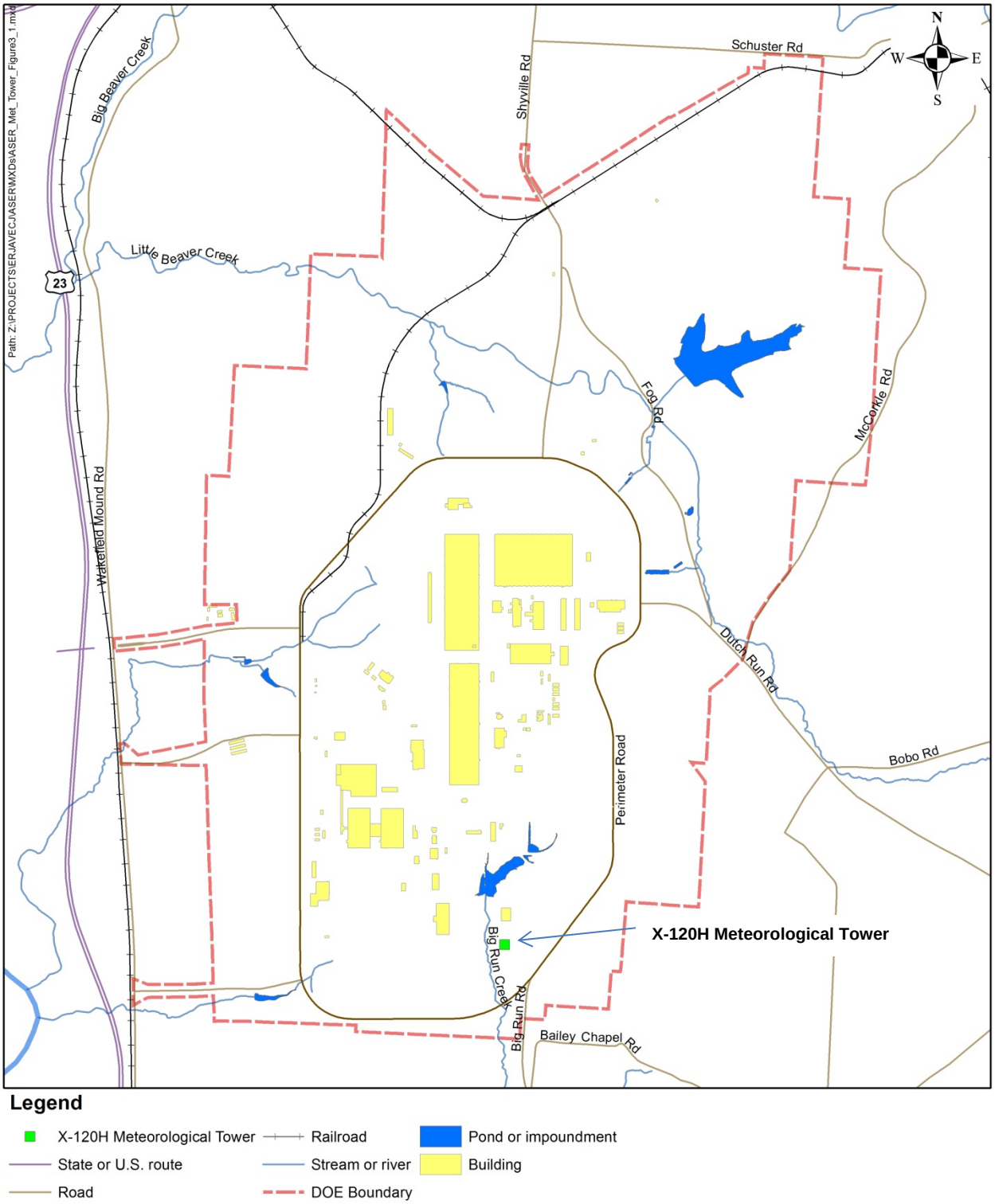

Figure 3.1. Location of meteorological tower at PORTS.

3.3 DATA ANALYSIS

The data collected from the meteorological tower are reviewed annually by a professional meteorologist as part of the preparation of the annual NESHAP report required by 40 CFR Part 61 Subpart H. Data from the National Weather Service or other local sources may be used in lieu of on-site data to replace missing or defective data in accordance with National Oceanic and Atmospheric Administration (NOAA) and U.S. EPA protocols. These data are used to generate an annual joint frequency distribution of wind direction, wind speed, and stability class. The average annual temperature and total annual precipitation are also calculated.

Data collected by the meteorological monitoring program may also be used in dispersion modeling, emergency planning/response, and other applications, as needed.

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4. ENVIRONMENTAL SURVEILLANCE

As defined in DOE Order 458.1 (DOE 2013c), environmental surveillance is the collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media at the DOE site and surrounding environs and the measurement of external radiation to demonstrate compliance with applicable standards, assess radiation exposure of members of the public, and assess effects, if any, on the environment.

Environmental surveillance programs conducted at PORTS are designed to provide information for the following areas:

- Compliance with applicable environmental quality standards, public exposure limits, and the requirements of DOE Order 458.1 (DOE 2013c),
- Background levels and site contributions of radioactive materials in the environment,
- Effectiveness of effluent treatment and controls in reducing effluents and emissions,
- Validity and effectiveness of models to predict the concentration of contaminants in the environment,
- Quantification of contaminant transport into the environment,
- Long-term buildup and prediction of environmental trends from site-released radioactive material, and
- Detection and quantification of unplanned releases.

PORTS confirms emission-based calculations, limits company liability, and reassures the public and outside regulators by performing routine environmental surveillance. Therefore, PORTS routinely samples and/or monitors various media for contaminants that may be attributable to PORTS operations. Air and surface water are considered the most important media to monitor since contamination could enter these media directly. External radiation, groundwater, soil, sediment, and biota are also monitored. The following environmental surveillance monitoring programs at PORTS are discussed in this chapter:

- Ambient air
- External radiation
- Groundwater (including exit pathway and off-site water supplies)
- Local surface water
- IGWMP surface water
- Sediment
- Soil
- Biota (vegetation, crops, deer, fish, and dairy).

DOE Order 458.1 (DOE 2013c) states that DOE radiological activities, including remedial actions, must be conducted so that exposure of members of the public to ionizing radiation is ALARA and does not cause a total effective dose exceeding 100 mrem/year, an equivalent dose to the lens of the eye exceeding 1500 mrem/year, or an equivalent dose to the skin or extremities exceeding 5000 mrem/year, from all sources of ionizing radiation and exposure pathways that could contribute significantly to the total dose.

DOE Order 458.1 (DOE 2013c) further states that if it is suspected that any of the dose limits specified in the order may be exceeded, or if the total effective dose exceeds 25 mrem/year, the dose to the lens of the eye, skin, and extremities must be evaluated.

Data collected by the effluent monitoring programs and environmental surveillance programs at PORTS are used to assess compliance with these standards. Chapter 7 provides additional information on dose calculations.

4.1 AMBIENT AIR

Because air is a primary exposure pathway to humans from radionuclides released to the atmosphere, ambient air monitoring is conducted to evaluate potential doses to the public and to monitor other pollutants. A Memorandum of Understanding between DOE and U.S. EPA (DOE and U.S. EPA 1995) requires evaluation of airborne emissions from diffuse emission sources, in addition to the point sources discussed in Chapter 2, Section 2.4. The PORTS ambient air monitoring program was developed to monitor emissions from both point and diffuse emissions sources. Additional benefits from the ambient air monitoring program include the following:

- assistance in developing an ALARA policy,
- assistance in the detection of unplanned releases, and
- promotion of public trust by providing additional radiological dose data.

Air monitoring is also conducted to monitor emissions from FBP process vents in the X-326, X-330, and X-344A buildings and MCS process vents. Chapter 2, Section 2.4 provides more information about the effluent monitoring program associated with these process vents.

4.1.1 Rationale and Design Criteria

Ambient air monitoring for environmental surveillance collects samples to determine activities of radionuclides in ambient air. The program is used to evaluate emissions from all radionuclide sources at PORTS including point, diffuse, and fugitive emissions.

Specific radionuclides monitored in ambient air at PORTS are selected based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and/or 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 during the Cold War. Sampling for these radionuclides was initiated in October 2000.

Fluoride is sampled in ambient air because it was historically released from the gaseous diffusion process; it may be released during D&D activities and processing of DUF_6 cylinders in the DUF_6 Conversion Facility.

The current ambient air monitoring locations are based on historic atmospheric dispersion modeling assessments performed by the Oak Ridge National Laboratory and have been confirmed by periodic assessments of the ambient air monitoring program. Locations were selected using a combination of dispersion modeling, where members of the public reside or abide, the modeled off-site maximum with respect to the annual reported dose for the site, and source-specific airborne emissions. The property-line station locations were the most likely to be affected by releases from PORTS, given typical annual meteorology. Property-line stations at or near these calculated points of maximum impact are in locations that are under the control of PORTS or at residences that are located near the property-line. No

residences or businesses are predicted to be affected routinely by radioactive materials released from PORTS without such releases being sampled at one of the selected locations.

The station near Otway (A37) provides an estimate of background or regional levels of radionuclides. The Otway station is approximately 13 miles southwest of PORTS, which meets the DOE Handbook guidance that states background stations for large sites should be located at least 15 kilometers (9.3 miles) in the least prevalent wind direction from the site. Two other locations, Camp Creek Road (A28) and Zahns Corner (A41A), provide backup or supporting information on background and long-range transport levels. The remote sampling location in Piketon (A6) serves as a confirmatory measure of a low dose to members of the public within this community.

Ambient air monitoring locations comply with the following criteria (to the extent practicable):

- The location is free from unusual localized effects or other conditions that could result in artificially high or low readings.
- The location is free from excessive large-particle (non-respirable) fugitive dust that may dominate the sample.
- Where applicable, the siting criteria in 40 CFR Part 58, Appendix E, was used as guidance to place the samplers at the various locations.

Both high volume air samplers (used for radionuclide sampling) and low volume air samplers (used to sample fluoride) meet the following criteria:

- Sample intake is approximately 1-2 m above ground level.
- The air sampling flow rate should not vary more than 20%.
- The total air volume is recorded.
- Filter media are selected to capture at least 99% of di-octyl-phthalate particles with an aerodynamic mean diameter of 0.3 micron, at the operational velocity and pressure drop.

High volume air samplers equipped with a mass-flow controller and a flow totalizer are used to collect particulate radionuclides. This sampling follows criteria specified in 40 CFR Part 50, Appendix G *Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air*. The high volume sampler design meets requirements specified in 40 CFR Part 53 *Ambient Air Monitoring Reference and Equivalent Methods*. The following criteria also apply:

- The linear flow rate across particulate filters is maintained between 20 and 50 m/min.
- Air sampling devices are designed to minimize the loss of sample during collection.

Low-volume air samplers equipped with a flow controller and a flow totalizer are used to collect gaseous fluorides. The following criteria also apply:

- The filter media is chemically treated for collecting gaseous fluoride.
- The nominal flow rate across particulate filters should be kept between 2 and 12 L/min, unless otherwise specified in the applicable procedure.

4.1.2 Monitoring Locations

Ambient air monitoring takes place at 16 stations, 14 of which are equipped to sample both particulate radionuclides and total gaseous fluorides. On-site station A40A is equipped to sample total gaseous fluorides only, and on-site station T7 is equipped to sample radionuclides only. Figure 4.1 shows the ambient air monitoring stations. The stations are described as follows:

On-site stations:

- A8–north-northwest of the plant near railroad right-of-way
- A10–Don Marquis Substation
- A29–west of the plant on the West Access Road near the Ohio Valley Electric Corporation
- A36–X-611 Water Filtration Plant
- A40A–near the northeast corner of the X-749A Landfill (fluoride only)
- T7–northwest side of X-734 Landfills near the former X-605 buildings (radionuclides only).

Off-site stations:

- A3–south of the plant on Bailey Chapel Road near Big Run Road
- A6–4 miles north-northwest of the plant inside the village of Piketon
- A9–southwest of the plant on Old US Route 23
- A12–east of the plant on McCorkle Road just north of Dutch Run Road
- A15–east-southeast of the plant on Loop Road south of Dutch Run Road
- A23–northeast of the plant on Taylor Road at McCorkle Road
- A24–north of the plant on the Shyville Road
- A28–6 miles southwest of the plant on Camp Creek Road
- A37–13 miles southwest of the plant approximately 4 miles north of Otway (background station)
- A41A–2.6 miles northeast of the plant at Zahns Corner.

The current ambient air monitoring program was implemented when control of the program was returned to DOE from USEC in October 2000. Ambient air station T7 was added to the program at that time to monitor potential emissions from activities at the X-747H Scrapyard. The monitoring frequency for transuranic radionuclides was changed from monthly to once per quarter beginning in October 2007 because transuranics are rarely detected in ambient air samples. Station A40 (at the X-100 Administration Building) was replaced by Station A40A (at the northeast corner of the X-749A Landfill) in 2012 due to demolition of the X-100 building. Station A41 in Zahns Corner was replaced by Station A41A (also in Zahns Corner) in 2014 due to road construction.

4.1.3 Monitoring Frequency and Parameters

Samples from high volume radionuclide samplers are collected weekly. Weekly samples are composited into one monthly composite sample. Compositing is completed in accordance with 40 CFR Part 50, Appendix G. Each composite sample is analyzed as follows:

- quarterly (one month in each quarter): transuranic radionuclides (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)

- monthly: technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238).

Fluoride samples from low volume samplers are collected and submitted to the laboratory weekly.

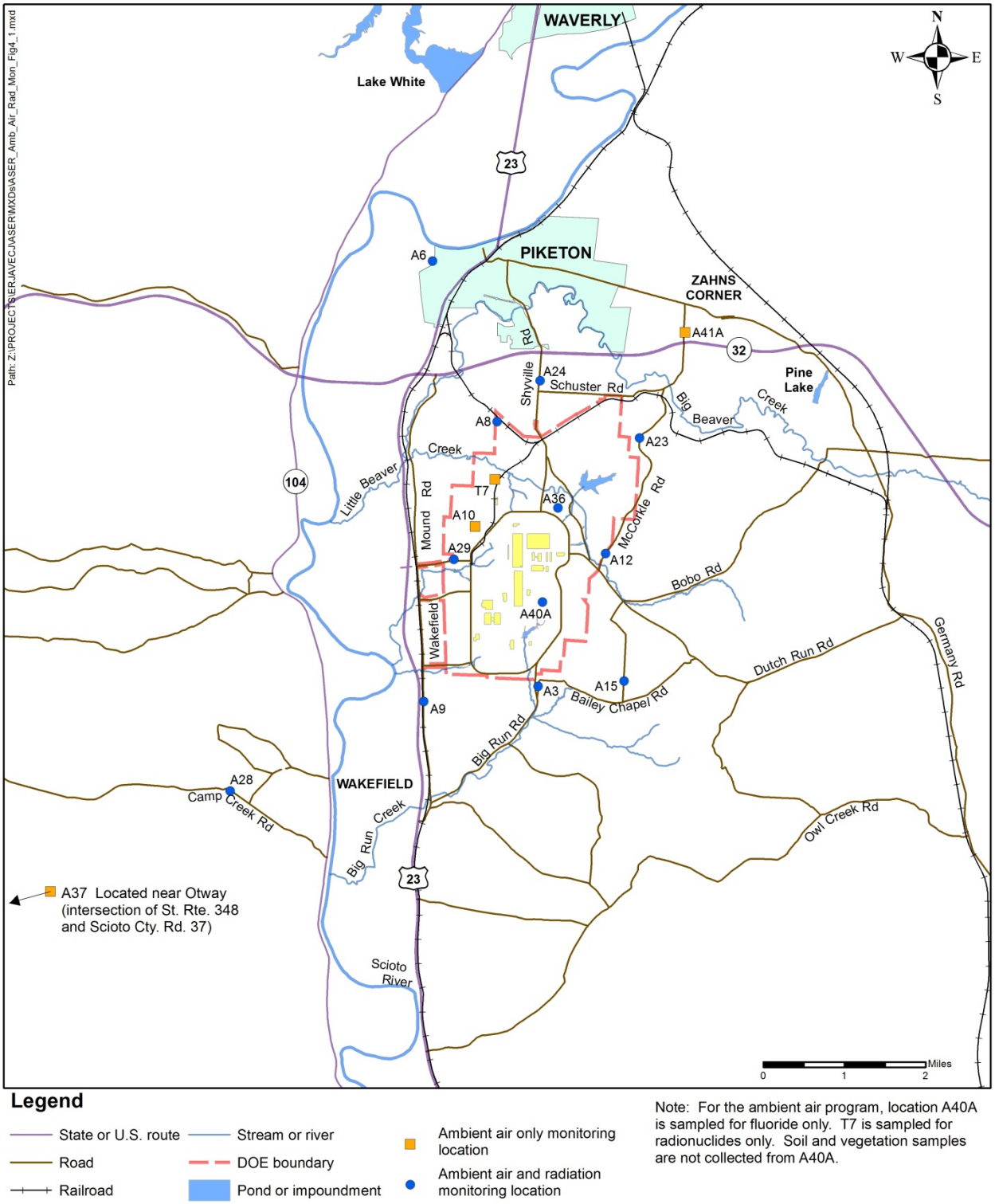

Figure 4.1. Ambient air monitoring locations.

In the event of unplanned releases of radionuclides that could potentially affect human health or the environment, samples may be collected at appropriate ambient monitoring stations. Appropriate stations would be selected based on meteorological information such as wind speed and direction and the release location.

4.2 EXTERNAL RADIATION

The external radiation monitoring program monitors radiation (measured as dose) at on-site and off-site locations around PORTS. The program provides data to confirm that PORTS does not contribute to off-site ambient radiation levels and provides data to assess the potential dose a member of the public may receive at accessible portions of the reservation.

The PORTS external radiation monitoring program assesses external exposure in air. External exposure in water is not assessed at PORTS because site-specific pathway analysis does not indicate that external exposure in water is a significant pathway (defined as more than 10 percent of the total off-site dose per the DOE Handbook).

4.2.1 Rationale and Design Criteria

PORTS managed alpha, beta, and gamma-emitting radionuclides as part of the gaseous diffusion uranium enrichment process and sealed radiation sources for testing and calibration. Sources of external radiation at PORTS are primarily storage areas for materials containing radionuclides, including the DUF_6 cylinder storage yards managed by FBP and MCS. Members of the public could hypothetically be exposed to radiation from the plant itself or from radionuclides released into the environment. However, historical data collected by the environmental radiation monitoring program indicate that there is no significant difference between radiation levels measured at the PORTS fence line and off-site monitoring locations.

The external radiation monitoring program is designed to provide exposure data on radiation from PORTS to members of the public. The primary factor in selecting the monitoring locations was the potential for a member of the public to be exposed to radiation. Secondary factors in selecting the monitoring locations were accessibility by environmental technicians, protection against casual vandalism, and consumption of manpower resources. The elevations of the external radiation monitoring locations range from approximately 550 to 810 feet above mean sea level (at stations A9 and A23, respectively).

The current external radiation monitoring program began in 2001, although radiation was measured as gamma radiation (in milliroentgen) at locations excluding the cylinder yards from 2001-2003. Radiation has been measured as a dose (in mrem) since 2004.

4.2.2 Monitoring Locations

On-site radiation monitoring locations (Figure 4.2) are located along the Perimeter Road and Hewes Street. These locations were selected considering 1) the elevated gamma radiation field in the vicinity of the cylinder storage yards in the northwest corner of the plant, 2) parking areas accessible to the public (where family members of plant workers might wait during shift changes), and 3) intersections of the Perimeter Road and the most commonly used plant access roads (representative of maximum public traffic loads on site).

