3. East Tennessee Technology Park

ETTP was originally built during World War II as part of the Manhattan Project. Formerly known as the K-25 Site, its primary mission was to enrich uranium for use in atomic weapons. After the war, the mission was changed to include the enrichment of uranium for nuclear reactor fuel elements and recycling of uranium recovered from spent fuel, and the name was changed to the “Oak Ridge Gaseous Diffusion Plant” (ORGDP). In the 1980s, a reduction in the demand for nuclear fuel resulted in the shutdown of the enrichment process and production ceased. The emphasis of the mission then changed to environmental management (EM) and remediation operations, and the name was changed to the “East Tennessee Technology Park.”

EM and remediation operations consist of operations such as waste management, the cleanup of outdoor storage and disposal areas, the demolition and cleanup of facilities, land restoration, and environmental monitoring. Proper disposal of huge quantities of waste that were generated over the course of production operations is also a major task. Beginning in the 1990s, reindustrialization (the conversion of underused government facilities for use by the private sector) also became a major mission at ETTP. Reindustrialization allows private industry to lease and purchase underused land and facilities, thus providing both jobs and a new use for facilities that otherwise would have to be demolished. State and federally mandated effluent monitoring and environmental surveillance at ETTP involve the collection and analysis of samples of air, water, soil, sediment, and biota from ETTP and the surrounding area. Monitoring results are used to assess exposures to members of the public and the environment, to evaluate the performance of treatment systems, to help identify areas of concern, to plan remediation efforts, and to evaluate the efficacy of remediation efforts. In 2018, there was 100 percent compliance with permit standards for emissions/discharges from ETTP operations.

On November 10, 2015, DOE and the US Department of Interior (DOI) signed a memorandum of agreement (MOA) establishing the Manhattan Project National Historical Park (MPNHP). The MOA defines the respective roles and responsibilities of the departments in administering the park and includes provisions for enhanced public access, management, interpretation, and historic preservation. A portion of the ETTP, (the K-25 Gaseous Diffusion Building footprint) is included within the MPNHP. As part of the activities to establish the park, DOE released the K-25 Virtual Museum, which is a website that details the history of the K-25 Gaseous Diffusion Plant through narrative and photographs, and can be found **here**.

Due to different permit reporting requirements and instrument capabilities, this report uses various units of measurement. The lists of units of measure and conversion factors on pages xxvii and xxviii are included to help readers convert numeric values presented herein as needed for specific calculations and comparisons.

3.1 Description of Site and Operations

Construction of the K-25 Site (Figure 3.1) began in 1943 as part of the World War II Manhattan Project. The plant’s original mission was the production of enriched uranium for nuclear weapons. Enrichment was initially carried out in the S-50 thermal diffusion process facility, which operated for 1 year, and the K-25 and K-27 gaseous diffusion process buildings. Later, the K-29, K-31, and K-33 buildings were built to increase the production capacity of the original facilities by raising the assay of the feed material entering K-27. Following the war years, the site became officially known as the Oak Ridge Gaseous Diffusion Plant (ORGDP).

After military production of highly enriched uranium was concluded in 1964, the two original process buildings were shut down. For the next 20 years, the plant's primary missions were the production of low enriched uranium fabricated into fuel elements for nuclear reactors throughout the world. Other missions during the latter part of this 20-year period included developing and testing the gas centrifuge method of uranium enrichment and laser isotope separation research and development.

Figure 3.1. East Tennessee Technology Park

By 1985, the demand for enriched uranium had declined, and the gaseous diffusion cascades at ORGDP were placed in standby mode. That same year, the gas centrifuge program was canceled. The decision to permanently shut down the diffusion cascades was announced in late 1987 and actions necessary to implement that decision were initiated soon thereafter. Because of the termination of the original and primary missions, ORGDP was renamed the "Oak Ridge K-25 Site" in 1989. Figure 3.2 shows the ETTP site areas before the start of decontamination and decommissioning (D&D) activities. In 1996, the K-25 Site was renamed the "East Tennessee Technology Park" to reflect its new mission.

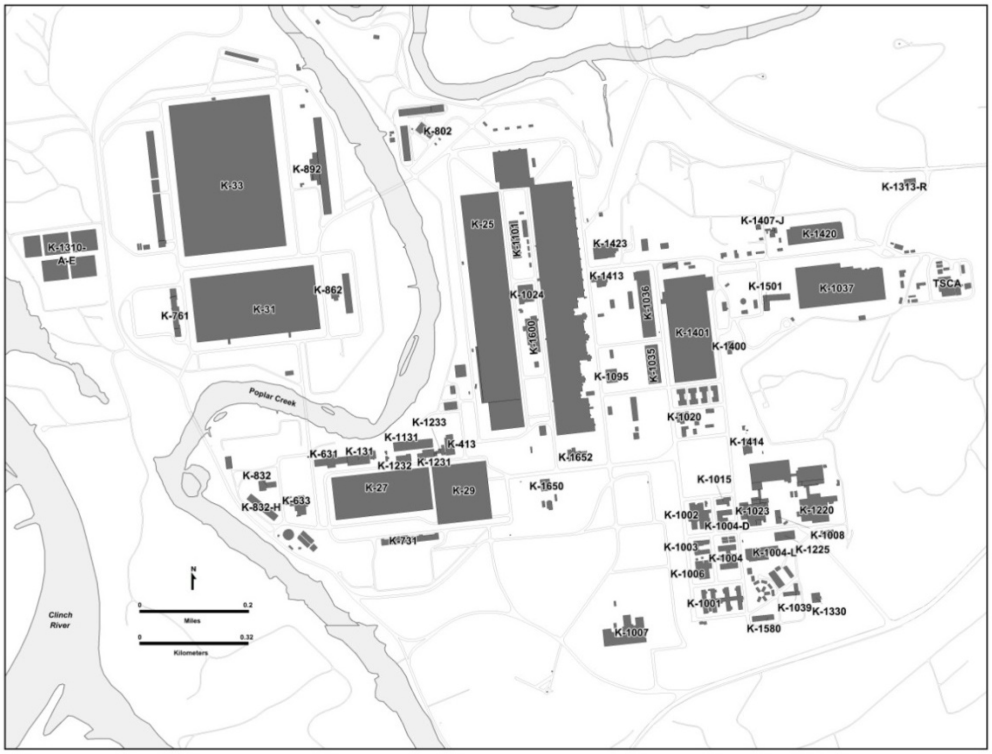


Figure 3.2. East Tennessee Technology Park before the start of decontamination and decommissioning activities in 1991

Figure 3.3 shows the ETTP areas designated for D&D activities through 2018. The ETTP mission is to reindustrialize and reuse site assets through leasing and/or transferring excess or underutilized land and facilities and through incorporating commercial industrial organizations as partners in the ongoing environmental restoration, D&D, and waste treatment and disposal.

The site is undergoing environmental cleanup of its land, as well as D&D of most of its buildings. The cleanup approach makes land and various types of buildings (e.g., office, manufacturing) suitable for private industrial use and for title transfer to the Community Reuse Organization of East Tennessee (CROET) or other entities such as the City of Oak Ridge (COR). The long-term DOE goal for ETTP is to transfer as much of the site property as practicable out of DOE ownership and into CROET's control for the development of a commercial business and industrial park. The facilities may then be subleased or sold, with the goal of stimulating private industry and recruiting business to the area. These transfers also reduce maintenance costs for DOE, which frees up additional money for environmental cleanup. The reuse of key facilities through title transfer is part of the site's closure plan.

UCOR, an AECOM-led partnership with Jacobs, the lead environmental management contractor for ETTP, supports DOE in the reindustrialization program as part of the continuing effort to transform ETTP into a private-sector industrial park. Unless otherwise noted, information on non-DOE entities located on the ETTP site is not provided in this document.

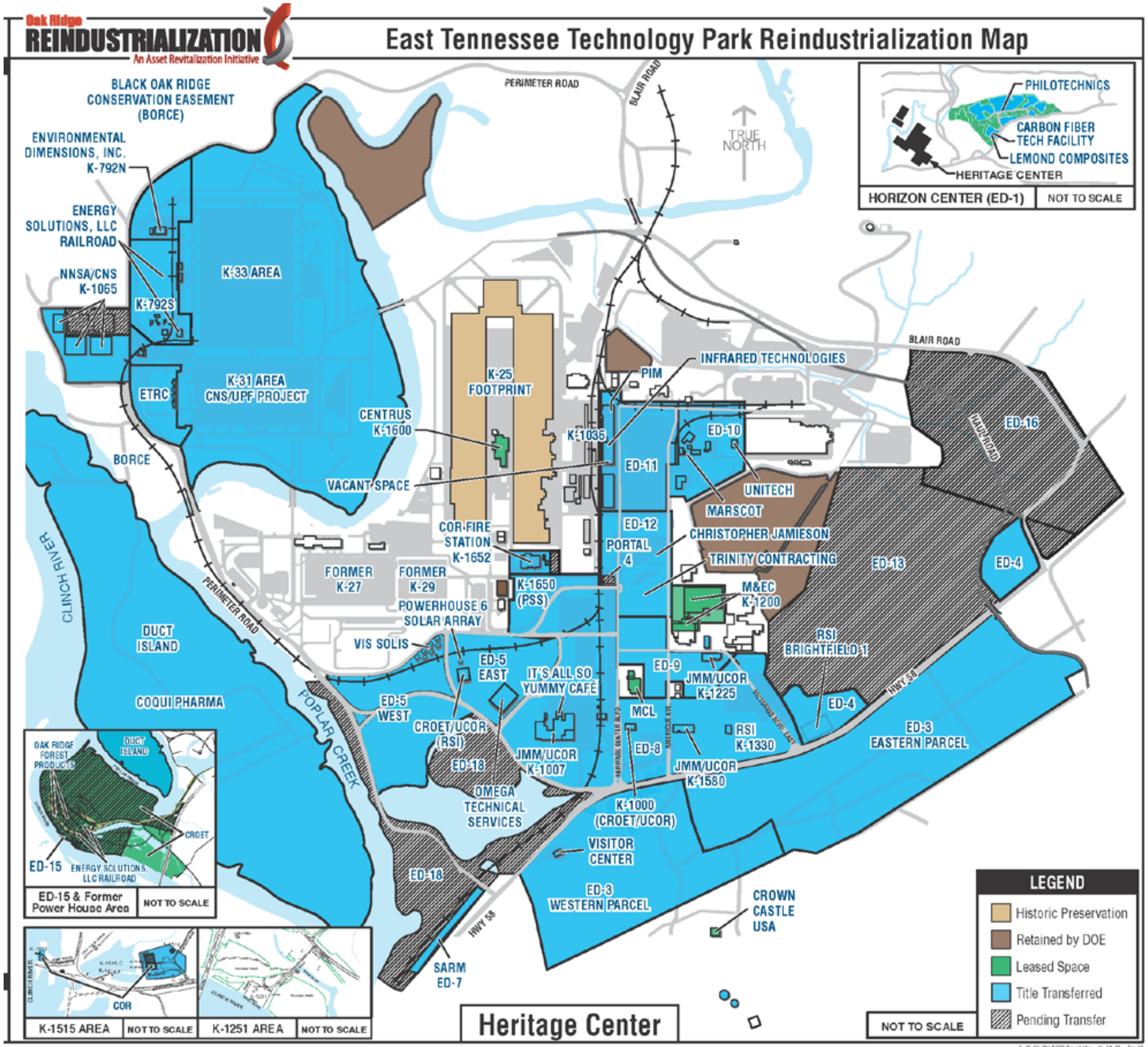


Figure 3.3. East Tennessee Technology Park in 2018, showing progress in reindustrialization

3.2 Environmental Management System

The UCOR Environmental Management System (EMS) is integrated with the UCOR Integrated Safety Management System (ISMS). UCOR's EMS is based on a graded approach for a closure and remediation contract and reflects the elements and framework contained in International Organization for Standardization (ISO) Standard 14001:2004 (ISO 2004), *Environmental management systems—Requirements with guidance for use*. UCOR is committed to incorporating sound environmental management, protection, and sustainability practices in all work processes and activities that are part of the DOE EM program in Oak Ridge, Tennessee. UCOR's environmental policy states in part, "Our commitment to protect and sustain human, natural, and cultural resources is inherent in our mission to complete environmental cleanup safely with reduced risks to the public, workers, and the environment." To achieve this, UCOR's environmental policy adheres to the following principles:

- **Leadership Commitment**—Integrate responsible environmental practices into project operations.
- **Environmental Compliance and Protection (EC&P)**—Comply with all environmental regulations and standards.
- **Sustainable Environmental Stewardship**—Minimize the effects of our operations on the environment through a combination of source reduction, recycling, and reuse; sound waste management practices; and pollution prevention (P2).
- **Partnership/Stakeholder Involvement**—Maintain partnerships through effective two-way communications with our customers and other stakeholders.

