TENNESSEE DEPARTMENT
OF
ENVIRONMENT AND CONSERVATION

DIVISION OF REMEDIATION
OAK RIDGE OFFICE

ENVIRONMENTAL MONITORING PLAN

January 2017 – June 2017

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List of Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	ambient water quality criteria
BCK	Bear Creek and Bear Creek kilometer
CBSQG	consensus-based sediment quality guidelines
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DNA	deoxyribonucleic acid
DOE	Department of Energy
DoR-OR	Division of Remediation, Oak Ridge Office
DQO	data quality objective
D&D	decontamination and decommissioning
EFPC	East Fork Poplar Creek
EMP	Environmental Monitoring Plan
EMWMF	Environmental Management Waste Management Facility
EPA	Environmental Protection Agency
ETTP	East Tennessee Technology Park
FFA	Federal Facilities Agreement
ft^2	square feet
GPS	global positioning system
MCL	maximum contaminant level
µg/g	micrograms per gram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mrem	millirem
MSRE	Molten Salt Reactor Experiment
NAREL	National Air and Radiation Environmental Laboratory
ng/g	nanograms per gram
NEPA	National Environmental Policy Act
NT	north tributary
NPDWR	National Primary Drinking Water Regulations
NRWQC	National Recommended Water Quality Criteria
NSDWR	National Secondary Drinking Water Regulations
NAWQA	National Water-Quality Assessment Program
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge operations
ORR	Oak Ridge Reservation
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls
pCi/g	picoCuries per gram
PRG	preliminary remediation goals
PWTC	Process Water Treatment Complex

QAPP	quality assurance plan
QA/QC	quality assurance/quality control
RPM	radiation portal monitor
ROD	Record of Decision
RSP	radiation sensor panels
SD	storm drain
SOP	standard operating procedure
SWSA	solid waste storage areas
TDEC	Tennessee Department of Environment and Conservation
TDH	Tennessee Department of Health
T&E	threatened and endangered
TOA	Tennessee Oversight Agreement
UCOR	URS | CH2M Oak Ridge LLC
WAC	waste acceptance criteria
WOC	White Oak Creek
WCK	White Oak Creek kilometer
WOL	White Oak Lake
Y-12	Y-12 National Security Complex

1.0 Introduction

The Tennessee Department of Environment and Conservation (TDEC), Division of Remediation, Oak Ridge Office (DoR-OR), is providing an annual environmental monitoring plan (EMP) for the first six months of calendar year 2017, under terms of the Tennessee Oversight Agreement (TOA) Section A.6.1.1. This monitoring plan will focus on radiological emissions and releases; mercury monitoring and releases; monitoring of decontamination and decommissioning (D&D) remedial activities; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) landfill; oversight of impacts to regional groundwater; and general site monitoring on the Oak Ridge Reservation (ORR) and its environs.

Work performed under this EMP will be conducted using elements stated in the Quality Assurance Project Plan (QAPP) developed for TDEC along with the Life Safety Plan that notes potential site hazards and adheres to appropriate OSHA procedures.

The goal is to ensure the Department of Energy (DOE) Oak Ridge Operations (ORO) has no adverse impact to public health, safety, or the environment from past or present activities. If there are adverse effects, then those effects are delineated and communicated to DOE, the responsible regulatory state agency, the Tennessee Department of Health (TDH), and affected members of the public when appropriate. Results from monitoring and findings of the quality and effectiveness of the DOE environmental programs are reported in the quarterly and annual status reports. Each fall an annual environmental monitoring report is provided that details the technical results of these studies.

1.1 Primary Focus Areas

TDEC has six primary focus areas that are covered by this extended EMP. They include radiological environmental releases, mercury monitoring and releases, monitoring D&D remedial activities, CERCLA landfill monitoring, oversight of impacts to regional groundwater, and general site monitoring.

1.1.1 Radionuclide Environmental Releases

Radionuclide remediation is an environmental priority in the Oak Ridge area. From the 1940s through 1987, various site operations released radionuclides to air and surface water and generated onsite land disposals of radionuclides. Historical radionuclide releases from the Oak Ridge facilities have been summarized and existing data on the estimated annual liquid release from the ORO includes:

- tritium (H-3) , cobalt-60 (Co-60), strontium-90 (Sr-90), niobium-95 (Nb-95), zirconium-95 (Zr-95), ruthenium-106 (Ru-106), iodine-131 (I-131), cesium-137 (Cs-137), and cerium (Ce-144)
- transuranics from Oak Ridge National Laboratory (ORNL)
- thorium-232 (Th-232) and uranium-238 (U-238) from the Y-12 National Security Complex (Y-12)

- technetium-99 (Tc-99), neptunium-237 (Np-237) and U-238 from the former K-25 facility at East Tennessee Technology Park (ETTP)

At ORNL, the activities of fuel reprocessing, isotopes production, waste management, radioisotope applications, reactor developments, and multi-program laboratory operations produced waste streams resulting in environmental releases that contain both radionuclides and hazardous chemicals. In addition, low-level radioactive waste generated by other sites has been disposed of at ORNL.

Y-12 continues to produce components for various nuclear weapons systems and a portion of the effort involves converting uranium-235 (U-235) compounds to metal. The associated waste streams have resulted in environmental releases that contain both radionuclides and hazardous chemicals.

Even though the gaseous diffusion activities at ETTP have concluded, past environmental waste streams and current decommissioning activities have resulted in environmental releases that contain both radionuclides and hazardous chemicals.

The TDEC DoR-OR environmental monitoring plan is designed to aid in determining the level and risk of historic and ongoing releases to public health and to the environment. The monitoring will focus on potential pathways of air, surface water, groundwater, sediment, soil, and ecological effects in areas of known contamination, active remediation, or ongoing activities.

1.1.2 Mercury Monitoring and Releases

Mercury remediation is the highest cleanup priority in the Oak Ridge area. The largest quantity of mercury released in the environment was from Y-12 operations during the 1950s and early 1960s. East Fork Poplar Creek (EFPC) is contaminated with average aqueous mercury concentrations exceeding those in reference streams by several hundred-fold. Remedial actions over the past 20 years have decreased aqueous mercury concentrations in EFPC by 85% [from >1600 nanograms per liter (ng/L) to <400 ng/L]. The water quality criterion for mercury in recreational waters for organisms only is 51 ng/L [TDEC Rule 0400-40-03-.03 (4)]. Fish fillet concentrations, however, have not responded to this decrease in aqueous mercury and remain above the Environmental Protection Agency (EPA) National Recommended Water Quality Criteria (NRWQC) of 0.3 milligrams per kilogram (mg/kg). To address this release, the DOE mercury remediation technology development scope in the near term includes three main areas:

1. ORNL field and laboratory studies are investigating the use of chemical, physical, and ecological manipulations and management actions in the watershed to decrease mercury concentration and bioaccumulation.
2. DOE is conducting preliminary evaluations to determine the feasibility of placing a field research station along Lower East Fork Poplar Creek. The station will serve as a near-stream research facility for mercury research.

3. URS | CH2M Oak Ridge LLC (UCOR) is investigating waste management practices to gain a better understanding of mercury-contaminated debris disposal techniques, strategies to reduce the quantity of debris that requires treatment, and the extent of contamination in mercury contaminated areas at Y-12.

DOE has proposed a phased, adaptive management approach to address mercury contamination in surface water. A key component of the plan is the proposed construction of a water treatment facility, the Outfall 200 Mercury Treatment Facility, to reduce the amount of mercury currently in the creek and to prepare for potential releases during future cleanup in the West End Mercury Area at Y-12.

The ongoing and future mercury remediation at Y-12 is a large and complex problem from all perspectives: chemical, geological, ecological, physical, regulatory, and monetary. Efforts are being made by multiple contractors, regulators, and DOE officials to define, develop, and implement solutions to the issues.

While the greatest impact with mercury is along EFPC, Bear Creek, White Oak Creek (WOC), and the Clinch River have also been impacted with mercury.

Bear Creek

Mean mercury concentrations in rock bass in lower Bear Creek (BCK) 3.3 increased in 2013 [0.82 micrograms per gram (μg/g) in fall 2012 and 0.97 μg/g in spring 2013] and are above EPA-recommended ambient water quality criteria (AWQC), now the NRWQC (0.3 μg/g mercury in fish). The concentrations remained consistent in FY2014 compared to FY2013 (0.68 μg/g in fall 2013 and 0.69 μg/g in spring 2014). The October 2012 total mercury result was 6.9 ng/L and the June 2013 result was 18.2 ng/L. The North Tributary 3 (NT-3) total mercury for October 2013 was 4.1 ng/L and the May 2014 was 11.5 ng/L. Methyl mercury data are available for NT-3 from surface water samples collected since winter 2010. The NT-3 methylmercury concentrations range from a low value of 0.09 ng/L to a high of 2.7 ng/L measured in June 2013. The NT-3 methylmercury concentrations range from a low value of 0.15 ng/L to a high of 0.49 ng/L measured in May 2014.

White Oak Creek

Mercury concentrations at the Bethel Valley watershed integration point (7500 Bridge) continue to meet the NRWQC of 51 ng/L. Mercury concentrations measured at Fifth Creek and WOC-105 locations upstream of the 7500 Bridge, also met the NRWQC limit. In October 2009, a pre-filter and ion exchange water treatment system was installed in the basement of ORNL Building 4501. Following pre-treatment, the sump water is routed to the Process Water Treatment Complex (PWTC) for final treatment and discharge to WOC. Mercury concentrations measured at the 7500 Bridge and WOC-105 have experienced dramatic decreases since the sump water reroute.

Average mercury concentrations in fish collected from the stream sections of WOC continue to remain below the EPA recommended fish-based mercury NRWQC of 0.3 μg/g in 2013. This is likely due to the decreases in aqueous mercury concentrations seen as a result of the work accomplished and noted in the Phased Construction Completion Report for the Bethel Valley Mercury Sumps Groundwater Action Completion at the Oak Ridge National Laboratory in 2008 (DOE/OR/01-2472&D1). Fillet concentrations averaged 0.20 μg/g at White Oak Creek kilometer (WCK) 3.9 and 0.23 μg/g at WCK 2.9 in 2013, and were not significantly different from concentrations observed in 2012 at these sampling locations. The concentrations were 0.24 μg/g at WCK 3.9 and 0.28 μg/g at WCK 2.9 in 2014.

While mercury concentrations in fish collected from upper WOC have been decreasing in recent years, mercury concentrations in fish collected in White Oak Lake (WOL) (WCK 1.5) have been generally increasing, possibly due to a better environment for methylation and uptake. Concentrations in bass collected at this site were similar to those seen since 2011, averaging 0.58 μg/g in 2013. Concentrations decrease in 2014 down to 0.42 μg/g for bass as shown in Fig 2.23 from the 2015 Remediation Effectiveness Report (i.e., RER).

Clinch River

Vertical profiles of mercury have been examined in sediment cores collected in offsite areas. The profiles show a strong correlation with the history of mercury releases from Y-12 and, because the largest releases of mercury from Y-12 coincided with the largest releases of Cs-137 from ORNL, the sediment profiles of mercury and Cs-137 correspond closely. Extrapolation of the mercury concentration data in the sediment cores indicates that between 50 and 300 metric tons of mercury may have accumulated in offsite areas.

1.1.3 Monitoring D&D Remedial Activities

Old, excess, and contaminated facilities on the ORR are being decommissioned and demolished. Alpha buildings at Y-12 contain radionuclides and mercury. Deterioration of facilities could open a number of pathways for release of contaminants at Y-12. The releases could affect workers and the residences of nearby communities.

1.1.4 CERCLA Landfill

Low-level radiological and hazardous wastes generated from Oak Ridge cleanup projects are disposed of in the Environmental Management Waste Management Facility (EMWMF). The EMWMF is comprised of six disposal cells that have a total capacity of 2.2 million cubic yards. Environmental monitoring is performed to demonstrate compliance with Applicable or Relevant and Appropriate Requirements (ARARs) specified in the Record of Decision (ROD) to include seasonal groundwater fluctuations in the uppermost aquifer beneath the site; and to determine impacts to groundwater, surface water, stormwater, contact water, leachate, sediment basin discharge, and ambient air.

Environmental monitoring of seasonal groundwater fluctuations in the uppermost aquifer beneath EMWMF is performed to demonstrate compliance with ARARs specified in the ROD.

1.1.5 Oversight of Impacts to Regional Groundwater

As a consequence of past mission activity, groundwater beneath several areas of the ORR has become contaminated. Measures have been implemented attempting to isolate remaining contaminant sources from groundwater, but additional efforts will be required to understand and respond to legacy groundwater challenges.

The projects designed for this focus area will use three criteria for communication of the different studies results:

1. Are contaminants detected?
2. Do they exceed health-based criteria (e.g., NPDWR or NSDWR)?
3. Can the contaminants be attributed to DOE activities?

Collection and interpretation of data in fractured rock and karst settings is complicated by changes in conditions that can occur rapidly in response to precipitation-induced recharge and hydraulic head changes. In order to assess potential public health threats and to protect and restore groundwater resources to beneficial use, a better understanding of the groundwater system is necessary.

1.1.6 General Site Monitoring

In accordance with the TOA, "ongoing environmental monitoring and surveillance programs shall continue to determine adequacy in providing information on the releases and impacts on public health and the environment from past and present Oak Ridge Reservation (ORR) actions. The program objective is to provide a comprehensive and integrated monitoring and surveillance program for all media (i.e., air, surface water, soil, sediments, groundwater, drinking water, food crops, fish and wildlife, and biological systems) and the emissions of any materials (hazardous, toxic, chemical, radiological) on the ORR and environs."

2.0 Oak Ridge Reservation Background Information

The ORR is owned by the federal government and contains three major operating sites: ETTP, Y-12, and ORNL. Facilities at these sites were constructed as part of the Manhattan Project. Their primary missions have evolved over the years and continue to adapt to meet the changing research, defense, and environmental restoration needs of the United States.

Site Description

The ORR, as shown in Figure 2.1, encompasses approximately 35,000 acres and three major operational DOE facilities: ETTP, Y-12, and ORNL. The initial objectives of the ORO were the production of plutonium and the enrichment of uranium for nuclear weapons components. In the 70 years since the ORR was established, a variety of production and research activities have generated numerous radioactive, hazardous, and mixed wastes. These wastes, along with wastes from other locations, were disposed of on the ORR. Early waste disposal methods on the ORR were rudimentary compared to today's standards.

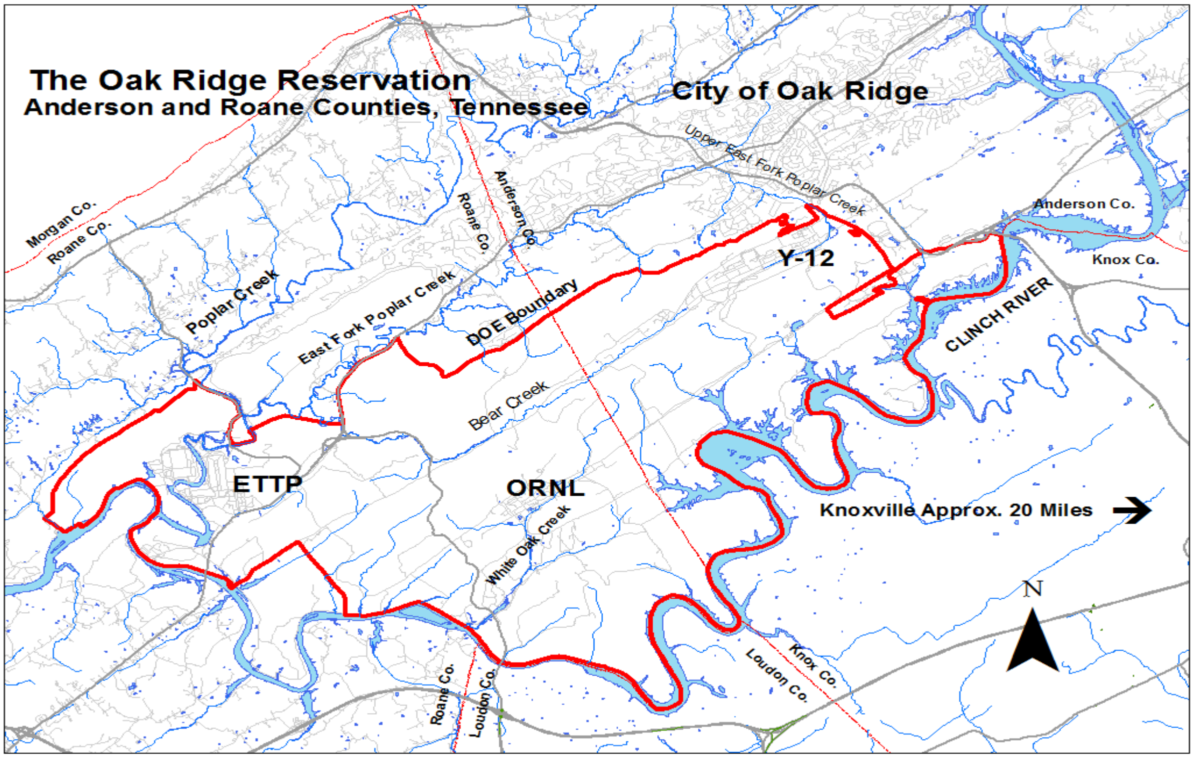

Figure 2.1 The Oak Ridge Reservation

The ORR is located in the counties of Anderson and Roane within the corporate boundaries of the City of Oak Ridge, Tennessee. The reservation is bound on the north and east by residential areas of the City of Oak Ridge and on the south and west by the Clinch River. Counties adjacent to the reservation include Knox to the east, Loudon to the southeast and Morgan to the northwest. Portions of Meigs and Rhea counties are immediately downstream from the ORR on the Tennessee River. The nearest cities are Oak Ridge, Oliver Springs, Clinton, Kingston, Harriman, Farragut, and Lenoir City. The nearest metropolitan area, Knoxville, lies approximately 20 miles to the east. Figure 2.2 depicts the general location of the Oak Ridge Reservation in relation to nearby cities and surrounding counties.