Additional monitoring locations are co-located with both on-site and off-site ambient air monitoring stations (Figure 4.1). These monitoring locations simplify access for PORTS personnel and quantify off-site radiation levels.

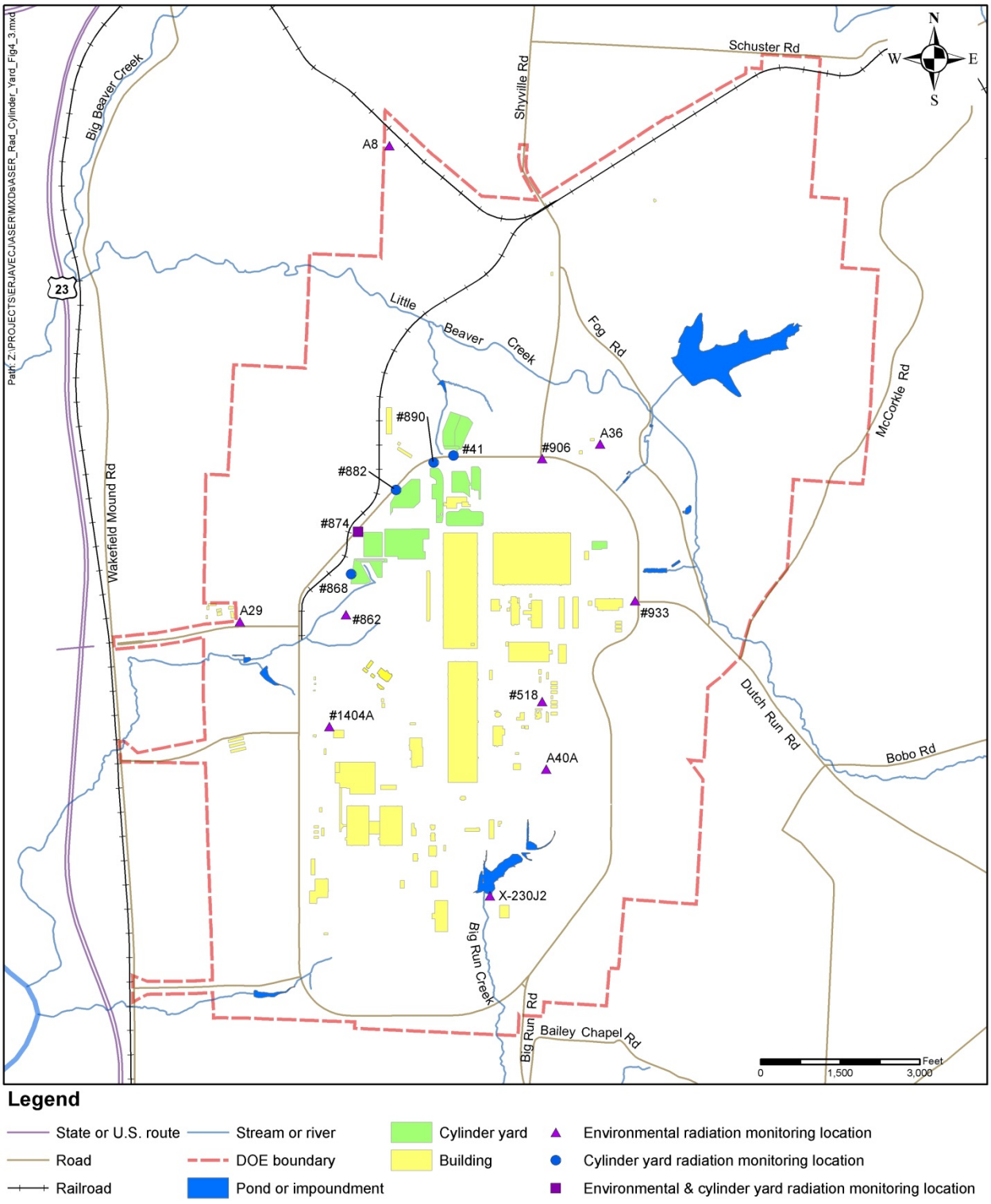

Figure 4.2. On-site external radiation monitoring locations.

On-site radiation monitoring locations include:

- Utility poles #41, #874, #882, #890 (northwest portion of Perimeter Road at cylinder storage yards)
- Ambient air monitoring station A29 (Ohio Valley Electric Corporation)
- Utility poles #868, #862 (intersection of Principal Access Road/Perimeter Road)
- Utility pole #1404A (X-7725 Parking Area)
- X-230J2 Building (Hewes Road at south end of X-230K Holding Pond)
- Utility pole #518 (south of the former X-746 building)
- Ambient air monitoring station A40A (near the northeast corner of the X-749A Landfill)
- Utility pole #933 (intersection of Perimeter Road and Dutch Run Road)
- Ambient air monitoring station A36 (X-611 Water Treatment Plant)
- Utility pole #906 (intersection of Perimeter Road and North Access Road)
- Ambient air monitoring station A8 (northern plant boundary).

Off-site radiation monitoring locations include (all located at ambient air monitoring stations):

- A28 (southwest of PORTS on Camp Creek Road)
- A9, A3, A15 (south of PORTS)
- A12, A23 (east of PORTS)
- A24, A6 (north of PORTS).

4.2.3 Monitoring Frequency and Parameters

Radiation is measured by thermoluminescent dosimeters. The dosimeters measure radiation as a dose (in mrem) that is reported in the following components:

- Deep dose: The deep dose equivalent that applies to external whole body exposure; the dose equivalent at a tissue depth of 1 cm. It includes dose for photon energies from approximately 10 kilo-electron volts to 6 mega-electron volts and neutrons.

- Eye dose: The eye dose equivalent applies to the external exposure of the lens of the eye and is the dose equivalent at a tissue depth of 0.3 cm. It includes dose for beta particles, neutrons, and photons.

- Shallow dose: The shallow dose equivalent applies to the external exposure of skin or an extremity and is the dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm^2. It includes dose for beta particles, neutrons, and photons.

Two or more dosimeters are placed at each monitoring location, in accordance with the DOE Handbook guidance. Dosimeters are changed and read quarterly per general industry practice.

4.3 GROUNDWATER

Groundwater monitoring at PORTS is designed to:

- Obtain data to determine baseline conditions of groundwater quality and quantity,
- Demonstrate compliance with and implementation of applicable regulations and DOE Orders,
- Provide data for early detection of groundwater contamination,
- Identify existing and potential groundwater contamination sources and maintain surveillance of the sources,
- Provide data for decision-making for land disposal practices and management of groundwater resources.

Per legal agreements with the State of Ohio and U.S. EPA, groundwater monitoring at PORTS is completed in accordance with the IGWMP, with the exception of exit pathway monitoring (a component of groundwater environmental surveillance). Although many of the exit pathway groundwater monitoring wells are also part of IGWMP monitoring, the exit pathway monitoring program is not specifically discussed in the IGWMP.

Off-site residential water supply monitoring (drinking water wells) is completed in accordance with the IGWMP to address the public's concern about the potential for off-site groundwater contamination, especially of drinking water sources.

4.3.1 Rationale and Design Criteria

The groundwater flow system at PORTS includes two water-bearing units (the bedrock Berea Sandstone and the unconsolidated Gallia Sand and Gravel [Gallia]) and two aquitards (the Sunbury Shale and the unconsolidated Minford Clay and Silt [Minford]). The basal portion of the Minford is generally grouped with the Gallia to form the uppermost and primary aquifer at the facility (DOE 1998a, DOE 1998b, DOE 2000, and DOE 2001a). Figure 4.3 is a geological cross-section of the PORTS area.

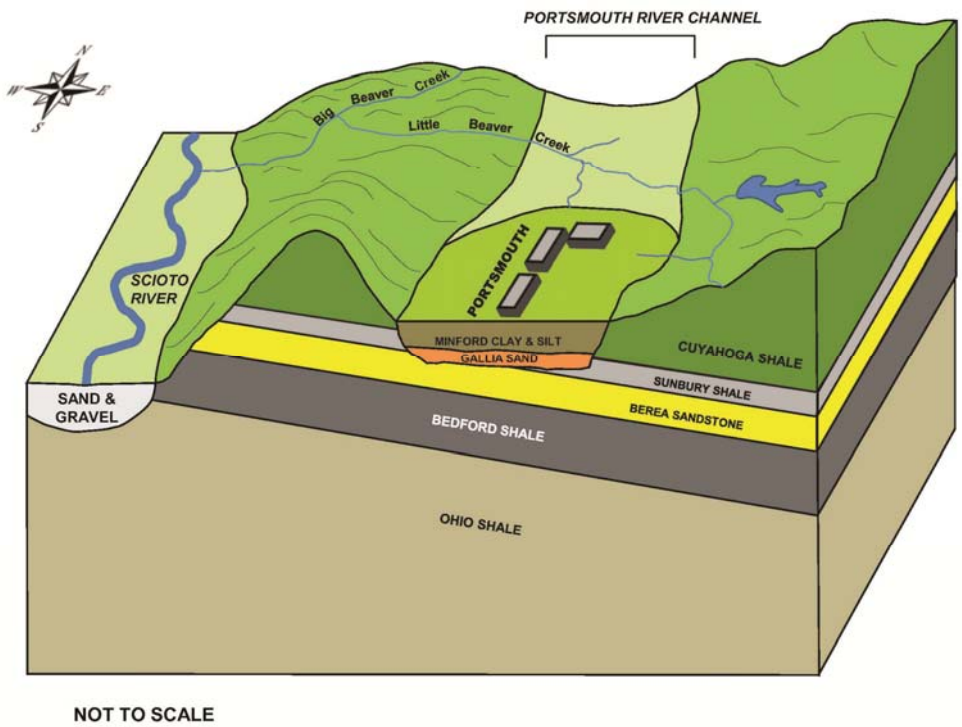

Figure 4.3. Regional structural cross-section.

At PORTS, the hydraulic conductivity of all hydrogeologic units is very low. The most conductive unit is the Gallia whose hydraulic conductivity determined from single-well tests across the entire PORTS facility varies from 0.11 to 150 feet per day (ft/d) with an arithmetic mean value of 3.4 ft/d. The hydraulic conductivity of the Gallia is generally higher in thicker areas. The next most permeable formation is the Berea Sandstone with a mean hydraulic conductivity of 0.16 ft/d.

Initial assessments of groundwater contamination at PORTS, conducted in the late 1980s and early 1990s, revealed a number of potential sources of contaminants distributed throughout the site. Hydrogeological evaluations revealed groundwater divides underlying the facility in the Gallia, Minford, and, to a lesser extent, the Berea Sandstone. The Gallia, with its tendency to discharge to surface water features within

the reservation boundary, is of primary concern for potential off-site transport. The Berea Sandstone has not exhibited widespread or high levels of contamination on site; however, its regional nature makes it the hydrogeologic unit of concern for potential off-site migration of contaminants. The ultimate discharge areas for most groundwater in both the Gallia and Berea are Little Beaver Creek to the north and east, Big Run Creek to the south, and two drainage channels to the west.

The following documents provide more detailed discussions of groundwater contaminants and the geology and hydrogeology of PORTS:

- *Deferred Units Resource Conservation and Recovery Act Facility Investigation/Corrective Measures Study Work Plan for the Portsmouth Gaseous Diffusion Plant* (DOE 2015a)

- *Ground Water Quality Assessment of Four RCRA Units for the Portsmouth Gaseous Diffusion Plant* (Martin Marietta Energy Systems 1989)

- *Final Reports for Quadrants I, II, III and IV RCRA Facility Investigations (RFIs)* (DOE 1996a, DOE 1996b, DOE 1996c, and DOE 1996d)

- *Cleanup Alternative Study (CAS)/Corrective Measures Study (CMS) Reports for Quadrants I, II, III and IV* (DOE 2000, DOE 2001a, DOE 1998a, DOE 1998b).

Monitoring parameters at the groundwater units are based on chemicals and radionuclides identified in Ohio EPA regulations and sampling conducted during the RFI, CAS/CMS, and other investigations. Chemicals may include, but are not limited to, volatile organic compounds (trichloroethene, dichloroethanes, dichloroethenes, vinyl chloride, etc.), metals (cadmium, chromium, nickel, etc.), and other parameters (alkalinity, chloride, sulfate, etc.).

Groundwater samples are analyzed for specific radionuclides based on the materials handled at PORTS and on historic monitoring data. For example, samples are analyzed for uranium and/or 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 during the Cold War.

The IGWMP describes in detail the rationale and criteria used to design groundwater effluent monitoring at PORTS as well as the off-site water supply monitoring program. The IGWMP includes background information and details concerning units or locations that require groundwater monitoring, wells included in the various monitoring programs, analytical parameters and methods for these monitoring programs, the frequency of monitoring at each unit or sampling location, and reporting requirements for each unit or sampling location.

Groundwater exit pathway monitoring at PORTS focuses on the southern portion of the reservation, where the X-749/X-120 groundwater plume is near the site boundary. One well also monitors the eastern portion of the site near the X-701B groundwater plume.

4.3.2 Monitoring Locations, Frequency, and Parameters

The IGWMP includes maps of well locations, sampling parameters, and monitoring frequencies for the groundwater monitoring areas at PORTS. The IGWMP also provides locations, sampling parameters, and frequencies for the water supply monitoring program (residential drinking water wells and the PORTS water supply).

The following wells are part of the exit pathway monitoring program (see Figure 4.4):

- Wells X749-14B, X749-44G, X749-45G, X749-64B, X749-68G, X749-96G, X749-97G, and X749-98G (also part of the monitoring program for the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility)

- Well X701-48G (also part of the monitoring program for the X-701B Former Holding Pond)

- Well F-29B (exit pathway monitoring well only).

The IGWMP provides the analytical parameters and frequency of sampling for locations that are part of the monitoring programs for the X-749 Contaminated Materials Disposal Facility/X-120 Former Training Facility or the X-701B Former Holding Pond.

At a minimum, exit pathway monitoring wells are sampled biennially and analyzed for the following parameters:

- volatile organic compounds
- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

4.4 SURFACE WATER

Surface water surveillance programs include local (off-site) surface water monitoring and surface water monitoring required by the IGWMP, which includes four exit pathway monitoring locations. Chapter 2, Effluent Monitoring, describes the NPDES monitoring program, the monitoring program for cylinder storage yards (surface water and sediment), and the settleable solids monitoring program.

4.4.1 Rationale and Design Criteria

The local surface water monitoring program is designed to assess levels of radionuclides in local streams at on-site and off-site locations upstream and downstream of PORTS.

Analytes are selected based on contaminants that have been detected at PORTS or that are potentially associated with PORTS activities. Local surface water samples are analyzed for selected radionuclides 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 during the Cold War.

The current local surface water monitoring program was implemented in 2002. Sampling location RW-1 (Scioto River downstream from PORTS) was replaced by RW-1A in 2016 due to access issues at the original location.

Surface water monitoring is also included in the IGWMP because on-site streams and drainage channels can be groundwater discharge areas and may indicate the discharge of groundwater contamination. These locations can also be affected by NPDES discharges or surface water runoff. These locations assess the impact of plant effluent discharges (groundwater and surface water) to local surface water bodies. The IGWMP provides additional information on parameters selected for IGWMP surface water monitoring.

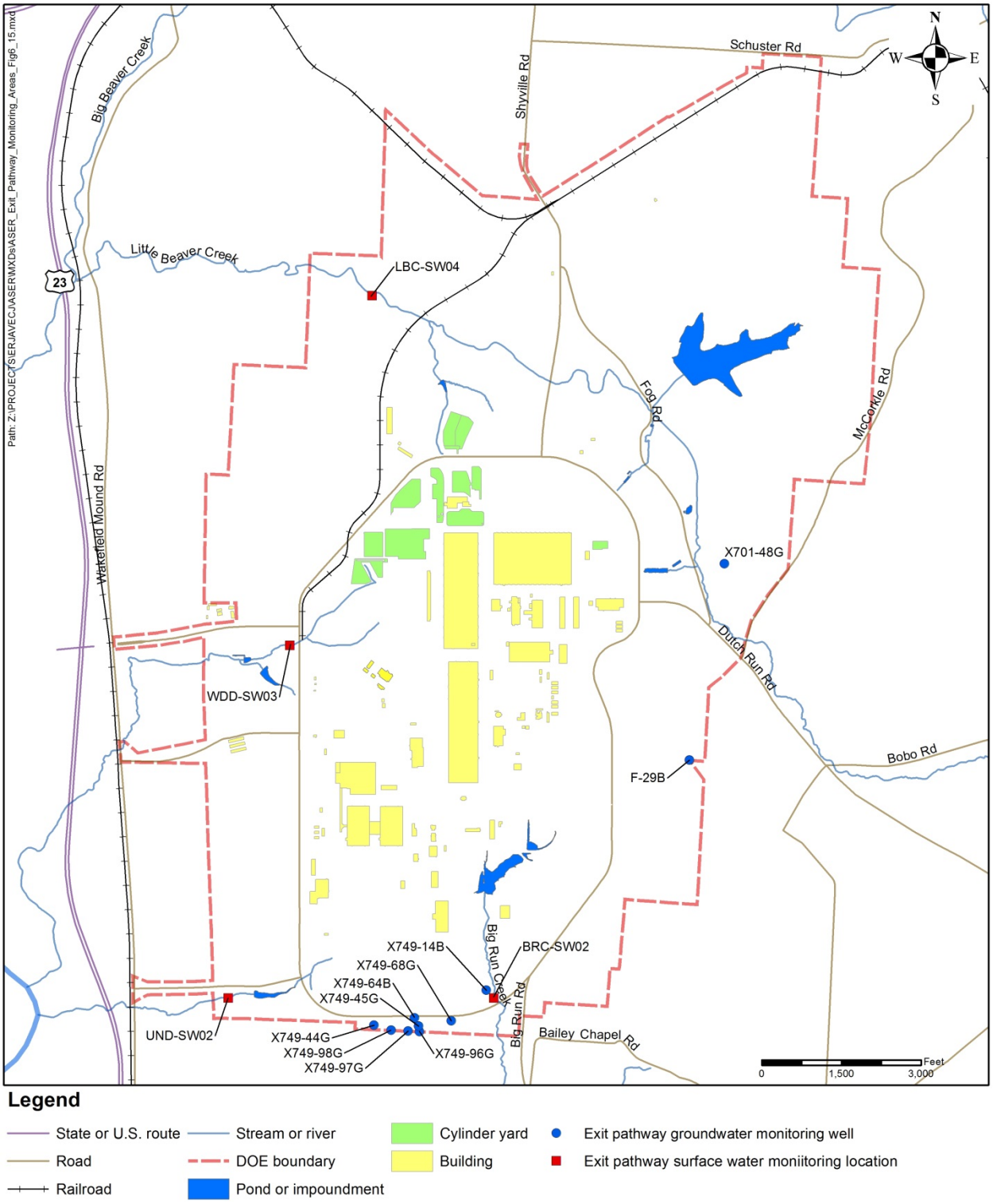

Figure 4.4. Exit pathway monitoring locations.

4.4.2 Monitoring Locations

For the local surface water monitoring program, surface water samples are collected at 14 locations on local streams (Little Beaver Creek, Big Beaver Creek, Big Run Creek and the Scioto River) and from background locations located approximately 10 miles from the plant. Figure 4.5 shows the local surface water monitoring points. The purpose for each local surface water monitoring location is listed below:

- Little Beaver Creek: RW-12 is the upstream monitoring point, RW-8 monitors on-site water quality at the North Drainage Ditch from the North Holding Pond, and RW-7 monitors water quality just prior to the confluence with Big Beaver Creek.

- Big Beaver Creek: RW-5 monitors water quality immediately upstream of the confluence with Little Beaver Creek and RW-13 monitors water quality after the confluence with Little Beaver Creek (downstream from PORTS).