3.2.1 Environmental Stewardship Scorecard

The Environmental Stewardship Scorecard is used to track and measure site-level EMS performance. During 2018 UCOR received "green scores" for EMS performance. As an example, Figure 3.4 presents information on UCOR's 2018 P2 recycling activities related to solid waste reduction at ETTP. UCOR recycles office and mixed paper, cardboard, phone books, newspapers, magazines, aluminum cans, antifreeze, engine oils, batteries (lead [Pb] acid, universal waste, and alkaline), universal waste bulbs, plastic bottles, all types of #1 and #2 plastics, and surplus electronic assets, such as computers (CPUs and laptops) and monitors (cathode ray tubes [CRTs] and liquid crystal displays [LCDs]). Other recycling opportunities include unique structural steel, stainless-steel structural members, transformers, and electrical breakers.

UCOR's exceptional electronics stewardship earned it an award in 2018 from the Green Electronics Council for its use of Electronic Product Environmental Assessment Tool (EPEAT) methods. There are two categories at the two-star level—one for computers and displays, and one for imaging equipment. EPEAT purchasers earn a star for each product category for which they have a policy in place and purchase EPEAT-registered electronics. EPEAT is a free and trusted source of environmental product ratings that help purchasers select high-performance electronics that meet their organizations' information technology (IT) and sustainability goals. Manufacturers register products based on the devices' ability to meet various criteria developed and agreed upon by diverse stakeholders to address the full life cycle of an electronic product.

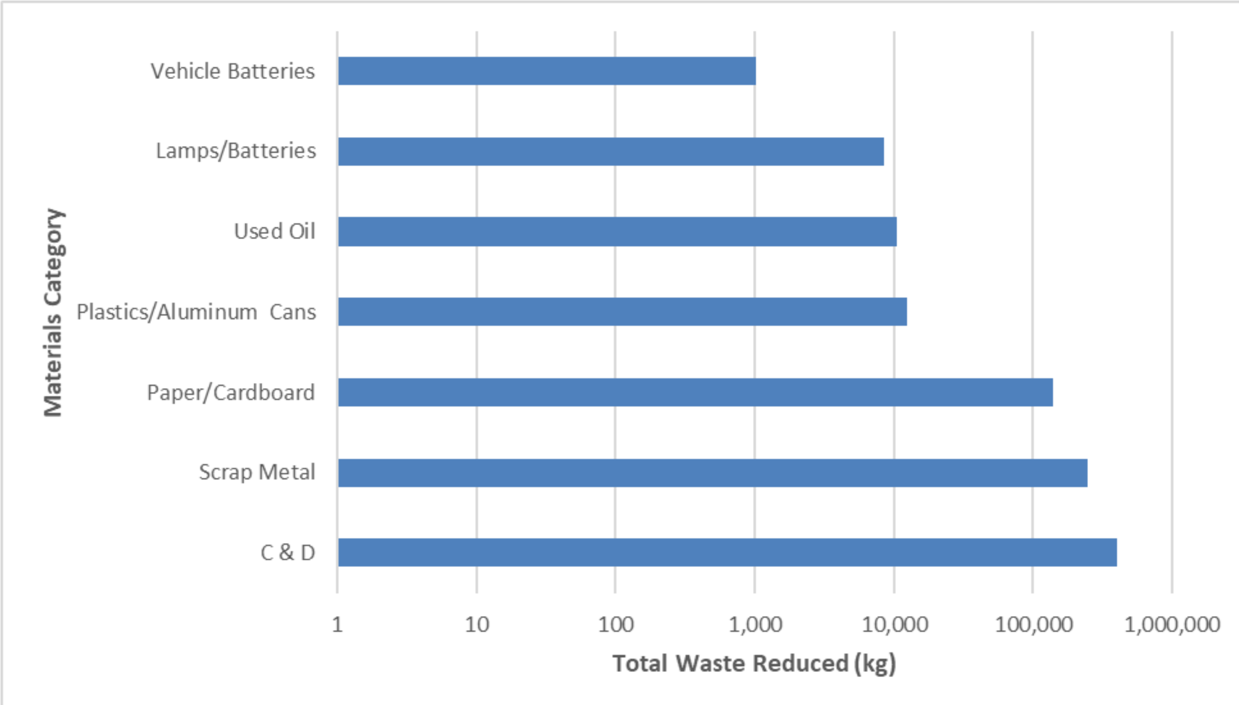


Figure 3.4. Pollution prevention recycling activities related to solid waste reduction at East Tennessee Technology Park in Calendar Year 2018

Additionally, UCOR internally recognized five projects for their P2/waste minimization (P2/WMin) accomplishments in 2018, which are summarized below.

- The Environmental Management Waste Management Facility (EMWMF) team was recognized for diverting approximately 156 tons of rubble through reuse, saving an estimated 1,100 yd^3 of landfill space.
- The K-1401 Treatability Study Team was recognized for its optimization of waste disposition efforts by applying the DOE preferred waste hierarchy model to the project. Through the diversion of offsite water treatment and waste disposal in favor of on-site options, carbon dioxide (CO_2) emissions and risk were greatly reduced, as well as approximately $9.4 million saved.
- The Oak Ridge National Laboratory Operations and Cleanup Enterprise project was recognized for identifying fill from the solid waste storage area (SWSA) 5 area for reuse at the SWSA 7 unit, saving approximately $3,000.
- The Operations and Cleanup Enterprise project diverted a contaminated manipulator from the 3028 building for reuse by UT-Battelle, LLC, saving approximately $75,000 and 10 yd^3 of landfill space.

The ETTP D&D/Exposure Unit (EU)-29/K-1407-C Retention Basin Soil Removal and Restoration Team was recognized for selecting a low maintenance, specialized seed mixture to restore the former K-1407-C Retention Basin at the EU-29 site in lieu of hydroseeding. The result was an enhanced cover of native plants, which provide a habitat conducive to pollinating insects and wildlife, as well as reduced life cycle surveillance and maintenance (S&M) costs through the avoidance of maintenance activities inherent with hydroseeding.

Together, the projects represented sustainability accomplishments in waste diversion, waste reduction and P2, and water management. These accomplishments were the result of team work, leveraging a number of work control and management tools to save landfill space, reduce the use of virgin material, mitigate hazards to the environment and workers, and increase work efficiencies. In addition to lessening the impact on the environment, P2 measures may also save money. In 2018, an estimated total in excess of $9 million was saved as a result of implementation of P2 measures by the projects.

ETTP also continually strives to find new avenues for waste diversion. In 2016, a significant improvement in the diversion of scrap metal was made. In the course of demolition and environmental cleanup, one challenge has been the ability to divert large volumes of construction and demolition debris from disposal in landfills due to radiological contamination. However, despite the radiological challenge, a substantial amount of scrap metal located inside of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)-designated areas is still eligible for recycling because it is not radiologically contaminated. For the nonradiological areas, a second challenge was identified due to the CERCLA Off-Site Rule that requires all disposal and recycle facilities receiving CERCLA waste be reviewed and approved by the EPA for acceptability (CERCLA 1993). UCOR conducted a nationwide search for scrap metal recyclers that EPA had determined to be acceptable with the CERCLA Offsite Rule requirements all the way through the required smelter/foundry process step; however, none were located. Therefore, the only available option for disposal of the noncontaminated CERCLA scrap metal was land disposal.

In 2018 UCOR continued to work with EPA and the Tennessee Department of Environment and Conservation (TDEC) to apply the CERCLA screening process that allows noncontaminated scrap metal from CERCLA areas to be shipped to commercial scrap-metal dealers for recycle. Effectively, the screening process removes the noncontaminated scrap metal from regulation under CERCLA; therefore, any non-CERCLA commercial scrap-metal recyclers can receive the material for recycle. This unprecedented agreement allowed approximately an additional 27,440 lb (12.44 MT of scrap metal to be recycled in FY 2018 in lieu of land disposal and provides a path forward for additional waste diversion for the duration of the contract.

Some of the significant benefits of the scrap-metal recycling under this approval include:

- Provides funds from the recycling payments that are available to go back into the programs and support further actions in the Oak Ridge cleanup program.
- Conserves valuable landfill space. To date, the scrap metal recycled as a result of the screening process has saved approximately 218 yd^3 of valuable landfill space which translates into a considerable cost savings, which takes into consideration capital cost, landfill capacity, historical operating costs, packing, and transportation.
- Supports EPA, TDEC, and DOE programmatic environmental stewardship goals for waste diversion.

The CERCLA screening process will continue to be used as more demolition and cleanup are continued at ETTP, Oak Ridge National Laboratory (ORNL), and the Y-12 National Security Complex (Y-12).

In the area of alternative energy, Restoration Services, Inc. (RSI), in concert with UCOR, continued operations of ETTP's solar parks. Brightfield 1 is a 200-kW solar array located on a 0.405-ha (1-acre) tract purchased from CROET and built by RSI as part of UCOR's commitment to the revitalization of the former K-25 Site.

Figure 3.5. Oak Ridge Solar Park

RSI self-financed the project, using solar panels manufactured in Tennessee, and partnering with other local small businesses for the installation. Power generated from Brightfield 1 is being sold to the Tennessee Valley Authority (TVA) through the City of Oak Ridge Electric Department using a TVA Generation Partners contract. The completed project was commissioned in April 2012 and is part of RSI's Brownfields to Brightfields initiative that works to develop restricted use properties into solar farms. Brightfield 1 energy production in its first year was 110 percent more than projected, with no downtime due to maintenance issues. In calendar year (CY) 2018, Brightfield 1 produced approximately 249,250 kWh of energy.

In addition, through the cooperative efforts of DOE, UCOR, RSI, Vis Solis, Inc., CROET, and COR, a second solar farm—the Powerhouse 6 Solar Farm—was constructed on the west end of the park (Fig. 3.5). It is a 1-MW solar farm that became operational in April 2015 and provides renewable energy, long-term lease income to CROET and boosters development at ETTP. This project provides numerous benefits to the environment and the community at large, and includes the following:

- Generates enough clean energy to power more than 100 homes.
- Prevents pollution by removing the equivalent of 240 cars from the road annually (1,141 MT of CO_2).
- Provides brownfield reuse/redevelopment at ETTP.
- Supports the COR renewable energy goals.
- Supports the TVA renewable energy initiative.
- Offers community economic development jobs and property tax income to COR.
- Demonstrates benefits of ETTP reindustrialization.

- Supports DOE renewable energy goals.
- Demonstrates collaborative success between DOE and a public utility for renewable energy development.