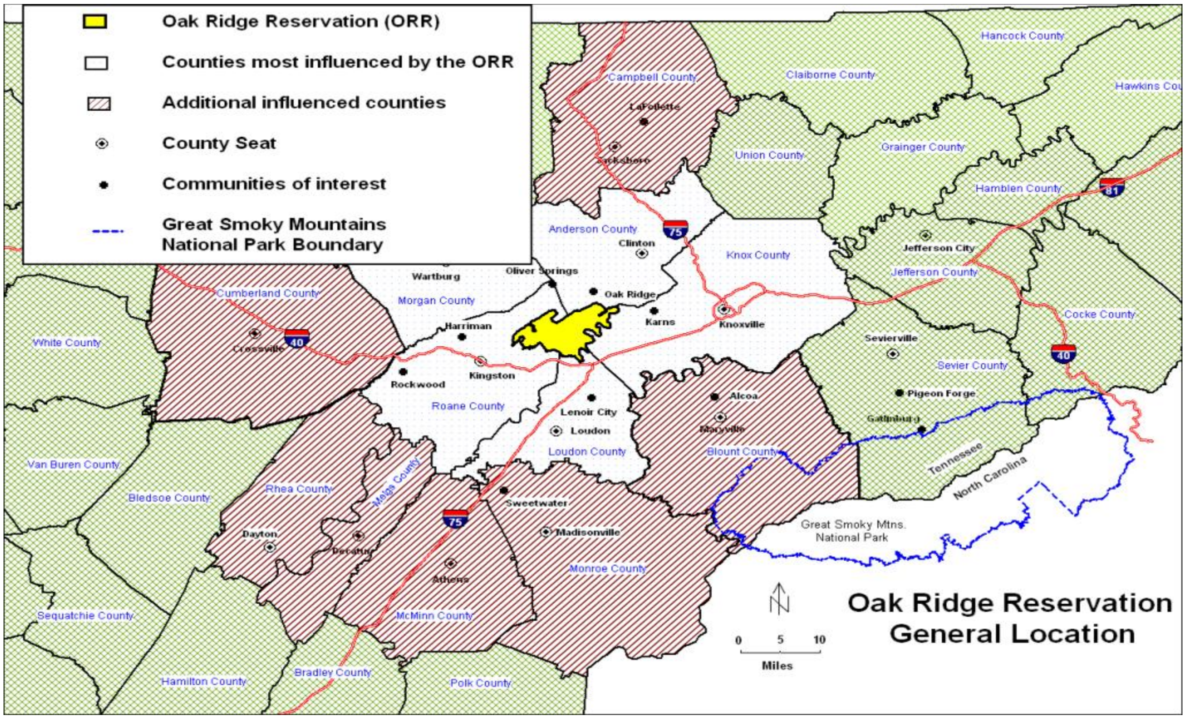

Figure 2.2 Location of the Oak Ridge Reservation in relation to surrounding counties

The ORR lies in the Valley and Ridge Physiographic Province of East Tennessee. The Valley and Ridge Province is a zone of complex geologic structures dominated by a series of thrust faults and characterized by a succession of elongated southwest-northeast trending valleys and ridges. In general, sandstones, limestones, and/or dolomites underlie the ridges that are relatively resistant to erosion. Weaker shales and more soluble carbonate rock units underlie the valleys.

The hydrogeology of the ORR is complex with a number of variables influencing the direction, quantity, and velocity of groundwater flow that may or may not be evident from surface topography. In many areas of the ORR, groundwater appears to travel primarily along short flow paths in the storm flow zone to nearby streams. In other areas, evidence indicates substantial groundwater flow paths, possibly causing the preferential transport of contaminants in fractures and solution cavities in the bedrock for relatively long distances and at considerable depths increasing the probability for offsite migration of those contaminants to the public.

3.0 Data Quality Objectives and Focus Areas

Data quality objectives (DQOs) are defined as an integrated set of thought processes that define the data quality requirements based on the intended uses of the data. DQOs are needed to obtain sufficient data of known and defensible quality for the intended use(s).

The DQO process is a seven-step iterative planning approach used to prepare plans for environmental data collection activities. It provides a systematic approach for defining the criteria that a data collection design should satisfy, including when, where, and how to collect samples or measurements; determination of tolerable decision error rates; and the number of samples or measurements that should be collected. DQOs define the purpose of the data collection effort, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data. These outputs, which are developed in the first six steps, are then used in the seventh and final step of the DQO process to develop a data collection design that meets all performance criteria and other design requirements and constraints (EPA/600/R-00/007).

3.1 DQO Step 1: State the Problem

The first step in the DQO process is to concisely describe the problem to be studied. Review of prior studies and existing information is necessary to gain a sufficient understanding to define the problem. The following problem statements were identified during the DQO meeting for this EMP.

3.1.1 Radionuclide Environmental Releases

Research, production, disposal activities, and accidents, past and present, have contributed to radiological releases to the environment on and near the ORR. This radionuclide focus area is designed to determine the effectiveness of the DOE monitoring program(s) and to conduct monitoring of media for radionuclides or their effects on the environment. Monitoring of air, sediment, surface water, groundwater, and biological media is warranted to determine human health and environmental risks.

3.1.2 Mercury Monitoring and Releases

Mercury has been described as the greatest environmental risk from Y-12. Releases of mercury have occurred at Y-12, ETTP, and ORNL. Research, production, disposal activities, and accidents, past and present, have contributed to mercury releases to the environment on and near the ORR. This focus on mercury will try to determine the effectiveness of the DOE monitoring program(s) and to conduct monitoring of media for mercury or its effects on the environment. Monitoring of air, sediment, surface water, groundwater, and biological media is warranted to determine human health and environmental risks.

3.1.3 Monitoring D&D Remedial Activities

Contaminated facilities on the ORR are being decommissioned and demolished. The process of demolishing buildings can make it difficult to contain hazardous compounds. In addition, several facilities would create a hazardous release if they collapsed. Building deterioration creates a number of exit pathways. Therefore, this focus on monitoring D&D activities is to determine the effectiveness of the containment strategies that are designed to prevent new releases to air, soil, sediment, surface water, and groundwater.

3.1.4 CERCLA Landfill

The materials from the D&D activities that meet the waste acceptance criteria (WAC) are placed onsite in a CERCLA landfill. Environmental monitoring is performed to determine compliance with ARARs specified in the ROD to include seasonal groundwater fluctuations in the uppermost aquifer beneath the site, and determine impacts to groundwater, surface water, stormwater, contact water, leachate, sediment basin discharge, and ambient air. In addition, another landfill has been proposed. Research is ongoing to determine if the new site meets the siting requirements to handle the anticipated waste.

3.1.5 Oversight of Impacts to Regional Groundwater

The groundwater beneath several areas of the ORR is contaminated from past mission activities. The contaminated groundwater on the ORR may have impacted groundwater at locations hydrologically downgradient of reservation sources. There is a need to assess the regional groundwater quality, providing a holistic approach to determine the impacts the contaminated groundwater sources have while establishing any risk to human health.

3.1.6 General Site Monitoring

To assess baseline conditions, current exposures, and to determine if there are new releases or sites, general site monitoring is warranted. Monitoring of air, sediment, surface water, groundwater, and biological media is warranted to determine human health and environmental risks.

3.2 DQO Step 2: Decisions to be Made

Step 2 of the DQO process is to identify what questions the study will attempt to resolve and what actions may result. The decisions identified during the DQO meeting are as follows:

3.2.1 Radionuclide Environmental Releases

Is radiological contamination leaving the ORR through property sales, surface water, sediment, groundwater, air, and biological media (fish, deer, and birds)?

Are there new releases or sites?

Do the detected concentrations of radionuclides in air, sediment, surface water, groundwater, and biological media exceed protective limits for human health or the environment?

3.2.2 Mercury Monitoring and Releases

Mercury in EFPC surface water exceeds standards for protection of aquatic life. How much mercury originates from the stream, floodplain, and legacy releases? How much originates from sources within Y-12?

Do the detected concentrations of mercury in air, sediment, surface water, groundwater, and biological media exceed protective limits for human health or the environment?

3.2.3 Monitoring D&D Remedial Activities

Are the containment strategies of the D&D remedial activities working?

Do the detected concentrations of contaminants in air, sediment, surface water, and groundwater exceed protective limits for human health or the environment?

3.2.4 CERCLA Landfill

Are the containment strategies for the landfill working?

Do the detected concentrations of contaminants in air, sediment, surface water, and groundwater exceed protective limits for human health or the environment?

3.2.5 Oversight of Impacts to Regional Groundwater

Are hazardous substances in offsite wells and springs potentially originating on the ORR?

Do the detected concentrations of contaminants in groundwater exceed protective limits for human health or the environment?

3.2.6 General Site Monitoring

How does the general site monitoring compare to previous years?

Did the general site monitoring determine a new site, source, or release?

Do the detected concentrations of contaminants in air, sediment, surface water, and groundwater exceed protective limits for human health or the environment?

3.3 DQO Step 3: Identify Inputs to Decisions

This step is to identify the information that needs to be obtained and the measurements that need to be taken to resolve the decisions statement. The inputs identified during the DQO process are as follows.

3.3.1 Radionuclide Environmental Releases

Inputs to the decisions will be sampling data and comparison to background, previous results, DOE Orders, EPA risk based criteria, or maximum contaminant levels (MCLs).

3.3.2 Mercury Monitoring and Releases

Inputs to the decisions will be sampling data and comparison to background, previous results, EPA risk based criteria, NRWQC, or MCLs. A baseline for airborne mercury particulate/vapor monitoring will need to be established prior to the D&D activities planned for in the subsequent years.

3.3.3 Monitoring D&D Remedial Activities

Inputs to the decisions will be sampling data and comparison to background, previous results, DOE Orders, EPA risk based criteria, NRWQC, or MCLs.

3.3.4 CERCLA Landfill

The inputs to the decisions will be the sampling data and the ARARs as specified in the ROD. In addition, surface water sampling data at the release points will be compared to state and federal AWQC.

3.3.5 Oversight of Impacts to Regional Groundwater

Inputs to the decisions will be sampling data and comparison to background, previous results, and MCLs.

3.3.6 General Site Monitoring

Inputs to the decisions will rely on sampling data and comparison to background data. This may include data used by DOE and TDEC, previous results, observations, DOE Orders, EPA risk based criteria, NRWQC, or MCLs (NPDWR and NSDWR) and National Water-Quality Assessment Program (NAWQA).

3.4 DQO Step 4: Define the Study Boundary

The purpose of this step is to clarify the site characteristics that the environmental measurements are intended to represent. In this step, time periods and spatial area to which decisions will apply (i.e., determine when and where the data will be collected) are specified. Practical constraints that could interfere with sampling also are identified in this step. For all the focus areas, the temporal limits of this plan are just for this year; however, the individual tasks to meet the focus area objectives may continue in future years to address the potential contaminant migration of legacy releases and to assess and detect potential new releases. The study area boundaries applicable to the EMP and defined during the DQO process are listed below.

3.4.1 Radionuclide Environmental Releases

The area limits are the ORR and the surrounding area.

3.4.2 Mercury Monitoring and Releases

The area limits are primarily associated with the surface water of WOC, Clinch River, EFPC, Bear Creek, and Y-12; however, groundwater area limit is a greater regional area surrounding the ORR, and the airborne area limit is currently just Y-12.

3.4.3 Monitoring D&D Remedial Activities

The area limits are buildings that are currently scheduled or scheduled in the near term to be demolished or could collapse and cause a release. In order to verify that no criteria established to be protective of environmental or human health risks are exceeded, monitoring will follow the scheduled demolition activities and, based on detected releases or potential releases, may continue for a year or more after demolition activity has concluded.

3.4.4 CERCLA Landfill

The area limits are the landfill and those areas immediately adjacent to it.

This present level of activity will continue until the site is closed and capped; however, long term monitoring of the facility is warranted upon closure of the site.

The proposed landfill will require additional investigation to verify the location is acceptable for long term storage.

3.4.5 Oversight of Impacts to Regional Groundwater

The area limits are the ORR and the surrounding area.

3.4.6 General Site Monitoring

The area limits are the ORR and the surrounding area for background.

3.5 DQO Step 5: Develop Decision Rules

Define the “if/then” statements, or logical basis, for determining the next course of action. These statements should include the project “action level.” The “if/then” statements identified during the DQO process provide a roadmap for achieving project goals for the EMP by making decisions, as identified in DQO Step 2, for each of the focus areas. The decisions to be made and goals to be attained are carried forward in a design process to ensure proper data are collected to determine if there are adverse impacts to public health, safety, or the environment from past or present activities.

3.5.1 Radionuclide Environmental Releases

If contamination is detected by screening level quality data, then determine if the location is a new release site by comparing results to historic data. Review the data with DOE representatives for the media or site monitored to determine an appropriate course of action. Additional sampling with definitive level data may be necessary to quantify risk or dose. If the data are definitive, then determine dose, environmental risk, and human health risk.

3.5.2 Mercury Monitoring and Releases

Known mercury releases for surface water and sediment are to be quantified to document trends to aid in determining appropriate actions. The data will be shared with DOE.

3.5.3 Monitoring D&D Remedial Activities

Determine if the contaminants detected are from a release due to D&D activities. If so, then review the results with DOE representatives to see if corrective actions can be applied and what actions are necessary to minimize the extent and prevent future releases.

3.5.4 CERCLA Landfill

Determine if the contaminants detected exceed the ARARs as specified in the ROD. If so, then review the data with EMWMF personnel.

3.5.5 General Site Monitoring

If the data from general site monitoring shows changing conditions that could warrant a potential new release, then contact DOE. Review the data with DOE representatives for the media or site being monitored to determine an appropriate course of action. With biological monitoring, determine what threatened and endangered species are on the ORR and share with the DOE representatives.

3.6 DQO Step 6: Specify Tolerable Limits on Decision Error

The purpose of this step is to define the tolerable decision error rates based on consideration of the consequences of making the incorrect decision. The probability limits on decision errors specify the level of confidence in conclusions drawn from site data. The outcome from the DQO process is as follows.

The DQO process provides a logical basis for linking Quality Assurance/Quality Control (QA/QC) procedures to the intended use for the data. Data categories were developed to assist in the interpretation of the data:

- Screening data with definitive confirmation: screening data are generated by rapid, less precise methods of sampling and analysis and looks only for the presence of a contaminant.
- Definitive data: definitive data are generated by rigorous sampling and analytical methods. Definitive data are used to define risk to the environment and human health.

With screening and definitive data, there are two primary components for decision error for the EMP:

- Sample error (largest factor) – location, frequency and timing, and procedure

- Analytical error (lesser factor) – detection limits and analytical procedure

To minimize sampling error and to ensure consistent, reproducible, and representative samples, sampling will be performed following Standard Operating Procedures (SOPs).

3.7 DQO Step 7: Optimize the Design for Obtaining Data

The purpose of this step is to identify a resource-effective field investigation sampling design that meets the decision performance criteria as specified in the preceding steps of the DQO process. Since this is an annual plan, adjustments will be made in subsequent years based on the results obtained with this plan.

4.0 Sampling and Monitoring Programs

To meet the DQOs of the primary focus areas, several sampling programs are designed based on functional media. The functional media includes radiological, biological, air, surface water, sediment, groundwater, CERCLA landfill monitoring, and the RadNet programs sponsored by the EPA.

4.1 Radiological Monitoring

The radiological monitoring projects will assist with the radiological monitoring goals of four of the primary focus areas (radiological environmental monitoring, monitoring D&D remedial activities, CERCLA landfill monitoring, and general site monitoring) as described in Section 1.1. The five radiological monitoring projects are environmental dosimeters, gamma tracer, portal monitor, surplus material verification, and the haul road survey.

4.1.1 Environmental Dosimeters

Environmental dosimeters are used to measure the radiation dose attributable to external radiation at 140 locations on and in the vicinity of the ORR. The environmental dosimeter program provides:

- conservative estimates of the potential dose to members of the public from exposure to gamma radiation attributable to DOE activities/facilities on the ORR
- baseline values used to assess the need for and/or effectiveness of remedial actions
- information necessary to establish trends in gamma radiation emissions
- information relative to the unplanned release of radioactive contaminants

The dosimeters used in the program are obtained from Landauer, Inc., of Glenwood, Illinois. Each of the dosimeters uses an aluminum oxide photon detector to measure the dose from gamma radiation [minimum reporting value = 1 millirem (mrem)]. At locations where there is a potential for the release of neutron radiation, the dosimeters also contain an allyl diglycol carbonate based neutron detector (minimum reporting value = 10 mrem). The dosimeters are collected quarterly and shipped to the vendor for processing. The areas being monitored with environmental dosimeters are listed in Table 4.1.

To account for exposures received in transit, control dosimeters are provided with each shipment of dosimeters received from Landauer, Inc. These dosimeters are stored in a lead container (lead pig) at the TDEC Oak Ridge office during the monitoring period and returned to Landauer, Inc. for processing with the associated field-deployed dosimeters. Any dose reported for the control dosimeters is subtracted from the results for the field-deployed dosimeters prior to being reported.

Table 4-1: Environmental Dosimeters

Sample Site	Number of Dosimeter Locations	Sampling Rationale
Offsite	13	Determine normal background
Y-12	3	Monitor three areas at Y-12
ETTP	24	Monitor areas at ETTP
ORNL	37	Monitor areas on ORNL and its surrounding areas
ORNL SNS	16	Monitor areas at SNS
EMWMF	47	Monitor EMWMF cells and ponds

ETTP - East Tennessee Technology Park
ORNL - Oak Ridge National Laboratory
SNS - Spallation Neutron Source
EMWMF - Environmental Management Waste Management Facility

4.1.2 Gamma Exposure Rate Monitoring

Gamma radiation exposure rate monitors equipped with microprocessor-controlled data loggers have been deployed on the ORR since 1996. The instruments are primarily used to record exposure rates at locations where the radiation levels are expected to fluctuate significantly over relatively short periods of time (e.g., remedial and waste management activities) and to supplement the integrated dose rates provided by the TDEC environmental dosimetry program. While the environmental dosimeters provide the cumulative dose over the time period monitored (months), the results cannot account for the specific time, duration, and magnitude of fluctuations in the dose rates. Consequently, when using dosimeters alone, a series of small releases cannot be distinguished from a single large release. The exposure rate monitors measure and record gamma radiation levels at predetermined intervals (e.g., minutes), providing an exposure rate profile that can be correlated with activities and/or changing conditions. The results are compared to background levels and dose limits provided in state regulations. Findings are used to identify unplanned releases of radioactivity, to assess compliance with state regulations and DOE Orders and to evaluate DOE control measures.

The gamma exposure rate monitors are used to monitor gamma emissions at the five locations listed below and depicted in Figure 4.1.