- Big Run Creek: RW-33 monitors upstream water quality, RW-2 monitors downstream water quality near Wakefield, and RW-3 monitors water quality at the site boundary.

- Scioto River: RW-6 monitors upstream water quality (in Piketon) and RW-1A monitors downstream water quality (in Wakefield) after PORTS discharges (confluence with Big Beaver Creek, NPDES discharges to the Scioto River, and confluence with Big Run Creek).

- Background creeks: locations 10 miles north, south, east, and west of PORTS (RW-10N [Crooked Creek], RW-10S [creek at State Route 728 and Pleasant Drive], RW-10E [Little Scioto River], and RW-10W [Sunfish Creek]).

IGWMP surface water samples are collected from 14 locations on Little Beaver Creek, Big Run Creek, Southwestern Drainage Ditch, West Drainage Ditch, North Holding Pond, and the East Drainage Ditch. Figure 4.6 shows the IGWMP surface water sampling locations. The purpose for each IGWMP surface water monitoring location is listed below:

- Little Beaver Creek and East Drainage Ditch sample locations LBC-SW01, LBC-SW02, and EDD-SW01 assess possible X-701B area plume groundwater discharges and surface water discharges from FBP Outfalls 001 and 015.

- Little Beaver Creek sample location LBC-SW03 assesses potential contamination from the X-611A Former Lime Sludge Lagoons and FBP Outfall 011.

- Big Run Creek sample locations BRC-SW01, BRC-SW02, and BRC-SW05 monitor potential groundwater discharges from Quadrant I groundwater plumes and FBP Outfall 002.

- 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 and Centrus Outfall 012 (UND-SW02 only).

- 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, FBP Outfall 009, and upstream discharges (see Little Beaver Creek locations LBC-SW01, LBC-SW02 and LBC-SW03).

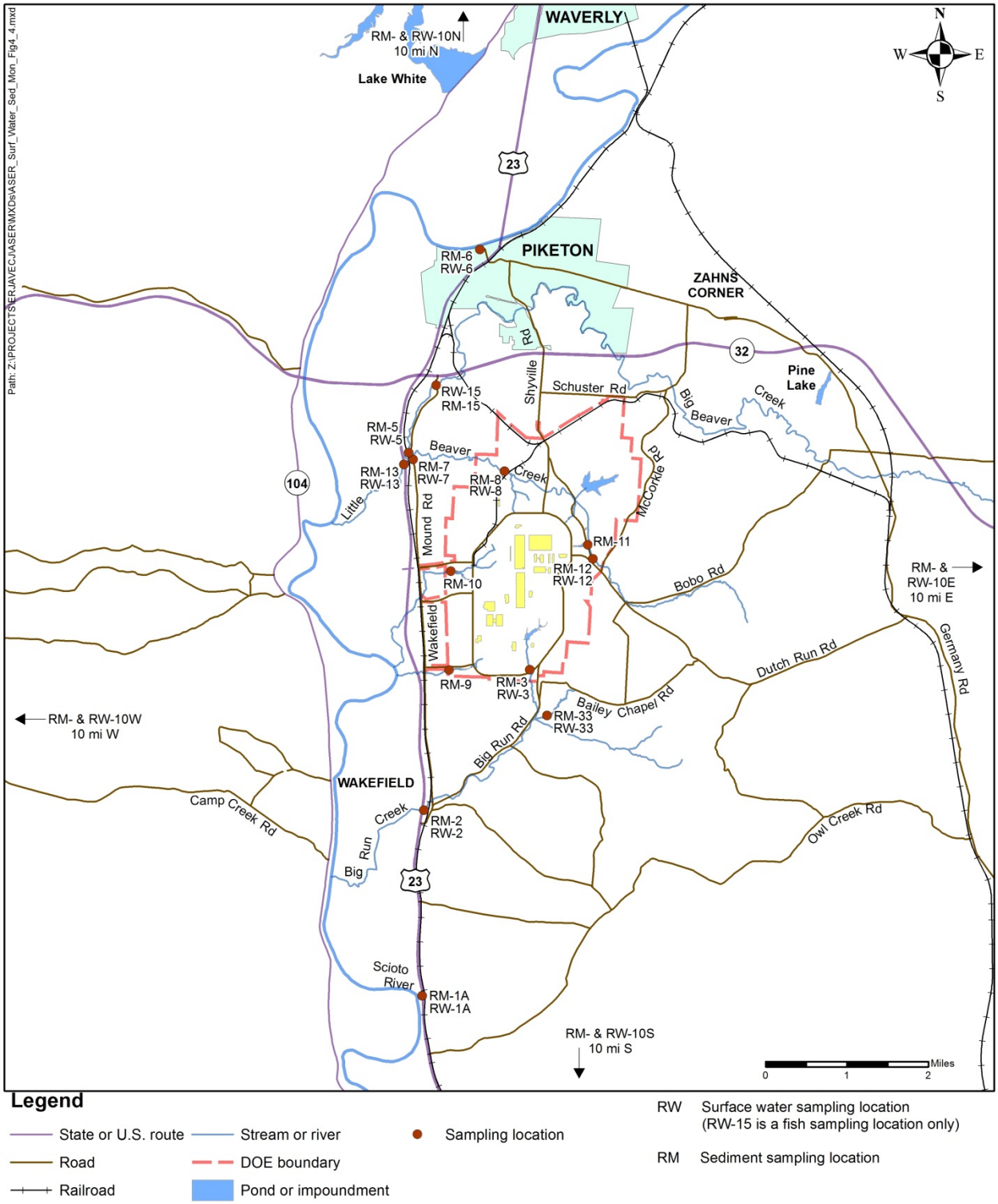

Figure 4.5. Local surface water and sediment monitoring locations.

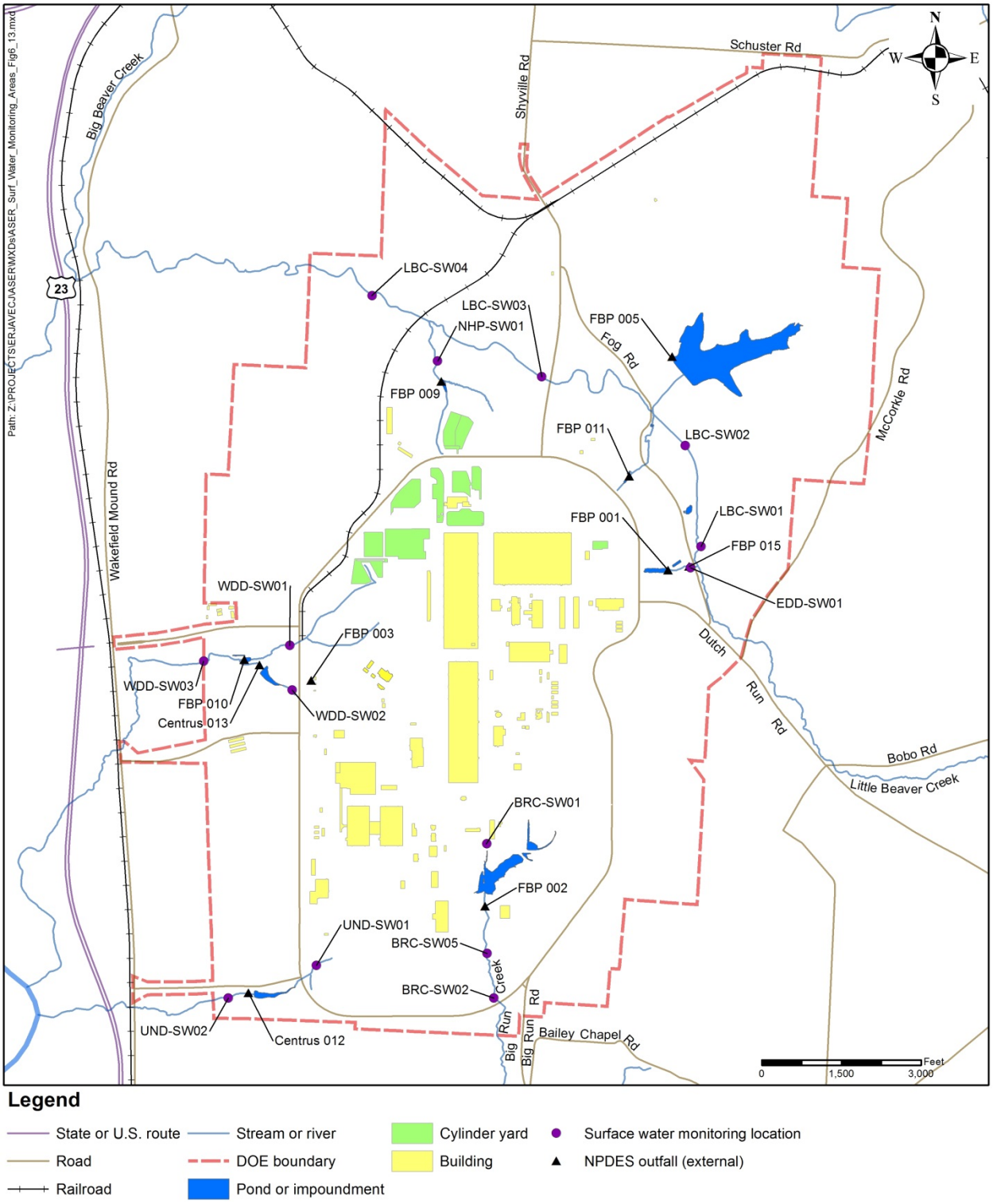

Figure 4.6. IGWMP surface water monitoring locations.

- 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. FBP Outfall 010, Centrus Outfall 013 and MCS Outfall 001 also affect location WDD-SW03.

Four of the IGWMP surface water monitoring locations also provide exit pathway monitoring: BRC-SW02 (Big Run Creek), LBC-SW04 (Little Beaver Creek), UND-SW02 (Southwestern Drainage Ditch), and WDD-SW03 (Western Drainage Ditch). Two of the IGWMP surface water monitoring locations are also sampled for the settleable solids monitoring program: EDD-SW01 (East Drainage Ditch) and WDD-SW03 (West Drainage Ditch).

4.4.3 Monitoring Frequency and Parameters

Local surface water samples are collected semiannually and analyzed for selected radionuclides as follows:

- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

IGWMP surface water samples are collected at the frequency provided in the IGWMP (currently quarterly). At a minimum, monitoring parameters include radionuclides and volatile organic compounds. The IGWMP provides the current list of monitoring parameters for the surface water sampling locations.

4.5 SEDIMENT

Sediments can collect, concentrate, and store specific kinds of contaminants. Concentrations of contaminants in sediments, thus, can be integrated measures of aqueous contaminant concentrations over some preceding period of time. Sediments also contain naturally occurring inorganic and organic chemicals. The PORTS sediment monitoring program measures contaminants potentially released by PORTS activities and naturally-occurring constituents.

4.5.1 Rationale and Design Criteria

Sediments are effective at concentrating and storing contaminants that have a high affinity for organic and inorganic surfaces. However, they also contain naturally-occurring inorganic and organic chemicals; thus, analytical measurements generally have higher backgrounds and less sensitivity than aqueous-phase measurements. Analytical parameters measured in sediment samples are restricted to those substances that are accumulated and retained in sediments. Analysis of sediment samples for volatile organic compounds, for example, is not useful because volatile organics would not be found in sediments at concentrations much higher than those in water, and would be rapidly removed from sediments following episodic releases.

Sampling locations are located on the surface water bodies that receive surface water runoff from PORTS, at NPDES outfalls, and at four background locations. The current sediment monitoring program was implemented in 2002. Sampling location RM-1 (Scioto River downstream from PORTS) was replaced by RM-1A in 2016 due to access issues at the original location. An additional sediment monitoring location on Big Beaver Creek (RM-15) was added to the monitoring program in 2017 to provide additional information about upstream conditions on Big Beaver Creek.

Analytes are selected based on contaminants that have been detected at PORTS or that are potentially associated with PORTS activities. Samples are analyzed for metals and PCBs based on historic releases from PORTS. PCBs are a widespread environmental contaminant that are present at PORTS. Samples

are analyzed for metals based on past releases, current or historic NPDES monitoring parameters, and other environmental monitoring data.

Sediment samples are analyzed for selected radionuclides 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 during the Cold War.

Chapter 2, Effluent Monitoring, describes the monitoring program for surface water and sediment at the cylinder storage yards.

4.5.2 Monitoring Locations

Sediment samples are collected at monitoring locations for local surface water and at three NPDES discharge points (see Figure 4.5). The purpose for each sediment monitoring location is listed below:

- Little Beaver Creek: RM-12 is the upstream monitoring point, RM-8 monitors the North Drainage Ditch from the North Holding Pond, and RM-7 monitors prior to the confluence with Big Beaver Creek.

- Big Beaver Creek: RM-15 is the upstream monitoring point, RM-5 is a monitoring point immediately upstream of the confluence with Little Beaver Creek, and RM-13 monitors sediment quality after the confluence with Little Beaver Creek (downstream from PORTS).

- Big Run Creek: RM-33 is the upstream monitoring point, RM-2 monitors downstream near Wakefield, and RM-3 monitors sediment quality at the site boundary.

- Scioto River: RM-6 is the upstream monitoring point (in Piketon) and RM-1A monitors downstream (in Wakefield) after PORTS discharges (confluence with Big Beaver Creek, NPDES discharges to the Scioto River, and confluence with Big Run Creek).

- Background creeks: locations 10 miles north, south, east, and west of PORTS (RM-10N [Crooked Creek], RM-10S [creek at State Route 728 and Pleasant Drive], RM-10E [Little Scioto River], and RW-10M [Sunfish Creek]).

- NPDES outfalls: RM-9 monitors Centrus Outfall 012, RM-10 monitors FBP Outfall 010 and Centrus Outfall 013, and RM-11 monitors FBP Outfall 001.

4.5.3 Monitoring Frequency and Parameters

Sediment samples are collected annually and analyzed for the following parameters:

- metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, manganese, mercury, nickel, selenium, silicon, silver, thallium, and zinc)
- PCBs
- transuranic radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240)
- technetium-99
- uranium and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238).

4.6 SOIL

Contaminants released from PORTS may reach soil by deposition of airborne materials and materials contained in irrigation water. Because soil provides an integrating medium for contaminants released to the atmosphere as particulates or gases, it is viewed as a long-term accumulator of material and is useful for long-term trend analysis and to quantify spatial distribution of contaminants around plant facilities.

4.6.1 Rationale and Design Criteria

Because the majority of the contaminants in soil are derived from airborne materials, soil samples are collected at ambient air monitoring stations that sample radionuclides (see Figure 4.1), making correlations with airborne emissions possible. These monitoring stations were sited using dispersion modeling and local meteorological data and include public exposure locations, the DOE site boundary, local communities, and background areas (see Section 4.1.1).

Soil samples are analyzed for selected radionuclides 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 during the Cold War.

The current soil monitoring program was implemented in 2002. Station A41 in Zahns Corner was replaced in 2014 by Station A41A (also in Zahns Corner) due to road construction.

4.6.2 Monitoring Locations

Soil samples are collected at 15 ambient air monitoring stations that sample radionuclides. Figure 4.1 shows the ambient air monitoring stations. The stations are described as follows:

On-site stations:

- A8–north-northwest of the plant near railroad right-of-way
- A10–Don Marquis Substation
- A29–west of the plant on the West Access Road near the Ohio Valley Electric Corporation
- A36–X-611 Water Filtration Plant
- T7–northwest side of X-734 Landfills near the former X-605 buildings.

Off-site stations:

- A3–south of the plant on Bailey Chapel Road near Big Run Road
- A6–4 miles north-northwest of the plant inside the village of Piketon
- A9–southwest of the plant on Old US Route 23
- A12–east of the plant on McCorkle Road just north of Dutch Run Road
- A15–east-southeast of the plant on Loop Road south of Dutch Run Road
- A23–northeast of the plant on Taylor Road at McCorkle Road
- A24–north of the plant on the Shyville Road
- A28–6 miles southwest of the plant on Camp Creek Road
- A37–13 miles southwest of the plant approximately 4 miles north of Otway (background station)
- A41A–2.6 miles northeast of the plant at Zahns Corner.

4.6.3 Monitoring Frequency and Parameters

Soil samples are collected annually and analyzed for the following parameters:

- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

4.7 BIOTA

Biota is defined as the animal and plant life of a region. Biota monitoring at PORTS includes vegetation (grass and similar plants eaten by grazing animals), crops, deer, fish, and dairy products (milk and eggs).

4.7.1 Vegetation

Contaminants released from PORTS may reach vegetation (i.e., grass and similar plants) by deposition of airborne materials and materials contained in irrigation water. Vegetation may also take up contaminants directly from the soil. Vegetation (grass and similar plants eaten by grazing animals) are sampled to verify that there is no ongoing accumulation of radionuclides.

4.7.1.1 Rationale and design criteria

Grass is an indicator of contaminants available to grazing animals. Because the majority of the contaminants in grass are derived from airborne materials, grass samples are collected at ambient air monitoring stations that sample radionuclides (see Figure 4.1), making correlations with airborne emissions possible. These monitoring stations were sited using dispersion modeling and local meteorological data and include public exposure locations, the DOE site boundary, local communities, and background areas (see Section 4.1.1).

Vegetation samples (grass and similar plants eaten by grazing animals) are analyzed for selected radionuclides 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 during the Cold War.

The current vegetation monitoring program was implemented in 2002. Station A41 in Zahns Corner was replaced in 2014 by Station A41A (also in Zahns Corner) due to road construction.

4.7.1.2 Monitoring locations, frequency, and parameters

Vegetation samples are collected at 15 ambient air monitoring stations that sample radionuclides (see Figure 4.1). The stations are described as follows:

On-site stations:

- A8–north-northwest of the plant near railroad right-of-way
- A10–Don Marquis Substation
- A29–west of the plant on the West Access Road near the Ohio Valley Electric Corporation
- A36–X-611 Water Filtration Plant
- T7–northwest side of X-734 Landfills near the former X-605 buildings.

Off-site stations:

- A3–south of the plant on Bailey Chapel Road near Big Run Road

- A6–4 miles north-northwest of the plant inside the village of Piketon
- A9–southwest of the plant on Old US Route 23
- A12–east of the plant on McCorkle Road just north of Dutch Run Road
- A15–east-southeast of the plant on Loop Road south of Dutch Run Road
- A23–northeast of the plant on Taylor Road at McCorkle Road
- A24–north of the plant on the Shyville Road
- A28–6 miles southwest of the plant on Camp Creek Road
- A37–13 miles southwest of the plant approximately 4 miles north of Otway (background station)
- A41A–2.6 miles northeast of the plant at Zahns Corner.

Samples of wide-blade grass, typical of local cattle forage, are collected annually. To the extent possible, grass samples consist of an equal mix of standing live and standing dead crop. A mix of live and dead crop provides a more representative estimate of deposition, which is the major pathway, rather than root uptake. Samples are analyzed for the following parameters:

- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

4.7.2 Crops

Contaminants released from PORTS may accumulate in food crops by deposition of airborne materials and materials contained in irrigation water. Crops may also take up contaminants directly from the soil.

4.7.2.1 Rationale and design criteria

Crop samples are analyzed for selected radionuclides 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 during the Cold War.

The current crop monitoring program was implemented in 2002.

4.7.2.2 Monitoring locations, frequency, and parameters

PORTS annually collects donated samples of food crops from local farmers and gardeners. Because of fluctuations in the availability of local farmers and the types of crops available, the locations and the selection of crops for analysis varies from year to year. Crop samples are analyzed for the following parameters:

- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

4.7.3 Deer

Deer may accumulate radionuclides released from PORTS via various pathways (ingestion, inhalation, deposition, etc.).