UCOR also continued to use green products whenever possible and evaluated large quantity purchases for less toxic alternatives. In addition, UCOR maintained its extensive recycling program, which helps provide employment to beneficiaries of local charities who are employed by the local recycling facility for the county.

3.2.2 Environmental Compliance

UCOR maintains various layers of oversight to ensure compliance with legal and other requirements. The methods of evaluation include independent assessments by outside parties, management assessments conducted by functional or project organizations, and routine field walkdowns conducted by a variety of functional and project personnel. Management and independent assessments are performed in accordance with *Assessments*, PROC-PQ-1420, and *Independent Assessment*, PROC-PQ-1401. Assessments are scheduled on the UCOR Quality Assurance System (QAS) in accordance with PROC-PQ-1420. Records are maintained for all formal assessments and audits. Issues identified in assessments are handled, as required, by ISO 14001:2004, Section 4.5.3, "Nonconformity, Corrective Action, and Preventive Action" (ISO 2004).

3.2.3 Environmental Aspects/Impacts

Using a graded approach appropriate for EMS includes an environmental policy that provides a unified strategy for the management, conservation, and protection of natural resources; the control and attenuation of risks; and the establishment and attainment of all environment, safety, and health (ES&H) goals. UCOR works continuously to improve EMS to reduce impacts from activities and associated effects on the environment (i.e., environmental aspects) and to communicate and reinforce this policy to its internal and external stakeholders.

3.2.4 Environmental Performance Objectives and Targets

UCOR conserves and protects environmental resources by (1) incorporating environmental protection and the elements of an enabling EMS into the daily conduct of business; (2) fostering a spirit of cooperation with federal, state, and local regulatory agencies; and (3) using appropriate waste management, treatment, storage, and disposal methods.

UCOR has established a set of core, corporate-level EMS objectives that remain relatively unchanged from year to year. These objectives are generally applicable to all operations and activities throughout UCOR's work scope. The core environmental objectives are based on compliance with applicable legal requirements and sustainable environmental practices contained in DOE Order (O) 436.1, *Departmental Sustainability* (DOE 2011a), and include the following:

- Comply with all environmental regulations, permits, and regulatory agreements.

- Reduce or eliminate the acquisition, use, storage, generation, and/or release of toxic, hazardous, and radioactive materials; waste; and greenhouse gas emissions through acquisition of environmentally preferable products, conduct of operations, waste shipment, and P2/WMin and sustainable practices.
- Reduce degradation and depletion of environmental resources and potential impact on climate change through post-consumer material recycling, energy, fuel, and water conservation efforts, use or promotion of renewable energy, and transfer for reuse valuable real estate assets.
- Reduce the environmental impact on surface water and groundwater resources.
- Reduce the environmental impact associated with project and facility activities.

3.2.5 Implementation and Operations

UCOR protects the safety and health of workers and the public by identifying, analyzing, and mitigating aspects, hazards, and impacts from ETTP operations, and by implementing sound work practices. All UCOR employees and subcontractors are held responsible for complying with all ES&H requirements during all work activities and are expected to correct noncompliant conditions immediately. UCOR's internal assessments also provide a measure of how well EMS attributes are integrated into work activities through ISMS. UCOR has embodied its program for EC&P of natural resources in a companywide EM and protection policy. The policy is UCOR's fundamental commitment to incorporating sound EM practices in all work processes and activities.

3.2.6 Pollution Prevention/Waste Minimization

UCOR's work control process requires that all waste-generating activities be evaluated for source reduction and that product substitution be used to produce less toxic waste, when possible. The reuse or recycling of building debris or other wastes generated is evaluated in all cases.

The ETTP EMS program fosters P2 at every level of its operations, from routine office recycling of paper, cardboard and plastics, to unique reuse and recycling at the project-field level. UCOR's P2 program is successful because it is tightly bound to its work control process. Thus many original applications of material reuse and recycling have resulted, many of which have been captured through its internal P2 awards program.

Total cost savings and avoidance associated with these projects were in excess of $9.2 million and resulted in conserving valuable landfill space, and resources, as well as mitigating water contamination, and greenhouse gas emissions. The internal awards will be evaluated for nomination in national-level awards (e.g., DOE Headquarters annual award program).

3.2.7 Competence, Training, and Awareness

The UCOR training and qualification process ensures that needed skills for the workforce are identified and developed. The process also documents knowledge, experience, abilities, and competencies of the workforce for key positions requiring qualification. This process is described in PROC-TC-0702, *Training Program*. Completion and documentation of training, including required reading, are managed by the Local Education Administration Requirements Network, or LEARN.

3.2.8 Communication

UCOR communicates externally regarding environmental aspects through the UCOR public website, which includes a link to its environmental policy statement in *Environmental Management and Protection,* POL-UCOR-007, and a list of environmental aspects.

A number of other documents and reports that address environmental aspects and cleanup progress are also published and made available to the public (e.g., the Annual Site Environmental Report [ASER] [DOE 2018b, DOE/ORO-2511] and the annual cleanup progress report [UCOR 2019a, *2018 Cleanup Progress—Annual Report to the Oak Ridge Regional Community,* OREM-18-2555]).

UCOR participates in a number of public meetings related to environmental activities at the site (e.g., Oak Ridge Site Specific Advisory Board [ORSSAB] meetings, which include community stakeholders, public permit reviews, and public CERCLA decision document reviews). Written communications from external parties are tracked using the weekly Open Action Report.

3.2.9 Benefits and Successes of Environmental Management System Implementation

An EMS program provides many benefits to an organization's success. Based upon the simplified model of Do-Act-Check, it provides a framework by which work incorporates environmental hazards into its work control and planning. This translates into many returns to the organization. UCOR uses EMS objectives and targets, an internal P2 recognition program, environmentally preferable purchasing, work control processes, and a recycle program to meet sustainability and stewardship goals and requirements. The approach is outlined in UCOR's *Pollution Prevention and Waste Minimization Program Plan for the East Tennessee Technology Park, Oak Ridge, Tennessee* (UCOR 2019b, UCOR-4127/R7). The EMS program is audited by a third party triennially as for conformance to the ISO 14001:2004 standard (ISO 2004) as required by DOE Order 436.1, *Departmental Sustainability, Attachment1 Contractor Requirements Document* (DOE 2011a), with the most recent having been conducted in 2018. The results of the audit were zero Findings, three Observations, and four Proficiencies.

3.2.10 Management Review

Senior management review of the EMS is performed at several layers and frequencies. A formal review/presentation with UCOR senior management that addresses the ISO 14001:2004 (ISO 2004) required elements is conducted at least once per year. At least two of the senior managers are present for management reviews. The environmental policy is also reviewed during the management review annually and revised as necessary.

3.3 Compliance Programs and Status

During 2018, ETTP operations were conducted in compliance with contractual and regulatory environmental requirements. There were no National Pollutant Discharge Elimination System (NPDES) permit noncompliances and no Clean Air Act (CAA) noncompliances in 2018. Figure 3.6 shows the trend of NPDES compliance at ETTP since 2008. The following sections provide more detail on each compliance program and the environmental remediation-related activities in 2018.

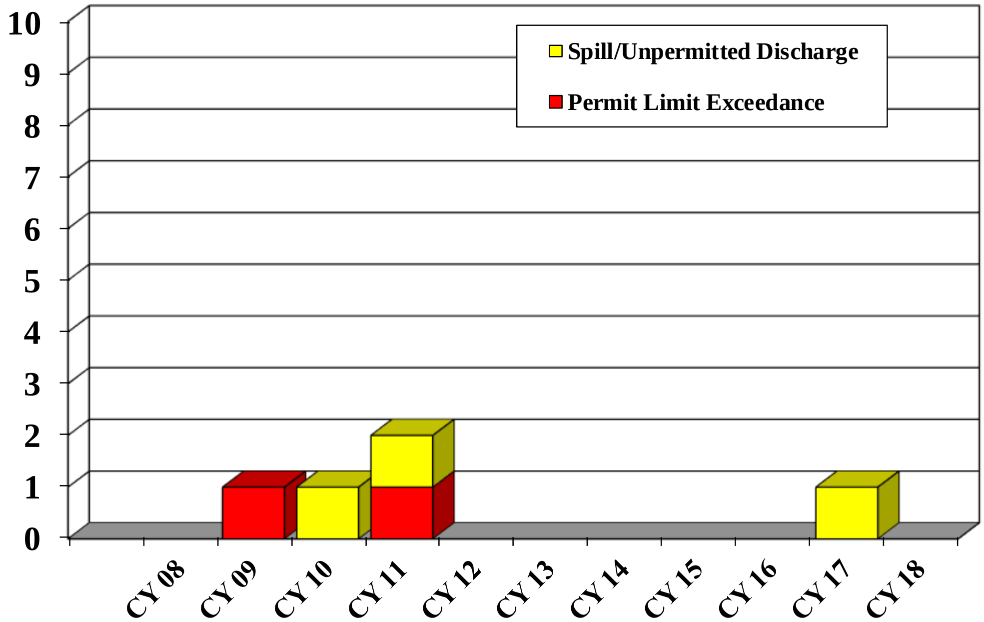


Figure 3.6. East Tennessee Technology Park National Pollutant Discharge Elimination System permit noncompliances since 2008

3.3.1 Environmental Permits

Table 3.1 contains a list of environmental permits that were in effect at ETTP in 2018.

3.3.2 Notices of Violation and Penalties

ETTP received no notices of environmental violations or penalties in 2018.

3.3.3 Audits and Oversight

Table 3.2 presents a summary of environmental audits and oversight visits conducted at ETTP in 2018.

Table 3.1. East Tennessee Technology Park environmental permits, 2018

Regulatory driver	Permit title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	State permit to operate an air contaminant source—internal combustion engine–powered emergency generators and fire water pump replaced by Permit-by-Rule when NOA received from TDEC	069346P, NOA Number R74133	03-03-2015 Amended 11-22-2016 NOA issued 7-19-2018	10-01-2024, none for NOA	DOE[a]	UCOR	UCOR
CWA	NPDES permit for storm water discharges	TN0002950	02-01-2015	03-31-2020	DOE	UCOR	UCOR
CWA	SOP—waste transportation project; Blair Road and Portal 6 sewage pump and haul permit	SOP-05068	07-01-2014	02-28-2019	TFE	TFE	TFE
CWA	SOP—ETTP holding tank/haul system for domestic wastewater	SOP-99033	07-01-2015	06-30-2020	UCOR	UCOR	UCOR
UST	Authorized/certified USTs at K-1414 Garage	Customer ID 30166 Facility ID 073008	03-20-1989	Ongoing	DOE	UCOR	UCOR
RCRA	ETTP container storage and treatment units	TNHW-165	09-15-2015	09-15-2025	DOE	UCOR	UCOR
RCRA	Hazardous waste corrective action document (encompasses entire ORR)	TNHW-164	09-15-2015	09-15-2025	DOE	DOE/All[a]	DOE/All[a]

[a] DOE and ORR contractors that are co-operators of hazardous waste permits.