- Fort Loudoun Dam (background location)

- EMWMF in Bear Creek Valley southwest of Y-12
- ORNL Central Campus Remediation (Radioisotope Development Lab Removal Action – 3000 Area)
- ORNL Molten Salt Reactor Experiment (MSRE)
- Spallation Neutron Source exhaust stack

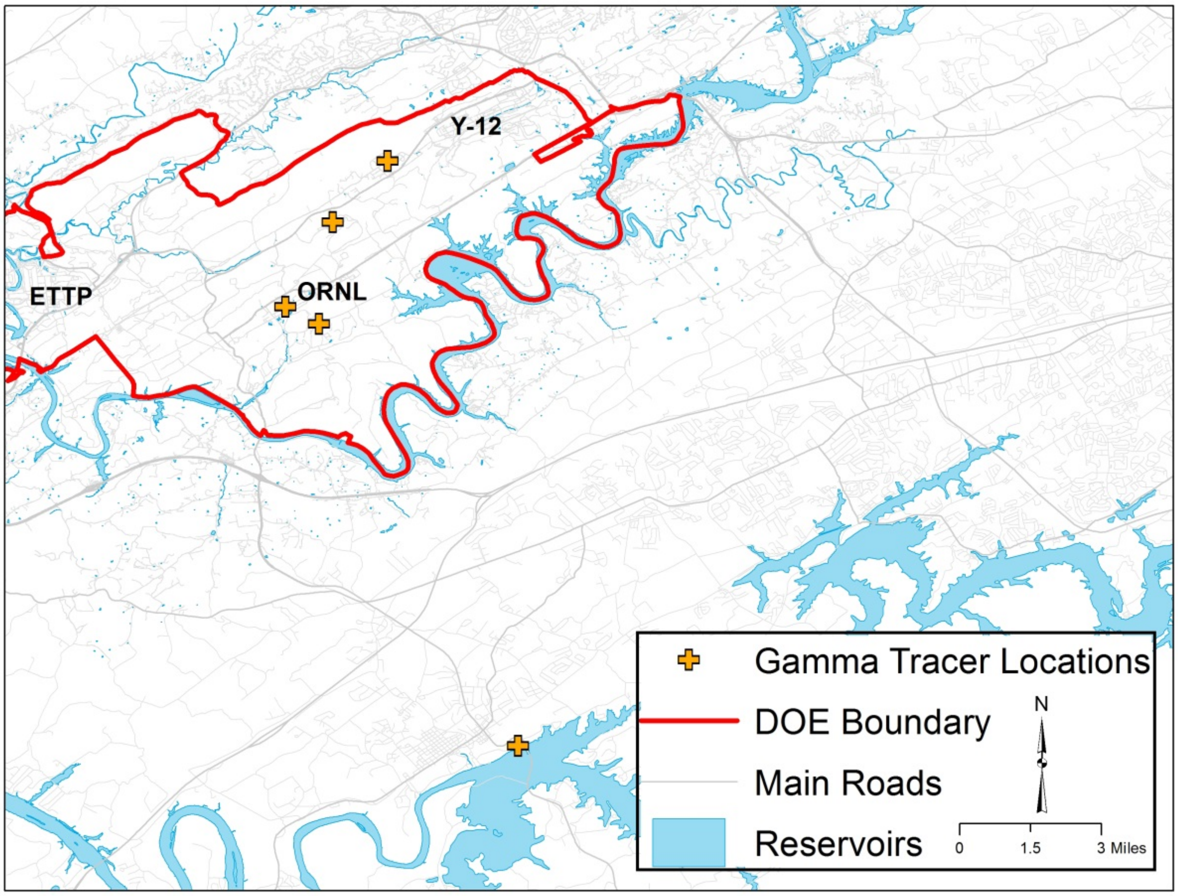

Figure 4.1 Gamma exposure rate monitoring locations

4.1.3 Portal Monitor

To help ensure compliance with the WAC for the CERCLA landfill, TDEC has placed a radiation portal monitor (RPM) at the check-in station to scan trucks transporting waste into EMWMF for disposal. As the trucks pass through the portal, gamma radiation levels are measured and transmitted to a secure website monitored by TDEC personnel and available to DOE and its authorized contractors for review. Basic information (the nature and source of the waste passing through the portal at the time of the measurements) is obtained from EMWMF personnel. If preliminary information indicates the facility's WAC may have been violated, the information is submitted to TDEC for review and disposition.

A Canberra© RadSentry Model S585 portal monitor is used in the program. The system is comprised of two large area gamma-ray scintillators, an occupancy sensor, a control box, a computer, and associated software. The gamma-ray scintillators and instrumentation are contained in radiation sensor panels (RSPs) mounted on stands located on each side of the road at the check-in station for trucks hauling waste into the disposal area. Measurements (one per 200 milliseconds) are initiated by the occupancy sensor when a truck enters the portal. Results are transmitted from the RSPs to the control box, where it is stored, analyzed, and uploaded to a secure website, along with associated information (e.g., date, time, and background measurements). Data on the website is monitored by TDEC personnel and available for review by DOE and their authorized contractors. If radiation levels exceed a predetermined level, the RPM sends an alert notification to TDEC personnel by email. When an alert notification is received or anomalies are noted in review of the data, DOE and EMWMF personnel are contacted and the source of the waste passing through the portal monitor at the time of the measurements is determined.

4.1.4 Surplus Material Verification

TDEC performs radiological oversight of DOE surplus "free release" materials to the public to ensure compliance with U.S Atomic Energy Commission Regulatory Guide 1.86 limits specified in Table 4.2 (USAEC, 1997). In addition, TDEC reviews the procedures used for release of materials under DOE radiological regulations. DOE currently operates their surplus materials release program under *DOE O 458.1 Admin Chg 3, Radiation Protection of the Public and the Environment*. Some surplus materials, such as scrap metal, may be sold to the public under annual sales contracts, whereas other materials are staged at various sites around the ORR awaiting public auction/sale. TDEC, as part of its larger radiological monitoring role on the reservation, conducts these surveys to help ensure that no potentially contaminated materials reach the public. If items are found with elevated levels of radionuclides, the information is provided to the surplus sales manager. If sales occur during the first six months of 2017 they will be recorded and reported.

Table 4.2: Acceptable Surface Contamination Levels			
Nuclide [a]	**Average [b,c]**	**Maximum [b,d]**	**Removable [b,e]**
U-natural, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emissions or spontaneous fission) except Sr-90 and other noted above.	5,000 dpm β-γ/100 cm^2	15,000 dpm β-γ/100 cm^2	1,000 dpm β-γ/100 cm^2

(USAEC, 1997)

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should be applied independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector by background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such objects.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping the area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination of objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

4.1.5 Haul Road Surveys

The haul road was constructed for and is dedicated to trucks transporting CERCLA radioactive and hazardous waste from remedial activities on the ORR for disposal to EMWMF in Bear Creek Valley. To account for wastes that may fall or be blown from the trucks in transit, TDEC personnel perform walk over inspections of the road and associated access roads quarterly or more often. Anomalous items noted are surveyed for radiological contamination, logged, and their description and location submitted to DOE for disposition. The nine-mile long haul road is surveyed in segments typically consisting of one to two miles on a quarterly or more frequent basis (weather permitting).

4.2 Biological Monitoring

The TDEC biological monitoring projects will assist with the monitoring goals for five of the primary focus areas (radiological environmental monitoring, mercury monitoring and release, monitoring

D&D remedial activities, CERCLA landfill monitoring, and general site monitoring) as described in Section 1.1. The four biological monitoring projects include bat monitoring, mercury uptake in biota, radiochemical uptake in aquatic vegetation, and benthic macroinvertebrates.

4.2.1 Bat Monitoring

TDEC is identifying and inventorying the bat community present on the ORR. This is done by using ultrasonic acoustic bat call recording equipment. Bat boxes are deployed to collect guano to assess mercury uptake and determine bat species by sampling the deoxyribonucleic acid (DNA) in the guano. The principal goal of this monitoring project is to assess seasonal use of DOE federal lands by bat species and determine if there is an increase in mercury uptake by bats along stretches of EFPC. Locations acoustically surveyed and sampled for guano are provided in Table 4.3 and shown on Figure 4.2.

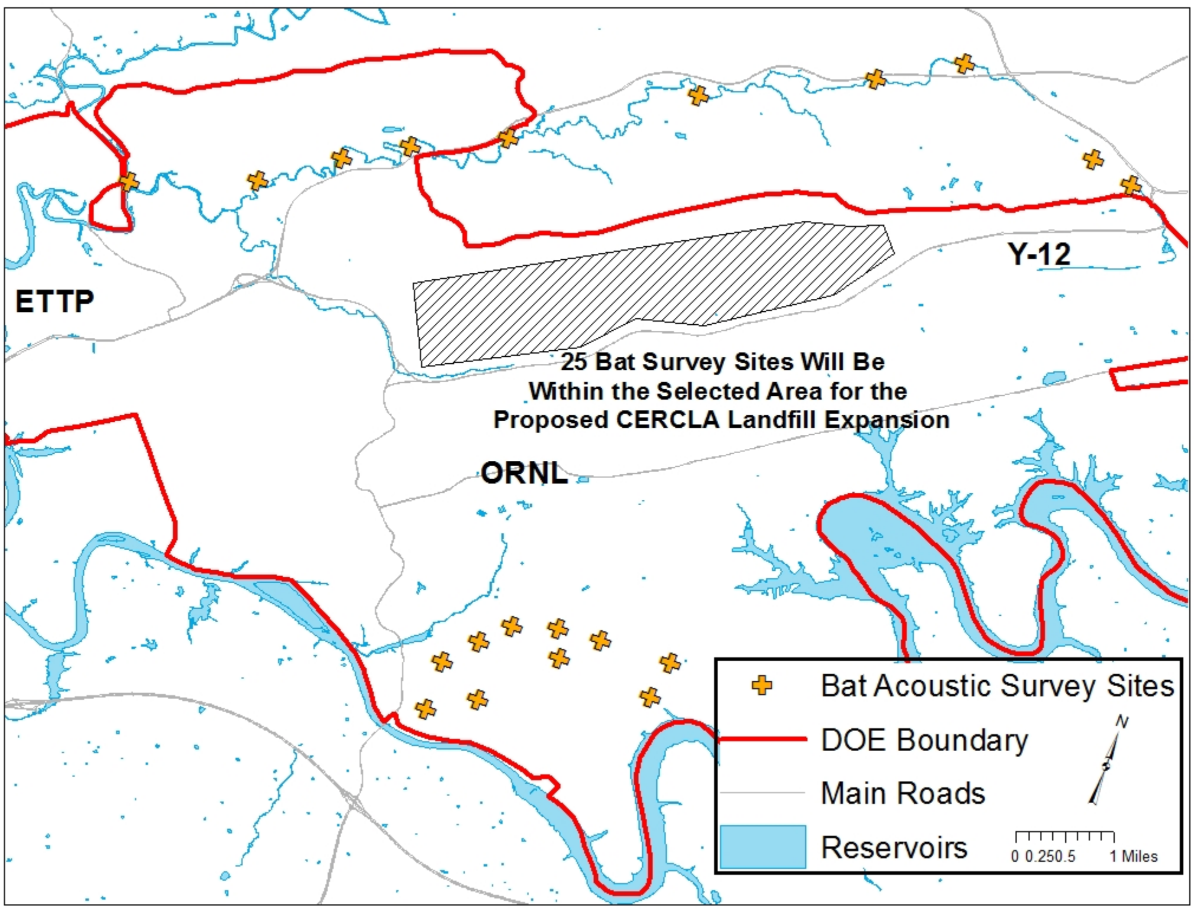

Figure 4.2 Bat acoustic survey and sample locations

The acoustic surveys will aid in determining the status of federally endangered bats (Indiana bat, Gray bat) in Tennessee. Acoustic information should be helpful in identifying areas where netting surveys could further build upon bat distribution data, especially where calls of the genus Myotis are recorded most frequently. The Northern Long-eared bat is currently listed as a federally threatened species by the US Fish and Wildlife Service. Many bat investigations on federal land have been limited to short-term 2-4 night surveys of mist-netting and acoustic surveys to meet the Indiana bat monitoring requirements of Section 7 of the Endangered Species Act. As a result, few bat acoustic surveys have been conducted over the years, and bat data are inconsistent or often non-existent in critical habitat areas such as the forested National Environmental Research Park (NERP) area of the ORR.

Lastly, this monitoring will support the protection and conservation of endangered bat species, a major component of the TDEC mission, and support efforts to combat white-nose syndrome, and determine if there is an effect from the historic and ongoing releases of mercury to the bat community. This project, along with a concurrent ORNL Environmental Science Division bat project, represents the first long term, large-scale acoustic bat community investigation on the ORR.

Table 4.3: Bat Acoustic Survey and Sampling Locations		
Sample Location	**Sampling Rationale**	**Survey/Sampling**
Tower Shielding-1	Cave monitoring for White Nose Syndrome	Acoustic bat survey
Tower Shielding-2		
Tower Shielding-3		
Tower Shielding-4		
Tower Shielding-5	Roost tree monitoring for T&E species	Acoustic bat survey
Tower Shielding-6		
Tower Shielding-7		
Tower Shielding-8		
Tower Shielding-9		
Tower Shielding-10		
EMDF-1	Determine if T&E species are present on the site	Acoustic bat survey
EMDF-2		
EMDF-3		
EMDF-4		
EMDF-5		
EMDF-6		
EMDF-7		
EMDF-8		
EMDF-9		
EMDF 10 Through EMDF-30		
EFPC-1	Determine if roost trees are present in riparian zone	Acoustic bat survey
EFPC-2		
EFPC-3		
EFPC-4		
EFPC-5		
EFPC-6		
EFPC-7		
EFPC-8		
EFPC-9		
EFPC-10		
EFPC-11	Determine if bats are uptaking Mercury from East Fork Poplar Creek insects	Bat box deployment (guano sampling for mercury analysis and DNA testing)
EFPC-12		
EFPC-13		
EFPC-14		
EFPC-15		
EFPC-16		
EFPC-17		
EFPC-18		
EFPC-19		
EFPC-20		
BCK-1	Determine if bats are uptaking Mercury from Bear Creek insects	Bat box deployment (guano sampling for mercury analysis and DNA testing)
BCK-2		
BCK-3		
BCK-4		
BCK-5		

EMDF - Environmental Management Disposal Facility
EFPC - East Fork Poplar Creek
DNA - deoyxribonnucleic acid
T&E - Threatened and Endangered Species
BCK - Bear Creek

4.2.2 Mercury Uptake in Biota

Three separate sampling efforts for fungi, fish, and insects will help quantify and document how mercury moves up the food chain. The goal is to collect samples at up to 45 locations combined for all three efforts. Samples are collected for total mercury with an option to add methyl mercury pending the results of initial mercury analyses.

Fungi

TDEC personnel will collect mushroom sporocarps and other fungi in the upper EFPC floodplain contaminated by legacy mercury releases from Y-12. It has been documented by researchers that fungi, including wild edible mushrooms, bioaccumulate significant concentrations of mercury and other heavy metals within their fruiting bodies (i.e., sporocarps). Wild, edible mushrooms such as the King Bolete (*B. edulis*) and the Common Chanterelle (*C. cibarius*) have been documented as effective bioaccumulators of methyl mercury from impacted substrates, which is a human health concern (Farlandysz and Bielawski 2001, Stihi et al. 2011, Falandysz 2012a). Metal contents in fruiting bodies are affected by the age and sheer size of the subterranean mycelium and the interval between fructifications (i.e., formation of fruiting bodies; Das 2005). Mushrooms are known to take up and bioconcentrate mercury (e.g., Stegnar et al. 1973, Byrne et al. 1976, Seeger and Nutzel 1976, Minagava et al. 1980, Kalač et al.1991, 1996, Sesli and Tüzen 1999, Alonso et al. 2000, Svoboda et al. 2000, Falandysz 2002, 2003, Cocchi et al. 2006; Ita et al. 2006, Svoboda et al. 2006, Melgar et al. 2009) due to their filamentous mode of growth, branching and extra cellular release of enzymes and metabolites. In contrast, studies on the accumulation of methyl mercury in mushrooms are few (Stegnar et al. 1973; Minagava et al. 1980; Bargagli and Baldi 1984; Fischer et al. 1995).

The goal is to collect enough fruiting bodies of each species to provide a 5-10 gram dry weight sample for laboratory analysis (Eckl et al. 1986). Mushrooms are photographed before extraction as an aid to taxonomic identification of each sporocarp. Mushrooms are carefully extracted from substrates with plastic, glass or pottery instruments to avoid any metal contacts that can influence the results (Elekes et al. 2010).

Fish

Members of the public could be exposed to contaminants originating from DOE ORR activities through consumption of fish caught in area waters. To monitor this human exposure pathway, sunfish and catfish are collected annually from three locations on the Clinch River and edible fish flesh is analyzed for selected parameters. In cooperation with ORNL Environmental Sciences Division, TDEC will obtain the associated gut contents of the fish to conduct taxonomic evaluation and mercury analysis of the gut contents. Biomagnification of methyl mercury through dietary pathways, rather than gill uptake from water alone, is considered the dominant mechanism for elevated methyl mercury concentrations in fish (Jernelöv and Lann 1971, Phillips and Buhler 1978, Rodgers and Beamish 1981, Harris and Snodgrass 1993, Rodgers 1994, 1996, Hall et al. 1997).

The goals are to identify the principal diet items of the selected ORR stream fish species, identify the collected fish to species, assess mercury and the option of methyl mercury content of fish gut contents collected from the ORR and control streams, and to determine the magnitude of the contamination in edible portions of EFPC fish species where pollutants could be incidentally consumed by humans.

Insects

Adult insects and their larvae also inhabit the contaminated floodplain of EFPC. Murphy et al. (2005) have shown that redbreast sunfish and smallmouth bass in the South River in Virginia consume appreciable quantities of the terrestrial green June beetle (*Cotinis nitida*) during the summer months. These beetles have been shown by Murphy (2004) to accumulate considerable mercury from the floodplain of the river. Terrestrial insects in the EFPC floodplain may be a potential vector for the spread of mercury contamination to the aquatic and terrestrial food chain. Adult flying insect samples, collected with malaise traps, light traps, bug nets, and beetle traps, will be sampled at 15 locations in EFPC and BCK floodplains. Reference insect samples will also be collected offsite at three locations to be determined. Total maximum samples expected is 18.

Stream benthic biota (i.e., snails, crawdads, fish, etc.) will be sampled at 10 locations in EFPC and BCK floodplains. Reference biota samples will also be collected offsite at three locations to be determined during the study. Total maximum samples expected is 26. TDEC anticipates collecting two biota samples at each of the 13 total sites.

4.2.3 Aquatic Vegetation Monitoring

If surface water bodies have been impacted by radiological contamination, certain aquatic organisms in the immediate vicinity may uptake radionuclides. This program will focus on the detection and characterization of radiological constituents that may be bioaccumulated by aquatic vegetation on and in the vicinity of the ORR.

Target vegetation for sampling includes, but will not be limited to, common cattail (Typha latifolia) and watercress (*Nasturtium officinale*). Locations considered as potential monitoring sites include springs, seeps, streams, creeks, wetlands, ponds, and floodplains. Watersheds such as Bear Creek and its tributaries, White Oak Creek/Lake and its tributaries, Mitchell Branch, and EFPC are all probable target locations for sampling.

Up to twenty locations will be sampled for gross alpha and gross beta, plus gamma radionuclides. The monitoring will focus on areas likely to have radiological contamination, either from past or current DOE activities. Current activities may include areas downstream of the demolition of buildings with radiological contamination from past activities to determine if radiological constituents are migrating into the environment. This project will continue to focus on the detection and characterization of radiological constituents that may be bioaccumulated by aquatic vegetation in and near water on the ORR.