4.7.3.1 Rationale and design criteria

Deer samples are analyzed for selected radionuclides 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 during the Cold War.

Samples of the liver, kidney and muscle are usually collected. The liver and kidneys are sampled because these organs are expected to concentrate radionuclides ingested by the animal. Muscle samples are collected because this portion of the deer is eaten by humans and provides data for a dose assessment as described in Chapter 7.

Monitoring the bioaccumulation of volatile organic compounds, including trichloroethene, is not recommended because these compounds have low bioconcentration potential.

The current deer monitoring program was implemented in 2000.

4.7.3.2 Monitoring locations, frequency, and parameters

Deer samples may be collected through two different means. Samples may be collected from road kills that occur on the reservation. Deer samples may also be obtained from hunting when allowed on the DOE reservation.

Samples are collected annually or as they are available. Deer samples (kidney, liver, and muscle) are analyzed for the following parameters:

- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

4.7.4 Fish

Radionuclides and PCBs released from PORTS may accumulate in fish living in streams and rivers downstream from PORTS.

4.7.4.1 Rationale and design criteria

Fish sampling locations are located upstream and downstream from PORTS at locations that are most likely to support fish of the size and species of interest to a sport fisherman. Only the fish fillet is collected because this portion of the fish is eaten by humans and provides data for a dose assessment as described in Chapter 7.

Fish samples are analyzed for selected radionuclides 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 during the Cold War.

Fish samples are analyzed for PCBs. PCBs are a widespread environmental contaminant that are present at PORTS. PCBs are routinely detected in fish sampled throughout the United States and have been detected in fish sampled at PORTS.

Monitoring the bioaccumulation of volatile organic compounds, including trichloroethene, is not recommended because these compounds have low bioconcentration potential.

The current monitoring program for fish was implemented in 2002. Chromium was included in the monitoring parameters from 2002-2007, and was removed from the monitoring in 2008 because chromium is not a contaminant of concern in fish.

4.7.4.2 Monitoring locations, frequency, and parameters

The fish monitoring program focuses on the following locations (see Figure 4.5):

- Little Beaver Creek (RW-8)
- Upstream and downstream Big Beaver Creek (RW-15 and RW-13)
- Upstream and downstream Scioto River (RW-6 and RW-1A).

Fish are collected as available and as weather permits. Whenever possible, only fish of a size and species likely to be taken by sport fishermen are sampled.

Fish samples are analyzed for the following parameters:

- PCBs
- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

4.7.5 Dairy

Radionuclides released from PORTS may accumulate in dairy products (milk and eggs) primarily via ingestion.

4.7.5.1 Rationale and design criteria

Milk and egg samples are analyzed for selected radionuclides 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 during the Cold War.

4.7.5.2 Monitoring locations, frequency, and parameters

Samples of locally produced dairy products (milk and eggs) are collected annually as available on a voluntary basis. Samples are analyzed for the following parameters:

- transuranics (americium-241, neptunium-237, plutonium-238, and plutonium-239/240)
- technetium-99
- uranium and isotopic uranium (uranium-233/234, uranium-235/236, uranium-238).

5. SAMPLE HANDLING, PREPARATION, AND ANALYSIS PROCEDURES

Procedures for sample handling, preparation, and analysis comprise, by definition, an integral element of the environmental monitoring program because both effluent monitoring and environmental surveillance are defined, in part, in DOE Order 458.1 (DOE 2013c) as "*the collection and analysis of samples*." Those objectives of the EMP concerning compliance with applicable regulations and commitments, identification of facility contributions to ambient contaminant levels, and determination of the effectiveness of effluent treatment/controls would be impossible to measure without a valid and reliable sampling and analytical system.

5.1 KEY REQUIREMENTS AND SUPPORTING DOCUMENTS

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

MCS is responsible for environmental monitoring data collected by MCS.

5.2 LABORATORY PROCEDURE REQUIREMENTS

Laboratories performing analyses on FBP samples must be capable of meeting requirements in the DOE *Quality Systems for Analytical Services Document* (QSAS) (DOE 2013b) and *Multi-Agency Radiological Laboratory Analytical Protocols Manual* (MARLAP) (U.S. Nuclear Regulatory Commission [NRC] 2004). The DOE QSAS, MARLAP, and/or SADQ provide information pertaining to the following analytical laboratory requirements:

- documentation
- sample identification system
- chain-of-custody
- screening of samples
- preventing cross contamination
- sample preservation
- sample packaging and transportation
- sample handling
- sample preparation
- instrumentation
- uncertainty
- analytical procedures.

Analytical laboratories providing services for FBP are responsible for compliance with the requirements of the SADQ and their specific contract. Laboratory performance is evaluated on an ongoing basis through use of assessments, performance evaluation samples, and data verification/validation of the laboratory's data packages.

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6. DATA ANALYSIS AND STATISTICAL TREATMENT

This chapter describes the design and implementation of data analysis and statistical treatment for data obtained through implementation of this EMP. The goals for collection of environmental data include:

- estimating chemical and radionuclide concentrations or activities with an estimated uncertainty (for radionuclides) for each sample or measurement;
- comparing the estimated chemical and radionuclide concentrations or activities at each sampling and/or measurement point to previous estimates at that point to identify changes or inconsistencies in contaminant levels;
- comparing the estimated chemical and radionuclide concentrations or activities at each sampling and/or measurement point to the established limits; and
- comparing the estimated chemical and radionuclide concentrations or activities at single sampling and/or measurement points or groups of points to those at control or other points and evaluating the reliability of those comparisons.

The SADQ is the programmatic document that provides data analysis and statistical treatment information for effluent monitoring and environmental surveillance data collected in accordance with the EMP. The SADQ was developed in accordance with applicable U.S. EPA and Ohio EPA guidelines, DOE orders, and other technical standards. These documents include DOE Order 458.1 (DOE 2013c) and MARLAP (NRC 2004).

Data collected in accordance with the EMP are periodically evaluated as described in the following sections.

6.1 LIQUID EFFLUENT (NPDES)

Liquid radiological effluents from PORTS are monitored by sampling NPDES outfalls (see Chapter 2, Section 2.1). Radionuclide data are periodically reviewed by assigned personnel for compliance with the DOE derived concentration standards (DCSs) in the *Derived Concentration Technical Standard* (DOE 2011a) as referenced in DOE Order 458.1 (DOE 2013c). The procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*, describes actions taken to evaluate data, including comparison of monitoring results to the DCSs and reporting requirements.

Non-radiological NPDES data are reviewed in a timely manner for compliance with the limits and requirements specified in the NPDES permits by the assigned environmental staff. For some parameters, limits are provided for individual measurements and for a monthly average (calendar month). Compliance with both limits is reviewed frequently enough to ensure that Ohio EPA exceedance reporting requirements are met.

6.2 LIQUID EFFLUENT (SETTLEABLE SOLIDS)

Settleable solids are monitored at seven NPDES outfalls, two IGWMP surface water monitoring locations, and three background locations (see Chapter 2, Section 2.3). When a low concentration of settleable solids is detected in a water sample, accurate measurement of the alpha and beta-gamma activity in the settleable solids portion of the sample is not practical due to the small sample size. A DOE memo (DOE 1995) states that settleable solids of less than 40 mg/L are in *de facto* compliance with the DOE Order 5400.5 limits: 5 pCi/g above background for alpha activity and 50 pCi/g above background for beta activity (DOE Order 458.1 [DOE 2013c] has replaced DOE Order 5400.5; however, the limits remain the same). Based on this memo, if settleable solids are not detected in the sample at a

concentration of 40 mg/L or more, the sample is considered in compliance with the DOE Order limits. The settleable solids portion of the sample is not analyzed for alpha and beta-gamma activity.

If settleable solids are detected in the sample at a concentration of 40 mg/L or more, the settleable solids portion of the sample is analyzed for alpha and beta-gamma activity. The background activity, if any, is then subtracted from the result. After the second semiannual sampling event, the results for each sampling location are averaged and compared to the limits set in DOE Order 458.1 (DOE 2013c). Analytical results reported as undetected are assumed to be zero.

6.3 AIRBORNE EFFLUENT (NESHAP)

Airborne radiological effluents from PORTS are either monitored through sampling continuously monitored vents (sources with a potential to emit greater than 0.1 mrem) as described in Chapter 2, Section 2.4 or are estimated based on process knowledge (sources with potential to emit less than or equal to 0.1 mrem). The procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*, describes actions taken to evaluate data, including calculation of baseline effluent quantities, data evaluation, and reporting requirements.

Results for radionuclides in ambient air are used in conjunction with meter or filter volumes and meteorological data (as needed) to calculate the presence of each radionuclide in air. As a conservative measure, analytes that are not detected are assumed to be present at the detection limit.

6.4 ASER

The ASER includes a summary of environmental data collected by FBP, MCS, and Centrus during the given calendar year. These data generally include sampling locations, sampling media (e.g., air, water, soil, etc.), parameters, analytical results, and units of measure. Data summaries may include the total number of samples collected, the number of detections, the minimum, maximum, and average concentrations or activities of monitoring parameters, and regulatory limits as defined by the environmental program (i.e. NPDES limits, DOE DCSs, etc.), as applicable. Summary parameters such as average concentrations of monitoring parameters are calculated using standard commercial software.

6.5 OTHER DATA ANALYSES

Data collected in accordance with the EMP may also be periodically evaluated for trends. Trend analyses may include data from multiple years, as appropriate. Descriptive statistical parameters associated with a data set may include the following:

- number of measurements
- data range
- mean and/or median
- variance, standard distribution, and/or coefficient of variation.

Graphs using standard commercial software (e.g., Microsoft Excel) may be used to evaluate and/or trend data. If necessary, Section 8 of the DOE Handbook will be used as guidance to identify appropriate methodology to further analyze data collected in accordance with the EMP.

7. DOSE CALCULATIONS

Operations at PORTS emit airborne and waterborne radionuclides and chemicals. After release, these substances disperse throughout the environment by applicable transport mechanisms, where eventually some may reach and affect humans. This chapter describes the methodologies that may be used to characterize dispersion of released radionuclides and to estimate human exposures to and intakes of the dispersed radionuclides. Ohio EPA and U.S. EPA do not currently require modeling of chemicals released from PORTS.

DOE Order 458.1 (DOE 2013c) states that DOE radiological activities, including remedial actions, must be conducted so that the exposure of members of the public to sources of ionizing radiation and radioactive material released by DOE radiological activities:

- is ALARA,
- does not cause a total effective dose exceeding 100 mrem/year,
- does not cause an equivalent dose to the lens of the eye exceeding 1500 mrem/year, and
- does not cause an equivalent dose to the skin or extremities exceeding 5000 mrem/year.

The dose limit does not include doses from occupational exposures, doses from naturally-occurring background radiation, doses received by a patient from medical procedures, or doses from consumer products.

DOE Order 458.1 (DOE 2013c) states that if it is suspected that any of the dose limits specified in the order may be exceeded, or if the total effective dose exceeds 25 mrem/year, the dose to the lens of the eye, skin, and extremities must be evaluated. From 2000-2015, the total effective dose to a member of the public from PORTS operations averaged 1.6 mrem/year with the highest dose during 2000-2015 less than 5 mrem. Because the historical dose from PORTS activities is significantly less than the 25 mrem/year threshold, the public doses to the lens of the eye, skin, and extremities are not evaluated.

U.S. EPA regulations establish additional public dose limits for exposures to selected sources or exposure modes. Regulations implementing NESHAP (40 CFR Part 61, Subpart H) establish a dose limit of 10 mrem from airborne emissions. The 10-mrem limit applies where the members of the public reside or abide. Additionally, U.S. EPA has determined that the 10-mrem limit applies to any member of the public that abides on DOE property where DOE no longer maintains a physical barrier with entry only through a badged access controlled gate or guarded portal.

7.1 REQUIRED PERFORMANCE STANDARDS FOR PUBLIC DOSE CALCULATIONS

DOE Order 458.1 (DOE 2013c) requires use of dose evaluation models that are codified or approved for use by DOE. Models selected to assess environmental transport of and human exposures to substances released from PORTS are appropriate for the physical and environmental setting and available data. As required by NESHAP (40 CFR Part 61 Subpart H), dose calculations for radionuclides released to air are modeled using a U.S. EPA-approved version of the CAP88 model.

Dose calculations are completed using standard U.S. EPA factors such as those provided in the *Exposure Factors Handbook* (U.S. EPA 1997) and *Federal Guidance Report No. 11 Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors of Inhalation, Immersion, and Ingestion* (U.S. EPA 1988). Models and dose calculations are documented including results of calculations, a description of exposure factors or models used, and the source of input data. Descriptions of models and exposure factors may consist of references to published documents and/or regulatory requirements.

Surface and groundwater transport modeling are not routinely required at PORTS by U.S. EPA or Ohio EPA. If necessary, transport modeling is conducted in accordance with the appropriate U.S. EPA, Ohio EPA, or DOE requirements and/or guidance.

7.2 POTENTIAL EXPOSURE PATHWAYS

Members of the public can receive radiation doses from radionuclides released to the atmosphere, surface water, and groundwater. In addition, some members of the public may receive doses from external radiation (i.e., radiation emanating from buildings and other objects such as the cylinders located within the reservation boundary).

The radionuclides managed at PORTS are primarily alpha and beta emitters. Consequently, the potential dose from external exposure pathways (immersion and direct irradiation) is generally smaller than the potential dose from internal exposures (ingestion and inhalation). Furthermore, none of the radionuclides managed at PORTS are volatile under normal aqueous conditions; consequently, the inhalation pathway is not a significant contributor. Therefore, ingestion of drinking water is the most significant potential exposure pathway. To the best of current site knowledge, radionuclides have not contaminated any drinking water sources. The Scioto River downstream from PORTS is not a water source for any public drinking water supply. Residential drinking water wells are monitored as described in Chapter 4, Section 4.3.

DOE Order 458.1 (DOE 2013c) 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 are completed for radionuclides released from PORTS via air and surface water, for external radiation, and for radionuclides detected in off-site environmental media (water, soil, and sediment), and biota (vegetation, deer, fish, crops, and dairy products).

Table 7.1 lists environmental release and transport mechanisms that potentially apply to releases from PORTS. Models and dose calculations evaluate radionuclides dispersed into the environment via these pathways (as applicable). Sections 7.3 and 7.4 provide additional information on modeling and dose calculations.

7.3 TRANSPORT MODELS

Transport models may be used to predict concentrations of contaminants in environmental media in the absence of direct measurements, or to confirm direct measurements. Transport models may be used to assess releases to air, surface water, or groundwater.

7.3.1 Atmospheric Transport

Modeling of airborne levels and deposition rates of radionuclides released to the atmosphere by PORTS radionuclide emission points is completed using the CAP88 model approved by U.S. EPA for demonstrating compliance with NESHAP (40 CFR Part 61, Subpart H). The CAP88 model calculates the predicted dose an individual member of the public could receive at selected locations (residences or businesses near PORTS), and the collective population dose received by the entire population within 50 miles of PORTS.

Whenever possible, site-specific values are used for meteorological variables (wind speed and direction, atmospheric stability class, air temperature, rainfall, and mixing layer height). Chapter 3 discusses the meteorological monitoring program at PORTS.

Table 7.1. Environmental transport mechanisms potentially applicable to releases from PORTS

Releases to air	Remain suspended in air Deposit on ground Deposit on vegetation Deposit on water surfaces
Releases to surface water	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Deposit in sediments Infiltrate to groundwater
Releases to groundwater	Remain dissolved or suspended in water Deposit on ground via irrigation Deposit on vegetation via irrigation Flow into surface water Absorb onto sub-surface soil
Radionuclides in objects	Remain in fixed sources

7.3.2 Surface Water Transport

Quantities of radionuclides released to surface waters are determined by monitoring NPDES outfalls (i.e., liquid effluent). Local receiving streams (Little Beaver Creek, Big Beaver Creek, Big Run Creek, and the Scioto River) are also sampled upstream and downstream of plant discharges to provide direct measurements of contaminant levels in these streams. In the Scioto River, radionuclide discharges from PORTS operations do not cause a significant difference between levels of radionuclides measured upstream and downstream.

Because all NPDES outfalls discharge to the Scioto River either directly or indirectly (from other local streams), the Scioto River represents the most common public exposure point to liquid radionuclide discharges from PORTS. For dose estimates, radionuclide activities in the Scioto River due to PORTS effluents are estimated by a simple dilution calculation.

Pathways assessed in the calculation include ingestion of water and aquatic foods, swimming, boating, and shoreline activities. This dose includes the conservative assumption that the river is a source of drinking water, although the State of Ohio does not classify the lower Scioto River as suitable for a drinking water source and no public or identified private drinking water sources have been identified on the Scioto River downstream of PORTS.

7.3.3 Groundwater Transport

At PORTS, transport models are not routinely required by regulators to predict concentrations of contaminants in groundwater. If required, transport modeling of contaminants in groundwater is performed by an experienced environmental professional using accepted modeling practices. Modeling is completed using local site information as available including aquifer characteristics and meteorological data.

7.4 ENVIRONMENTAL PATHWAY ASSESSMENTS

Environmental pathway models or calculations are used to assess the dose to humans or aquatic or terrestrial organisms based on direct measurement of radionuclide activities in environmental media and biota. In general, models or calculations are completed using conservative data assumptions. For

example, maximum contaminant activities are often used instead of average activities. Assumptions are documented for all models or calculations.

At PORTS, these dose calculations may be completed for detections of radionuclides in environmental media (ambient air, surface water, residential drinking water [well water], sediment, and soil), and biota (vegetation, crops, deer, fish, and dairy products) at off-site sampling locations. Detections of radionuclides on the DOE reservation are not used in dose calculations where the public does not have access to the sampling locations.

Dose calculations for individual media are added to determine compliance with the 100 mrem standard in DOE Order 458.1 (DOE 2013c). These calculations are completed annually as dictated by the findings of the sampling program and documented in the ASER.

7.4.1 Contaminants in Air

The CAP88 model calculates doses to individuals and the population for compliance with NESHAP regulations as described in Section 6.3. Additionally, the calculated activity of a radionuclide detected in ambient air is used in conjunction with dose conversion factors generated by the CAP88 model to determine a dose in mrem/year associated with a given activity of a radionuclide in air. Chapter 4, Section 4.1, describes the ambient air monitoring program that generates these data. However, the NESHAP dose is used when totaling doses from environmental media because it evaluates more exposure pathways and results in a larger dose (i.e., using the NESHAP dose is a more conservative assumption).

The calculated activity of a radionuclide detected in ambient air is used in conjunction with dose conversion factors generated by the CAP88 model to determine a dose in mrem/year associated with a given activity of a radionuclide in air. For radionuclides that are detected in ambient air, the dose for that radionuclide is calculated by using the maximum activity of each detected radionuclide for the calendar year. For radionuclides that are not detected during the calendar year, the dose is calculated by using half the highest undetected result to calculate the maximum activity of the radionuclide in air. The doses attributable to each radionuclide are then added to obtain the gross dose for each station. The net dose is obtained by subtracting the dose at station A37, the background monitoring station.

7.4.2 Contaminants in Sediment

Discharges from PORTS to surface waters may result in accumulations of radionuclides in sediment. Humans may receive a dose from these radionuclides through direct ingestion or by eating fish that have ingested the sediment.

Sediments from the Scioto River and local creeks are sampled annually to monitor the presence of metals, PCBs, and radionuclides (see Chapter 4, Section 4.5). Activities of radionuclides detected at off-site sampling locations are used to calculate a dose for ingestion of sediment based on standard exposure factors for ingestion of soil in children. Section 7.4.6 discusses dose calculations for fish.