Acronyms
CAA = Clean Air Act
CWA = Clean Water Act
DOE = US Department of Energy
ETTP = East Tennessee Technology Park
ID = identification (number)
NOA-Notice of Authorization
NPDES = National Pollutant Discharge Elimination System
ORR = Oak Ridge Reservation
RCRA = Resource Conservation and Recovery Act
SOP = state operating permit
TFE = Technical and Field Engineering, Inc.
UCOR = UCOR, an AECOM-led partnership with Jacobs
UST = underground storage tank

Table 3.2. Regulatory oversight, assessments, inspections, and site visits at East Tennessee Technology Park, 2018

Date	Reviewer	Subject	Issues
February 2	COR	Sewage Pretreatment Plan	0
February 27 and October 30	TDEC	Annual RCRA Compliance Inspection	0
July 5	COR	Windshield Tour of ETTP	0

COR = City of Oak Ridge
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation

3.3.4 National Environmental Policy Act/National Historic Preservation Act

The National Environmental Policy Act (NEPA) provides a means to evaluate the potential environmental impact of proposed federal activities and to examine alternatives to those actions. ETTP maintains compliance with NEPA through the use of site-level procedures and program descriptions that establish effective and responsive communications with program managers and project engineers to ensure NEPA is a key consideration in the formative stages of project planning. Many of the current operations at ETTP are conducted under CERCLA. NEPA reviews are part of the CERCLA planning process to ensure that NEPA values are incorporated into CERCLA projects and documentation.

During 2018, ETTP continued to operate under site-level, site-specific procedures that provide requirements for project reviews and NEPA compliance. These procedures call for a review of each proposed project, activity, or facility to determine the potential for impacts on the environment. To streamline the NEPA review and documentation process, DOE Oak Ridge Office (ORO) has approved generic categorical exclusion (CX) determinations that cover certain proposed activities (i.e., maintenance activities, facility upgrades, personnel safety enhancements). A CX is one of a category of actions defined in 40 Code of Federal Regulations (CFR) Part 1508.4 (EPA 1978) that does not individually or cumulatively have a significant effect on the human environment and for which neither an environmental assessment nor an environmental impact statement is normally required. UCOR activities on the ORR are in full compliance with NEPA requirements, and procedures for implementing NEPA requirements have been fully developed and implemented. At ETTP, a checklist incorporating NEPA and EMS requirements has been developed as an aid for project planners. For routine, recurring activities, DOE generic CX determinations are used. During 2018, a new CX determination was generated, CX-K25-564, for the demolition of non-CERCLA buildings at ETTP.

Compliance with the National Historic Preservation Act (NHPA) at ETTP is achieved and maintained in conjunction with NEPA compliance. The scope of proposed actions is reviewed in accordance with the ORR cultural resource management plan (Souza et al. 2001). At ETTP, there were 135 facilities eligible for inclusion on the National Register of Historic Places (NRHP), a US National Park Service (NPS) program to identify, evaluate, and protect historic and archeological resources in the United States, as well as numerous facilities that were not eligible for inclusion on NRHP. To date, more than 800 facilities have been demolished. Artifacts of historical and/or cultural significance are identified before demolition and are catalogued in a database to aid in the historic interpretation of ETTP.

Consultation for the development of a memorandum of agreement (MOA) for D&D of the K-25 and K-27 buildings started in 2001; the document, approved in 2003, required a third-party analysis of the preservation and interpretive strategies for those two buildings. In 2005, DOE, the Tennessee State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation (ACHP) entered into an MOA that included the retention of the north end tower (also known as north wing and north end) of the K-25 building and Portal 4 (K-1028-45), among other features, as the “best and most cost-effective mitigation to permanently commemorate, interpret, and preserve the significance” of ETTP. Another series of consultation meetings ensued in 2009 and DOE advised that prohibitive costs and safety considerations precluded fulfillment of three stipulations in the 2005 MOA, including the preservation of the north end tower. The parties offered a wide array of potential mitigation measures and, in the absence of consensus on how best to commemorate Building K-25, DOE, SHPO, and ACHP entered into a bridge MOA until the parties could reach a final agreement. After completing an evaluation of the structural integrity of the K-25 building and interpretative approaches for the site, DOE distributed a preferred mitigation plan to the consulting parties in October 2011. The DOE final mitigation plan, which addressed comments submitted by consulting parties in November 2011, permitted demolition of the entire K-25 building and called for, among other mitigation measures, the designation of a commemorative area around the building’s perimeter from which future surface development would largely be restricted; the retention, if possible, of the entire concrete slab or the demarcation of the building’s footprint; the construction of a viewing tower and structure for equipment display; and the development of a history center within the ETTP Fire Station. A final MOA was signed in August 2012, finalizing the aspects set forth in the mitigation plan. A Professional Design Team and Museum Professional were selected in 2014. The museum design was completed in 2017 and a construction subcontract was awarded for the K-25 History Center in 2018.

On December 14, 2014, Congress authorized the establishment of the Manhattan Project National Historical Park to commemorate the history of the Manhattan Project (DOI 2015). It will comprise the three major sites: Los Alamos, New Mexico; Oak Ridge, Tennessee; and Hanford, Washington, which were dedicated to accomplishing the Manhattan Project mission.

The *Memorandum of Agreement Between the United States Department of the Interior and the United States Department of Energy for the Manhattan Project National Historical Park* was signed by DOI and DOE on November 10, 2015 (DOE 2015), creating the new Manhattan Project National Historical Park. The K-25 Virtual Museum website (K-25 Virtual Museum) was launched in conjunction with the signing of the MOA.

The Museum Preliminary Design Report was completed and provided to the Consulting Parties in July 2016. The Consulting Parties reviewed the report and plans and provided comments. The Final Design Plan was completed and sent to the consulting parties for review in January 2017. Comments from the consulting parties were received and incorporated into the Certified for Construction design package and a request for proposal was issued for construction, exhibit fabrication, and installation activities for the K-25 History Center. Construction of the K-25 History Center was begun in 2018 and is expected to open in the fall of 2019.

The Historic American Engineering Record (HAER) documentation is being prepared for the K-25 Building. The documentation will be transmitted to the NPS upon completion.

3.3.5 Clean Air Act Compliance Status

The CAA, passed in 1970 and amended in 1977 and 1990, forms the basis for the national air pollution control effort. This legislation establishes comprehensive federal and state regulations to limit air emissions and includes five major regulatory programs: the National Ambient Air Quality Standards (NAAQS), State Implementation Plans (SIPs), New Source Performance Standards (NSPSs), Prevention of Significant Deterioration permitting programs, and National Emission Standards for Hazardous Air Pollutants (NESHAPs). Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by EPA and the TDEC Division of Air Pollution Control.

Full compliance with CAA regulations and permit conditions was demonstrated in 2018. The ETTP ambient air-monitoring program, permitted source operations tracking, and record keeping provided documentation fully supporting a 100 percent compliance rate.

3.3.6 Clean Water Act Compliance Status

The objective of the Clean Water Act (CWA) is to restore, maintain, and protect the integrity of the nation’s waters. This act serves as the basis for comprehensive federal and state programs to protect the waters from pollutants (see Appendix C for water reference standards). One of the strategies developed to achieve the goals of CWA was EPA establishment of limits on specific pollutants allowed to be discharged in US waters by municipal sewage treatment plants (STPs) and industrial facilities. EPA established the NPDES permitting program to regulate compliance with pollutant limitations. The program was designed to protect surface waters by limiting effluent discharges into streams, reservoirs, wetlands, and other surface waters. EPA has delegated authority for implementation and enforcement of the NPDES program to the state of Tennessee. In 2018, ETTP discharged storm water to the waters of the state of Tennessee under the individual NPDES permit TN0002950, which regulates storm water discharges.

In 2018, sewage discharges from routine breakrooms, restrooms, and change house showers were discharged to the COR Rarity Ridge Wastewater Treatment Plant collection network and sewage holding tanks under permits SOP-05068 and SOP-99033.

3.3.7 National Pollutant Discharge Elimination System Permit Noncompliances

In 2018, compliance with ETTP NPDES storm water permit TN0002950 was determined by more than 150 laboratory analyses, field measurements, and flow estimates. The NPDES permit compliance rate for all discharge points for 2018 was 100 percent. There were no permit noncompliances in 2018.

3.3.8 Safe Drinking Water Act Compliance Status

Since October 1, 2014, all water at the ETTP site is supplied by the COR drinking water plant, located north of the Y-12 Complex in Oak Ridge, Tennessee.

3.3.9 Resource Conservation and Recovery Act Compliance Status

ETTP is regulated as a large-quantity generator of hazardous waste because the facility generates more than 1,000 kg of hazardous waste per month. This amount includes hazardous waste generated under permitted activities (including repackaging or treatment residuals). At the end of 2018, ETTP had two generator accumulation areas for hazardous or mixed waste.

In addition, ETTP is permitted to store and treat hazardous and mixed waste under the Resource Conservation and Recovery Act (RCRA) Part B Permit TNHW-165. Hazardous waste may be treated and stored at permitted locations at the K-1065 complex. This hazardous waste permit was reissued on September 15, 2015, as a replacement for TNHW-117. The hazardous waste corrective action document, TNHW-164, which covers the ORR areas of concern and solid waste management units, was also reissued on September 15, 2015, as a replacement for TNHW-121.

In CY 2018, ETTP prepared and submitted to the TDEC Division of Solid Waste Management the CY 2017 annual report of hazardous waste activities. This report identifies the type and amount of hazardous waste that was generated, shipped off site, or is currently in storage.

3.3.10 Resource Conservation and Recovery Act Underground Storage Tanks

Underground storage tanks (USTs) containing petroleum and hazardous substances are regulated under RCRA Subtitle I (40 CFR 280, EPA 2015). EPA granted TDEC authority to regulate USTs containing petroleum under TDEC Rule 0400-18-01, *Underground Storage Tank Program* (TDEC 2018b); however, EPA still regulates hazardous substance USTs. During 2018, operations of the two USTs at ETTP were in complete regulatory compliance. In April 2018, TDEC was notified that both tanks had been emptied and were temporarily out of service, pending final closure.

3.3.11 Comprehensive Environmental Response, Compensation, and Liability Act Compliance Status

CERCLA, also known as "Superfund," was passed in 1980 and was amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA). Under CERCLA, a site is investigated and remediated if it poses significant risk to health or the environment. The EPA National Priorities List (NPL) is a comprehensive list of sites and facilities that have been found to pose a sufficient threat to human health and/or the environment to warrant cleanup under CERCLA. ORR is on the NPL and numerous CERCLA decision documents are approved for ETTP site cleanup actions for both facility demolitions and soil remediation.

3.3.12 East Tennessee Technology Park RCRA-CERCLA Coordination

The *Federal Facility Agreement for the Oak Ridge Reservation* (FFA, DOE 2017, DOE/OR-1014) is intended to coordinate the corrective action processes of RCRA required under the *Hazardous and Solid Waste Amendments* permit with CERCLA response actions.

3.3.13 Toxic Substances Control Act Compliance Status—Polychlorinated Biphenyls

On April 3, 1990, DOE notified EPA headquarters (as required by 40 CFR 761.205, *Polychlorinated Biphenyls (PCBS) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions* [EPA 1979]) that ETTP is a generator with on-site storage, a transporter, and an approved disposer of polychlorinated biphenyl (PCB) wastes.

PCB waste generation, transportation, disposal, and storage at ETTP are regulated under EPA ID number TN0890090004. In 2018, ETTP operated five PCB waste storage areas in ETTP generator buildings, and when longer-term storage of PCB/radioactive wastes was necessary, RCRA-permitted storage buildings were used. These facilities were operated under 40 CFR 761.65(b)(2)(iii) (EPA 1979), which allows PCB storage permitted by the state authorized under Section 3006 of RCRA to manage hazardous waste in containers, and spills of PCBs are cleaned up in accordance with Subpart G of this part. ETTP operated one long-term PCB waste storage area on site where nonradioactive PCB waste was stored in a facility that was not a RCRA-permitted storage facility. The continued use of authorized PCBs in electrical systems and/or equipment (e.g., transformers, capacitors, rectifiers) is regulated at ETTP. At this time, no PCB-contaminated electrical equipment is in service at ETTP. Most TSCA-regulated equipment at ETTP has been disposed of. However, some ETTP facilities continue to use or store non-electrical PCB-contaminated equipment for future reuse.