4.2.4 Benthic Macroinvertebrates

Benthic macroinvertebrates include insects, crustaceans, annelids, mollusks, and other organisms with long aquatic life cycles (i.e., multiple stages of larval instars) that inhabit the bottom substrates of aquatic systems and can be easily collected using aquatic sampling nets of ≤500 μm (Hauer and Resh 1996). Occupying the primary consumer trophic level in aquatic ecosystems, macroinvertebrates serve as a link between producers (e.g., algae) and decomposers (e.g., microorganisms) in a food chain, provide a major food source for fisheries, and maintain a diverse spectrum in species composition (Song 2007). Because they are ubiquitous and sedentary, and sensitive in varying degrees to anthropogenic pollutants and other stressors, macroinvertebrate communities can provide considerable information regarding the biological condition of water bodies (Davis and Simons 1995, Karr and Chu 1998). Aquatic macroinvertebrate assemblages provide a surrogate measure of water chemistry and physical stream conditions (Cummins 1974, Vannote et al. 1980, Rosenberg and Resh 1993, Weigel et al. 2002) to indicate the overall health of the aquatic system (Meyer 1997, Karr 1999).

Semi-quantitative kick net samples (SQKICK) provide a snapshot of the benthic community population at a particular stream location and the respective taxonomic identifications and taxa counts present at this site are used to calculate the Tennessee Macroinvertebrate Index. Several quantifiable attributes of the biotic assemblage (i.e., "metrics") that assess macroinvertebrate assemblage structure, composition, and function comprise these indices (Hilsenhoff 1982, 1987, 1988, Fore et al. 1996, Karr and Chu 1998), and metrics are used to measure and calculate an overall score to represent the ecological condition and integrity of stream health. This multimetric index approach is effective for evaluating anthropogenic disturbance and pollution, for standardizing assessment and for communicating the biotic condition of streams (Barbour et al. 1999), because susceptibility to toxic agents varies with the response of individual genera and species (Resh et al. 1988, 1996).

Historically, four aquatic systems originating on the ORR (EFPC, Bear Creek, Mitchell Branch, and the WOC/Melton Branch watershed) have been impacted by DOE-related activities. EFPC and Bear Creek have received input from Y-12, Mitchell Branch from ETTP, and the White Oak Creek/Melton Branch watershed from the ORNL. Contaminant releases to surface water and groundwater vary among these industrial sites, but generally include organic pollutants, heavy metals, and radionuclides.

Thirteen stream stations will be sampled on the ORR from the four main watersheds (i.e., EFK, BCK, MIK, & WOC). Melton Branch (MEK) is a tributary to WOC. In addition, six reference streams will be sampled (Table 4.4, Figure 4.3).

Table 4.4: Oak Ridge Reservation Benthic Macroinvertebrates Monitoring Sites				
Station	**Description**	**Reference**	**TDEC DWR Designation**	**Sampling Rationale**
EFK 25.1	East Fork Poplar Creek km 25.1	thin canopy	EFPOP015.6AN	Impacted Site
EFK 24.4	East Fork Poplar Creek km 24.4	canopy	EFPOP015.2AN	Impacted Site
EFK 23.4	East Fork Poplar Creek km 23.4	open	EFPOP014.5AN	Impacted Site
EFK 13.8	East Fork Poplar Creek km 13.8	open	EFPOP008.6AN	Impacted Site
EFK 6.3	East Fork Poplar Creek km 6.3	canopy	EFPOP003.9RO	Impacted Site
HCK 20.6	Hinds Creek km 20.6 reference	canopy	HINDS012.8AN	Reference Site
CCK 1.45	Clear Creek km 1.45 reference	thin canopy	ECO67F06	Reference Site
GHK 2.9	Gum Hollow Branch km 2.9 reference	canopy	GHOLL001.8RO	Reference Site
MIK 1.43	Mitchell Branch km 1.43 reference	canopy	MITCH000.9RO	Reference Site
MIK 0.71	Mitchell Branch km 0.71	open	MITCH000.4RO	Impacted Site
MIK 0.45	Mitchell Branch km 0.45	thin canopy	MITCH000.3RO	Impacted Site
BCK 12.3	Bear Creek km 12.3	canopy	BEAR007.6AN	Impacted Site
BCK 9.6	Bear Creek km 9.6	canopy	BEAR006.0AN	Impacted Site
MBK 1.6	Mill Branch km 1.6 reference	canopy	FECO67I12	Reference Site
WCK 6.8	White Oak Creek km 6.8 reference	thin canopy	WHITE004.2RO	Reference Site
WCK 3.9	White Oak Creek km 3.9	thin canopy	WHITE002.4RO	Impacted Site
WCK 3.4	White Oak Creek km 3.4	canopy	WHITE002.1RO	Impacted Site
WCK 2.3	White Oak Creek km 2.3	canopy	WHITE001.4RO	Impacted Site
MEK 0.3	Melton Branch km 0.3	thin canopy	MELTO000.2RO	Impacted Site

km - kilometer
TDEC DWR - Tennessee Department of Environment and Conservation Division of Water Resources

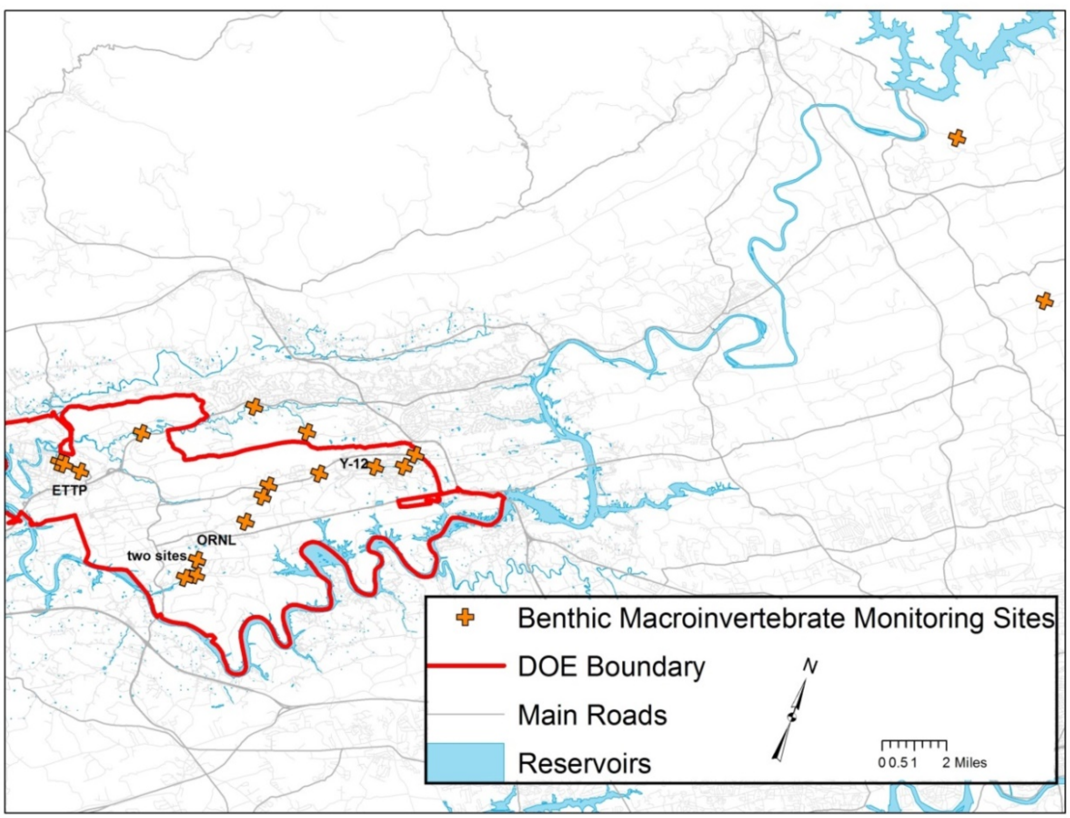

Figure 4.3 Benthic macroinvertebrate sampling locations

4.3 Air Monitoring

Currently, only the fugitive air monitoring program for the ORR is planned; however, we supplement this program with an EPA program discussed in Section 4.9. The fugitive air monitoring program will assist with meeting several primary focus areas of radiological monitoring, monitoring D&D remedial activities, CERCLA landfill monitoring, and general site monitoring.

Efforts will be made to determine what is required to analyze air emissions for mercury at Y-12. With the threats of mercury in the environment and the amount of mercury that may be in some of the buildings scheduled for demolition in subsequent years, TDEC will explore mercury monitoring technologies to enhance monitoring prior to any airborne releases.

4.3.1 Fugitive Air Monitoring

The fugitive air monitoring program uses eight mobile high-volume air samplers. The fugitive air monitoring project will focus on locations where there is a potential for airborne releases of radioactive pollutants from non-point sources of contaminants (i.e., fugitive emissions). Candidate monitoring locations include remedial activities, waste management operations, and the D&D of contaminated facilities (Figure 4.4). Table 4.5 provides the sampling frequency and the analyses for each location. The results from the ORR monitors are compared to background measurements for determining if releases are occurring, and to limits provided in the Clean Air Act for assessing compliance with associated emission standards. Findings are used to identify and characterize unplanned releases, assess the dose to the public as defined in 10 Code of Federal Regulations 835, and to evaluate DOE monitoring and control measures for preventing airborne releases to the environment as required by the TOA (C.2 Radiological Oversight).

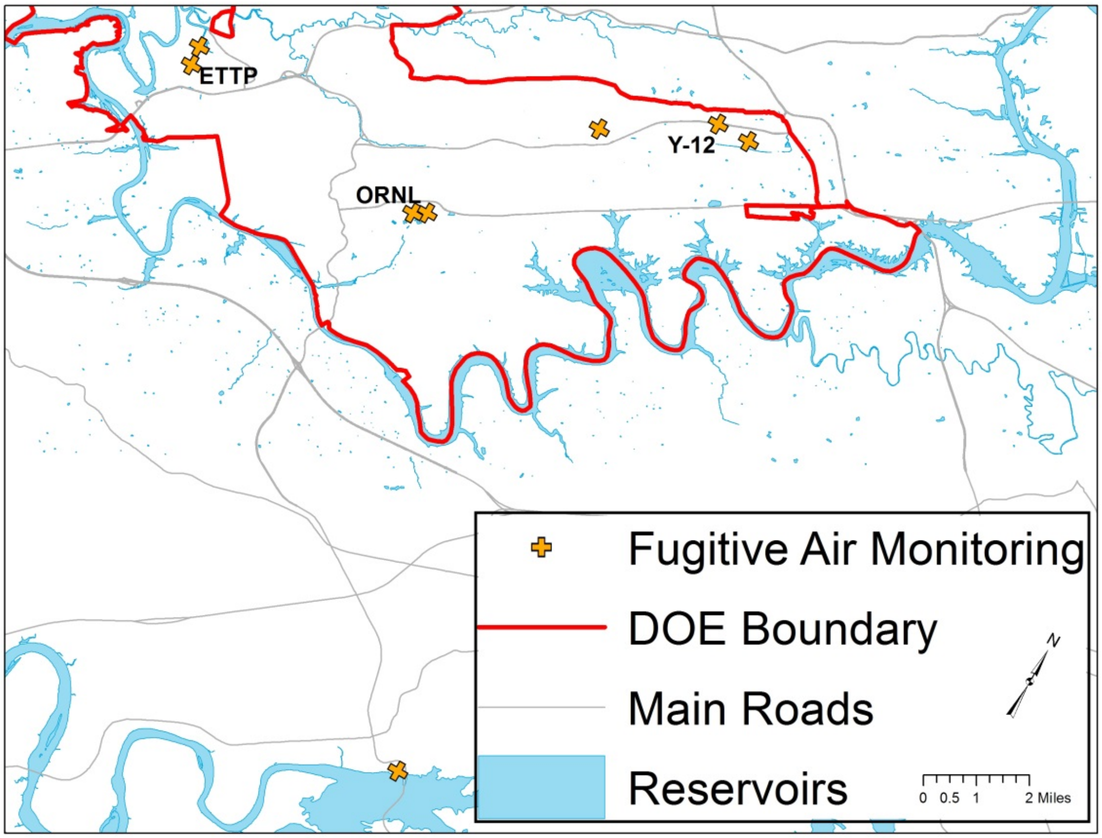

Figure 4.4 Fugitive air monitoring locations

Table 4.5: Fugitive Air Monitoring		
Station	**Sampling Frequency**	**Analysis**
Y12 B9723-28	Collected Weekly, Composited every four weeks	Isotopic Uranium, Technetium-99
Y12 B9212		Isotopic Uranium, Technetium-99
ETTP K25 K11		Isotopic Uranium, Technetium-99
ETTP Portal 4		Isotopic Uranium, Technetium-99
ORNL Corehole 8		Isotopic Uranium, Gamma Radionuclides
ORNL B4007		Isotopic Uranium, Gamma Radionuclides
EMWMF		Isotopic Uranium, Gamma Radionuclides, Technetium-99
Background		Isotopic Uranium, Gamma Radionuclides, Technetium-99

ETTP - East Tennessee Technology Park
ORNL - Oak Ridge National Laboratory
EMWMF - Environmental Management Waste Management Facility
B - building number

4.4 Surface Water Monitoring

The surface water monitoring projects will assist with the monitoring goals for five of the primary focus areas (radiological environmental monitoring, mercury monitoring and release, monitoring D&D remedial activities, CERCLA landfill monitoring, and general site monitoring) as described in Section 1.1. There are four surface water monitoring projects and they include surface water physical parameters, surface water physical parameters with continuous data loggers, ambient surface water, and rain event surface water.

4.4.1 Surface Water Physical Parameter Monitoring

Due to the presence in some areas of anthropogenic point- and non-point source contamination on the ORR, there exists the potential for contamination to impact surface water on the ORR. To assess the degree of surface water impact relative to this potential contamination displacement, stream monitoring data will be collected monthly to establish a database of physical stream parameters (specific conductivity, pH, temperature, and dissolved oxygen). The purpose of this monitoring is to have a database/baseline of conditions on and around the ORR and to record ambient conditions that can be compared in the event of accidents that may have impacted surface water bodies. Table 4.6 and Figure 4.5 provide the locations selected for the monthly physical parameter monitoring.

Table 4.6: Surface Water Physical Parameter Monitoring Locations

Stream	DWR ID	Alternate ID	Location
East Fork Poplar Creek	EFPOP015.6AN	EFK 23.4	East Fork Poplar Creek (near Y-12 east gate)
	EFPOP014.5AN	EFK 13.8	East Fork Poplar Creek (near Big Turtle Park)
Bear Creek	BEAR007.6AN	BCK 12.3	Bear Creek(near Y-12 west gate)
	BEAR006.0AN	BCK 9.6	Bear Creek (near Walk-in Pits)
	BEAR002.8AN	BCK 4.5	Bear Creek (Weir at Hwy 95)
Mitchell Branch	MITCH00.06RO	MIK 0.1	Mitchell Branch (Weir at ETTP)
Mill Branch	FEC067112	MBK 1.6	Mill Branch (Reference)

ETTP - East Tennessee Technology Park
DWR ID - Division of Water Resources's Identification

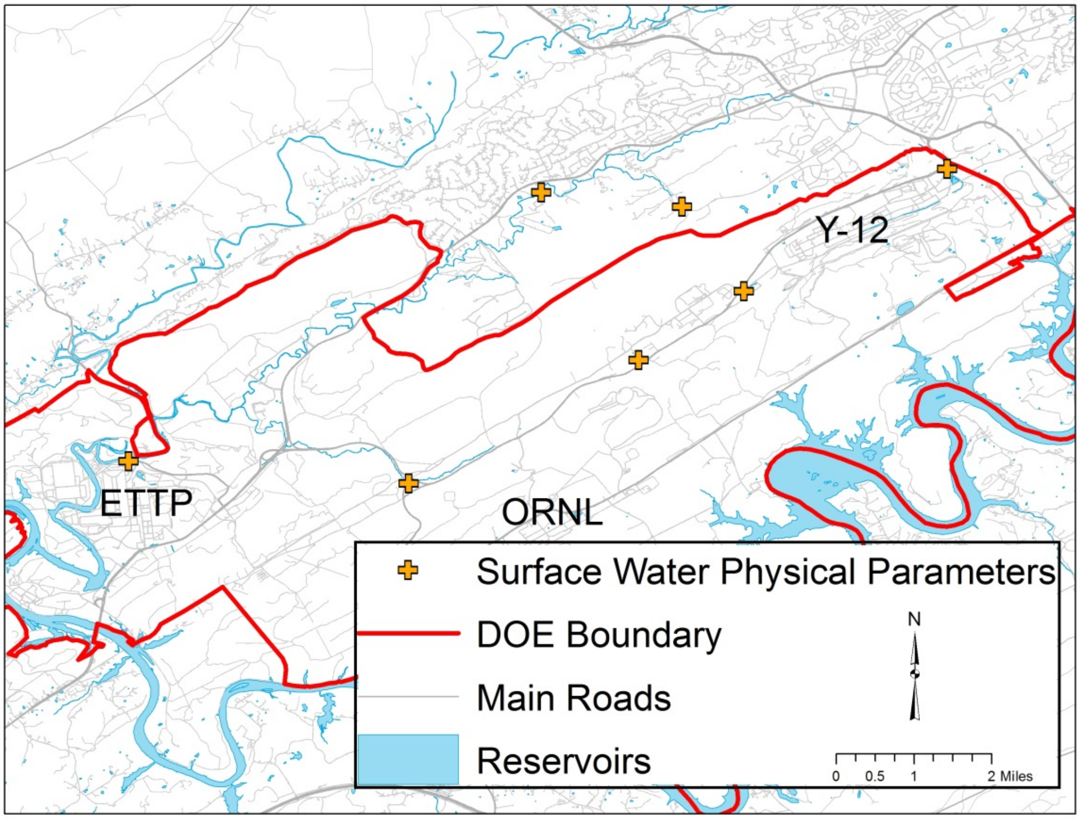

Figure 4.5 Surface water physical parameter monthly sampling locations

4.4.2 Ambient Surface Water Monitoring

The ORR Clinch River tributaries of Raccoon Creek, Grassy Creek, Poplar Creek, and McCoy Branch drain into the Clinch River. The public municipalities in this area of the Clinch River are the city of Norris, the city of Clinton, the city of Oak Ridge, the city of Kingston, and parts of Knox County. The ORR nuclear processing facilities in this area of the Clinch River are ETTP, Y-12 and ORNL. To obtain public drinking water and industrial plant processing water, all of these areas utilize the surface water of the Clinch River. TDEC will conduct surface water sampling at the locations provided in Table 4.7 and shown in Figure 4.6 to detect possible contamination from ORR DOE facilities. All sampling locations are analyzed for hardness, dissolved and suspended residue, arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, gross alpha, and gross beta. Samples are collected at White Oak Creek kilometer 2.3 and one reference site for the analysis of gamma radionuclides. Strontium-90 and technetium-99 will be analyzed from samples collected at Raccoon Creek and one reference site.