7.4.3 Contaminants in Groundwater

Dose calculations are completed for the drinking water pathway if measurable activities of radionuclides (not including naturally-occurring levels of uranium) are found in water samples collected in accordance with the IGWMP from private drinking water systems (see Chapter 4, Section 4.3). A maximally exposed individual is assumed to ingest water containing the measured activities of radionuclides throughout the year.

7.4.4 Contaminants in Soil

Contaminants may reach soil by deposition of airborne radionuclides and radionuclides contained in irrigation water. Soil samples are collected annually at ambient air monitoring stations (see Chapter 4,

Section 4.6). Activities of radionuclides detected at off-site sampling locations are used to calculate a dose based on ingestion of soil.

7.4.5 Contaminants in Vegetation or Crops

Contaminants may reach vegetation (food and feed crops) by deposition of airborne materials, uptake from soil, and deposition of materials contained in irrigation water. Vegetation samples (grass and similar plants eaten by grazing animals) are collected annually at ambient air monitoring stations (see Chapter 4, Section 4.6). Samples of local crops are also collected annually (see Chapter 4, Section 4.7).

The only significant potential direct pathway for human exposure to contaminants in food crops is ingestion. Indirect pathways involve ingestion of feed crops by terrestrial animals. A dose calculation is completed for consumption of beef cattle if radionuclides are detected in off-site vegetation. A dose calculation is completed for consumption of crops if radionuclides are detected in crops.

7.4.6 Contaminants in Terrestrial Animals and Fish

Contaminants may accumulate in terrestrial animals from eating contaminated feed or soil, drinking contaminated water, and breathing contaminated air. Contaminants may accumulate in fish when they eat contaminated foods or sediment and equilibrate with surrounding waters. Potential direct pathways for human exposure to contaminants in terrestrial animals and fish are eating beef, venison, eggs, and fish and drinking milk.

Section 7.4.5 describes the dose calculation for beef cattle. Samples of deer (muscle, kidney, and/or liver), fish, eggs, and milk are collected annually (as available) from on-site or off-site locations (see Chapter 4, Section 4.7). Dose calculations are completed if radionuclides are detected in the samples of fish, eggs, milk, and deer (muscle only).

7.4.7 External Radiation

External radiation is measured on site at locations near the cylinder storage yards, other on-site locations that may be accessible to the public, and selected off-site locations (see Chapter 4, Section 4.2). A dose calculation is completed 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).

External radiation is also measured at the Ohio Valley Electric Corporation (OVEC), a private company located on the west side of the PORTS reservation. A dose calculation is completed for a representative off-site member of the public, such as a worker at OVEC, based on the difference between the average annual off-site background dose and the annual dose at measured at the OVEC monitoring station.

7.5 DOSE COEFFICIENTS

Standard dose conversion factors are used in dose calculations and models, including, but not limited to *Federal Guidance Report No. 11 Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors of Inhalation, Immersion, and Ingestion* (U.S. EPA 1988). Dose calculations made with CAP88 use the dose conversion factors included in the model.

The DCSs in *Derived Concentration Technical Standard* (DOE 2011a) are also used in evaluating results for radionuclides detected in air and water for compliance with the 100 mrem/year dose limit in DOE Order 458.1 (DOE 2013c).

7.6 PROTECTION OF BIOTA

DOE Order 458.1 (DOE 2013c)sets absorbed dose rate limits for aquatic animals, riparian animals, terrestrial plants, and terrestrial animals and requires evaluation of dose rates by using DOE Technical Standard *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002) or an alternative approach that demonstrates compliance with the limits in the DOE Technical Standard.

Analytical data for radionuclides detected in sediment (for aquatic and riparian animals), soil (for terrestrial plant and animals) and surface water (used for each dose assessment) collected at approximately the same location are used to assess compliance with the dose limits. The maximum values of transuranic radionuclides, technetium-99, and uranium isotopes detected in sediment/soil and surface water samples are entered into the spreadsheet that is part of DOE Technical Standard. The spreadsheet, developed as part of the DOE Technical Standard, is used to evaluate compliance with the dose limits. Results of these dose assessments are reported in the ASER.

8. RECORDS, RETENTION, AND REPORTING

This chapter provides an overview of the reports prepared by PORTS that use data collected in whole or in part by the environmental monitoring program. Reporting requirements have been established in accordance with regulations, statutes, and orders issued by regulatory agencies of government and by DOE. Reporting requirements can change as regulations are developed and amended. In addition, the applicability of reporting requirements varies at individual DOE sites or facilities. PORTS is committed to identifying and complying with all applicable reporting requirements.

Records associated with this EMP are generated and retained in accordance with DOE Order 243.1B, *Records Management Program,* the SADQ, and the applicable implementing procedures.

8.1 REPORTING REQUIREMENTS

DOE Orders 436.1, *Departmental Sustainability* (DOE 2011b), and 231.1B, *Environment, Safety and Health Reporting* (DOE 2012), establish guidelines and procedures for reporting to DOE on matters of significance to environmental protection, safety, and health protection, and identify an ASER.

DOE Order 458.1 (DOE 2013c) provides policy on notification of significant, actual, or potential exposures of the public to radionuclides.

Table 8.1 summarizes reports that include environmental monitoring data collected by programs discussed in the EMP. This EMP does not include reports that may be required to address environmental monitoring for the Consent Decree with the State of Ohio, U.S. EPA/DOE Toxic Substance Control Act Federal Facilities Compliance Agreement, and various other regulatory programs. The ASER contains summary data for the given calendar year for the effluent monitoring and environmental surveillance monitoring programs discussed in Chapters 2 and 4. Data collected less frequently than annually may be provided in each year's report until new data are available. The ASER also includes the results of dose modeling and dose calculations described in Chapter 7.

Table 8.1. Report summary

Report	Deadline	Source of Requirements	Requirement
NPDES Discharge Monitoring Report	Monthly	Clean Water Act (NPDES Permit)	Required by current FBP, MCS, and Centrus NPDES permits.
NESHAP Annual Report	Annual (June 30)	40 CFR Part 61, Subpart H	Includes dose calculations based on emissions of radionuclides from PORTS and results of ambient air monitoring.
Groundwater Monitoring Report	Annual (April 1)	IGWMP (Director's Final Findings and Orders)	Summarizes data collected in accordance with the IGWMP.
ASER	Annual (October 1)	DOE Order 231.1B (DOE 2012)	Summarizes environmental data to characterize site environmental performance.
Occurrence Report	Determined by categorization	DOE Order 232.2 (DOE 2014a)	Occurrence reports are prepared in accordance with DOE Order 232.2 (DOE 2014a).

8.1.1 NPDES Reporting

The NPDES permits require submission of a Discharge Monitoring Report to Ohio EPA by the 15th day of the month following the month-of-interest if submitted in hardcopy and by the 20th day of the month following the month-of-interest if submitted electronically. These reports must be completed on the forms designated by the Ohio EPA and include the following information:

- NPDES permit number and holder, plant mailing address, the month and year of the information, and the outfall, parameters, and units being reported;
- a listing of the individual parameter values or explanatory codes for any required values not available;
- a summary of each parameter (number of measurements, average, monthly maximum value, and monthly minimum value, as calculated by the reporting software); and
- any additional information requested by Ohio EPA.

In addition, Ohio NPDES regulations require reporting of any exceedance of a daily maximum limitation to the Ohio EPA by e-mail or telephone within 24 hours. The e-mail must attach a completed non-compliance report. If the telephone option is chosen, then the phone call must be followed by a written report to the Ohio EPA within five days. Other specified noncompliances with the NPDES permit (such as a spill or release to surface waters not included on the permit) must be reported, in writing, to the District Office of the Ohio EPA within five working days of the discovery of the exceedance or noncompliance. For parameters requiring laboratory analysis, this time limit starts when the analysis is completed. The reporting mechanism for NPDES exceedances for off-site laboratories is specified in the laboratories' contracts.

The exceedance report to Ohio EPA must include the plant's NPDES permit number, unique identifier for the occurrence, the date of the occurrence, the outfall involved, the NPDES limit exceeded (if applicable), and the actual value of the parameter or nature of the noncompliance. In addition, a brief description of the cause of the occurrence and any measures taken to prevent a recurrence must be included.

Section 8.1.4 describes how data collected at NPDES monitoring locations is reported in the ASER.

8.1.2 NESHAP Reporting

NESHAP (40 CFR Part 61, Subpart H) establishes the following reports:

- A report to U.S. EPA Headquarters and U.S. EPA Region V or to the delegated state technical administrator is required by June 30 of each year (40 CFR 61.94[a]). This report pertains to monitoring results and dose calculations and must follow 40 CFR 61.94(b).
- If the facility exceeds emission limits, it will report remediation progress monthly to the Administrator until the Administrator has determined that reports are no longer necessary.

At PORTS, the annual NESHAP report also includes the results of the dose calculations completed based on data collected for the ambient air monitoring program.

Section 8.1.4 describes how data collected at ambient air monitoring locations is reported in the ASER.

8.1.3 Annual Groundwater Report

In general, data collected in accordance with the IGWMP is reported to Ohio EPA in an annual groundwater report. Additional reporting requirements are included in the IGWMP or provided by Ohio EPA. The ASER includes the results of exit pathway monitoring program and a summary of IGWMP monitoring.

8.1.4 ASER Reporting

The ASER includes a summary of environmental data collected by FBP, MCS, and Centrus during the given calendar year. These data generally include sampling locations, sampling media (e.g., air, water, soil, etc.), parameters, analytical results, and units of measure. Data summaries may include the total number of samples collected, the minimum, maximum, and average concentrations or activities of monitoring parameters, and regulatory limits as defined by the environmental program (i.e. NPDES limits, DOE DCSs, etc.), as applicable. Summary parameters such as average concentrations or activities of monitoring parameters are calculated using standard commercial software.

The ASER includes two additional calculations using NPDES data:

- The overall percent compliance with the current NPDES permits (calculated separately for FBP, MCS, and Centrus NPDES permits), and

- The total annual discharge in curies for external DOE and Centrus NPDES outfalls (calculated separately for DOE and Centrus).

The most recent guidance issued by DOE for preparation of the ASER is considered when preparing the report. The guidance may be adapted as needed for applicability to PORTS.

The following dose calculations are reported in the ASER. Chapter 7 provides additional information about these dose calculations:

- airborne discharges (in compliance with NESHAP, Section 8.1.2)
- ambient air (reported in the annual NESHAP report)
- external radiation
- radionuclides discharged to the Scioto River
- radionuclides detected by EMP programs at locations accessible to the public
- biota dose based on radionuclides detected in surface water, sediment, and soil.

8.2 RECORDS AND RETENTION

Records applicable to the environmental monitoring program and required by DOE Order 458.1 (DOE 2013c) include the following:

- Information and data necessary to identify and characterize releases of radioactive material to the environment, their fate in the environment, their probable impact on radiation dose to members of the public, and any impacts on ecological systems.

- Documentation of individual and collective dose to members of the public due to radiological activities. Documentation includes site-specific information on radiation source dispersion patterns, location and demography of members of the public in the vicinity of the radiological activity, and assumed default values or site-specific parameters used in calculations (as applicable).

- Requests for specific authorization for temporary public dose limits, and subsequent approvals and other related actions.

- Identification of radiological activities subject to environmental radiological protection program requirements and descriptions of the measures to be used in implementing these requirements.

- Documentation of actions taken to demonstrate compliance with the public dose limits of DOE Order 458.1 (DOE 2013c).

- Effluent monitoring and environmental surveillance information and data, including:

  – Results of effluent monitoring for determining sources of radiation and radioactive material that provide direct exposure to members of the public and releases of radioactive material in liquid or airborne effluent;

  – Results of surveys for radiation and radioactive material in the environment;

  – Results of surveys, measurements, and calculations used to determine the dose to members of the public and ecological receptors from external and internal radiation sources;

  – Meteorological data used in assessing dose; and

  – Results of pre-operational monitoring.

Auditable records relating to environmental surveillance and effluent monitoring are maintained by the appropriate personnel. These include, but are not limited to, monitoring data, dose assessments, calculations, computer programs, and other forms of data.

Documentation of calculations, measurements, methods, input parameters, and procedures used to estimate dose from PORTS radiological sources are maintained on site by the appropriate personnel. These records are sufficient to enable an independent audit to verify compliance. Records are made available for inspection at the request of U.S. EPA or Ohio EPA.

Records associated with this EMP are generated and retained in accordance with DOE Order 243.1B, *Records Management Program,* the SADQ, and applicable implementing procedures. Additional recordkeeping requirements for non-radiological data may be identified in source-specific conditions for operation or permit requirements.

9. QUALITY ASSURANCE

FBP activities at PORTS are conducted in accordance with the *Quality Assurance Program Description* (FBP 2016d). The SADQ is the programmatic document that provides QA criteria for sample collection and data evaluation for environmental samples collected by FBP in accordance with the EMP. MCS is responsible for data collected by MCS.

9.1 KEY REQUIREMENTS AND SUPPORTING DOCUMENTS

The SADQ is prepared in compliance with state and federal regulations, site-specific legal agreements, DOE Orders, and other applicable requirements. The SADQ incorporates requirements of DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE 2013c), and DOE Order 414.1D, *Quality Assurance* (DOE 2013a).

Analytical laboratories used by DOE contactors participate in the DOE Mixed-Analyte Performance Evaluation Program.

9.2 QA PROGRAM IMPLEMENTATION

This section discusses the management, performance, and assessment of the QA Program for data collected in accordance with the EMP.

9.2.1 Management

The SADQ provides a systematic process to ensure that standardized and consistent processes are utilized to obtain samples, perform data collection, and perform laboratory services. The SADQ provides the organization, objective, functional activities, and specific QA/QC activities associated with FBP activities at PORTS. QA components of the SADQ applicable to activities performed in compliance with the EMP include, but are not limited to the following:

- Completion of field documentation
- Sample collection (environmental and QC samples)
- Sample custody, handling, and shipment
- Equipment calibration
- Data management and reporting
- Assessments and oversight.

DQOs for the EMP have been developed and documented through preparation and implementation of this EMP, compliance with the SADQ, and development of analytical laboratory scopes of work for the data collected in accordance with this EMP. Measurement quality objectives were considered when developing the analytical laboratory scopes of work.

9.2.2 Performance

Analytical laboratories used by DOE contactors at PORTS participate in the DOE Mixed-Analyte Performance Evaluation Program. These laboratories:

- Use DOE/EPA approved or recognized analytical procedures whenever possible;

- Analyze sufficient numbers of quality control samples (blanks, duplicates, spikes, etc.) to determine the bias and precision of the analytical process;

- Calibrate radiation measuring equipment, including portable instruments, environmental dosimeters, *in situ* monitoring equipment, and laboratory and analytical equipment according to the

manufacturer's recommendations and National Institute of Standards and Technology (NIST)-traceable calibration standards; and

- Participate in a DOE approved quality assessment program (sample exchange) to ensure quality of the analytical process.

Programmatic components of the *Quality Assurance Program Description* (FBP 2016d) apply to the analytical laboratories used by the PORTS DOE contractors. Contracted analytical laboratories should be compliant with American Society of Mechanical Engineers NQA-1a-2008 with NQA-1a-2009 addenda, *Quality Assurance Requirements for Nuclear Facility Applications*.

9.2.3 Assessment

Management assessment of effluent monitoring and environmental surveillance management processes are performed periodically to verify compliance with documented standard operational procedures, QC procedures, and other aspects of the QA program. Assessment results are documented, reported to, and reviewed by responsible management. Follow-up actions are taken where indicated.

Independent assessments of analytical laboratories used by DOE contractors at PORTS are performed by the DOE Consolidated Assessment Program. Assessment results are documented, reported to, and reviewed by responsible management. Follow-up actions are taken where indicated.

Usefulness of the data collected in accordance with the EMP is verified through the data validation process as described in the SADQ and implementing procedures.

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APPENDIX A

CONSIDERATIONS FOR SELF ASSESSMENTS OF ENVIRONMENTAL MONITORING AND SURVEILLANCE PROGRAMS

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The following lines of inquiry and approach are provided in Appendix B of the DOE Handbook entitled *Environmental Radiological Effluent Monitoring and Environmental Surveillance* (DOE 2015b). As stated in the Handbook, these lines of inquiry are provided as examples for conducting self-assessments and performance assessments to:

1) verify that the environmental monitoring surveillance programs are effective and in compliance with the appropriate requirements; and

2) provide a mechanism to monitor and document the existence of continuous improvement of the environmental monitoring and surveillance programs.

The following lines of inquiry are illustrative and may not be applicable to some DOE operations.

DESIGNING, REVIEWING, AND UPDATING RADIOLOGICAL ENVIRONMENTAL MONITORING

1. Is there an integrated environmental monitoring program and associated documentation in place? How is it systematically reviewed to ensure monitoring needs associated with specific program or site operations are being addressed in a holistic, cost-effective, and efficient manner? How are program redundancies and gaps identified and addressed?

   The EMP documents the environmental monitoring program for PORTS. The program is reviewed 1) annually as part of the production of the ASER, 2) when trending data collected in accordance with the EMP, and 3) when preparing an update of the EMP. Assessment and oversight activities conducted in accordance with the SADQ provide additional opportunities for review, assessment, and continual improvement of the FBP environmental monitoring programs at PORTS.

2. How are environmental monitoring and associated quality assurance and assessment data appropriately tracked, reviewed, and trended to ensure that changes in environmental conditions are fully identified and reported? Are procedural controls consistent with line management expectations established for trending and reporting anomalous conditions?

   Environmental monitoring data are regularly reviewed as described in the SADQ and as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in Chapter 6 to evaluate trends and evaluate current program design and overall program performance. Procedures have been developed for trending and reporting anomalous conditions as appropriate for the varying components of the environmental monitoring program.

3. Are environmental monitoring data reviewed regularly to determine if modifications or improvements to the overall design (sampling methods, location, and analysis) are needed to meet data quality objectives or overall program performance?

   Environmental monitoring data are regularly reviewed as described in the SADQ and as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in Chapter 6 to evaluate trends and evaluate current program design and overall program performance.

4. How are environmental sampling and analysis methods and approaches systematically reviewed and evaluated to ensure they are sufficient to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental monitoring program?

   Data quality objectives have been developed to ensure that data collected in accordance with the EMP are sufficient to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental surveillance program.

5. Is a program in place to evaluate unplanned releases and assess the impacts of such releases on the public and the environment?

   The comprehensive monitoring programs described in the EMP will form the basis of any monitoring needed to assess an unplanned release. Additional monitoring may be completed as appropriate based on the specific nature of the unplanned release.

6. What processes are employed in notifying responsible managers and stakeholders of environmental monitoring implementation and results?

   The ASER is the primary process used to inform responsible managers and stakeholders of environmental monitoring implementation and results. Periodic mailings, public meetings, the PORTS Envoy Program, and the Environmental Information Center are also means by which stakeholders can obtain information about environmental monitoring.

7. How is information gained through routine radiological monitoring efforts used to support the ALARA process and evaluate its effectiveness?

   Results for water effluent (NPDES) and air effluent monitoring are evaluated in accordance with the procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*, and shared with the FBP ALARA committee as described in the procedure.

8. Are formalized reporting procedures and criteria for monitoring results in place?

   Formalized reporting procedures and criteria for monitoring results are in place for programs that are part of the EMP, as applicable. Results for water effluent (NPDES) and air effluent monitoring are evaluated and reported in accordance with the procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*.

9. Are programs in place to ensure the overall precision of radiological effluent monitoring data?

   The SADQ describes the QA objectives for environmental surveillance data, including precision.