Because of the age of many ETTP facilities and the varied uses for PCBs in gaskets, grease, building materials, and equipment, DOE self-disclosed unauthorized use of PCBs to EPA in the late 1980s. As a result, DOE ORO and EPA Region 4 consummated a major compliance agreement known as the *Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement* (DOE 2018c, ORR-PCB-FFCA), which became effective December 16, 1996, and was last revised on October 8, 2018, to Revision 6. The modification in 2018 allowed the continued use of the Chuck Vacuum System in Building 9215 and the Foundry Hydraulic System in Building 9998 located at Y-12. The prior modification that took place in 2012 incorporated PCB institutional controls at the TSCA Incinerator where limited areas of contamination remained in place at the facility after the facility closure actions were completed. The PCB institutional controls are also documented in the Oak Ridge Reservation (ORR) Corrective Actions Permit TNHW-165. The institutional controls remained in place until CERCLA demolition activities begun on June 7, 2018, and were completed September 13, 2018. All of the TSCA Incinerator PCB contaminated areas were disposed at the ORR EMWMF landfill.

ORR-PCB-FFCA (DOE 2018c) specifically addresses the unauthorized use of PCBs in ventilation ducts and gaskets, lubricants, hydraulic systems, heat transfer systems, and other unauthorized uses; storage for disposal; disposal; cleanup and/or decontamination of PCBs and PCB items, including PCBs mixed with radioactive materials; and ORR records and reporting requirements. A major focus of the agreement is the disposal of PCB waste. As a result of that agreement, DOE and UCOR continue to notify EPA when additional unauthorized uses of PCBs, such as in paint, adhesives, electrical wiring, or floor tile, are identified at ETTP. This notification process is routinely incorporated into the CERCLA documentation for demolition and remedial actions (RAs).

The ETTP site prepares a PCB Annual Document Log (PCBADL) each year per 40 CFR 761.180(a) (EPA 1979). The written PCBADL is prepared by July 1 of each year and covers the previous CY. The PCBADL documents such things as container inventory, shipments, and PCB spills at the facility. Authorized representatives of EPA may inspect the PCBADL at the facility where they are maintained during normal business hours. The PCBADL must be maintained on site for a minimum of 3 years.

3.3.14 Emergency Planning and Community Right-to-Know Act Compliance Status

The Emergency Planning and Community Right-to-Know Act (EPCRA) that is also identified as Title III of SARA requires that facilities report inventories that exceed threshold planning quantities and releases of hazardous and toxic chemicals. The reports are submitted electronically and are available online for the local emergency planning committee, the state emergency response commission, and the local fire department. ETTP complied with these requirements in 2018 through the submittal of required reports as applicable under EPCRA Sections 302, 311, 312, and 313. ETTP had no reportable releases of hazardous substances or extremely hazardous substances, as defined by EPCRA, in 2018.

3.3.14.1 Chemical Inventories (EPCRA Section 312)

Inventories, locations, and associated hazards of hazardous and extremely hazardous chemicals were submitted in an annual report to state and local emergency responders, as required by EPCRA Section 312. Of the ORR chemicals identified for 2018, 13 were located at ETTP. These chemicals were nickel metal, lead metal (including large, lead-acid batteries), sodium metal, diesel fuel, sulfuric acid (including large, lead-acid batteries), Chemical Specialties Ultrapoles, creosote-treated wood, unleaded gasoline, Sakrete Type S or N mortar mix, Portland cement, CCA Type C pressure-treated wood, Flexterra FGM erosion control agent, and sodium chloride.

3.3.14.2 Toxic Chemical Release Reporting (EPCRA Section 313)

EPCRA Section 313 requires facilities to complete and submit a toxic chemical release inventory (TRI) form (Form R) annually. Form R must be submitted for each TRI chemical that is manufactured, processed, or otherwise used in quantities above the applicable threshold quantity. The reports address releases of certain toxic chemicals to air, water, land, and waste management, recycling, and P2 activities.

Threshold determinations and reports for each of the ORR facilities are made separately. Operations involving TRI chemicals were compared with regulatory thresholds to determine which chemicals exceeded the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations were made, releases and off-site transfers were calculated for each chemical that exceeded the threshold quantity. In 2018, there were no chemicals that met the reporting requirements..

3.4 Quality Assurance Program

3.4.1 Integrated Assessment and Oversight Program

Quality assurance (QA) program implementation and procedural and subcontract compliance are verified through the UCOR integrated assessment and oversight program. The program identifies the processes for planning, conducting, and coordinating assessment and oversight of UCOR activities, including both self-performed and subcontracted activities, resulting in an integrated assessment and oversight process. The program is composed of three key elements (1) external assessments conducted by organizations external to UCOR, (2) independent assessments conducted by teams composed of UCOR personnel who are not directly involved with the project/function being assessed, and (3) management assessments and surveillances conducted as self-assessments and surveillances by the organization or on behalf of the organization manager.

Self-assessments are performed by the organization/function with primary responsibility for the work, process, or system being assessed. Organizations and functions within the company plan and schedule self-assessments. Self-assessments encompass both formal and informal assessments. The formal self-assessments include management assessments and surveillances, and subcontractor oversight. Informal self-assessments include weekly inspections and routine walkthroughs conducted by subcontractor coordinators, ES&H and QA representatives, quality engineers, and line managers.

Conditions adverse to quality identified from internal and external assessments are documented, causal analyses are performed, and corrective actions are developed and tracked to closure. Analyses are conducted periodically to identify trends for management action. Senior management evaluates data from those processes to identify opportunities for improvement.

3.5 Air Quality Program

The state of Tennessee has been delegated authority by EPA to convey the clean air requirements that are applicable to ETTP operations. New projects are governed by construction and operating permit regulatory requirements. The owner or operator of air pollutant emitting sources is responsible for ensuring full compliance with any issued permit or other generally applicable CAA requirement. During 2018, ETTP DOE EM operations were under UCOR responsibility for regulatory compliance.

3.5.1 Construction and Operating Permits

UCOR ETTP operations are subject to CAA regulations and permitting under TDEC Air Pollution Control rules that are specific to stationary fossil-fueled reciprocating internal combustion engines (RICE) for emergency use. TDEC originally issued an operating permit (069346P) covering six stationary emergency RICE units on March 3, 2015. An amended permit was issued on November 22, 2016, that removed one permanently shut down unit. The last operating permit was amended on November 22, 2016, and covered four stationary emergency RICE generators and one stationary emergency RICE firewater booster pump. Three generators have diesel-fueled engines, one generator has a natural gas-fueled engine, and the firewater booster pump engine is diesel fueled. On July 19, 2018, TDEC provided a Notice of Authorization (NOA) to UCOR for coverage under Permit-by-Rule for all of the ETTP stationary emergency RICE.

Although the Permit-by-Rule subsumed the previous operating permit for the ETTP stationary emergency RICE generators and firewater booster pump, the compliance requirements remained the same. Compliance for all units is demonstrated by following specified maintenance schedules, limiting hours of operations for nonemergencies to 100 h per year, and record keeping. Regulations exempt any operating hours of these units during nonscheduled (emergency) power outages.

All other ETTP operations that emit low levels of air pollutants have been classified as insignificant under TDEC rules. Any planned stationary sources that may emit air pollutants are evaluated and compared against applicable pollutant emission limits to document this classification and pursue permitting if required under TDEC regulations.

3.5.1.1 Generally Applicable Permit Requirements

ETTP is subject to a number of generally applicable requirements that involve management and control. Asbestos, ozone-depleting substances (ODSs), and fugitive particulate emissions are specific examples.

Control of Asbestos

ETTP's asbestos management program ensures all activities involving demolitions and all other actions impacting asbestos-containing materials (ACM) are fully compliant with 40 CFR 61, Subpart M, *National Emission Standards for Hazardous Air Pollutants*, "National Emission Standard for Asbestos." This includes using approved engineering controls and work practices, inspections, and monitoring for proper removal and waste disposal of ACM. ETTP has numerous buildings and equipment that contain ACMs. Major demolition activities during 2018 involved the abatement of ACM that were subject to the requirements of 40 CFR Part 61, Subpart M. Most demolition and ACM abatement activities are governed under CERCLA. Under this act, notifications of asbestos demolition or renovations, as specified in 40 CFR Part 61.145(b), are incorporated into CERCLA document regulatory notifications. All other non-CERCLA planned demolition or renovation activities were individually reviewed for applicability of the TDEC notification requirements of the rule. During 2018, seven Notifications of Demolition and/or Asbestos Renovation were submitted to TDEC for non-CERCLA ETTP activities. All of these notifications were for non-asbestos demolition. The rule also requires an annual notification for all nonscheduled, minor asbestos renovations if the accumulated total amount of regulated or potentially regulated asbestos exceeds stipulated thresholds. For 2018, the total ETTP projected nonscheduled amounts were below thresholds that would require the submittal of an annual notification to TDEC. No releases of reportable quantities of ACM occurred at ETTP during 2018.

Stratospheric Ozone Protection

The management of ODSs at ETTP is subject to regulations in 40 CFR Part 82, Subpart F, Recycling and Emissions Reduction; these regulations require preparation of documentation to establish that actions necessary to reduce emissions of Class I and Class II refrigerants to the lowest achievable level have been observed during maintenance activities at ETTP. The applicable actions include, but may not be limited to, the service, maintenance, repair, and disposal of appliances containing Class I and Class II refrigerants, such as motor vehicle air conditioners. In addition, the regulations apply to refrigerant reclamation activities, appliance owners, manufacturers of appliances, and recycling and recovery equipment. Figure 3.7 illustrates the historical onsite ODS inventory at ETTP.

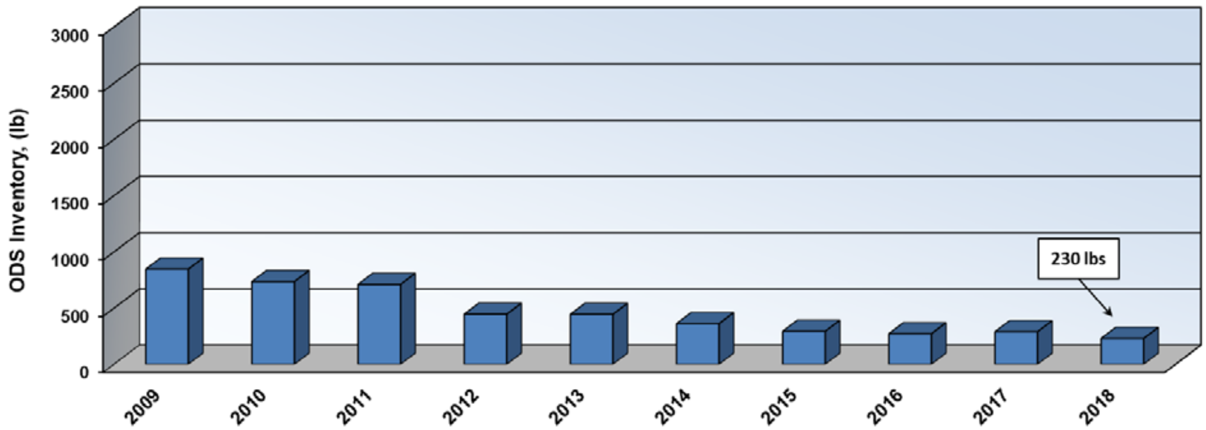


Figure 3.7. East Tennessee Technology Park total onsite ozone-depleting substances inventory, 10-year history

3.5.1.2 Fugitive Particulate Emissions

ETTP has been the location of major building demolition activities, soil remediation activities, and waste debris transportation with the potential for the release of fugitive dust. All planned and ongoing activities include the use of dust control measures to minimize the release of visible fugitive dust beyond the project perimeter. This includes the use of specialized demolition equipment and water misters. Gravel roads in and around ETTP that are under DOE control are wetted with water, as needed, to minimize airborne dusts caused by vehicle traffic.