Table 4.7: Ambient Surface Water Monitoring Locations				
River System	Monitoring Location	DWR ID	Alternate ID	Monitoring Rationale
Clinch River	Clinch River Mile 78.7	CLINC078.7AN	CRK 126.7*	Reference site upstream of DOE ORR facilities
	Clinch River Mile 17.9	CLINC017.9RO	CRK 28.8	Surveillance of water quality downstream of White Oak Creek outfall
	Clinch River Mile 10.0	CLINC010.0RO	CRK 16.1	Surveillance of water quality downstream of all DOE ORR facilities
Raccoon Creek	Raccoon Creek Mile 1.6	RACCO001.6RO	RCK 2.6	Surveillance of water quality possibly influenced by contaminated groundwater from SWSA 3
East Fork Poplar Creek	East Fork Poplar Creek Mile 15.6	EFPOP015.6AN	EFK 25.1	Surveillance of water quality at East Fork Poplar Creek (EFPC) headwaters
	East Fork Poplar Creek Mile 14.5	EFPOP014.5AN	EFK 23.4	Surveillance of water quality at point where EFPC leaves leaves DOE property and enters Oak Ridge
	East Fork Poplar Creek Mile 8.6	EFPOP008.6AN	EFK 13.8	Surveillance of EFPC water quality just upstream of Oak Ridge sewage treatment outfall
	East Fork Poplar Creek Mile 3.9	EFPOP003.9RO	EFK 6.3	Surveillance of EFPC water quality downstream of Oak Ridge
Bear Creek	Bear Creek Mile 7.6	BEAR007.6AN	BCK 12.3	Surveillance of Bear Creek water quality near headwaters
	Bear Creek Mile 6.0	BEAR006.0AN	BCK 9.6	Surveillance of Bear Creek water quality downstream of Environmental Management Waste Management Facility (EMWMF)
Mitchell Branch	Mitchell Branch Mile 0.9	MITCH000.9RO	MIK 1.43 *	Surveillance of Mitchell Branch (MIK) water quality upstream of ETTP
	Mitchell Branch Mile 0.3	MITCH000.3RO	MIK 0.45	Surveillance of MIK water quality at a point influenced by ETTP activities.
White Oak Creek	White Oak Creek Mile 4.2	WHITE004.2RO	WCK 6.8 *	Reference site upstream of ORNL
	White Oak Creek Mile 2.4	WHITE002.4RO	WCK 3.9	Surveillance of White Oak Creek (WCK) at a point influenced by ORNL
	White Oak Creek Mile 1.4	WHITE001.4RO	WCK 2.3	Surveillance of White Oak Creek (WCK) at a point downstream of Melton Valley Burial Grounds
Melton Branch	Melton Branch Mile 0.2	MELTO000.2RO	MEK 0.3	Surveillance of Melton Branch (MEK) at a point influenced by Melton Valley Burial Grounds
Reference Sites	Gum Hollow Branch Mile 1.8	GHOLL001.8RO	GHK 2.9 *	Reference site on ORR
	Hinds Creek Mile 12.8	HINDS012.8AN	HCK 20.6 *	Reference site north of Oak Ridge
	Mill Branch Mile 1.0	FECO67I12	MBK 1.6 *	Reference site in Oak Ridge

DWR ID - Division of Water Resources site designation
ID is an abbreviation of the stream name with the distance from mouth in km; * - Reference Stream
DOE - Department of Energy
EFPC - East Fork Poplar Creek
ETTP - East Tennessee Technology Park
ORNL - Oak Ridge National Laboratory
ORR - Oak Ridge Reservation
SWSA -Solid Waste Storage Area

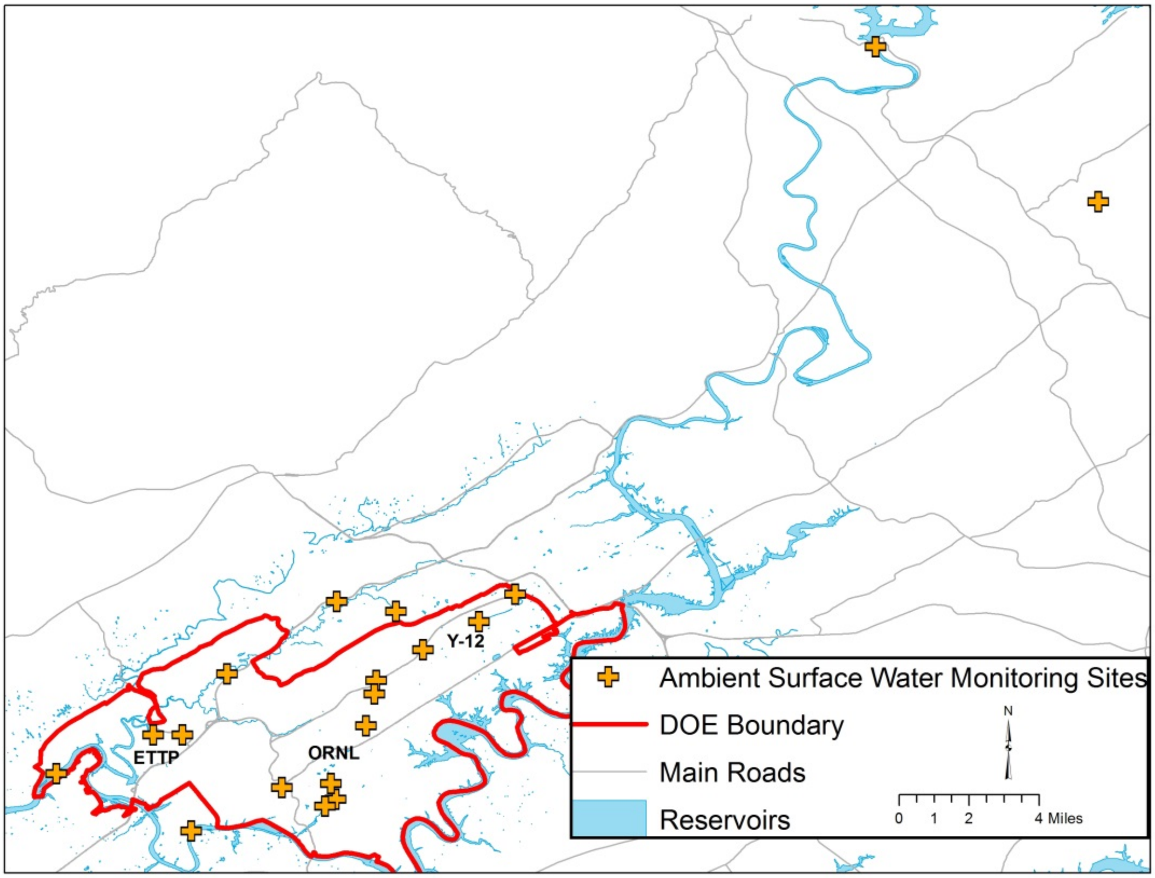

Figure 4.6 Ambient surface water sampling locations

4.4.3 Rain Event Surface Water Monitoring

The rain event surface water sampling program was established to assess the degree of impact, if any, caused by heavy rain events. Eight locations will be sampled after a qualifying rain event each quarter. Table 4.8 and Figure 4.7 show the rain event surface water monitoring locations. Mill Branch serves as a reference location and is located off the ORR. Sampling EFK 23.4 location will help determine what is exiting the eastern side of Y-12. WCK 0.0 sample location is anticipated to capture surface water exiting ORNL Melton Valley and the central campus area. BCK 4.5 sample location is intended to capture water exiting the western side of Y-12, along with EMWMF and the burial grounds. Mitchell Branch kilometer (MIK) 0.01 location was selected to sample runoff along the north side of ETTP. The P1 pond weir was selected to sample the runoff along the south side of ETTP. Storm drain (SD) 490 is sampled to study and quantify the observed technetium-99 (Tc-99) release that may have occurred during the demolition activities from the K-25 building. SD 510 is sampled to see what may be exiting the demolition activities from Building K-31.

Table 4.8: Rain Event Surface Water Monitoring Locations			
Monitoring Location	**DWR ID**	**Alternate ID**	**Monitoring Rationale**
East Fork Poplar Creek Mile 14.5	EFPOP014.5AN	EFK 23.4	Surveillance from Y-12, along EFPC
White Oak Creek Mile 0.0	WHITE000.0RO	WCK 0.0	Surveillance of White Oak Creek (WCK) and ORNL prior to discharging in the Clinch River
Bear Creek mile 2.8	BEAR002.8RO	BCK 4.5	Surveillance from Y-12, EMWMF, and the burial grounds along Bear Creek
Mitchell Branch	MITCH000.1RO	MIK 0.1	Surveillance from ETTP and hexavalent chromium
Storm Drain 490	NA	SD 490	Surveillance from ETTP, Technetium-99 release tracking
P1 Pond Weir	NA	P1 POND WEIR	Surveillance from ETTP
Mill Branch Mile 1.0	FECO67I12	MBK 1.6	Background location
Storm Drain 510	NA	SD 510	Surveillance from ETTP, monitoring remedial action activities from K-31. This location may move to K-27

DWR ID - Division of Water Resources site designation
Alternate ID is an abbreviation of the stream name with the distance from mouth in km
NA - not applicable
EFPC - East Fork Poplar Creek
EMWMF - Environmental Management Waste Management Facility
ETTP - East Tennesee Technology Park
ORNL - Oak Ridge National Laboratory

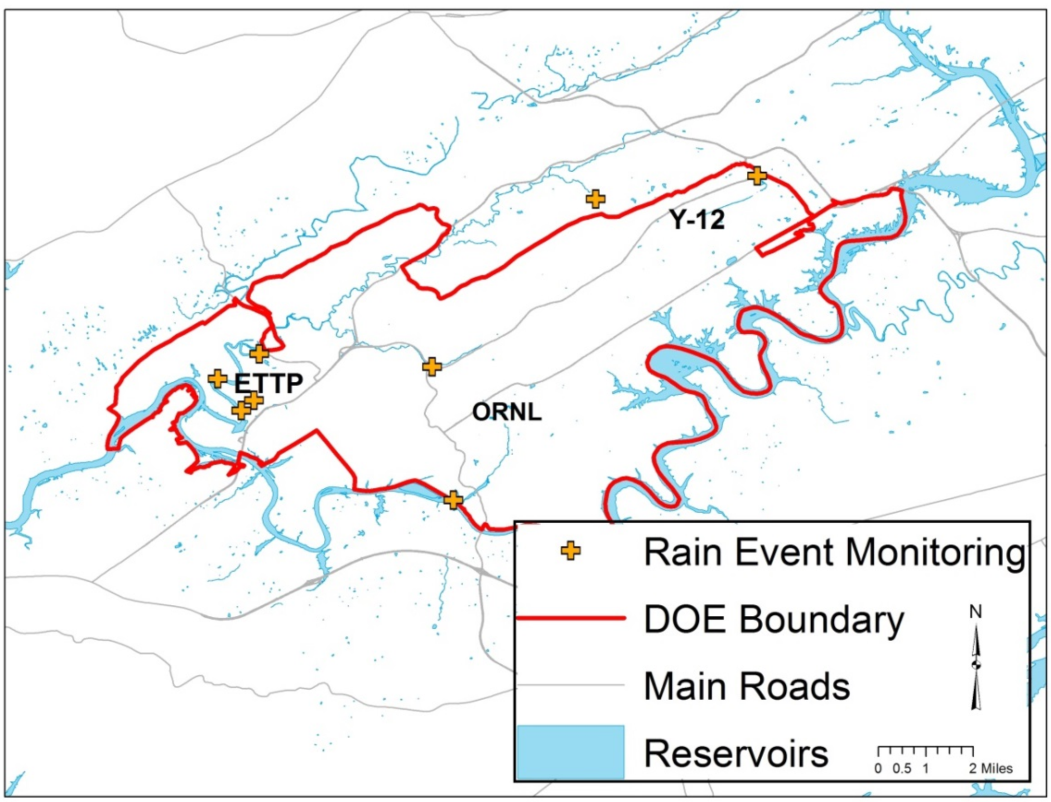

Figure 4.7 Rain event surface water monitoring locations

4.5 Sediment Monitoring

The sediment monitoring projects will assist with the monitoring goals for five of the primary focus areas (radiological environmental monitoring, mercury monitoring and release, monitoring D&D remedial activities, CERCLA landfill monitoring, and general site monitoring) as described in Section 1.1. There are two sediment monitoring projects: ambient sediment monitoring and trapped sediment monitoring.

Sediment is an important part of aquatic ecosystems. Many aquatic organisms depend on sediment for habitat, sustenance, and reproduction. Sediment is also a depository for anthropogenic chemicals and waste materials such as metals, radionuclides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and agricultural chemicals. Concentrations of contaminants can be higher in sediment than in the water column. Some sediment contaminants may be directly toxic to benthic organisms or may bioaccumulate in the food chain, creating health risks for wildlife and humans. Sediment analysis is an important aspect of environmental quality and impact assessment for rivers, streams, and lakes. Past sediment sampling activities by TDEC have shown that Poplar Creek has elevated levels of mercury in sediments. This mercury can be attributed to historical discharges from Y-12, and, to a lesser extent, ETTP.

4.5.1 Ambient Sediment Monitoring

Contaminants from past DOE activities on the ORR have made their way into several streams that feed into Poplar Creek and the Clinch River. The major pathways of concern are WOC and EFPC. The major contaminants of concern from WOC are strontium-90 and cesium-137. EFPC is contaminated with mercury from past activities at Y-12. In order to characterize and monitor the impact from these streams, TDEC will sample sediment in the Clinch River, Poplar Creek, EFPC, Bear Creek, and Mitchell Branch as presented in Table 4.9 and shown in Figure 4.8. Sediment samples are analyzed for metals (arsenic, barium, beryllium, boron, cadmium, chromium, copper, lead, mercury, nickel, uranium, and zinc) and radiological parameters (gross alpha, gross beta and gamma). Isotopic uranium is included in the analyses of sediment at North Tributary 5 (NT-5). The metals data are compared to Consensus-based Sediment Quality Guidelines (CBSQGs) (MacDonald et al. 2000). Radiological data are compared to the DOE Preliminary Remediation Goals (PRGs) (DOE 2013). PRGs are upper concentration limits for specific chemicals in environmental media that are intended to protect human health. PRGs are often used at CERCLA sites for risk assessment (Efroymson et al. 1997).

Table 4.9: Ambient Sediment Monitoring Locations			
Monitoring Location	**DWR ID**	**Alternate ID**	**Monitoring Rationale**
Clinch River Mile 48.7	CLINC048.7AN	CRK 78.4	Reference site upstream of DOE facilities
Clinch River Mile 14.5	CLINC014.5RO	CRK 23.3	Sediment depositional area downstream of White Oak Creek outfall
Clinch River Mile 10.0	CLINC010.0RO	CRK 16.1	Sediment depositional area downstream of White Oak Creek and Poplar Creek outfalls
Poplar Creek Mile 3.5	POPLA003.5RO	PCK 5.6	Sediment depositional area downstream of Mitchell Branch and East Fork Poplar Creek outfalls
East Fork Poplar Creek Mile 3.9	EFPOP003.9RO	EFK 6.3	Sediment depositional area downstream of Y-12 influence
Bear Creek Mile 2.8	BEAR002.8RO	BCK 4.5	Sediment depositional area downstream of Y-12 influence
Mitchell Branch Mile 0.1	MITCH000.1RO	MIK 0.1	Sediment depositional area downstream of some ETTP influences
North Tributary 5 of Bear Creek	BEAR006.5T0.1AN	NT5	Sediment depositional area downstream of EMWMF

DWR ID - Division of Water Resources Idenfication
Alternate ID is an abbreviation of the stream name with the distance from mouth in kilometers
DOE - Department of Energy
ETTP - East Tennessee Technology Park
EMWMF - Environmental Waste Management Facility

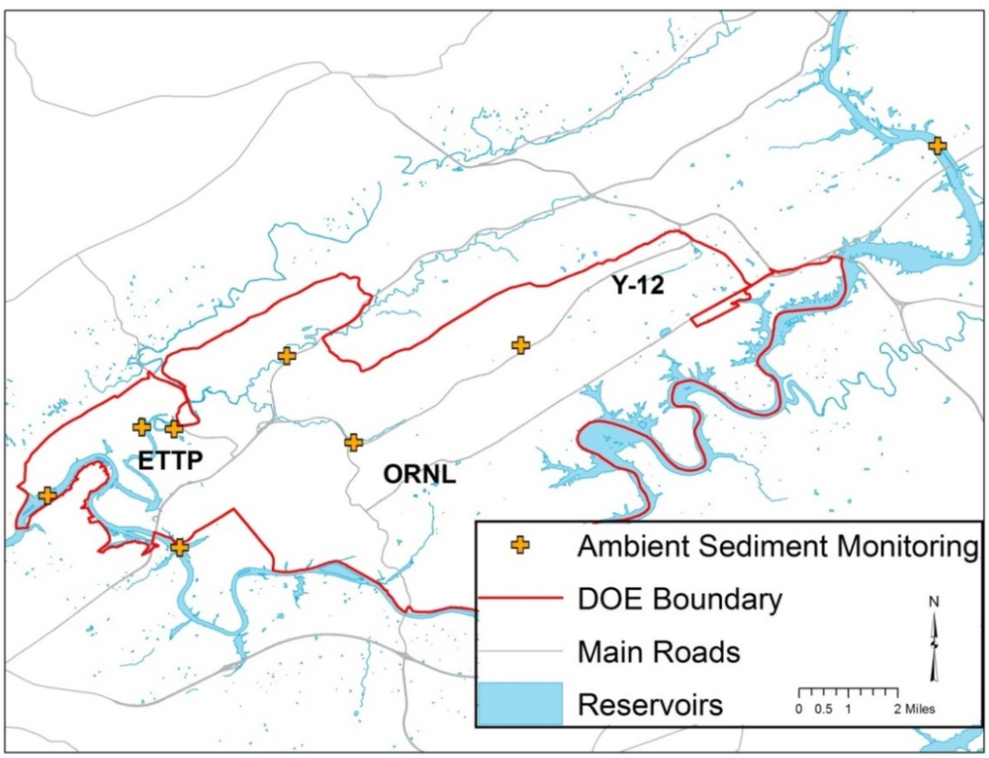

Figure 4.8 Ambient sediment monitoring locations

4.5.2 Trapped Sediment Monitoring

The goal of this project is to focus on the sediments that are currently being transported in EFPC, Bear Creek, and NT-5 by utilizing passive sediment collection at determined locations (Table 4.10 and Figure 4.9). In order to monitor for changes in contaminant flow through sediment transport, passive sediment samplers (traps) are deployed. Sediment samples are analyzed for metals (arsenic, barium, beryllium, boron, chromium, mercury, nickel, and uranium) and radiological parameters (gross alpha, gross beta, gamma, and isotopic uranium). The metals data are compared to CBSQGs (MacDonald et al. 2000). Radiological data are compared to the DOE PRGs (DOE 2013).