LIQUID RADIOLOGICAL EFFLUENT MONITORING AND SAMPLING

1. Is there an integrated environmental monitoring program and associated documentation in place? How is it systematically reviewed to ensure monitoring needs associated with liquid radiological effluent monitoring are being addressed in a holistic, cost-effective, and efficient manner? How are program redundancies and gaps identified and addressed?

   The EMP documents the environmental monitoring program for PORTS. The program is reviewed 1) annually as part of the production of the ASER, 2) when trending data collected in accordance with the EMP, and 3) when preparing an update of the EMP. Assessment and oversight activities conducted in accordance with the SADQ provide additional opportunities for review, assessment, and continual improvement of the FBP environmental monitoring programs at PORTS.

2. Are self- and performance assessments of different parts of the liquid radiological effluent monitoring program completed periodically to document acceptable performance and continuous improvement in the effluent monitoring program?

   Section 14 of the SADQ describes the assessments that may be applicable to the EMP. These assessments are performed periodically for all aspects of the EMP.

3. How are environmental monitoring and associated quality assurance and assessment data appropriately tracked, reviewed, and trended to ensure that changes in environmental conditions are fully identified and reported? Are procedural controls consistent with line management expectations established for trending and reporting anomalous conditions?

   Environmental monitoring data are regularly reviewed as described in the SADQ and as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in Chapter 6 to evaluate trends and evaluate current program design and overall program performance. Procedures have been developed for trending and reporting anomalous conditions as appropriate for the varying components of the environmental monitoring program.

4. Are environmental monitoring data reviewed regularly to determine if modifications or improvements to the overall design (sampling methods, location, and analysis) are needed to meet data quality objectives or overall program performance?

   Environmental monitoring data are regularly reviewed as described in the SADQ and as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in Chapter 6 to evaluate trends and evaluate current program design and overall program performance.

5. How are environmental sampling and analysis methods and approaches systematically reviewed and evaluated to ensure they are sufficient to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental monitoring program?

   Data quality objectives have been developed to ensure that data collected in accordance with the EMP are sufficient to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental surveillance program.

6. Is a program in place to evaluate unplanned releases and assess the impacts of such releases on the public and the environment?

   The comprehensive monitoring programs described in the EMP will form the basis of any monitoring needed to assess an unplanned release. Additional monitoring may be completed as appropriate based on the specific nature of the unplanned release.

7. What processes are employed to notify responsible managers and stakeholders of environmental monitoring implementation and results?

   The ASER is the primary process used to inform responsible managers and stakeholders of environmental monitoring implementation and results. Periodic mailings, public meetings, the PORTS Envoy Program, and the Environmental Information Center are also means by which stakeholders can obtain information about environmental monitoring.

8. How is information gained through routine liquid effluent monitoring efforts used to support the ALARA process and evaluate its effectiveness?

   Results for water effluent (NPDES) and air effluent monitoring are evaluated in accordance with the procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*, and shared with the FBP ALARA committee as described in the procedure.

9. Are formalized reporting procedures and criteria for monitoring results in place?

   Formalized reporting procedures and criteria for monitoring results are in place for programs that are part of the EMP, as applicable. Results for water effluent (NPDES) and air effluent monitoring are evaluated and reported in accordance with the procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*.

10. Are programs in place to ensure the overall precision of liquid effluent monitoring data?

    The SADQ describes the QA objectives for environmental surveillance data, including precision.

11. Are programs in place to ensure that representative samples are obtained and that all factors germane to proper sample collection are identified and incorporated into sampling activities?

    The SADQ and associated procedures provide proper sample collection procedures for samples collected in accordance with the EMP, including the processes for collecting representative samples.

12. What systems are in place for performing and recording calibration and maintenance activities associated with field and laboratory instrumentation?

    The SADQ describes calibration, maintenance, and recordkeeping requirements for field and laboratory instrumentation. Calibration of instruments is entered in the plant maintenance management system (SOMAX). Maintenance is documented and records are maintained in accordance with applicable procedures.

13. Is a validated and consistent approach for sampling and analysis of radionuclide samples applied to ensure laboratory data meet program-specific needs and requirements within the framework of a performance-based approach for analytical work?

    The SADQ provides a validated and consistent approach for sampling and analysis of radionuclide samples to ensure laboratory data meet program-specific needs and requirements.

14. What systems are in place to ensure corrective actions are implemented during malfunctions of field and laboratory instrumentation?

    The SADQ describes the actions to be taken during malfunctions of field and laboratory instrumentation. Corrective maintenance is tracked and documented through the plant maintenance management system (SOMAX). Corrective actions are tracked through issuing problem reports and/or tracking in the Issue Tracking System.

15. Is a program in place to conduct a pre-operational assessment prior to startup of all facilities (new or modified) with the potential to expose the public or environment to radiation or radioactive material to determine the types and quantities of effluents to be expected?

    Nuclear Safety and Engineering procedure FBP-NSE-PRO-00034, *Identifying Scope and Review Level*, documents the review requirements for start-up of new systems or the re-start of existing systems that have been shut down. The procedure requires a detailed review of the operations to be performed and includes a review of the hazards associated with the operations. The review process is used to determine the level of assessment that will be performed to determine the readiness for starting/re-starting the operations prior to actual start/re-start. Additionally, Nuclear Safety and Engineering procedure FBP-NSE-PRO-00081, *Design Control,* requires a review of all new designs and system modifications to ensure compliance with requirements and standards including environmental regulatory requirements which would include air emissions.

16. Are measures in place to obtain representative liquid flow rate data necessary to assess the impact of routine and accidental releases of radioactivity? How well do they provide the data needed to help determine the transport and fate of radionuclides released to uncontrolled aquatic environment and the assessment of their impacts to public health and the environment?

    Flow meters are installed at each of the external NPDES outfalls. The flow meters meet NPDES requirements and provide adequate data to estimate releases of radionuclides through the NPDES outfalls.

17. Are all potential routes of liquid effluents from facilities on site identified and evaluated on a periodic basis to ensure that the monitoring program for all liquid radiological effluents is complete and up-to-date?

    The routes of liquid effluents from facilities on site have been identified. Sources of radioactive effluents are evaluated on a periodic basis to ensure that the monitoring program for all liquid radiological effluents is complete and up-to-date.

18. Have provisions for monitoring liquid effluents during non-routine situations been considered in the overall monitoring program needs?

    The comprehensive monitoring programs described in the EMP will form the basis of any monitoring needed to assess an unplanned release. Additional monitoring may be completed as appropriate based on the specific nature of the unplanned release.

19. Is continuous monitoring required when a significant potential exists for approaching or exceeding the Derived Concentration Standards (sum-of-fractions)? Do these systems have alarms that provide timely warnings to signal the need for corrective actions?

    A significant potential does not exist at PORTS for approaching or exceeding the DCSs (sum-of-fractions) in liquid effluents as monitored at NPDES outfalls. Continuous monitoring and alarms are not required.

20. Does the documentation of the site's radiological effluent monitoring program include the rationale for the design and selection of monitoring locations, procedures and equipment used, frequency and analyses required for each sample extraction, detection limits of the monitoring system (e.g., lower limit of detection, minimum detectable activity, or minimum detectable concentration) and uncertainty, quality assurance components, and investigation and alarm levels?

    The EMP, SADQ, and implementing procedures provide the pertinent documentation for the radiological effluent monitoring program.

21. Are the recommended criteria in Table 3-1 used to establish the liquid radiological effluent monitoring program at the site?

    The liquid radiological effluent monitoring program meets the recommended criteria in Table 3-1.

22. Have all of the important characteristics of the liquid effluent system, other pertinent structural information, the pertinent characteristics of the process control systems, and the sampling and measurement systems been documented? Have evaluation reports of the operational systems been retained?

    Manufacturers' specifications, procedures, and evaluation reports, as applicable to the liquid effluent monitoring systems, are maintained by the responsible personnel. Records are maintained in accordance with applicable procedures.

23. Are the proper methods used to measure liquid stream characteristics adequately?

    The SADQ and applicable procedures document the appropriate methods for measurement of liquid process effluent characteristics.

24. Have sample transport lines been designed and installed with the characteristics needed to obtain a representative sample at the sampling or monitoring point?

    Where necessary, sample transport lines have been designed and installed so that a representative sample can be collected at the sampling or monitoring point.

25. Are liquid flow measurements for the effluent and sample streams accurate to ± 10 percent by documented calibration, unless extenuating circumstances exist?

    Flow measurements at the external NPDES outfalls are measured at the weir for each outfall. This system of measuring flow is accepted by Ohio EPA for NPDES compliance. The accuracy of these measurement systems is not documented; however, this system of measurement is adequate due to the low levels of radionuclides released in liquid effluent from PORTS and the D&D status of PORTS.

26. Are flow-measuring devices used for compliance determinations located downstream from the collector when possible or feasible?

    Flow-measuring devices are located downstream from sample collection points when possible.

27. Are the detectors used relatively insensitive to environmental conditions and do they seldom need attention or adjustment?

    Not applicable.

AIRBORNE RADIOLOGICAL EFFLUENT MONITORING AND SAMPLING

1. Is there an integrated environmental monitoring program and associated documentation in place? How is it systematically reviewed to ensure monitoring needs associated with point and diffuse source air effluents and emissions are being addressed in a holistic, cost-effective, and efficient manner? How are program redundancies and gaps identified and addressed?

   The EMP documents the environmental monitoring program for PORTS. Monitoring associated with point and diffuse source air effluents and emissions is reviewed 1) periodically as required by procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment,* 2) annually when preparing the NESHAP report and the ASER, 3) when trending data collected in accordance with the EMP, and 4) when preparing an update of the EMP. Assessment and oversight activities conducted in accordance with the SADQ provide additional opportunities for review, assessment, and continual improvement of the FBP environmental monitoring programs at PORTS.

2. Is a program in place to conduct a pre-operational assessment prior to startup of all facilities (new or modified) with the potential to expose the public or environment to radiation or radioactive material to determine the types and quantities of effluents expected?

   Nuclear Safety and Engineering procedure FBP-NSE-PRO-00034, *Identifying Scope and Review Level* documents the review requirements for start-up of new systems or the re-start of existing systems that have been shut down. The procedure requires a detailed review of the operations to be performed and includes a review of the hazards associated with the operations. The review process is used to determine the level of assessment that will be performed to determine the readiness for starting/re-starting the operations prior to actual start/re-start. Additionally, Nuclear Safety and Engineering procedure FBP-NSE-PRO-00081, *Design Control* requires a review of all new designs and system modifications to ensure compliance with requirements and standards including environmental regulatory requirements which would include air emissions.

3. Are the criteria in Table 4-1 (or equivalent) used to establish the airborne radiological effluent monitoring program at the site?

   The airborne radiological effluent monitoring program meets the recommended criteria in Table 4-1.

4. How is information gained through routine air effluent sampling and monitoring efforts used to support the ALARA process and evaluate its effectiveness?

   Results for airborne radiological effluent monitoring are evaluated in accordance with procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment* and shared with the FBP ALARA committee as described in the procedure.

5. Have all of the important characteristics of the exhaust handling system, other pertinent structural information, the pertinent characteristics of the process-effluent control systems, and the sampling and measurement systems been documented? Have evaluation reports of the operational systems been retained?

   The *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision) and the *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) describe the radionuclide air emission sources, monitoring system design, and other applicable information for monitoring airborne radionuclide emissions.

6. What systems are in place for performing and recording calibration and maintenance activities associated with field and laboratory instrumentation?

   The SADQ describes calibration, maintenance, and recordkeeping requirements for field and laboratory instrumentation. Calibration of field instruments is entered in the plant maintenance management system (SOMAX). Maintenance is documented and records are maintained in accordance with applicable procedures.

7. What systems are in place to ensure corrective actions are implemented during malfunctions of field and laboratory instrumentation?

   The SADQ describes the actions to be taken during malfunctions of field and laboratory instrumentation. Corrective maintenance is tracked and documented through the plant maintenance management system (SOMAX). Corrective actions are tracked through issuing problem reports and/or tracking in the Issue Tracking System.

8. Are self- and performance assessments of different parts of the radiological air effluent monitoring program completed periodically to document acceptable performance and continuous improvement in the effluent monitoring program?

   Section 14 of the SADQ describes the assessments that may be applicable to the EMP. These assessments are performed periodically for all aspects of the EMP.

9. Are all potential routes of airborne effluents and emissions from facilities on site identified and evaluated on a periodic basis to ensure that the monitoring program for all airborne radiological effluents and emissions is complete and up-to-date? Is the loss of effluent controls considered when assessing the potential to exceed emissions performance standards?

   Radionuclide air emission sources have been historically evaluated as described in the *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision). Historic emission estimates were determined based on the discharge of the effluent stream that would result if all pollution control equipment did not exist (i.e., the loss of effluent controls) in accordance with NESHAP (40 CFR Part 61, Subpart H).

   The sources with the potential to emit greater than 0.1 mrem are continuously monitored. The emissions from monitored sources are evaluated at least annually against established Baseline Effluent Quality values in accordance with FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*. Results of this evaluation are documented and provided to Environmental Protection management and the site ALARA committee.

10. Does the air effluent monitoring program consider minimum dose sensitivity, release conditions, and particle size?

    The historic development of the PORTS radionuclide air effluent monitoring program considered criteria such as dose, release conditions, and particle size. The *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision) provides additional information on development of the PORTS radionuclide air effluent monitoring program.

11. Has the effectiveness of effluent treatment and controls been evaluated in their capability in reducing effluents? If they were not adequate, how were they changed to ensure acceptable levels of effluents?

    During operation of PORTS, effectiveness of effluent treatment and controls were periodically evaluated by the site contractor. Because PORTS is currently in D&D, effectiveness of the effluent treatment and controls is not typically evaluated, unless monitoring results or other criteria indicate a need for evaluation.

12. Have the air moving systems, including pumps and mechanical components been designed to operate continuously under anticipated operating conditions? Is preventive maintenance scheduled periodically and repair performed and documented when necessary?

    The systems associated with the continuously monitored vents were designed to operate continuously under the anticipated operating conditions. Preventive maintenance is scheduled in the plant maintenance management system (SOMAX). Maintenance and repairs, if necessary, are documented and records are maintained in accordance with applicable procedures.

13. Are the detectors used relatively insensitive to environmental conditions and do they seldom need attention or adjustment?

    Not applicable; the vent monitors that FBP currently utilizes are continuous samplers, which may also include a space recorder. Currently only one continuous vent sampler utilizes a space recorder. A continuous sampler is a point source radionuclide sampling system that consists of a probe, nozzles on the probe, collection traps, a pump and/or air jet and a sample flow meter. The system continuously extracts a representative sample of point source gas through the series of two traps which contain activated alumina for subsequent laboratory analysis. A space recorder is a real-time, continuous radiation monitor consisting of a flow through ionization detector that will alarm if excessive radionuclide concentration of uranium and/or technetium-99 occurs in vent streams. Radiological air emissions are calculated based upon the results of the laboratory analyses.

14. Are flow measurements accurate to ±10 percent by calibration with National Institute of Standards and Technology (NIST) standards, unless extenuating circumstances exist?

    The *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) states that the precision of the flow meters employed for the continuous vent samplers is generally better than ±5 percent and more typically approaches ±2 percent.

15. Are the record flow-measuring devices located downstream from the sample extraction point?

    The record flow-measuring devices are located downstream of the sample extraction ports.

16. Are programs in place to ensure that representative samples are obtained and that all factors germane to proper sample collection are identified and incorporated into sampling activities?

    The SADQ, *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision), *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014), and additional operating procedures ensure that representative samples are obtained and that all factors germane to proper sample collection are identified and incorporated into sampling activities.

17. Does the documentation of the site's radiological air effluent monitoring program include the rationale for the design and selection of monitoring locations, procedures and equipment, frequency and analyses for each sample extraction, minimum detectable concentration and uncertainty, quality assurance components, and investigation and alarm levels?

    The *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision) and *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) provide the documentation for the radiological effluent monitoring program.

18. Is continuous monitoring addressed when a significant potential exists for approaching or exceeding a large fraction of the emission standard (e.g., 20 percent)? Do these systems have alarms that provide timely warnings to signal the need for corrective actions?

    Continuous monitors are installed on sources that were historically determined to have the potential to emit radionuclides that could cause a dose of more than 0.1 mrem to the most exposed member of the public as required by NESHAP (40 CFR Part 61, Subpart H). Alarms are not installed on the continuous monitors.

19. Are systems and methods in place that can adequately monitor or sample the concentrations of gases, vapors, and particulates that are potentially in the effluents?

    Systems and methods are in place that are capable of monitoring and sampling the concentrations of gases, vapors, and particulates that are potentially in the effluents. The *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision) and *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) provide more information about these systems.

20. Are the proper EPA and American National Standards Institute (ANSI) methods used to measure gas-stream characteristics adequately?

    The *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision), *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014), and/or other procedures list the EPA and ANSI methods applicable to the airborne radionuclide effluent monitoring program.

21. Is a validated and consistent approach for sampling and analysis of radionuclide samples applied to ensure laboratory data meet program-specific needs and requirements within the framework of a performance-based approach for analytical work?

    The SADQ describes the approach for sampling and analysis of samples collected by FBP at PORTS. The *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision) and *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) provide additional information specific to the airborne radionuclide effluent monitoring program.

22. Are the sampling and monitoring methods discussed in ANSI/HPS N13.1-1999 used when a new or modified facility or process is involved? Otherwise, are the methods in ANSI N13.1-1969 referenced and used? As appropriate, do program plans include updating ANSI N13.1-1969 systems to meet ANSI/HPS N13.1-1999 criteria?

    The design of the continuous samplers is based on ANSI N13.1-1969. The *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) provides additional information about the historical design of the monitoring system.

23. Have sample-transport lines been designed and installed with the characteristics needed to minimize the loss of material in the line prior to reaching the monitor?

    The sample-transport lines have been designed and installed with the characteristics needed to minimize the loss of material in the line prior to reaching the monitor.

24. Radionuclide-specific Considerations:

    a. Are radioiodine monitors designed in such a way that the replacement of sorbent and filter does not disturb the geometry between the collector and detectors?

       Radioiodine is not a contaminant of concern at PORTS.

    b. Are the instrumentation and sampling methods for radioiodine adequate to measure the radioisotope alone or when other radionuclides are present? Have minimum levels of detectability been measured and documented for various iodine isotopes?

       Not applicable.

    c. Have studies been performed to measure the composition of noble gases present so that measurements can be interpreted correctly?

       Noble gases are not a contaminant of concern at PORTS.

    d. Does the minimum detection level for radioactive noble gases and particulates meet ANSI N42.18-2004?

       Minimum detection levels for particulates meet ANSI N42.18-2004. Noble gases are not a contaminant of concern at PORTS.

    e. Is tritium removal performed before other measurements are made when significant amounts of tritium are present?

       Tritium is not present at PORTS.

    f. Does the minimum detection level for tritium meet ANSI N42.18-2004?

       Not applicable.

    g. Has the detection level of tritium been determined when other radionuclides are present?

       Not applicable.

25. Have studies been performed (either by the site or by the instrument manufacturer) that document the collection efficiency of the particle collection/retention devices used over the range of 0.01 to 10.0 μm?

    The design of the continuous samplers is based on ANSI N13.1-1969. The *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) provides additional information about the historical design of the monitoring system.

26. Are formalized reporting procedures and criteria for monitoring results in place?

    Chapter 8 discusses reporting of air effluent data in the annual NESHAP report. The procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment* describes actions taken to evaluate data, including calculation of baseline effluent quantities, data evaluation, and reporting requirements.

27. Are programs in place to ensure the overall precision of airborne radiological effluent monitoring data?

    The SADQ, *Compliance Plan for National Emission Standards for Hazardous Air Pollutants* (FBP 2013, or latest revision), and *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) provide information about the overall precision of airborne radiological effluent monitoring data.