3.5.1.3 Radionuclide National Emission Standards for Hazardous Air Pollutants

Radionuclide airborne emissions from ETTP are regulated under 40 CFR Part 61, *National Emission Standards for Hazardous Air Pollutants (Rad-NESHAP)*. Characterization of the impact on public health of radionuclides released to the atmosphere from ETTP operations was accomplished by conservatively estimating the dose to the maximally exposed member of the public. The dose calculations were performed using the Clean Air Assessment Package (CAP-88) computer codes, which were developed under EPA sponsorship for use in demonstrating compliance with the 10 mrem/year effective dose Rad-NESHAP emission standard for the entire DOE ORR. Source emissions used to calculate the dose are determined using EPA-approved methods that can range from continuous sampling systems to conservative estimations based on process and waste characteristics. Continuous sampling systems are required for radionuclide-emitting sources that have a potential dose impact of not less than 0.1 mrem per year to any member of the public. ETTP Rad-NESHAP sources that operated during 2018—the K-1407 Chromium Water Treatment System (CWTS) Volatile Organic Compound (VOC) Air Stripper and K-2500-H Segmentation Shop C—are considered minor based on emissions evaluations using EPA-approved calculation methods. A minor Rad-NESHAP source is defined as having a potential dose impact on the public that is less than 0.1 mrem/year. Compliance is demonstrated using data collected by the ETTP ambient air monitoring program described in Section 3.5.2.

Quarterly radiochemical analyses are performed on composited samples collected at all ETTP ambient air sampling stations. The selected isotopes of interest were ^{234}U, ^{235}U, and ^{238}U with the ^{99}Tc inorganic analysis results included as a dose contributor. The concentration and dose results for each of the nuclides are presented in Table 3.3 for the 2018 reporting period.

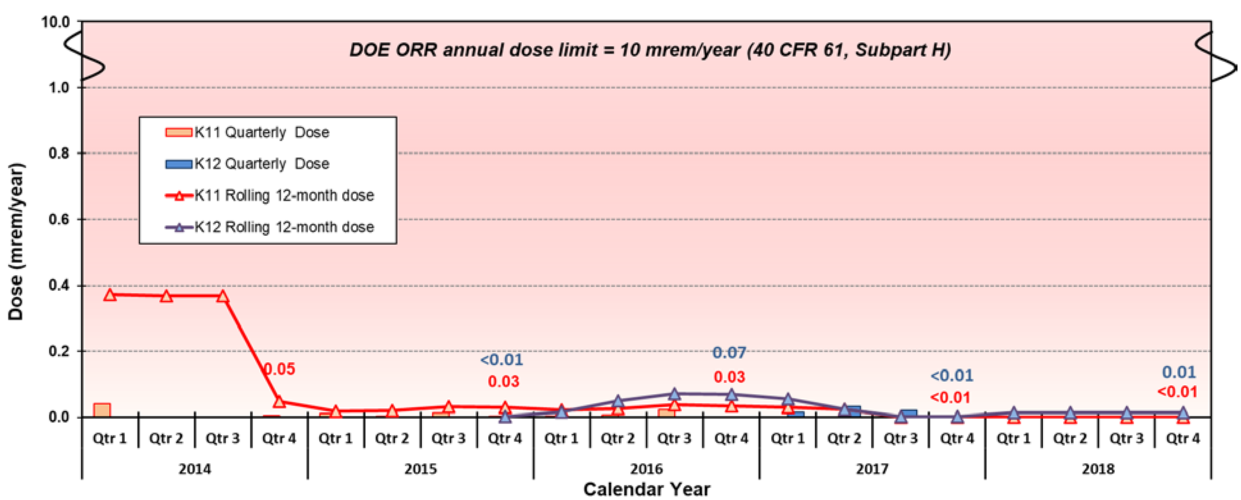
Table 3.3. Radionuclides in ambient air at East Tennessee Technology Park, January 2018 through December 2018

Station	Concentration (μCi/mL)				
	^{99}Tc	^{234}U	^{235}U	^{238}U	
K2[a]	ND[b]	4.38E-18	5.16E-19	ND	
K11[c]	ND	1.41E-17	2.03E-18	1.42E-17	
K12[c]	ND	3.59E-16	1.56E-17	8.98E-17	
	40 CFR 61, Effective Dose (mrem/year)				Total Dose
K2	ND	< 0.001	< 0.001	ND	< 0.001
K11	ND	< 0.01	< 0.01	< 0.01	0.01
K12	ND	0.010	0.001	0.002	0.013

[a] K2 result represents a residential exposure.
[b] ND = not detectable.
[c] K11 and K12 represent an onsite business exposure equivalent to half of a yearly exposure at this location.

Figure 3.8 provides a historical dose trend for the most impacted onsite member of the public if they were located at any of the three sampling locations. Each data point represents the accumulated dose over the previous four quarterly sampling periods. Stations K11 and K12 are near onsite businesses, therefore the estimated doses based upon residential exposures were divided by 2 to account for occupational exposures following approved procedures. This conservatively assumes that the onsite member of the public is at his or her workstation for half of the year.

During 2018, the onsite annual dose remained very low at <0.01 mrem at ambient air station K11. The highest annual dose impact as measured at the ambient air station K12 was 0.013 mrem; this was an increase from 2017 but still very low as compared to the annual dose limit of 10 mrem. The onsite location of K12 was in close proximity to K-29 concrete slab removal that impacted radiologically contaminated materials. The results are based on actual ambient air sampling in a location conservatively representative of onsite business locations. All data continue to show potential exposures are all well below the 10 mrem annual dose limit.



DOE = US Department of Energy ORR = Oak Ridge Reservation

Figure 3.8. East Tennessee Technology Park ambient air stations K11 and K12 radionuclide monitoring results: 5-year rolling 12-month dose history up through 2018

3.5.1.4 Quality Assurance

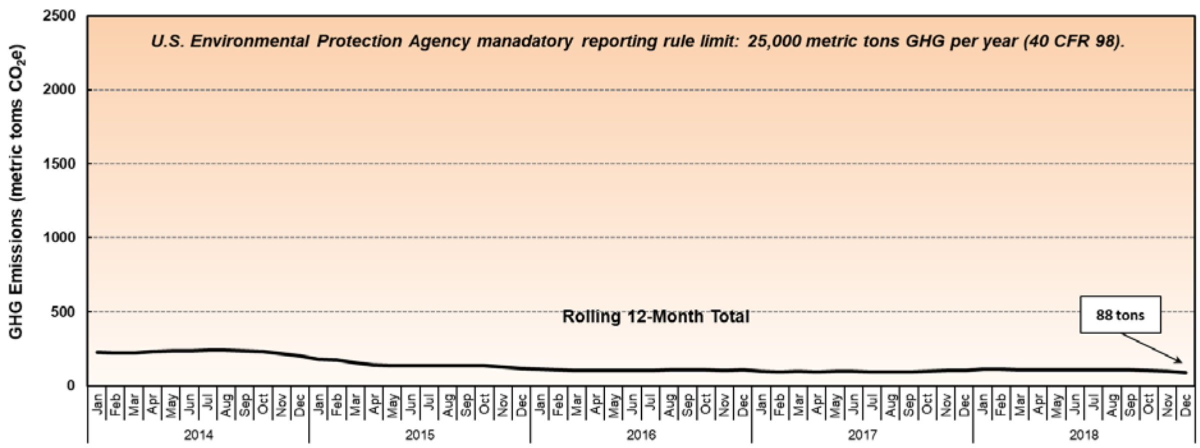
QA activities for the Rad-NESHAP program are documented in the *Quality Assurance Program Plan for Compliance with Radionuclide National Emission Standards for Hazardous Air Pollutants, East Tennessee Technology Park, Oak Ridge Tennessee* (UCOR 2018b, UCOR-4257/R2). The plan satisfies the QA requirements in 40 CFR Part 61, Method 114, for ensuring that the radionuclide air emission measurements from ETTP are representative of known levels of precision and accuracy and that administrative controls (ACs) are in place to ensure prompt response when emission measurements indicate an increase over normal radionuclide emissions. The requirements are also referenced in TDEC regulation 1200-3-11-08, *Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities*. The plan ensures the quality of ETTP radionuclide emission measurement data from continuous samplers and minor radionuclide release points. Only EPA preapproved methods are referenced through the *Compliance Plan National Emission Standards for Hazardous Air Pollutants for Airborne Radionuclides on the Oak Ridge Reservation, Oak Ridge, Tennessee* (DOE/ORO/2196).

3.5.1.5 Greenhouse Gas Emissions

The EPA rule for mandatory reporting of Greenhouse Gases (GHGs) (also referred to as the “Greenhouse Gas Reporting Program”) was enacted October 30, 2009, under 40 CFR Part 98. According to the rule in general, the stationary source emissions threshold for reporting is 25,000 MT of CO_2 equivalent (CO_2e) or more of GHGs per year. The rule defines GHGs as:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons
- Perfluorocarbons
- Sulfur hexafluoride (SF_6)

A 2018 review was performed of ETTP processes and equipment categorically identified under 40 CFR 98.2 whose emissions must be included as part of a facility annual GHG report starting with the CY 2010 reporting period. Based on total GHG emissions from all ETTP stationary sources during 2018, ETTP did not exceed the annual threshold limit and therefore was not subject to mandatory annual reporting under the GHG rule during this performance period. The total GHG emissions for any continuous 12-month period beginning with CY 2008 have not exceeded 12,390 MT of GHGs. The most significant decrease in stationary source emissions was due to the permanent shutdown of the TSCA Incinerator in 2009. The remaining sources are predominantly small comfort heating systems, hot water systems, and power generators. Figure 3.9 shows the 5-year trend up through 2018 of ETTP total GHG stationary emissions. For the 2018 CY, GHG emissions totaled only 88 MT, which is less than 1 percent of the 25,000 MT per year threshold for reporting.



in carbon dioxide equivalent [CO^2e]; CFR = Code of Federal Regulations; GHG = greenhouse gas

Figure 3.9. East Tennessee Technology Park stationary source greenhouse gas emissions tracking history

Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, was signed by President Barak Obama on October 5, 2009. The purpose of this order was to establish policies for federal facilities that will increase energy efficiency; measure, report, and reduce GHG emissions from direct and indirect activities; conserve and protect water resources through efficiency, reuse, and storm water management; eliminate waste; recycle; and prevent pollution at all such facilities. While the order deals with a number of environmental media, only its applicability to GHG is considered here. The EO defines three distinct scopes for purposes of reporting:

1. Scope 1 is essentially direct GHG emissions from sources that are owned or controlled by a federal agency.
2. Scope 2 encompasses GHG emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency.
3. Scope 3 involves GHG emissions from sources not owned or directly controlled by a federal agency, but related to agency activities, such as vendor supply chains, delivery services, and employee business travel and commuting.

One goal of this order was to establish a FY 2020 Scope 1 and Scope 2 reduction target of 28 percent, as compared to the 2008 baseline year.

EO 13693, *Planning for Federal Sustainability in the Next Decade*, was signed and issued on March 25, 2015. This order supersedes EO 13514 and established a new Scope 1 and Scope 2 total reduction target of 40 percent by 2025, as compared to the 2008 baseline year. For reporting purposes, GHG emission data are compared to both goals.