Table 4.10: Trapped Sediment Monitoring Locations

Monitoring Location	DWR ID	Alternate ID	Monitoring Rationale
Bear Creek Mile 2.8	BEAR002.8AN	BCK 4.5	Surveillance of suspended sediment at point where Bear Creek leaves DOE property
Bear Creek Mile 4.7	BEAR004.7AN	BCK 7.6	Surveillance of suspended sediment at point between NT5 and Y-12 boundary
North Tributary 5 of Bear Creek	BEAR006.5TO.1AN	NT5	Surveillance of suspended sediment at point just downstream of EMWMF
East Fork Poplar Creek Mile 14.5	EFPOP014.5AN	EFK 23.4	Surveillance of suspended sediment at point where EFPC leaves DOE property
East Fork Poplar Creek Mile 8.6	EFPOP008.6AN	EFK 13.8	Surveillance of suspended sediment at point just upstream of Oak Ridge STP
East Fork Poplar Creek Mile 3.9	EFPOP003.9RO	EFK 6.3	Surveillance of suspended sediment at point downstream of Oak Ridge
Mill Branch Mile 1.0	FECO67I12	MBK 1.6	Surveillance of suspended sediment at a reference site

DWR ID - Division of Water Resources Idenfication
Alternate ID is an abbreviation of the stream name with the distance from mouth in km
DOE - Department of Energy
EFPC - East Fork Poplar Creek
EMWMF - Environmental Waste Management Facility
NT5 - North Tributary 5
STP - Sewage Treatment Plant

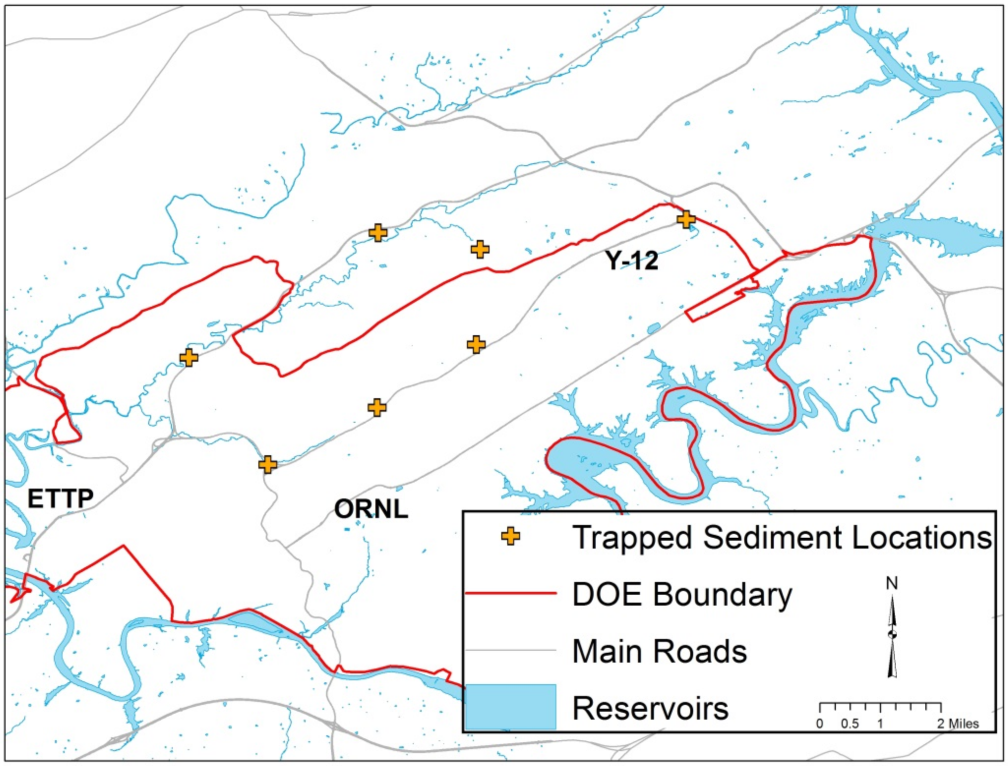

Figure 4.9 Trapped sediment monitoring locations

4.6 Groundwater Monitoring

TDEC will conduct the monitoring of groundwater on the ORR and its environs. In accordance with the mission of the state, as established under the TOA and the Federal Facilities Agreement (FFA), monitoring will facilitate protection of the people as well as protection and improvement of the environment of East Tennessee.

The groundwater monitoring projects will assist with all six of the monitoring goals of the primary focus areas (radiological environmental monitoring, mercury monitoring and release, monitoring D&D remedial activities, CERCLA landfill monitoring, oversight of impacts to regional groundwater, and general site monitoring) as described in Section 1.1. The three groundwater monitoring projects are background residential groundwater, downgradient residential groundwater, and local springs.

4.6.1 Background Residential Well Monitoring

The goal of the background groundwater program is to evaluate chemical data, hydrogeologic characteristics, and geochemical parameters in order to estimate the upper bounds of background chemical concentration ranges and to identify and/or acquire datasets that adequately represent background conditions. In order to meet this goal, several tasks need to be performed. The first task is to identify upgradient residential wells that are from the same aquifers and exhibit the same types of geochemical environments that exist on and downgradient of the ORR. Once the potential background groundwater locations have been identified, the second task is to sample enough times to collect sufficient data to determine the spatial (between wells) and temporal (over time) trends.

The background sampling program will be completed in two phases. The first phase is to continue the search of the area northeast of the ORR and collect initial groundwater samples. Figure 4.10 shows the area where the active well search will continue. The second step of the first phase is to sample a target population of the wells to determine the hydrogeologic characteristics and provide initial sample results from a list of potential contaminants of concerns provided in Table 4.11. Analysis methods and detection levels for the groundwater samples are delineated in the TDEC QAPP.

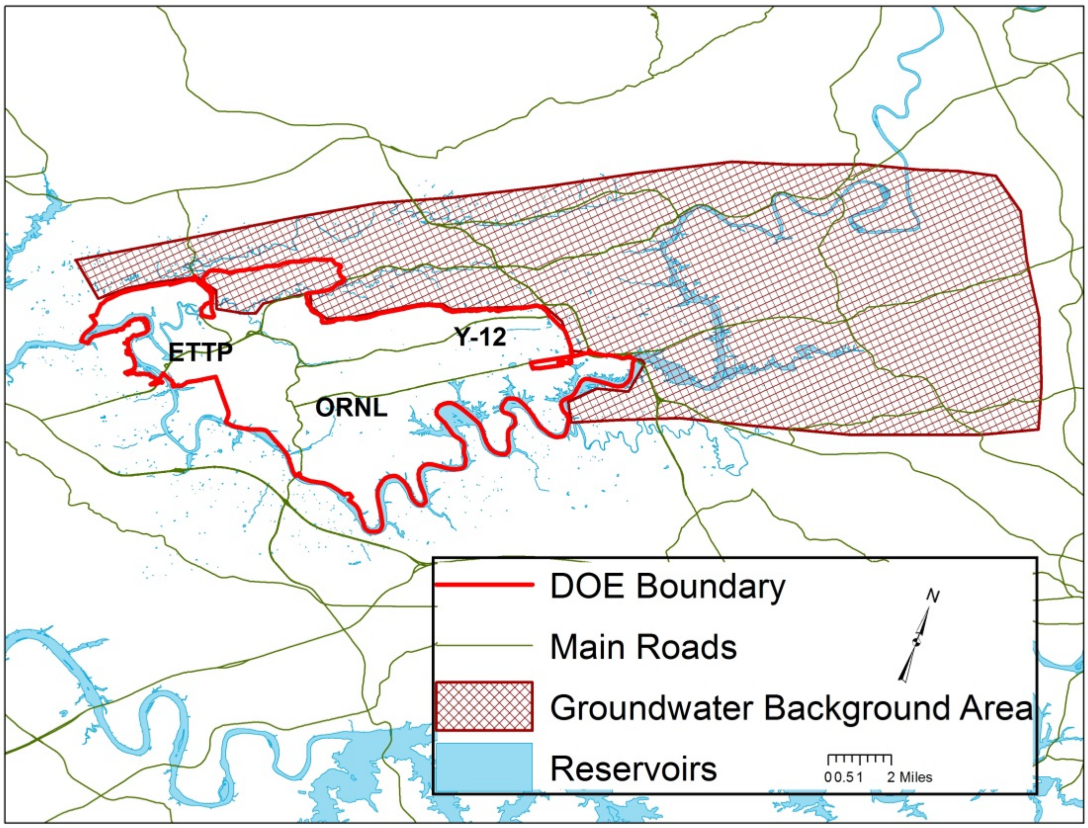

Figure 4.10 Background residential groundwater survey and sample area

Table 4.11: Groundwater Well Sampling Contaminants of Concern			
Analytes			
VOCs	Volatile Organic	**Inorganics**	Alkalinity
Metals	Aluminum		Chloride
	Antimony		Fluoride
	Arsenic		Hardness
	Barium		Nitrate/Nitrite
	Boron		Ammonia
	Beryllium		TDS
	Cadmium		Sulfate
	Calcium		Stable Isotopes (N_2 & O_2)
	Chromium	**Radionuclides**	Alpha/Beta
	Copper		Gamma Radionuclides
	Iron		Technetium-99
	Lead		Tritium
	Lithium		Radium-226 by alpha
	Magnesium		Radium-228
	Manganese		Strontium-89/90
	Nickel		Transuranics
	Potassium		Uranium Isotopic
	Selenium		
	Silver		
	Sodium		
	Strontium		
	Thallium		
	Uranium	N - Nitrogen	
	Vanadium	O - Oxygen	
	Zinc	TDS - Total Dissolved Solids	
	Mercury	VOC - Volatile Organic Compounds	

4.6.2 Offsite Residential Well Monitoring

The downgradient residential groundwater monitoring program is continuing its investigation of privately-owned water wells southwest of the ORR. The downgradient groundwater monitoring is in conjunction with the DOE assessment of groundwater southwest of the reservation. The goal of these efforts is to better understand the distribution of potential contaminant pathways to assist in the decision-making processes under the FFA in order to protect human health and the environment.

The downgradient sampling program will be completed in two phases. The first phase is to continue a residential well search of the area southwest of the ORR. Figure 4.11 shows the area where the active well search will continue. The second step is to sample a target population of the wells to determine the hydrogeologic characteristics and provide initial sample results from a list of potential contaminants of concerns provided in Table 4.12. The goal is to sample ten downgradient residential wells.

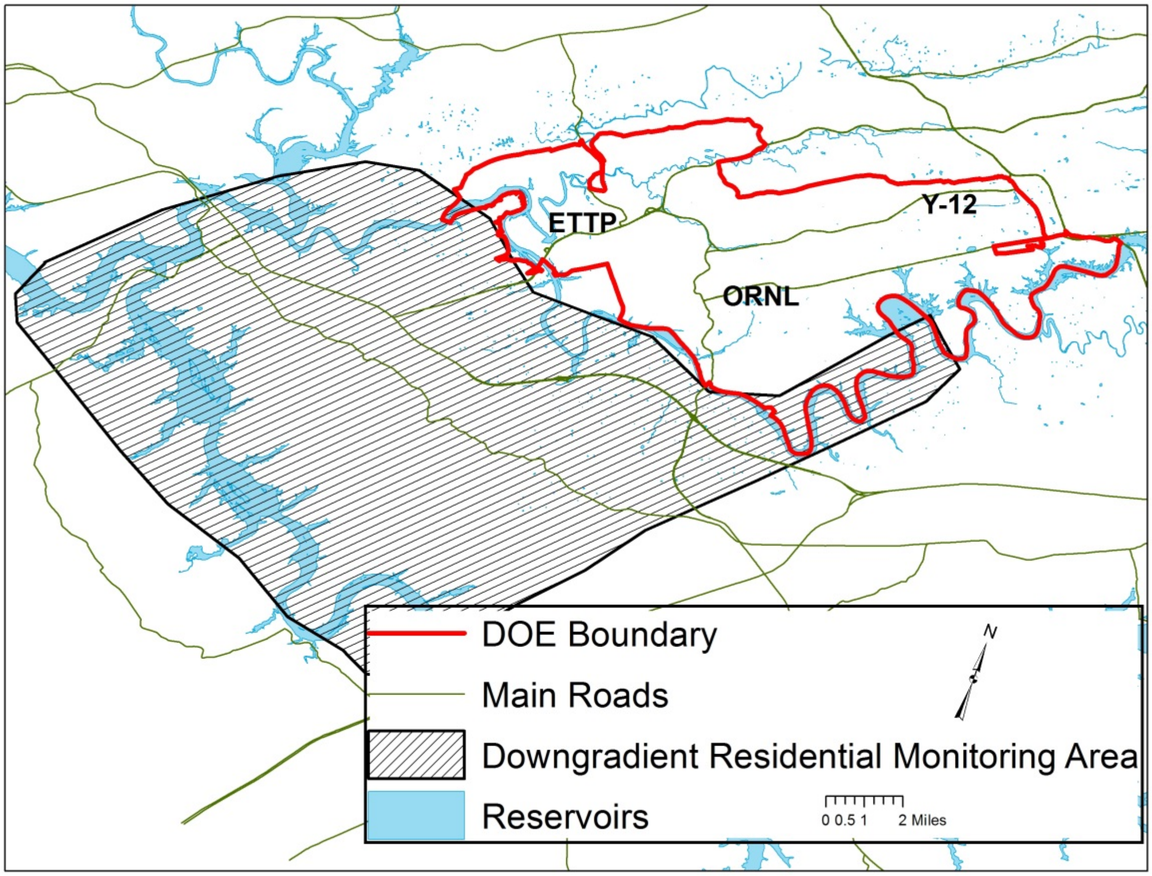

Figure 4.11 Offsite residential groundwater survey and sample area

4.6.3 Springs

Springs will be sampled and analyzed on the ORR and its environs to evaluate the quality of groundwater at groundwater discharge locations. Sixty-nine springs, 40 of which are historic springs documented on topographic maps, are scheduled to be visited to document the water quality parameters. Water quality parameters (temperature, pH, specific conductivity, oxidation-reduction potential and dissolved oxygen) can provide indications of the different flow regimes (deep/shallow flow or baseflow/overflow springs) that may be encountered. The 69 springs are provided in Table 4.12 and shown on Figure 4.12. In addition to measuring water quality parameters at the 69 springs, five springs will be sampled. The sample locations and analytical parameters sampled will be determined based on representative measured water quality data and the spring location as provided in Table 4.12. Samples will be analyzed for metals, inorganics, volatile organics, and radionuclides.

Table 4.12: Spring Sampling Locations			
Spring	Station Number	Analysis Requested	Sampling Rationale
Knight Spring	SPG-041	M I V R1	Characterization of basic water quality parameters and hydraulically upgradient from ORNL
Carter Big Spring	SPG-048	M I V R1	Characterization of basic water quality parameters and south of ORNL
Malone Spring	SPG-049	M I V R1	Characterization of basic water quality parameters and south of ORNL
McNeely Spring	SPG-050	M I V R1	Characterization of basic water quality parameters and south of ORNL
Concord Spring	SPG-051	M I V R1	Characterization of basic water quality parameters and southeast of ORNL
Herron Spring	SPG-052	M I V R1	Characterization of basic water quality parameters and southeast of ORNL
Duncan Spring	SPG-053	M I V R1	Characterization of basic water quality parameters and southeast of ORNL
Dentist Spring	SPG-054	M I V R1	Characterization of basic water quality parameters and southeast of ORNL
Blue (Southeast) Spring	SPG-055	M I V R1	Characterization of basic water quality parameters and southeast of ORNL
Eldridge Spring	SPG-056	M I V R1	Characterization of basic water quality parameters and east of ORNL
Pitts Spring	SPG-057	M I V R1	Characterization of basic water quality parameters and east of ORNL
Roberts Spring	SPG-076	M I V R1	Characterization of basic water quality parameters and east of ORNL
Horizon Spring	2015SPGEMP15-11	M I V R1	Regional spring and characterizatioin of basic water quality parameters
Haynes Spring	SPG-042	M I V R1	background and potential for Y-12 contaminants
Gamble (Quarry) Spring	SPG-043	M I V R1	Characterization of basic water quality parameters and hydraulically upgradient from Y-12
Holbert Spring	SPG-044	M I V R1	Characterization of basic water quality parameters and hydraulically upgradient from Y-12
Miller Spring	SPG-045	M I V R1	Characterization of basic water quality parameters and hydraulically upgradient from Y-12
Yarnell Spring	SPG-046	M I V R1	Characterization of basic water quality parameters and hydraulically upgradient from Y-12/ETTP
Turpin Spring	SPG-047	M I V R1	Characterization of basic water quality parameters and hydraulically upgradient from Y-12/ETTP
Love Spring	2015SPGEMP15-20	M I V R1	Characterization of basic water quality parameters and hydraulically downgradient from Y-12
Dead Horse Spring	2015SPGEMP15-19	M I V R1	Characterization of basic water quality parameters and hydraulically downgradient from Y-12
Green Barn Spring	2015SPGEMP15-08	M I V R1	Spring below the Chestnut Ridge/Landfills
RCB Spring	2015SPGEMP15-23	M I V R1	Regional spring Northeast from Y-12
SS-5 Spring	2015SPGEMP15-28	M I V R1	Spring drains most of western Y-12/SNS/EMWMF
SS-7 Spring	2015SPGEMP15-29	M I V R1	Spring drains most of western Y-12/EMWMF
Gallaher Spring	2015SPGEMP15-30	M I V R1	Regional offsite spring in Bear Creek Valley near the Clinch River
SS-4 Spring	2015SPGEMP15-31	M I V R1	Spring drains most of western Y-12. Historic analytical data suggest discharge is from S-3 ponds
Gum Branch 1 Spring	2015SPGEMP15-33	M I V R1	Spring north of the burial grounds, EMWMF, and EMDF
Gum Branch 2 Spring	2015SPGEMP15-34	M I V R1	Spring north of the burial grounds, EMWMF, and EMDF
Pinhook Spring	2015SPGEMP15-35	M I V R1	Spring north of the burial grounds, EMWMF, and EMDF
Bootlegger Spring	2015SPGEMP15-38	M I V R1	Baseflow spring that drains Chestnut Ridge/Security Pits
Cattail Spring/Cattail Spring East	2015SPGEMP15-39	M I V R1	Spring drains east end of Y-12 volatile plume
Blue (Crosseyed Cricket) Spring	2015SPGEMP15-10	M I V R1	Characterization of basic water quality parameters and south of ORNL