28. Can the levels of gross beta and gross alpha emitters be measured with the accuracy identified by International Electrotechnical Commission (IEC) 60761 standards?

    The continuous monitoring system at PORTS was designed prior to development of the IEC 60761 standard implemented in 2002. The *PORTS Quality Assurance Project Plan for Compliance with NESHAP* (FBP 2014) provides additional information about the completeness, accuracy, precision, and sensitivity objectives for airborne radiological effluent data. The measurement accuracy of radionuclides that could be present in the PORTS airborne effluent is sufficient for compliance with NESHAP standards (40 CFR Part 61, Subpart H).

29. Is the monitoring of diffuse sources included in the site's radiological effluent monitoring program and, if so, are the computational models and/or downwind arrays of samplers arranged and operated to adequately determine the release? Has the rationale for choosing the computational models or monitoring equipment used been documented?

    The PORTS ambient air monitoring program monitors emissions from both point and diffuse emission sources. This program is discussed in Chapter 4, Section 4.1.

30. Is a program in place to evaluate unplanned releases and assess the impacts of such releases on the public and the environment?

    The comprehensive monitoring programs described in the EMP will form the basis of any monitoring needed to assess an unplanned release. Additional monitoring may be completed as appropriate based on the specific nature of the unplanned release.

31. Have provisions for monitoring radioactive airborne effluents and emissions during nonroutine situations been considered in the overall monitoring program needs?

    The comprehensive monitoring programs described in the EMP will form the basis of any monitoring needed to assess an unplanned release. Additional monitoring may be completed as appropriate based on the specific nature of the unplanned release.

METEOROLOGICAL MONITORING

1. Is there an integrated environmental monitoring program and associated documentation in place? How is it systematically reviewed to ensure monitoring needs associated with meteorological conditions are being addressed in a holistic, cost-effective, and efficient manner? How are program redundancies and gaps identified and addressed?

   PORTS maintains an on-site meteorological tower that is the basis of the site meteorological monitoring program. The EMP and FBP procedures FBP-ER-PRO-00291, *Weather Tower Data* and FBP-ER-PRO-00235, *Downloading Meteorological Data*, document the PORTS meteorological monitoring program. The data collected from the meteorological tower are reviewed annually by a professional meteorologist as part of the preparation of the annual NESHAP report required by 40 CFR Part 61 Subpart H. Assessment and oversight activities conducted in accordance with the SADQ provide opportunities for review, assessment, and continual improvement of the FBP environmental monitoring programs at PORTS.

2. Is there a program in place to obtain representative meteorological data necessary to assess the impact of routine and accidental releases commensurate with the level of site activities? How well does it provide the data needed to help determine the transport and fate of radionuclides released to the atmosphere, and the assessment of their impacts on the public and the environment?

   The meteorological monitoring program is designed to obtain representative meteorological data necessary to assess the impact of routine and accidental releases. These data are appropriate for use in annual modeling required for compliance with NESHAP.

3. Has the meteorological monitoring program been established using site specific information? Does it take into consideration the specific activities at the site, topographical characteristics of the site, distance to each of the critical receptors, and planned future uses of the site?

   Meteorological measurements are collected from an on-site meteorological tower (X-120H Meteorological Tower) with instruments located at 10, 30, and 60 meters. These heights correlate with potential release heights from plant vents and facilities.

4. Is the scope of the program based on an evaluation of the applicable regulatory requirements and a determination of meteorological data needed to support various analyses including facility operations, environmental impact assessments, environmental surveillance activities, safety analyses, environmental restoration activities, and the consequence assessment element of emergency preparedness and response?

   The on-site meteorological data provides the inputs necessary for modeling radionuclide emissions using the CAP88 air dispersion model to meet NESHAP requirements in 40 CFR Part 61 Subpart H. Additionally, the on-site meteorological tower data and capabilities have been incorporated and discussed in the Portsmouth Gaseous Diffusion Plant Safety Basis and Emergency Response Programs and have been determined to be adequate based on the acceptance of these documents.

5. Has the meteorological monitoring program been documented appropriately, such as in a site environmental monitoring plan or an environmental radiological protection program?

   The meteorological program is documented in the EMP and in FBP procedures FBP-ER-PRO-00291, *Weather Tower Data*, and FBP-ER-PRO-00235, *Downloading Meteorological Data*.

6. Do the on-site meteorological measurements include wind direction and speed, temperature, and a direct or inferential measure of atmospheric turbulence?

   The on-site meteorological tower measures wind direction and speed, temperature, and provides the information used to determine turbulence (or stability class).

7. Does the meteorological monitoring program make use of measurements obtained from offsite sources? If so, are the data spatially representative of conditions at the site and are they consistent with onsite monitoring requirements?

   The meteorological monitoring program may use measurements obtained from off-site sources to supplement on-site data. The data are obtained from a National Weather Service station near PORTS and are deemed representative of site conditions by a professional meteorologist.

8. Are the meteorological monitoring program requirements incorporated into the effluent monitoring and the environmental surveillance programs?

   Meteorological monitoring program requirements, effluent monitoring, and environmental surveillance programs are each part of the EMP.

9. Are meteorological measurements made in locations that, to the extent practicable, provide data spatially representative of the atmospheric conditions into which material will be released and subsequently transported?

   Meteorological measurements are collected from an on-site meteorological tower (X-120H Meteorological Tower) with instruments located at 10, 30, and 60 meters. These heights correlate with potential release heights from plant vents and facilities.

10. Are the instruments used in monitoring capable of continuous operation within the normal range of atmospheric conditions at the facility?

    The X-120H Meteorological Tower was upgraded in 2016 and is capable of monitoring atmospheric conditions 24 hours/day.

11. Have any special meteorological monitoring requirements imposed by other agencies (i.e., outside of DOE) been taken into consideration when designing the meteorological measurement systems and establishing measurement locations?

    No special meteorological monitoring requirements are required at PORTS.

12. Has an uninterruptible power supply and an alternate source of power been included in the meteorological monitoring system?

    The X-120H Meteorological Tower is powered from the plant electrical grid with a solar-powered battery back-up capable of operating the meteorological tower for a minimum of 12 hours.

13. Are wind speed and wind direction measurements made at a sufficient number of heights to adequately characterize the wind (including turbulence) at potential release heights?

    The X-120H Meteorological Tower collects measurements at 10, 30, and 60 meters. These heights correlate with potential release heights from plant vents and facilities.

14. Have the temperature monitoring levels been selected and spaced so that the profile is representative and characterizes the magnitude of atmospheric turbulence (if being inferred through vertical temperature differences) and/or to estimate plume buoyancy at the potential release heights?

    The X-120H Meteorological Tower collects measurements at 10, 30, and 60 meters. These heights correlate with potential release heights from plant vents and facilities and are sufficient to characterize the magnitude of atmospheric turbulence and/or to estimate plume buoyancy.

15. Are wind measurements made at locations and heights that avoid airflow modification by obstructions?

    The X-120H Meteorological Tower is located upwind of plant structures relative to the prevailing wind direction for the site.

16. Are air temperature and relative humidity measurements made in such a way as to avoid airflow modification by heat and moisture sources?

    The X-120H Meteorological Tower is located upwind of plant structures relative to the prevailing wind direction for the site. The closest facility that emits heat and moisture is the X-690 Steam Plant, which is more than ½ mile from the meteorological tower.

17. Was the location of the meteorological monitoring tower chosen to avoid being on or near man-made surfaces such as concrete or asphalt?

    The X-120H Meteorological Tower is located in an open field that is covered with grass and is approximately 250 feet away from the nearest paved area.

18. Does the on-site meteorological monitoring system use an electronic digital data acquisition system housed in a climatically controlled environment as a primary data recording system? Is there a backup recording system available for use if needed?

    The data loggers that record meteorological data are housed in a climatically controlled environment. The data loggers store the data for more than 24 hours. The data are continually transferred to the meteorological database including an active dashboard that provides real time data available on the FBP intranet. The database is backed up at rolling 8-hour increments with a complete back-up of the meteorological database completed daily.

19. Are the digitally recorded data (except for wind direction ($\sigma\Theta$) and precipitation) averaged over at least 30 samples taken at intervals not to exceed 60 seconds?

    Data (except wind direction and precipitation) are recorded at 15 minute intervals, which are based on 450 measurements taken at 2 second intervals.

20. Are the accuracies of the monitoring measurements consistent with those listed in Table 5-2 of this Handbook?

    The accuracies of the monitoring measurements are consistent with those listed in Table 5-2 of the DOE Handbook.

21. Does the monitoring program provide for routine inspection of the data and scheduled calibration and maintenance of the meteorological instrumentation and data acquisition system based on the calibration frequency recommendations of the manufacturers?

    Calibration of instruments has been entered into the plant maintenance management system (SOMAX). The instruments are scheduled for calibration on a periodic basis that aligns with the manufacturer's recommendation documented in the systems manual.

22. Are the inspections and calibrations conducted in accordance with written procedures and are the logs of the inspections, maintenance, and calibrations kept and maintained as permanent records?

    Inspections and calibrations are completed in accordance with applicable procedures. The plant maintenance management system (SOMAX) documents inspections and preventive maintenance completed for systems associated with the meteorological tower.

23. Is the meteorological instrument system capable of providing data recovery of at least 90 percent quality-assured data on an annual basis?

    The meteorological instrument system, upgraded in 2016, is capable of providing data recovery of at least 90 percent quality-assured data on an annual basis.

24. Are the monitoring and data recording systems protected from lightning-induced electrical surges and electrical faults, and severe environmental conditions?

    Monitoring and data recording systems associated with the meteorological tower are protected from lightning-induced electrical surges, electrical faults, and severe environmental conditions.

25. Have functional checks been made and properly documented of instrumentation after exposure to extreme meteorological conditions or other events that have or may have compromised system integrity?

    The meteorological tower data are monitored through a site dashboard. Data are downloaded and checked in accordance with procedure FBP-ER-PRO-000291, *Weather Tower Data*.

26. Does every facility on site have a valid and accurate meteorological database which can be utilized by the analyst and codes to evaluate environmental impacts and consequence assessments? Was pre-operational data obtained for at least one year?

    Data are maintained per procedure FBP-ER-PRO-000291, *Weather Tower Data*, and are available to data users upon request. The site maintains an active dashboard that provides real time data on the FBP intranet.

    The Portsmouth Gaseous Diffusion Plant began operations in the 1950s; therefore, pre-operational data are not available.

27. Are meteorological monitoring data collected as 15-minute averages for use in emergency response applications and combined into hourly averages for use in consequence assessments? Are these data examined and entered into permanent archive at least monthly?

    The meteorological monitoring data are recorded as 15-minute and 60-minute averages. The data are examined and entered into a permanent archive at least monthly.

28. If required, are the meteorological data being made available to the National Advisory Release Advisory Center (NARAC) in support of emergency response consequence assessments?

    Meteorological data are not required to be made available to NARAC.

29. Are meteorological data retained for a period of at least five years and validated data retained for the life of the facility?

    Meteorological data are retained for a period of at least five years and validated data retained for the life of the facility in accordance with the applicable file plan.

30. Does the Quality Assurance documentation meet the guidance provided in Section 7.4 of ANSI/ANS-3.11-2005 (R2010) and Section 8 of EPA-454/R-99-005 (EPA 2000a)?

    Quality Assurance documentation for the meteorological monitoring system meets the guidance provided in the referenced documents.

31. Has the QA Plan been reviewed and updated as needed every 5 years or when a substantive change to the meteorological program was made?

    Meteorological data are subject to the QA components of the SADQ. The SADQ is reviewed annually and updated as needed.

ENVIRONMENTAL SURVEILLANCE

1. Are an integrated environmental surveillance program and associated documentation in place? How is the environmental surveillance program systematically reviewed to ensure needs associated with specific program or site operations are being addressed in a holistic, cost-effective, and efficient manner? How are program redundancies and gaps identified and addressed?

   The EMP documents the environmental surveillance program for PORTS. The program is reviewed 1) annually as part of the production of the ASER, 2) when trending data collected in accordance with the EMP, and 3) when preparing an update of the EMP. Assessment and oversight activities conducted in accordance with the SADQ provide additional opportunities for review, assessment, and continual improvement of the FBP environmental monitoring programs at PORTS.

2. Are self-and performance assessments of different parts of the environmental surveillance program performed periodically to document acceptable performance and continuous improvement?

   Section 14 of the SADQ describes the assessments that may be applicable to the EMP. These assessments are performed periodically for all aspects of the EMP.

3. How are environmental surveillance and associated quality assurance and assessment data appropriately tracked, reviewed, and trended to ensure that changes in environmental conditions are fully identified and reported? Are procedural controls consistent with line management expectations established for trending and reporting anomalous conditions?

   Environmental monitoring data are regularly reviewed as described in the SADQ and as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in Chapter 6 to evaluate trends and evaluate current program design and overall program performance. Procedures have been developed for trending and reporting anomalous conditions as appropriate for the varying components of the environmental monitoring program.

4. Are environmental surveillance data reviewed regularly to determine if modifications or improvements to the overall design (sampling methods, location, and analysis) are needed to meet data quality objectives or overall program performance?

   Environmental monitoring data are regularly reviewed as described in the SADQ and as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in Chapter 6 to evaluate trends and evaluate current program design and overall program performance.

5. How are environmental sampling and analysis methods and approaches systematically reviewed and evaluated to ensure they are sufficient to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental surveillance program?

   Data quality objectives have been developed to ensure that data collected in accordance with the EMP are sufficient to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental surveillance program.

6. Has trending and tracking of ground water monitoring data been established to ensure that changes in ground water contamination conditions are fully identified and reported?

   Groundwater monitoring data is evaluated annually and reported to Ohio EPA in the annual groundwater monitoring report. Groundwater data are also reported in the ASER, including trends

in contaminants of specific interest. Additionally, five-year reviews are completed in groundwater monitoring areas that have implemented remedial actions specified in Decision Documents issued by Ohio EPA. The five-year review may include analyses for trends in contaminants of concern for the monitoring area, as appropriate.

7. Have all ground water plumes, including those containing lower concentrations of contaminants, been monitored through direct measurement to determine the full nature and extent of the contamination?

   Groundwater plumes are monitored through direct measurement as described in the IGWMP. Groundwater monitoring data are evaluated annually and reported to Ohio EPA in the annual groundwater monitoring report.

8. Are settleable solids being analyzed?

   The settleable solids monitoring program is described in Chapter 2, Section 2.3.

9. Are sediment sampling locations and rigor sufficient to detect contamination and evaluate trends?

   Sediment samples are collected annually. The DOE Handbook states that an annual sampling frequency for sediment is generally sufficient. Sediment samples are collected at appropriate locations on the streams and river upstream and downstream from PORTS. Detection limits for sediment samples are at appropriate levels so that radionuclides that are part of the monitoring program can be detected, if present. Chapter 6 describes the methodology for evaluating trends in contaminant concentrations.

10. Has the site relied too heavily on gross alpha and beta analyses and not on analyses of specific radionuclides? Did the site routinely establish proper data quality objectives in support of environmental radiological sampling and decision-making?

    Samples collected in accordance with the EMP are analyzed for specific radionuclides, with the exception of surface water runoff from cylinder storage yards, which is analyzed for alpha and beta activity per Ohio EPA requirements. Data quality objectives have been established for data collected in support of environmental radiological sampling and decision-making as part of the EMP.

11. Is a program in place to evaluate unplanned releases and assess the impacts of such releases on the public and environment?

    The comprehensive monitoring programs described in the EMP will form the basis of any monitoring needed to assess an unplanned release. Additional monitoring may be completed as appropriate based on the specific nature of the unplanned release.

12. What processes are employed in notifying responsible managers and stakeholders of environmental monitoring implementation and results?

    The ASER is the primary process used to inform responsible managers and stakeholders of environmental monitoring implementation and results. Periodic mailings, public meetings, the PORTS Envoy Program, and the Environmental Information Center are also means by which stakeholders can obtain information about environmental monitoring.

13. Are formalized reporting procedures and criteria for monitoring results in place?

    Formalized reporting procedures and criteria for monitoring results are in place for programs that are part of the EMP, as applicable. Results for water effluent (NPDES) and air effluent monitoring are evaluated and reported in accordance with the procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*.

14. Are programs in place to ensure the overall precision of the environmental surveillance data?

    The SADQ describes the QA objectives for environmental surveillance data, including precision.

15. Are programs in place to ensure that representative samples are obtained and that all factors germane to proper sample collection are identified and incorporated into sampling activities?

    The SADQ and associated procedures provide proper sample collection procedures for samples collected in accordance with the EMP, including the processes for collecting representative samples.

16. What systems are in place for performing and recording calibration and maintenance activities associated with field and laboratory instrumentation?

    The SADQ describes calibration, maintenance, and recordkeeping requirements for field and laboratory instrumentation. Calibration of instruments is entered in the plant maintenance management system (SOMAX). Maintenance is documented and records are maintained in accordance with applicable procedures.

17. Is a validated and consistent approach for sampling and analysis of radionuclide samples applied to ensure laboratory data meet program-specific needs and requirements within the framework of a performance-based approach for analytical work?

    The SADQ provides a validated and consistent approach for sampling and analysis of radionuclide samples to ensure laboratory data meet program-specific needs and requirements.

18. What systems are in place to ensure corrective actions are implemented during malfunctions of field and laboratory instrumentation?

    The SADQ describes the actions to be taken during malfunctions of field and laboratory instrumentation. Corrective maintenance is tracked and documented through the plant maintenance management system (SOMAX). Corrective actions are tracked through issuing problem reports and/or tracking in the Issue Tracking System.

19. Have the minimum criteria for determining the need for environmental surveillance listed in Table 6-1 been used to help establish the environmental surveillance program?

    The EMP has been evaluated against the requirements of Table 6-1 (Minimum Criteria for Determining the Need for Environmental Surveillance) and meets or exceeds the requirements listed in the table.

20. Is the environmental surveillance program able to distinguish site radiation contributions from other local sources adequately?

    The environmental surveillance program monitors the following radionuclides that can be attributed to PORTS operations: transuranic radionuclides (americium-241, neptunium-237, plutonium-238, plutonium-239/240), technetium-99, uranium, and uranium isotopes (uranium-233/234, uranium-235/236, and uranium-238). Each of these radionuclides is also present in the environment due to fallout from world-wide nuclear weapons testing or is naturally-occurring (uranium and uranium isotopes). Radionuclides attributable to PORTS operations can often be distinguished by the presence of enriched uranium and elevated levels of technetium-99 and transuranics. However, when very low levels of these radionuclides are detected, it can be difficult to distinguish site radiation contributions from background radiation (natural radionuclides and fallout).

21. Has the particle size of effluent particulates been measured or considered in the establishment of the environmental surveillance program?

    NESHAP modeling uses a default particle size of 1 micron. The low levels of radiological emissions from PORTS and resulting low doses do not warrant measurements of particle size.

22. What provisions for emergency monitoring have been planned and how do they fit into the routine environmental surveillance program?

    The comprehensive monitoring programs described in the EMP will form the basis of any monitoring needed to assess an unplanned release. Additional monitoring may be completed as appropriate based on the specific nature of the unplanned release.

23. Are all potential exposure pathways covered in the environmental surveillance program?

    The EMP has been evaluated against the requirements of Table 6-1 (Minimum Criteria for Determining the Need for Environmental Surveillance) and meets or exceeds the requirements listed in the table.

24. Is the proper instrumentation used to make the external radiation measurements in terms of precision, sensitivity for the measurements needed, and suitability for use in the field?

    The Sample Management Office, in conjunction with Radiological Protection as needed, has selected the appropriate instrumentation for the external radiation monitoring program.