The information reported here includes GHG emissions from the industrial landfills at Y-12 that are managed and operated by UCOR. The landfills are not part of the contiguous ETTP site; however, DOE requested that UCOR, as the operator, include landfill GHG emissions with ETTP reporting in the Consolidated Energy Data Report. To be consistent with reporting this information, the landfill emissions are also included with ETTP ASER data. Figure 3.10 shows the trend toward meeting both the original EO 13514 28 percent total Scope 1 and 2 GHG emissions reduction target by FY 2020 and the current EO 13693 40 percent goal by FY 2025.

With respect to EO 13514, emissions for FY 2018 Scope 1 and 2 including the landfills totaled 19,731 MT CO_2e, roughly 47 percent below the FY 2020 target level of 37,478 MT CO_2e and a 62 percent reduction to date compared to the FY 2008 baseline year level of 52,053 MT. When compared to the EO 13693 target, FY 2018 data show that the targeted 40 percent reduction has already been achieved by comparing the FY 2018 total of 19,731 MT to the 40 percent target level of 31,232 MT.

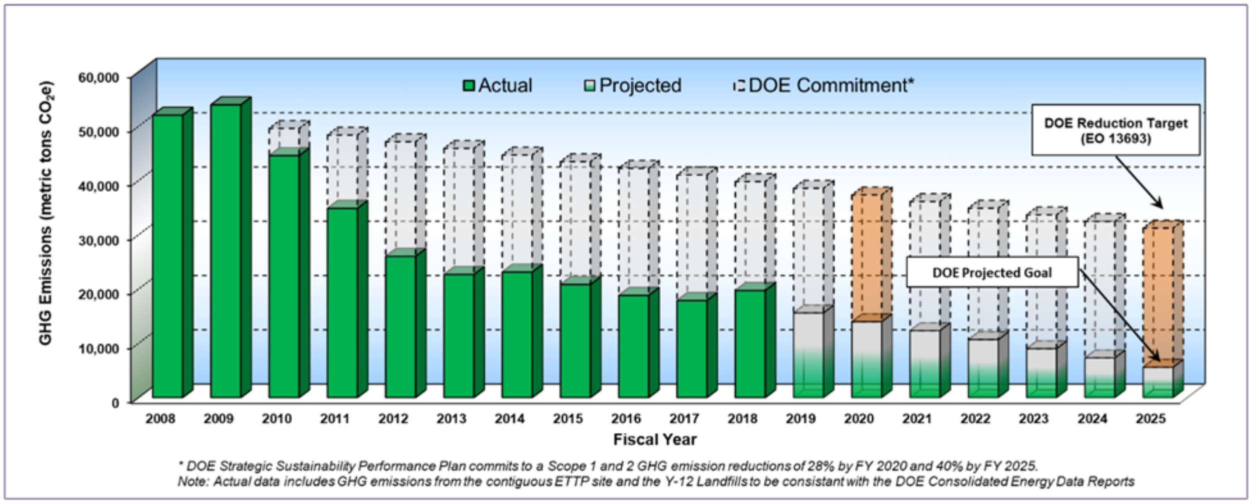
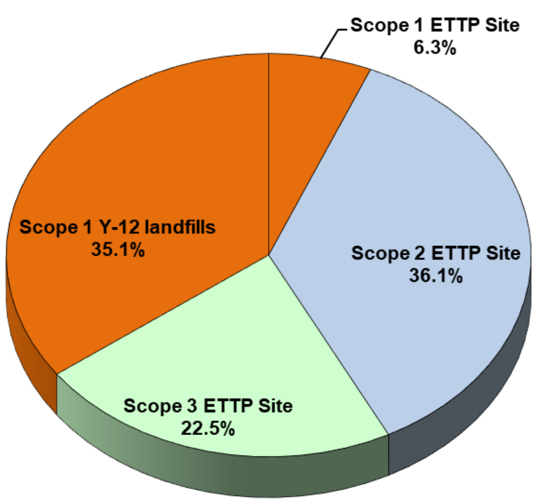


Figure 3.10. East Tennessee Technology Park greenhouse gas emissions trend and targeted reduction commitment

Figure 3.11 shows the relative distribution and amounts of all ETTP FY 2018 GHG emissions for Scopes 1, 2, and 3 including the landfills. Total GHG emissions remain well below the levels first reported in the 2008 baseline year as demolition and remediation efforts continue at ETTP. Many of the early reductions were due to lower onsite combustion of fuels (stationary and mobile sources), lower consumption of electricity, and a smaller workforce. The total amount of GHG emissions for FY 2018 was 25,454 tons, as compared to the 23,709 tons for FY 2017. Total reduction to date starting with the 2008 baseline year of 61,453 tons of GHG emissions is 58.6 percent.



ETTP FY 2018 Greenhouse Gas Emissions: 25,454 tons

Scope 1: ETTP Site Releases
Onsite stationary fossil fuel combustion, 108 tons
Onsite releases of freons and SF_6, 351 tons
Onsite mobile source fuel combustion, 1,156 tons

Scope 1: Y-12 Industrial Landfills
Y-12 Industrial Landfills, 8,924 tons

Scope 2: Indirect GHG Releases
Electricity purchase, 9,192 tons

Scope 3: Indirect GHG Releases
Business alr travel, 51 tons
Business ground travel, 24 tons
Employee commuting, 5,639 tons
Contracted wastewater treatment, 9 tons

ETTP = East Tennessee Technology Park
GHG = greenhouse gas
SF_6 = sulfur hexafluoride)
Y-12 = Y-12 National Security Complex

Figure 3.11. FY 2018 East Tennessee Technology Park greenhouse gas emissions by scope, as defined in Executive Order 13514

3.5.1.6 Source-Specific Criteria Pollutants

ETTP operations included one functioning minor stationary source, the CWTS, with a potential to emit any form of criteria air pollutant. This unit is equipped with an air stripper to remove VOCs from the effluent stream. All process data records and the calculated potential maximum VOC emission rates for the CWTS air stripper were below levels that would require permitting. The calculated VOC annual emissions during 2018 for CWTS were only 0.013 ton/year as compared to an emission limit of 5 tons/year. The annual potential emissions for this facility would be well below the 5 ton/year limit assuming it operated at the maximum hourly emission rate continuously for the entire year.

Federal regulations amended in January of 2013 require TDEC permitting for existing and new stationary RICE-powered emergency generators and firewater booster pumps (i.e., emergency or e-RICE). Permitting actions do not apply to e-RICE covered under CERCLA projects. However, specific maintenance and recordkeeping requirements specified in the federal regulations are applicable to CERCLA projects operating e-RICE. The 2018 operations included four e-RICE powered emergency generators (K-1007, K-1039, K-1095, and K-1652), and one e-RICE powered firewater booster pump (K-1310-RW). During 2016 the K-802 e-RICE powered firewater booster pump was permanently removed from service. TDEC issued an amended permit with an effective date of November 22, 2016. The expiration date of the amended permit is October 1, 2024. TDEC issued a Notice of Authorization (NOA) to UCOR on July 19, 2018, for e-RICE at ETTP to operate under the Permit-by-Rule provisions of Rule 1200-03-09-.07 for stationary emergency internal combustion engines. This authorization (number R74133) subsumed the previous operating permit.

Regulations limit e-RICE nonemergency and maintenance operations to 100 h of operations per 12-month rolling total (i.e., 100 h of running the engines for testing and maintenance purposes per year). Additionally, nonemergency operations are limited to 50 h of the 100-h annual limit. The current permit specifies conditions that must be met to demonstrate compliance. These requirements include performing scheduled maintenance, record keeping, and tracking the run times of each of the five permitted units. Copies of all maintenance activities are provided for permit compliance review, and the runtimes are entered into spreadsheets to track against annual limits. Table 3.4 provides the number of hours of operations for each unit, up through December 31, 2018.

Table 3.4. East Tennessee Technology Park UCOR emergency reciprocating internal combustion engine air permit compliance demonstration, 2018

e-RICE Unit	Permit limits: Total hours/year = 100		Nonemergency hours/year = 50	
	PM Testing (hours/year)	Nonemergency (hours/year)	Total (hours/year)	Emergency (hours/year)
K-1007	6.0	1.2	7.2	3.9
K-1039	6.0	0.1	6.1	1.5
K-1095	6.0	10.9	16.9	0.0
K-1310-RW	5.5	23.8	29.3	0.0
K-1407[a]	3.7	0.5	4.2	2.6
K-1652	6.0	26.8	32.8	6.5

[a] K-1407 e-RICE operating under CERCLA and exempt from TDEC air emission permitting.

e-RICE = emergency reciprocating internal combustion engine
PM = particulate matter
TDEC = Tennessee Department of Environment and Conservation
UCOR = UCOR, an AECOM-led partnership with Jacobs

ETTP operations released airborne pollutants from a variety of minor pollutant-emitting sources, such as stacks, vents, and fugitive and diffuse activities. The emissions from all stacks and vents are evaluated following approved methods to establish their low emissions potential. This is done to verify and document their minor source permit exempt status under all applicable state and federal regulations.

3.5.1.7 Hazardous Air Pollutants (Nonradionuclide)

Unplanned releases of hazardous air pollutants (HAPs) are regulated through the risk management planning regulations under 40 CFR Part 68. To ensure compliance, periodic inventory reviews of ETTP operations were performed that used monthly data obtained through the EPCRA Section 311 reporting program. This program applies to any facility at which a hazardous chemical is present in an amount exceeding a specified threshold. A comparison of the EPCRA 311 monthly Hazardous Materials Inventory System (HMIS) chemical inventories at ETTP with the risk management plan (RMP) threshold quantities listed in 40 CFR 68.130 was conducted. This is an ongoing action that documents the potential applicability for maintaining and distributing an RMP and to ensure threshold quantities are not exceeded.

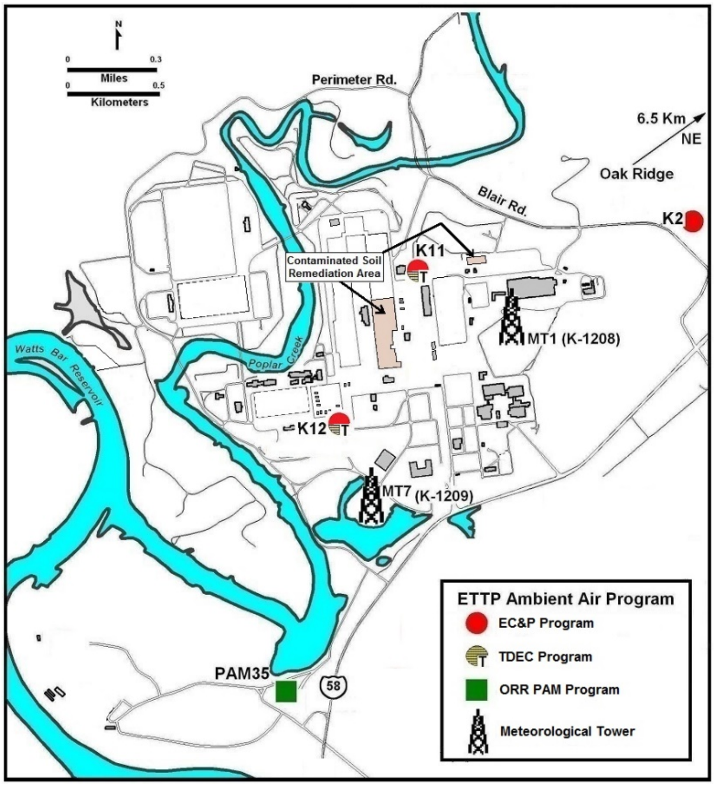
ETTP personnel have determined that there are no processes or facilities containing inventories of chemicals in quantities exceeding thresholds specified in rules pursuant to CAA, Title III, Section 112(r), "Prevention of Accidental Releases." Therefore, activities at ETTP are not subject to the rule. Procedures are in place to continually review new processes, process changes, or activities with the rule thresholds.