Table 4.12: Spring Sampling Locations (continued)			
Spring	**Station Number**	**Analysis Requested**	**Sampling Rationale**
Key Spring	SPG-058	M I V R2	Characterization of basic water quality parameters and hydraulically upgradient from ETTP
Bacon Spring	SPG-059		
Deep	SPG-060		
Shetterly	SPG-061		
Burress	SPG-062		
Shinlever	SPG-063		
Pop Hollow	SPG-064		
Martin	SPG-065		
Mill	SPG-066		Located in Sugar Grove Valley, west of ETTP
Dickey	SPG-067		
Turnpike Spring	2015SPGEMP15-02		Regional offsite spring, western Oak Ridge
Edwards Spring	2015SPGEMP15-09		Located in Sugar Grove Valley
Regina Loves Bobby Spring	2015SPGEMP15-27		
21002 Spring	2015SPGEMP15-32		Spring has been dye traced from K-1070A
Rarity Spring	2015SPGEMP15-36		Regional spring located in Clinch River
USGS 10-895 Spring	2015SPGEMP15-37		Suspect to discharge from the Contractor Spoils Area and or K-1070A
Sugar Grove Spring	2015SPGEMP15-15		Offsite spring in Sugar Grove Valley
PCO Spring	SPG-079		Determine if any new inputs from remedial activities at ETTP are discharging to this spring
Sands	SPG-068	M I V R3	Characterization of basic water quality parameters and hydraulically upgradient from ORNL
Black Ferry	SPG-069		
Moore	SPG-070		
Fowler	SPG-071		
Bowman	SPG-072		
Conner	SPG-073		
Lewis	SPG-074		
Big	SPG-075		
CCC-Spring	2015SPGEMP15-03		Spring in the Copper Ridge Formation, hydraulically downgradient from ORNL
Poplar Spring	2015SPGEMP15-04		
Concrete Box or County Line Spring	SPG-077		Drains Chestnut Ridge
NW Tributary Spring	2015SPGEMP15-06		Spring drains parts of WAG 3
Rifle Range Spring/0956 Spring	2015SPGEMP15-17		Spring drains Chestnut Ridge towards ORNL
Crooked Tree Spring	2015SPGEMP15-18		Spring drains WAG 6
Mt Vernon Spring	SPG-080		Baseflow spring that drains Chestnut Ridge/Landfills
Sycamore Spring/Raccoon Creek Trib.	2015SPGEMP15-26		Spring drains parts of WAG 3
Mtn. Dew/Overhang Spring	2015SPGEMP15-40		Provide confirmation sampling
Ish Weir Spring	SPG-078		Spring that drains a portion of Bear Creek Valley, near the Firing Range

MIVR1 - Metals, Inorganics, Volatiles, and Radionuclides (Gross Alpha\Beta, Gamma Radionuclides, Tritium)
MIVR2 - Metals, Inorganics, Volatiles, and Radionuclides (Gross Alpha\Beta, Gamma Radionuclides, Technetium-99, Tritium)
MIVR3 - Metals, Inorganics, Volatiles, and Radionuclides (Gross Alpha\Beta, Gamma Radionuclides, Strontium-90, Technetium-99, Tritium)
EMDF - Environmental Management Disposal Facility
EMWMF - Environmental Management Waste Management Facility
ETTP - East Tennessee Technology Park
ORNL - Oak Ridge National Laboratory
WAG - waste area grouping

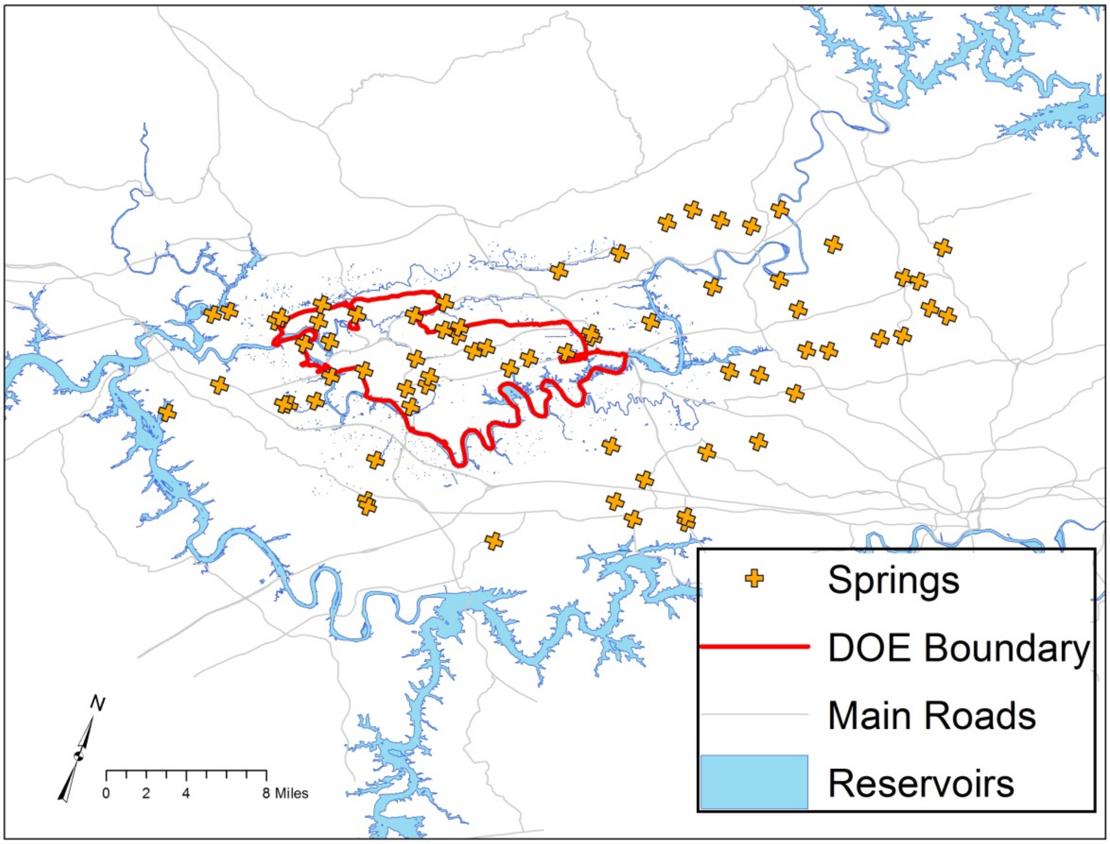

Figure 4.12 Springs sampling locations

4.7 CERCLA Landfill

There is one CERCLA landfill monitoring project (EMWMF); however, we supplement TDEC monitoring of EMWMF with radiological, biological, air, surface water, and sediment programs as discussed in Sections 4.1 through 4.5.

4.7.1 EMWMF

TDEC will monitor surface water, stormwater, groundwater, effluents, and sediments at EMWMF, located in eastern Bear Creek Valley. This facility was constructed to dispose of low-level radioactive waste and hazardous waste generated by remedial activities on the ORR and is operated under the authority of CERCLA. While the facility holds no permit from any state agency, it is required to comply with substantive portions of relevant and appropriate legislation contained in the CERCLA ROD (DOE, 1999) and DOE directives developed to address responsibilities delegated to the agency by the Atomic Energy Act of 1946.

The EMWMF was constructed in eastern Bear Creek Valley, approximately one mile west of Y-12. The valley is formed by Pine Ridge on the north and Chestnut Ridge to the south with the major drainage, Bear Creek, flowing parallel to the ridges, southwest down the axis of the valley. Flow in the stream is dominated by a mature karst network developed in the Maynardville Limestone formation underlying the channel, with gaining and loosing reaches common. The stream is fed by the discharge from numerous springs located primarily on the south side of the channel and small tributaries on the north. The EMWMF is located on the southern slope of Pine Ridge approximately 1,500 feet to the north of Bear Creek, between NT-3 on the east and the NT-5 on the west. To accommodate construction of EMWMF, flow from a third tributary, North Tributary 4 (NT-4), was diverted upslope of the facility to the NT-5 tributary and the channel filled. Shortly after the facility became operational, groundwater levels above the filled channel were found to have risen to levels near the basal liner of the facility. The drainage provided by the NT-4 channel was subsequently restored by the construction of a rock-filled drain, running north to south beneath the facility. The underdrain discharges to the existing NT-4 channel south of the facility. Construction of the underdrain lowered the water table, but groundwater levels remain near a ten-foot geologic buffer required between the water table and the facility's liner.

Currently, the only authorized discharges from EMWMF are contaminated stormwater (contact water), which tends to pond in the disposal cells above the leachate collection system. The contact water is routinely pumped from the disposal cells to holding ponds and tanks, sampled, and, based on the results, either sent offsite for treatment or released to a stormwater sedimentation basin. The sedimentation basin discharges to the NT-5 tributary of Bear Creek. The EMWMF was designed with a 5% slope along the centerline of each disposal cell to direct stormwater and leachate to the southern (lower) end of the cells (Williams, 2004). This design feature, along with the abundant rainfall of the region and low porosity native soils used as a protective layer over the leachate collections system, have resulted in excessive pooling of the contact water at the lower end of the cells (Williams, 2004). Heavy rainfall the first year of operations resulted in the stormwater and associated leachate overflowing the cell berms, releasing contaminants to adjacent land and into the NT-5 tributary. To avoid similar incidents, the allowable release limits for the contact water ponds were established and the compliance point moved from the ponds to the discharge from the stormwater sedimentation basin. The limit on releases from the holding ponds/tanks to the sedimentation basin is based on requirements contained in DOE Order 5400.5 that restrict the release of liquid wastes containing radionuclides to an average concentration equivalent to 100 mrem/year. The limit for discharges from the sedimentation basin to NT-5 are based on state regulations [TDEC 0400-20-11-.16(2)] that restrict concentrations of radioactive material released to the general environment in groundwater, surface water, air, soil, plants or animals to an annual dose equivalent of 25 mrem. In addition, DOE Order 458.1 limits gross alpha and gross beta activity of settling solids in liquid effluents to 5.0 pCi/g and 50 pCi/g respectively.

To ensure that EMWMF is meeting its operational requirements, EMWMF collected discharge data will be reviewed quarterly. In addition, confirmation samples will be collected in accordance with Table 4.13. The locations of the samples are shown on Figure 4.13. To ensure best practices are utilized to limit contaminant migration, site visits will be performed to monitor ongoing activities at EMWMF.

Table 4.13: EMWMF Sampling Locations			
Sample Location	**Sample ID**	**Frequency**	**Sampling Rationale**
GW-918	EMWMF-1	Semiannually	Upgradient well that is linked to a spring. The spring is the headwaters for both NT4 and NT5. This sample is co-sampled with EMWMF personnel for quality control.
EMWMF-Underdrain	EMWMF-2	Quarterly	NT4 discharge below the landfill. The underdrain was installed below Cell 3 and it is threorized that if cells 1, 2 and 3 were to leak contaminants, they would first be observed at the underdrain.
Sediment Basin Outfall	EMWMF-3	Quarterly	Provides confirmation of contaminants levels being discharged from the sediment basin.
Cell 6 Drainage	EMWMF-4B	Spot checked semiannually	This location is used as a verification that water collected in Cell 6 (prior to waste placement) is, in fact, storm water.
Sediment Basin Sediments	EMWSB-1 and EMWSB-2	Annually	This location is only sampled when the sediment basin is dry. The results are used to observe the loading of radionuclides in the sediment of the basin.

GW - groundwater
EMWMF - Environmental Management Waste Management Facility
NT - North Tributary

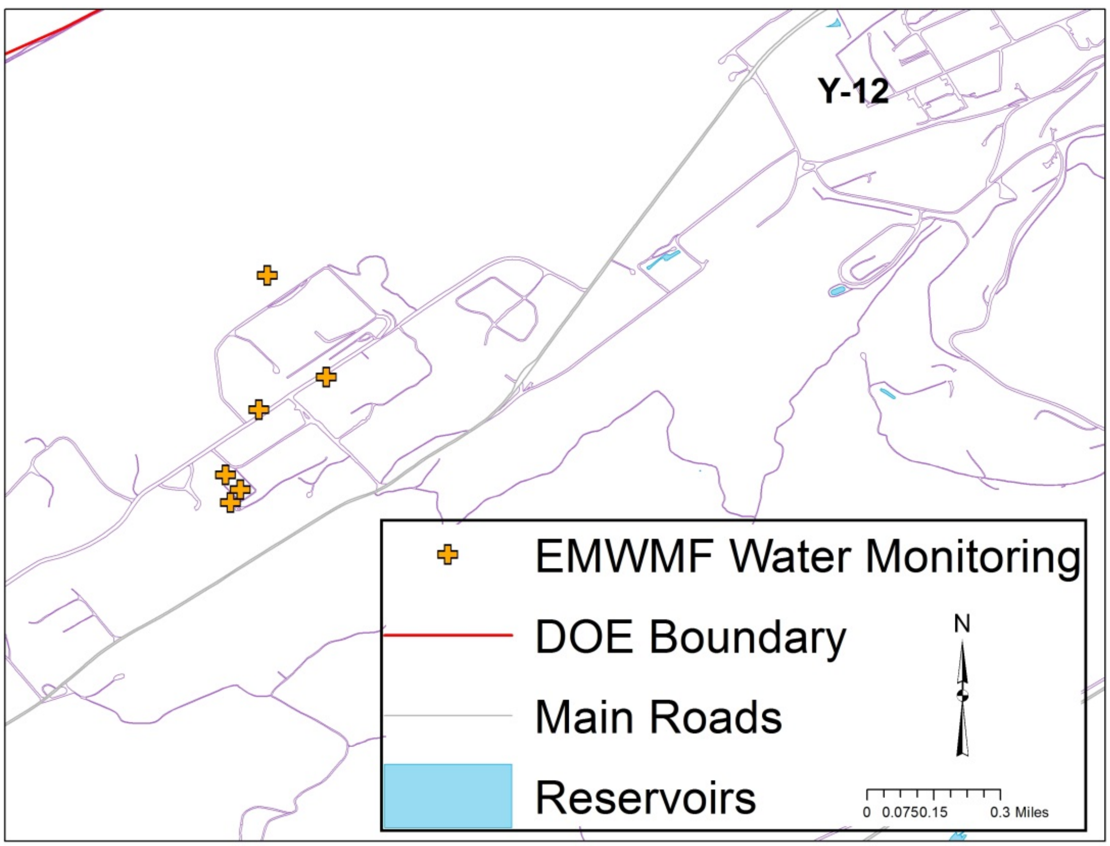

Figure 4.13 EMWMF sampling locations

4.8 RadNet

TDEC's participation in the EPA RadNet air, precipitation, and drinking water monitoring programs supplements information generated by the TDEC monitoring programs while providing independent third party analysis. The EPA RadNet system monitors the nation's air, precipitation, and drinking water for radiation. Results from the RadNet programs are provided to TDEC and are available on the EPA RadNet searchable Envirofacts database. More information on the program can be found on the EPA RadNet webpage.

4.8.1 RadNet Air Monitoring

The RadNet air monitoring program on the ORR began in August of 1996 and provides radiochemical analysis of air samples taken from five air monitoring stations located near potential sources of radiological air emissions on the ORR. RadNet samples are collected by TDEC personnel and analysis is performed at the EPA National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, Alabama.

The locations of the five RadNet air samplers are provided in Figure 4.14 and the EPA analytical parameters and frequencies are listed in Table 4.14. The RadNet air samplers run continuously, collecting suspended particulates on synthetic fiber filters (10 centimeters in diameter) as air is drawn through the units by a pump at approximately 35 cubic feet per minute. TDEC personnel collect the filters from each sampler twice weekly and ship to the EPA NAREL for analysis.

NAREL performs gross beta analysis on each sample collected. If the gross beta result for a sample exceeds one picocurie per cubic meter (pCi/m^3), gamma spectrometry is performed on the sample. A composite of the air filters collected from each monitoring station during the year is analyzed for uranium and plutonium isotopes annually.

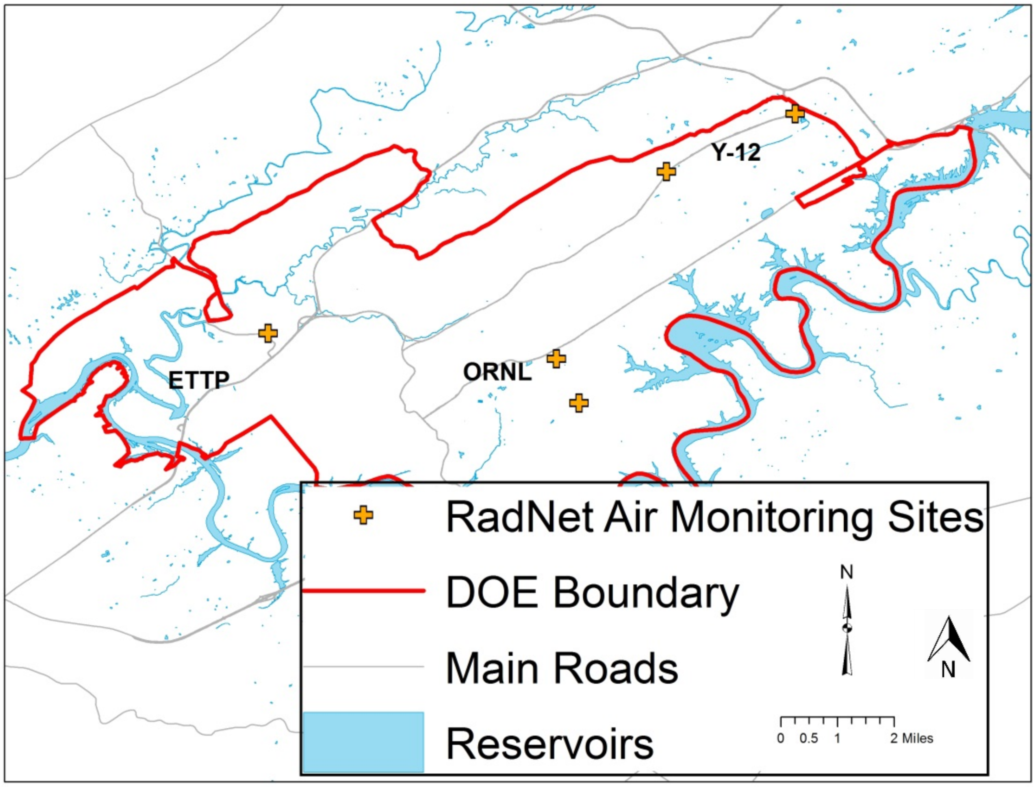

Figure 4.14 Locations of air stations monitored by TDEC on the ORR in association with the EPA RadNet air monitoring program

The results of the NAREL analyses of the nationwide RadNet air data are available at the NAREL website in the Envirofacts RadNet Searchable Database, via either a simple or a customized search.