25. Have the sampling and measurement locations, number of samples, and frequency of data acquisition been justified adequately and documented in the environmental surveillance plan or other appropriate record?

    The EMP documents and justifies sampling and measurement locations, number of samples, and frequency of data acquisition for environmental surveillance.

26. How have the background radiation levels been considered during the process of identifying locations of samples and measurements?

    Background sampling is part of sampling programs for ambient air, external radiation, surface water, sediment, soil, and biota.

27. What other precautions (besides background radiation levels) related to environmental sampling and monitoring were considered during the process of establishing the environmental surveillance program and during the implementation of the program? Are the precautions adequate?

    The FBP Integrated Safety Management System provides a comprehensive program to identify, evaluate, and mitigate hazards associated with environmental sampling and monitoring.

28. Are radon isotopes and their daughters potential interferences in the analyses of the samples or the measurements made on site? If so, how are their interferences taken into account or compensated for?

    Per the *Environmental Radiation Protection Program* (FBP 2016b), radon is not a contaminant of concern at PORTS.

29. Is the process of obtaining the environmental samples and measurements on site controlled such that the samples can be easily identified and followed through their analyses and the samples maintained in such a way that the integrity of the sample is preserved adequately prior to analyses?

    Environmental samples and measurements are collected in accordance with the SADQ. These samples can be easily identified and followed through their analyses and the samples maintained in such a way that the integrity of the sample is preserved adequately prior to analysis.

30. Are there chain-of-custody procedures for the samples?

    Chain-of-custody is discussed in the SADQ. Chain-of-custody procedures are documented, available and maintained electronically (in Documentum) and followed by the personnel obtaining the data.

31. Is the analysis equipment used in the environmental surveillance program adequate to identify and measure the presence of all of the radionuclides of concern in the local environment with the appropriate level of precision?

    Laboratories performing analyses on FBP samples must be capable of meeting requirements in the DOE QSAS and MARLAP (NRC 2004). Analytical laboratories providing services for FBP are responsible for compliance with the requirements of the SADQ and their specific contract. Laboratory performance is evaluated on an ongoing basis through use of assessments, performance evaluation samples, and data verification/validation of the laboratory's data packages.

32. Are all of the sampling and monitoring procedures used to implement the environmental surveillance program documented adequately and followed by the personnel obtaining the data?

    Sampling and monitoring procedures used to implement the environmental surveillance program are documented, available and maintained electronically (in Documentum) and followed by the personnel obtaining the data.

SAMPLE HANDLING, PREPARATION, AND ANALYSIS PROCEDURES

1. Are standard operating procedures (SOPs) in place to guide sampling, sample handling, sample preparation, sample analysis, and quality assurance verifications?

   Samples are collected in accordance with the SADQ and applicable procedures. Periodic assessments of sampling activities are completed to ensure compliance with these requirements.

2. Are self- and performance assessments of sample handling, preparation, analysis, and quality assurance procedures performed periodically to document acceptable performance and continuous improvement in the processes?

   Section 14 of the SADQ describes assessment and oversight activities applicable to FBP sampling programs at PORTS.

3. Are deviations from procedures documented and investigated?

   The SADQ describes assessment and oversight activities applicable to FBP sampling programs at PORTS, including actions to be taken if deviations from procedures are identified.

4. Is a system in place to properly identify samples throughout handling, preparation, analytical processes, and data reporting?

   The SADQ and laboratory QAPs describe the systems in place to properly identify samples throughout handling, preparation, analytical processes, and data reporting.

5. Are chain-of-custody protocols used and documented?

   The SADQ, applicable procedures, and laboratory QAPs describe chain-of-custody protocols applicable to samples collected in accordance with the EMP.

6. Are sample preservation techniques properly used?

   The SADQ and laboratory QAPs describe sample preservation requirements applicable to samples collected in accordance with the EMP. Samples are preserved as required by the analytical laboratory and in accordance with standard analytical procedures (such as SW-846).

7. Are contamination controls adequately implemented during sampling?

   The SADQ and laboratory QAPs describe contamination controls applicable to samples collected in accordance with the EMP.

8. Is appropriate instrumentation used for analysis?

   All laboratories performing analyses on FBP samples meet applicable requirements of the DOE QSAS and MARLAP.

9. Are the instruments used for quantification calibrated and their operation routinely verified?

   All laboratories performing analyses on FBP samples meet applicable requirements of the DOE QSAS and MARLAP, including calibration requirements.

10. Are systems in place for performing and recording calibration and maintenance activities associated with field and laboratory instrumentation?

    The SADQ and laboratory QAPs describe systems in place for performing and recording calibration and maintenance activities associated with field and laboratory instrumentation.

11. Are the sample preparation and analytical procedures used adequate for the sample matrices, radionuclides of interest, and potentially required concentrations?

    The SADQ provides a systematic process to ensure that standardized and consistent processes are utilized to obtain samples, perform data collection, and perform laboratory services. This process ensures that sample preparation and analytical procedures are adequate for the sample matrices, radionuclides of interest, and potentially required concentrations.

12. Is a validated and consistent approach for sampling and analysis of radionuclide samples applied to ensure laboratory data meet program-specific needs and requirements within the framework of a performance-based approach for analytical work?

    The SADQ provides a systematic process to ensure that standardized and consistent processes are utilized to obtain samples, perform data collection, and perform laboratory services.

13. How are analytical methods and results systematically reviewed and evaluated to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental monitoring program?

    The Sample Management Office reviews analytical data for compliance with the laboratory statement of work (SOW), which is developed to ensure that data can demonstrate compliance with applicable limits. Additionally, the responsible group reviews data to ensure that the data continue to be adequate to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental monitoring program.

14. How are program redundancies and gaps identified and addressed?

    Environmental monitoring data are reviewed annually during development of the ASER and as described in Chapter 6, Data Analysis and Statistical Treatment. Assessments and oversight activities of EMP activities, which can include evaluation of program gaps and redundancies, are routinely completed.

15. Are protocols in place to ensure corrective actions are implemented?

    Chapter 14 of the SADQ describes assessment and oversight activities applicable to FBP sampling programs at PORTS, including actions to be taken if corrective actions are identified.

DATA ANALYSIS AND STATISTICAL TREATMENT

1. Are the justification and rationale for the data analysis and statistical treatments current and described in appropriate program plans, procedures, and protocols?

   The EMP and applicable procedures provide the current methodology for analysis of data collected in accordance with the EMP.

2. Is a system in place for selecting and validating appropriate methods and models used for data analysis and statistical treatments?

   When necessary, professional judgement and use of appropriate guidance material such as the DOE Handbook, DOE Orders, and Ohio EPA/U.S. EPA documents are used to select and validate methods and models used for data analysis and statistical treatments.

   In general, models are not used for analysis of data collected in accordance with the EMP.

3. Are SOPs in place to guide sample analysis, statistical treatments, and quality assurance verifications?

   Sample analysis, statistical treatments (if necessary), and QA verifications are completed in accordance with the DOE Handbook, the SADQ, and applicable procedures.

4. Are deviations from procedures documented and investigated?

   The SADQ describes assessment and oversight activities applicable to FBP sampling programs at PORTS, including actions to be taken if deviations from procedures are identified.

5. Are analytical results, their uncertainty and associated statistical treatments properly documented and readily available?

   Analytical results, their uncertainty, and associated statistical treatments for radiological analyses are documented in the Project Environmental Measurements System (PEMS) in accordance with laboratory SOWs and the SADQ.

6. Are backup systems implemented to minimize potential losses of data?

   Analytical data collected obtained from samples collected in accordance with the EMP are stored in PEMS. PEMS is an enterprise level, server-based system built on an Oracle platform. Back-ups are established, monitored, and performed by administrators utilizing approved, privileged accounts. Backups are performed in accordance with standard Oracle recommendations and include nightly exports, archive-logging to allow point-in-time recovery, Oracle's flashback feature, and standard tape backups performed by the network infrastructure support contractor.

   Laboratory data packages are retained in electronic pdf format, separate from the database, in the PORTS electronic records management system (Documentum) under approved file plans.

7. Are procedural controls consistent with line management expectations established for trending and reporting anomalous conditions?

   Environmental monitoring data are regularly reviewed as described in the SADQ and as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in

Chapter 6 to evaluate trends and evaluate current program design and overall program performance. Procedures have been developed for trending and reporting anomalous conditions as appropriate for the varying components of the environmental monitoring program. The procedure FBP-EP-PRO-00040, *Tracking of Radiological Releases to the Environment*, describes actions to be taken to evaluate data, including calculation of baseline effluent quantities, data evaluation, and reporting requirements for water effluent (NPDES) and air effluent monitoring described in Chapter 2.

8. Are programs in place to ensure overall precision of radiological effluent monitoring and environmental surveillance data?

   The SADQ describes the QA objectives for radiological effluent monitoring and environmental surveillance data, including precision.

9. Does the data analysis and statistical treatment program appropriately track, review, and trend the data to ensure that changes in environmental conditions are fully identified and reported?

   Chapter 6 describes the data analysis and statistical treatment program for FBP data collected in accordance with the EMP.

10. Are data analysis and statistical treatments and approaches periodically reviewed and evaluated to ensure they are sufficient to demonstrate compliance with applicable limits and provide an adequate technical basis for the environmental monitoring program and to meet the overall data quality objectives?

    All aspects of environmental monitoring, including the EMP, are routinely evaluated through self-assessment and other oversight activities. Section 14 of the SADQ describes assessment and oversight activities applicable to FBP sampling programs at PORTS.

11. Is a system in place to ensure that data analysis and statistical treatments are supported with updated and accurate information, which includes identification and documentation of values of assumed default or site-specific parameters used in calculations?

    The site-specific parameters used in dose calculations in the ASER, such as default values used in the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2015d) are updated as needed when this document is revised.

12. How are program redundancies and gaps identified and addressed?

    All aspects of environmental monitoring, including the EMP, are routinely evaluated through self-assessment and other oversight activities. Section 14 of the SADQ describes assessment and oversight activities applicable to FBP sampling programs at PORTS.

13. What protocols are in place to ensure corrective actions are implemented?

    Chapter 14 of the SADQ describes assessment and oversight activities applicable to FBP sampling programs at PORTS, including actions to be taken if corrective actions are identified.

14. Are environmental monitoring data reviewed regularly to determine if modifications or improvements to the overall design (sampling methods, location, and analysis) are needed to meet data quality objectives or overall program performance?

    Environmental monitoring data are regularly reviewed as an integral part of the process of developing the ASER. Data are also reviewed periodically as described in Chapter 6 to evaluate trends and evaluate current program design and overall program performance.

DOSE CALCULATIONS

1. Has a system been established for evaluating doses to the public and the environment considering relevant exposure modes and pathways from DOE activities? Are doses less than DOE's all-pathways limit of 100 mrem/year and ALARA? Are doses through the air pathway less than 10 mrem/year?

   The methodology for evaluating doses to the public and the environment is documented in Chapter 7 of this EMP and reported in the ASER. The all-pathways dose is less than 100 mrem/year and ALARA. The air pathway dose is less than 10 mrem/year.

2. Is a system in place to ensure that dose evaluations are supported with updated and accurate information, which includes identification and documentation of values of assumed default or site-specific parameters used in calculations?

   When available, specific PORTS exposure scenarios provided in the *Methods for Conducting Human Health Risk Assessments and Risk Evaluations at the Portsmouth Gaseous Diffusion Plant* (DOE 2015d) are used in the dose assessments used to demonstrate compliance with DOE Order 458.1 (DOE 2013c). 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. If this risk assessment document is updated, any applicable changes are made to the dose calculations discussed in the EMP.

3. Is a system in place for selecting and validating appropriate methods and models used for evaluating doses to the public and the environment?

   Methodology and models used to evaluate dose have historically been selected and reviewed by the DOE site office, the DOE office providing oversight of PORTS, and the implementing contractor. Current methodology used to assess dose is reviewed annually as part of the review process for the ASER.

4. Is the information used to calculate doses to the public (e.g., including the extent and use of affected air, land, and water media data) identified, documented, reported, and periodically re-evaluated?

   Information used to calculate doses to the public is identified, documented, and reported in the ASER and reviewed as part of the review process for the ASER.

5. Do the assessment models used for all environmental dose assessments appropriately characterize the physical and environmental situations existing at the site?

   Models used for environmental dose assessments appropriately characterize the physical and environmental situations existing at the site.

6. Is surface and ground water modeling conducted as necessary to conform to the applicable requirements of the State government and the regional EPA office?

   Surface and ground water modeling is not typically required for PORTS by Ohio EPA or U.S. EPA. When surface or groundwater modeling is needed, modeling is conducted in accordance with industry standards and/or state/federal EPA guidance.

7. Are data/information used in the dose assessment models or resulting from the modeling consistent with the data obtained from the site's ASER?

   In general, modeling is not used at PORTS to predict actual concentrations of radionuclides in environmental media. Data/information used in dose assessment models are the same as data obtained from the site's ASER.

8. Are all external exposures, inhalation, and ingestion pathways taken into account in the dose assessment modeling?

   The EMP documents the significant exposure pathways included in the dose assessment calculations.

9. Are parameter sensitivities and uncertainties in modeling results properly justified and documented?

   In general, parameter sensitivities and uncertainties in modeling results are not significant in PORTS current modeling. Modeling and calculations that are likely to overestimate the dose to a member of the public are usually described as such in the ASER.

10. Are controls or reviews established in the dose assessment process to prevent the occurrence of "overkill", inappropriate prediction, and misinterpretation of the data?

    Methodology used to assess dose is reviewed as part of the review process for the ASER.

11. Do parameters used in the atmospheric transport and dispersion models include horizontal and vertical diffusion parameters, wind data, plume-rise parameters, and plume deposition and depletion factors?

    The CAP88 model used in compliance with U.S. EPA regulations for assessment of radionuclides released to the air includes these factors.

12. Is the RESRAD family of codes or another environmental transport code used to model and evaluate radiation doses and risks? If so, are the parameters/inputs and results documented properly?

    RESRAD BIOTA is used to evaluate radiation doses to populations of aquatic animals, terrestrial plants, and terrestrial animals. Input parameters and results are documented in the ASER. Inputs and results for additional dose calculations are documented within calculation spreadsheets and reported in the ASER.

    Other components of the RESRAD family of codes are not routinely used at PORTS to evaluate data collected in accordance with the EMP.

13. With regard to protection of biota and the evaluation of radiation doses to populations of aquatic animals, terrestrial plants, and terrestrial animals, is a graded approach used such as the one discussed in DOE-STD-1153-2002? Are all assumptions and input parameters justified and properly documented?

    RESRAD BIOTA, part of DOE-STD-1153-2002, is used to evaluate radiation doses to populations of aquatic animals, terrestrial plants, and terrestrial animals. Assumptions and input parameters are documented in the ASER.

14. Are dose coefficients used in the dose assessment process referenced, justified, and properly documented?

    Dose coefficients used in the dose calculations using EMP data are referenced and documented within the calculation spreadsheets.

15. Have results obtained through computer programs been compared and evaluated against field or laboratory data? How did they compare and how were differences justified?

    In general, modeling is not used at PORTS to predict actual concentrations of radionuclides in environmental media. When applicable, however, modeling results are compared to actual concentrations and differences evaluated and justified as necessary.

RECORDS, RETENTION AND REPORTING

1. Have all relevant reporting requirements been identified?

   Chapter 8 identifies the relevant reporting requirements for data collected in accordance with the EMP.

2. Was compliance with all identified reporting requirements achieved?

   Compliance with all reporting requirements has been achieved.

3. Is a documented program in place to ensure that appropriate DOE and other responsible authorities will be, or have been notified of all occurrences and information involving DOE and its contractors in a timely manner in accordance with the identified requirements?

   Notification of occurrences is provided to the appropriate DOE officials and other responsible authorities in accordance with the requirements of DOE Order 232.2, *Occurrence Reporting and Processing of Operations Information,* and regulatory authorities.

4. Have auditable records relating to environmental monitoring and surveillance been maintained?

   Auditable records pertaining to the EMP are maintained in accordance with DOE Order 243.1B, *Records Management Program*, the SADQ, and applicable procedures.

5. Have calculations, computer programs, and other data handling methods been recorded and referenced appropriately?

   Calculations, computer programs, and other data handling methods pertaining to the EMP are recorded and referenced appropriately in accordance with the SADQ and applicable procedures.

6. Have record disposition and disposals been conducted in accordance with approved plans, procedures, and DOE records management requirements?

   Record disposition and disposals pertaining to the EMP are conducted in accordance with DOE Order 243.1B, *Records Management Program*, the SADQ, and applicable procedures.

7. Have records documenting the source of input parameters including the results of all measurements upon which they are based, the calculations and/or analytical methods used to derive values for input parameters, and the procedure used to determine effective dose been generated? Are the records sufficient to allow an independent auditor to verify determinations made concerning the facility's compliance with the standard? Are the records kept at the site of the facility for at least five years and, available, upon request, for inspection by appropriate authorities?

   Analytical data, which are often the basis of input parameters, are maintained in PEMS and the PORTS Oak Ridge Environmental Information System as described in the SADQ. Records documenting dose calculations, including input parameters, are maintained in on-site project files and are available for inspection.

8. Was an ASER issued?

   An ASER is prepared and issued for each calendar year.

9. Does the program systematically plan, document, execute, and evaluate the management of DOE radioactive waste and assist in planning, executing and evaluating the management of DOE radioactive waste in accordance with DOE O 435.1, *Radioactive Waste Management*?

   Radioactive waste is managed in accordance with the *Waste Management Plan* (FBP 2015, or latest revision). The *Waste Management Plan* defines the overall strategy for managing FBP PORTS waste and implements the applicable requirements of DOE Order 435.1, *Radioactive Waste Management* (DOE 2001b) and DOE Order 458.1 (DOE 2013c).

10. Does the facility NESHAP document meet the requirements of 40 CFR Part 61?

    The annual NESHAP report meets the requirements of 40 CFR Part 61.

QUALITY ASSURANCE

1. Are environmental monitoring and surveillance data reviewed regularly to determine if modifications or improvements to the overall design (sampling methods, location, and analysis) are needed to meet data quality objectives or overall program performance?

   Analytical results are reviewed by the Sample Management Office to ensure that aspects related to data quality objectives (analytical methods, reporting limits, etc.) have been met. The responsible group (generally Environmental Monitoring and Reporting or Environmental Protection) periodically evaluates the data to confirm that data collected continue to meet overall program objectives.

2. Are programs in place to ensure that representative samples are obtained and that all factors germane to proper sample collection are identified and incorporated into sampling activities?

   Samples are collected in accordance with the SADQ and applicable procedures. Periodic audits of sampling activities are completed to ensure compliance with these requirements.

3. What systems are in place for performing and recording calibration and maintenance activities associated with field and laboratory instrumentation?

   The SADQ and applicable procedures describe calibration, maintenance, and recordkeeping requirements for field instrumentation.

   Laboratory instrumentation is calibrated and maintained by the analytical laboratory. Analytical laboratories used by DOE contractors participate in the DOE Consolidated Audit Program and Mixed-Analyte Performance Evaluation Program. 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.

4. What systems are in place to ensure corrective actions are implemented during malfunctions of field and laboratory instrumentation?

   If malfunctions of field instrumentation occur, corrective actions are implemented in accordance with the SADQ and applicable procedures. Corrective maintenance is tracked and documented through the plant maintenance management system (SOMAX). Corrective actions are tracked through issuing problem reports and/or tracking in the Issue Tracking System.

   Laboratory instrumentation is calibrated and maintained by the analytical laboratory. Analytical laboratories used by DOE contractors participate in the DOE Consolidated Audit Program and Mixed-Analyte Performance Evaluation Program. 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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