Table 4.14: EPA Analysis of Air Samples Taken in Association with EPA's RadNet Program	
Analysis	**Frequency**
Gross Beta	Each sample, twice weekly
Gamma Scan	As needed on samples showing greater than 1 pCi/m^3 of gross beta
Plutonium-238, Plutonium-239, Plutonium-240, Uranium-234, Uranium-235, Uranium-238	Annually on a composite of the filters from each station

EPA - Environmental Protection Agency
pCi/m^3 - picoCuries per cubic meter

4.8.2 RadNet Precipitation Monitoring

The RadNet precipitation monitoring program on the ORR provides radiochemical analysis of precipitation samples taken from monitoring stations at three locations on the ORR. Samples are collected by TDEC personnel and analysis is performed at the EPA NAREL. EPA has provided three monitors to date, which have been co-located at RadNet air stations at each of the ORR sites. One is located in Melton Valley, in the vicinity of the ORNL. Another is located east of the ETTP, off Blair Road. The third is co-located with the RadNet air station east of Y-12. Figure 4.15 depicts the locations of the precipitation samplers. Analysis for gamma radionuclides is performed by EPA monthly on each composite sample. Since there is not a regulatory limit for radioisotopes in precipitation, the results from ORR sampling locations are compared to the EPA drinking water limits and can also be compared to data from other sites nationwide.

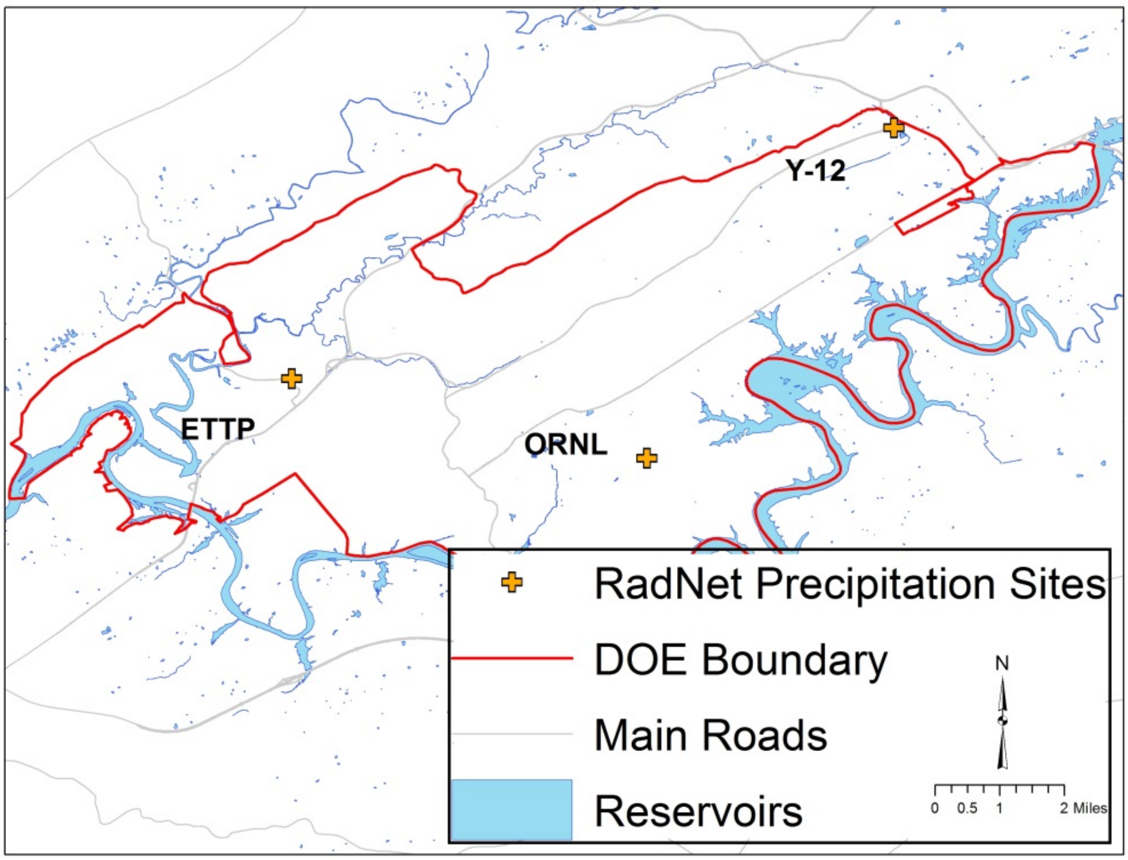

Figure 4.15 RadNet precipitation monitoring locations

4.8.3 RadNet Drinking Water Monitoring

TDEC will continue to monitor drinking water quarterly at four area water treatment plants through the EPA RadNet drinking water monitoring program. This program is important because it conducts radiological analysis of public drinking water processed from waters near the ORR. Since any radiological contaminants released on the ORR can enter local streams and be transported to the Clinch River, the possibility that ORR pollutants could impact area water supplies remains. The program provides a mechanism to evaluate the impact of DOE activities on water systems located near the ORR and to verify DOE monitoring in accordance with the TOA (TDEC, 2011).

EPA will provide radiochemical analysis of finished drinking water samples collected quarterly by TDEC personnel at four public water supplies located on and in the vicinity of the ORR (Figure 4.18). This analysis will be performed at the EPA NAREL. When received, the results are compared to each other (to identify anomalies) and to drinking water standards (to assess DOE compliance, adequacy of contaminant controls, and any associated hazards). Analytical parameters and the frequencies of RadNet analysis are provided in Table 4.15.

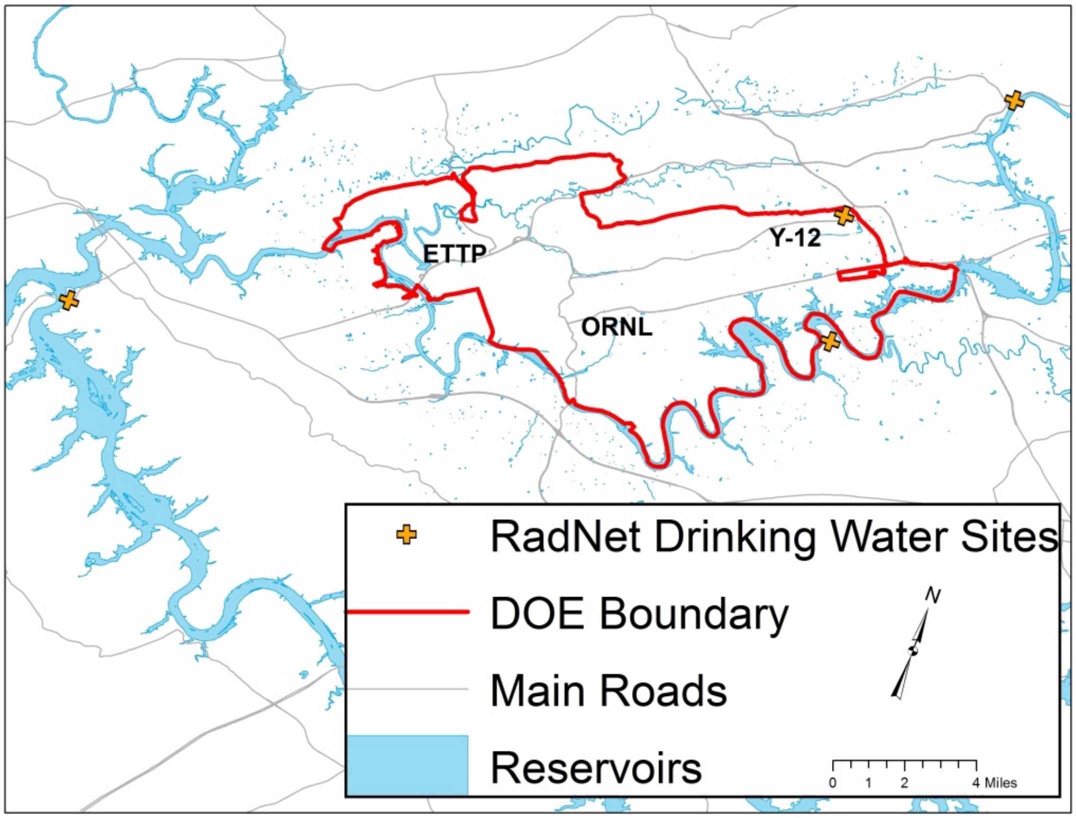

Figure 4.16 RadNet drinking water sample locations

Table 4.15: EPA Analysis for RadNet Drinking Water Samples	
Analysis	**Frequency**
Tritium	Quarterly
Gross Alpha	Annually on composite samples
Gross Beta	Annually on composite samples
Gamma Scan	Annually on composite samples
Iodine-131	Annually on one individual sample/site
Strontium-90	Annually on composite samples
Radium-226	Annually on samples with gross alpha > 2 pCi/L
Radium-228	On samples with Radium-226 between 3-5 pCi/L
Plutonium-238, Plutonium-239, Plutonium-240	Annually on samples with gross alpha > 2 pCi/L
Uranium-234, Uranium-235, Uranium-238	Annually on samples with gross alpha > 2 pCi/L

EPA - Environmental Protection Agency
pCi/L - picoCuries per liter

5.0 Sampling Methodology

TDEC is currently standardizing the processes used by this office; however, final, draft, and reference documentation are available for procedures that are specifically used. Listed below each sampling media are references that provide procedures currently used by TDEC.

Radiological Monitoring

The following reference documents are used for radiological monitoring:

U.S. Department of Energy (DOE) Application of DOE Order 5400.5 requirements for release and control of property containing residual radioactive material. Air, Water and Radiation Division, EH-412; November 17, 1995.

U.S. Nuclear Regulatory Commission (NRC). Termination of Operating Licenses for Nuclear Reactors. Regulatory Guide 1.86, Washington, D.C., June 1974, retyped August 1997.

American Society for Testing and Materials (ASTM). Selection and Use of Portable Radiological Survey Instruments for Performing In Situ Radiological Assessments in Support of Decommissioning. E 1893-97; March 1998.

NUREG-1575 (MARSSIM) ["Multiagency Radiation Survey and Site Investigation Manual (MARSSIM)."] December 1997.

U.S. Department of Energy. Environmental Implementation Guide for Radiological Survey Procedures. Washington, D.C.: U.S. Department of Energy; February 1997.

U.S. Nuclear Regulatory Commission (NRC). Monitoring for compliance with decommissioning termination survey criteria. NUREG/CR-2082; Washington, DC: 1981.

U.S. Nuclear Regulatory Commission. Manual for Conducting Radiological Surveys in Support of License Termination (Draft). NUREG/CR-5849; Washington, DC: May 1992

Biological Monitoring

The following reference documents are used for biological monitoring:

- Kentucky Division of Water (KDOW). Laboratory Procedures for Macroinvertebrate Processing, Taxonomic Identification and Reporting. (DOWSOP03005, Revision 2). Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. 2009.
- Klemm, D.J., P.A. Lewis, F. Fulk, and J.M. Lazorchak. *Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of SurfaceWaters*. EPA-600-4-90-030. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. 1990.
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- Tennessee Department of Environment and Conservation (TDEC). Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys. Revision 5. TDEC, Division of Water Pollution Control, Nashville, Tennessee. July 2011.
- Guidance Levels for Radionuclides in Domestic and Imported Foods (CPG-7119.14), Sec.560.750, U.S. Food and Drug Administration, November 2005. http://www.fda.gov/ora/compliance_ref/cpg/cpgfod/cpg560-750.html

Air Monitoring

TDEC has three SOPs in preparation for air monitoring. They include Fugitive Air Equipment Sample Collection, Fugitive Air Equipment Calibration, and Fugitive Air Equipment Maintenance.

Surface Water/Springs Monitoring

For surface water and springs, TDEC currently uses the *Division of Water Pollution Control August 2011, Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water*; however, specifics to TDEC will be incorporated into a site specific SOP for surface water and spring sampling, currently being prepared.

Sediment Monitoring

TDEC is preparing a draft SOP for sediment sampling.

Groundwater Monitoring

TDEC has approved the SOP for groundwater sampling for residential wells; however, additional references include:

- U. S. Environmental Protection Agency Science and Ecosystem Support Division Athens, Georgia Groundwater Sampling SESDPROC-301-R3, March 6, 2013
- Division of Water Pollution Control August 2011, Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water

Sample Shipments

TDEC has approved the SOP for procedures for shipping samples to the state lab in Nashville.

Data Recording

Each SOP has a data recording requirement; however, a general requirement for data collection follows the U. S. Environmental Protection Agency Science and Ecosystem Support Division Athens, Georgia, Logbooks SESDPROC-010-R5, May 30, 2013

6.0 Quality Assurance Program

6.1 Introduction

The application of QA/QC programs for environmental monitoring activities is essential for generating data of known and defensible quality. Each aspect of an environmental monitoring program from sample collection to data management and record keeping should address and meet applicable quality standards.

6.2 Work/Project Planning and Control

All environmental sampling tasks are performed following the four steps required in the work control subject areas:

1. Define scope of work
2. Work planning: analyzing hazards and defining controls
3. Work execution
4. Provide feedback

In addition, TDEC is developing project-specific SOPs for several activities that are controlled. Requirements for the development and control of documents, including SOPs, are established in the TDEC Quality Management Plan.

Environmental sampling SOPs developed for ORR environmental surveillance programs provide detailed instructions on maintaining chain of custody; sample identification; sample collection and handling; sample preservation; equipment decontamination; and collection of quality control (QC) samples such as field and trip blanks, duplicates, and equipment rinses.

6.3 Personnel Training and Qualifications

Training status is routinely monitored by the DoR-OR training officer and notices of training needs or deficiencies are automatically sent to individual employees. Assessments of personnel training activities and qualifications are included in Section 6.5.

6.4 Equipment and Instrumentation

6.4.1 Calibration

The TDEC quality management system includes subject area directives that establish the standard that all personnel shall use equipment of known accuracy based on appropriate calibration requirements that are traceable to an authority standard. Procedures are in place to ensure equipment is functioning properly and within defined tolerance ranges. The determination of calibration schedules and frequencies is based on a graded approach at the activity planning level. The environmental monitoring programs follow rigorous calibration schedules to eliminate gross drift and the need for data adjustments. Instrument tolerances, functions, ranges, and calibration frequencies are established based on manufacturer specifications, program requirements, actual operating environment and conditions. At a minimum, equipment manufacturer recommendations are followed. Project plans and work control evaluations incorporate all calibration requirements.

All field equipment is inspected, calibrated weekly and tested each day the equipment is used. In the event of malfunction, equipment is immediately sent for repair or replacement if spare equipment is not available. It is the responsibility of the lead and/or in-house QC officer to verify procedures are followed. Calibration records are documented in the appropriate bound calibration logbook. If instruments do not maintain calibration, the source of the problem is determined and resolved with maintenance. If the problem cannot be solved in-house, a repair authorization is requested. Any maintenance or repairs are documented in the appropriate instrument logbook.

6.4.2 Standardization

Sampling procedures, maintained on the network, include requirements and instructions for the proper standardization and use of monitoring equipment. These requirements include use of traceable standards and measurements; performance of routine, before-use equipment standardizations; and actions to follow when standardization steps do not produce required values. Sampling SOPs also include instructions for designating nonconforming instruments as "out-of-service" and initiating requests for maintenance.

6.4.3 Visual Inspection, Housekeeping and Grounds Maintenance

The environmental sampling personnel conduct routine visual inspections of all sampling instrumentation and sampling locations. These inspections identify and address any safety, grounds keeping, general maintenance, and housekeeping issues or needs.

6.5 Assessment

In accordance with, Attachment A: MONITORING AND OVERSIGHT SCOPE of the TOA, *"The joint assessment of the ongoing environmental monitoring and surveillance programs shall continue to determine adequacy in providing information on the releases and impacts on public health and the environment from past and present Oak Ridge Reservation (ORR) actions. The program objective is to provide a comprehensive and integrated monitoring and surveillance program for all media (i.e., air, surface water, soil, sediments, groundwater drinking water, food crops, fish and wildlife, and biological* *systems) and the emissions of any materials (hazardous. toxic, chemical. radiological) on the ORR and environs."*

Independent audits, surveillance, and internal management assessments are performed by the quality officer to verify that requirements have been accurately specified and activities conform to expectations and requirements.

6.6 Analytical Quality Assurance

The TDH laboratory performs analyses of environmental samples from TDEC environmental monitoring programs and has documented QA/QC programs, trained and qualified personnel, appropriately maintained equipment and facilities, and applicable certifications. If the TDH lab cannot perform the testing, they contract the work to a certified/approved lab and enforce these same quality requirements on the contractor.

A statement of work for each project specifies any additional QA/QC requirements and includes detailed information on data deliverables, turnaround times, and required methods and detection limits. Blank and duplicate samples are routinely submitted with TDEC environmental samples to provide an additional check on analytical laboratory performance.

Laboratory Quality Control

The TDH Regional Environmental Laboratory chemist(s) is responsible for quality control.

Laboratory Equipment and Instrument Testing, Inspection, Maintenance and Repair

All TDH Environmental Laboratory instruments undergo regularly scheduled preventive maintenance either by the instrument manufacturer via service agreement or by laboratory personnel, as stipulated in the Environmental Laboratories Laboratory Quality Assurance Plan (TDH, 2010). The Environmental Inorganic SOPs (TDH, 2002-2009) and the Environmental Organic SOPs (TDH, 2002-2012) stipulate laboratory equipment and instrument acceptance criteria, testing criteria, inspection, maintenance and repair protocols, and documentation procedures.

Analytical Methods

Analytical methods are used as shown on the TDH lab website to analyze for contaminants of potential concern as identified and delineated in the individual projects. http://health.state.tn.us/lab/Directory/Section6.pdf

6.7 Data Management and Reporting

The individual projects have requirements for documentation that are listed in the SOPs. Currently, the standard control of records and logbooks is similar to EPA Region 4 Science and Ecology Support Division:

SESD Operating Procedure for Control of Records, SESDPROC-002-R6

SESD Operating Procedures for Logbooks, SESDPROC-010-R5

ORR environmental surveillance data are summarized and reported annually in the Environmental Monitoring Report and the Status Report to the Public and are provided to the Oak Ridge Environmental Information System (i.e., OREIS).

6.8 Records Management

Requirements include creating and identifying record material, and scheduling, protecting, and storing records in both TDEC office areas and on TDEC servers. Records management will follow Tennessee Secretary of State Records Management Division RDA Management System procedures for the destruction of records. Records Disposition Authorizations (RDA) are the Public Records Commission's approved retention schedule that lists records grouped by a common function, the length of time they must be kept, and the required method of destruction. RDAs reflect the length of time that records have historical, administrative, legal, and/or fiscal value.

7.0 Reporting

The results of the sampling are reported in the 2017 Environmental Monitoring Report and the Status Report to the Public as described in the TOA.

8.0 References

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9.0 Supporting Documents

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