3.5.2 Ambient Air

Compliance of fugitive and diffuse sources is demonstrated based on environmental measurements. The ETTP Ambient Air Quality Monitoring Program is designed to provide environmental measurements to accomplish the following:

- Tracking of long-term trends of airborne concentration levels of selected air contaminant species.
- Measurement of the highest concentrations of the selected air contaminant species that occur in the vicinity of ETTP operations.
- Evaluation of the potential impact on air contaminant emissions from ETTP operations on ambient air quality.

The three sampling programs in the ETTP area are designated as the EC&P program, TDEC program, and the ORR perimeter air monitoring (PAM) program. Figure 3.12 shows the locations of all ambient air sampling stations in and around ETTP that were active during the 2018 reporting period. Figure 3.13 shows an example of a typical EC&P program air monitoring station.



ETTP = East Tennessee Technology Park
MT = meteorological tower
ORR = Oak Ridge Reservation
PAM = perimeter air monitoring
TDEC = Tennessee Department of Environment and Conservation

Figure 3.12. East Tennessee Technology Park ambient air monitoring station locations

The EC&P program consisted of three sampling locations throughout 2018. All projects are operating similar high-volume sampling systems. The EC&P, TDEC, and PAM samplers operate continuously with exposed filters collected weekly. The radiological monitoring results for samples collected at the one ETTP area PAM station are the responsibility of UT-Battelle, LLC. TDEC is responsible for the data collected from their two samplers. UT-Battelle, LLC and TDEC results are not included with the EC&P data presented in this section. However, periodic requests for results from the other programs are made for comparison purposes.

The analytical parameters were chosen with regard to existing and proposed regulations and with respect to activities at ETTP. The principle reason for EC&P program stations is to demonstrate that radiological emissions from the demolition of ETTP gaseous diffusion buildings, supporting structures, and associated remediation activities are in compliance with the annual dose limit to the most exposed members of the public that is either onsite (on the ORR) or offsite. K12 remained a key sampling location regarding the potential dose impact on the most exposed member of the public at an onsite business location during the demolition and debris removal of the last gaseous diffusion building on the ETTP site.

Changes of emissions from ETTP will warrant periodic reevaluation of the parameters being sampled. Ongoing ETTP reindustrialization efforts will also introduce new locations for members of the public that may require adding or relocating monitoring site locations. To ensure understanding of the potential impacts on the public and to establish any required emissions monitoring and emissions controls, a survey of all onsite tenants is reviewed every 6 months through a request for the most recent ETTP reindustrialization map.

Figure 3.13. East Tennessee Technology Park ambient air monitoring station

All EC&P program stations collected continuous samples for radiological analyses during 2018. Radiological analyses of samples from the EC&P stations test for the isotopes ^{234}uranium (^{234}U), ^{235}uranium (^{235}U), and ^{238}uranium (^{238}U).

Station K2 is in the prevailing topography of influenced downwind directions that are for identifying the impact to offsite members of the public. Stations K11 and K12 are located to provide a conservative measurement of the impact to onsite members of the public.

3.6 Water Quality Program

3.6.1 NPDES Permit Description

The latest ETTP NPDES permit became effective on April 1, 2015. It is scheduled to expire on March 31, 2020. A total of 27 representative outfalls are monitored on an annual basis for oil and grease, TSS, pH, and flow. Outfall 170 is monitored quarterly for total chromium and hexavalent chromium. ETTP NPDES permit monitoring requirements for storm water outfalls are shown in Tables 3.5 and 3.6.

Table 3.5. Representative outfalls

(Outfalls 05A, 100, 142, 150, 170, 180, 190, 195, 198, 230, 280, 294, 334, 350, 430, 490, 510, 560, 660, 690, 694, 700, 710, 724, 890, 930, and 992)

Parameter	Qualifier	Value	Unit	Sample Type	Frequency	Statistical Base
Flow	Report	-	million gallons per day (MGD)	Estimate	Annual	Daily Maximum
Oil & Grease	Report	-	mg/L	Grab	Annual	Daily Maximum
Total Suspended Solids (TSS)	Report	-	mg/L	Grab	Annual	Daily Maximum
pH	≥ 6.0 and ≤ 9.0	-	SU	Grab	Annual	Daily Minimum and Daily Maximum

Table 3.6. Storm Water Outfall 170 for chromium monitoring

Parameter	Qualifier	Unit	Sample Type	Frequency	Report
Chromium, hexavalent (as Cr)	Report	mg/L	Grab	Quarterly	Daily Maximum
Chromium, total (as Cr)	Report	mg/L	Grab	Quarterly	Daily Maximum

In addition to periodic monitoring requirements specified in the ETTP NPDES permit, several additional monitoring efforts were included to support the CERCLA actions that are ongoing at ETTP. This monitoring was conducted as part of the Storm Water Pollution Prevention (SWPP) Program and/or the ETTP Biological Monitoring and Abatement Program (BMAP).

3.6.1.1 Flux Monitoring

For bioaccumulative pollutants such as mercury, a long-term monitoring of pollutant loadings (known as flux) was conducted. This flux monitoring included the following:

- Flow Monitoring

  For Outfalls 100, 170, 180, and 190, field-installed flow meters were used to gauge flows for various ranges of rain events during the permit term at each outfall.

- These flows were used to compare against flows generated using the Natural Resources Conservation Service (NRCS) Technical Report-55 (TR-55, NRCS 1986), the current flow modeling technique used at ETTP, to increase the accuracy of the TR-55 flow modeling process.

- Mercury Monitoring

  Mercury was sampled at Outfalls 180 and 190 using the flow-weighted sampling technique. Specific sample collection guidelines were included as part of SWPP Program sampling and analysis plans (SAPs).

- Flux Calculation

  Flow monitoring results were used to calibrate the variable inputs to the TR-55 flow model. Flow-paced mercury samples were also collected at Outfalls 180 and 190. Results from the analyses of these samples are being used with the revised flow models in order to determine mercury flux at Outfalls 180 and 190.

3.6.1.2 RA Activities, CERCLA, and Legacy Pollutant Monitoring

- Storm water samples have been collected at locations that are affected by RA activities prior to the initiation of these activities in order to determine the conditions present before remediation begins. In addition, storm water samples were collected at potentially affected outfalls and storm water catch basins after remedial activities had been undertaken, and after they had been completed, to help gauge the effectiveness of the remediation efforts.
- The results of the monitoring effort at the D&D sites, which are a subset of remedial activities, are utilized in determining the effectiveness of best management practices (BMPs) in controlling off-site releases of legacy pollutants.
- Periodic monitoring was performed as part of the ETTP SWPP Program to monitor the continued effectiveness of the chromium collection system.

3.6.1.3 Permit Renewal Sampling

- Sampling required for the completion of the NPDES permit application was initiated in FY 2015 as part of the ETTP SWPP Program. The application for this permit renewal is required to be submitted to TDEC by October 1, 2019, for a 180-day review prior to permit expiration on March 31, 2020. Additionally, DOE will require time to review the permit application before it is submitted to TDEC. Based on previous TDEC guidance, composite samples were collected as time-weighted composites due to the short travel time for storm water runoff in the storm drain piping system and to site conditions within the watersheds. Monitoring was conducted to ensure all required samples were collected to complete EPA Form 2F, *Application for Permit to Discharge Storm Water Discharges Associated with Industrial Activity* for each representative outfall
- The following sampling was conducted:

  Representative outfalls were sampled to ensure completion of EPA Form 2F, Section VII, Discharge Information, Parts A, B, and C, as required:

- Part A—Parameters were collected in compliance with Form 2F. Oil and grease, total nitrogen, total phosphorus, and pH were collected as grab samples per EPA guidance. Biochemical oxygen demand, chemical oxygen demand, and total suspended solids (TSS) were collected as either grab samples or as time-weighted composites.
- Part B—All facilities generating process wastewater at ETTP have been closed, and the respective NPDES permits have expired. Therefore, ETTP is no longer subject to any effluent guidelines, and there are no sampling requirements under Part B at any storm water outfall at ETTP.
- Part C—Each representative storm water outfall was sampled only for pollutants that could potentially be present based on the characteristics and uses of the drainage area for that outfall. The potential pollutants to be considered for monitoring are shown in Tables 2F-2, 2F-3, and 2F-4 of EPA Form 2F. Based upon historical site knowledge and analytical monitoring results, metals, mercury, and PCBs were collected from all representative outfalls. In addition, each representative outfall was evaluated, and VOCs, radionuclides, and other selected parameters

were collected as required. Part C parameters that must be collected by grab sample, per analytical method or regulatory guidance, were collected as grab samples only. All other Part C parameters were collected as time-weighted composites only.

3.6.1.4 Investigative Sampling

- Investigative sampling was performed as part of the ETTP SWPP Program. This included sampling of storm drain networks for bioaccumulative parameters and investigations triggered by analytical results, CERCLA requirements, changes in site conditions, etc. (UCOR 2018b, UCOR-4028, *East Tennessee Technology Park Storm Water Pollution Prevention Program Sampling and Analysis Plan, Oak Ridge, Tennessee).*
- Storm water sampling results were reviewed and evaluated to provide feedback for the next round of investigative sampling, generate suggested modifications and improvements to storm water runoff controls, and provide input for CERCLA project cleanup decisions.

3.6.2 Storm Water Pollution Prevention Program

3.6.2.1 Radiologic Monitoring of Storm Water

ETTP conducts radiological monitoring of storm water discharges to determine compliance with applicable dose standards. ETTP also applies the as low as reasonably achievable (ALARA) process to minimize potential exposures to the public. Sampling for gross alpha and gross beta radioactivity, as well as specific radionuclides, is conducted as part of the ongoing SWPP Program sampling efforts. Analytical results are used to estimate the total discharge of each radionuclide from ETTP via the storm water discharge system.

As part of the ETTP SWPP SAP, storm water samples were collected from discharges that occurred after a storm event that (1) was greater than 0.1 in. in 24 h, and (2) occurred at least 72 h after a rain event greater than 0.1 in. in 24 h. No specified dry period was required before the samples were taken. A series of at least three manual grab samples of equal volume were collected during the first 60 min of a storm event discharge, and combined into a composite sample.

Table 3.7 contains the results of this sampling effort. Screening levels for individual radionuclides are established at 4 percent of the derived concentration standards (DCS) values listed in DOE Standard 1196 (DOE 2011b, DOE-STD-1196). Table 3.8 lists the cumulative activity levels of each of the major isotopes that were discharged from the overall ETTP storm water system in 2018.

Table 3.7. Analytical results for radiological monitoring at ETTP storm water outfalls

Parameter	Screening level	Outfall 198	Outfall 382	Outfall 660	Outfall 750	Outfall 760
Alpha activity (pCi/L)	15	1.95 U	**22.5**	2.82 U	4.17 U	3.11 U
Beta activity (pCi/L)	50	5.38	8.8	2.1 U	5.07	1.44 U
^{99}Tc (pCi/L)	1760	1.32 U	5.59 U	-2.28 U	4.08 U	3.34 U
$^{233/234}$U (pCi/L)	28	0.46 U	10.3	1.1	3.46	2.16
$^{235/236}$U (pCi/L)	29	0.164 U	0.9	0.0477 U	0.704	0.295 U
^{238}U (pCi/L)	30	0.154 U	10	0.787	2.35	1.02

Bold indicates screening level exceeded.

Table 3.8. Radionuclides released to off-site waters from the ETTP storm water system in 2018 (Ci)

Isotope	^{234}U	^{235}U	^{238}U	^{99}Tc
Activity level	8.4 E-3	7.2 E-4	4.5 E-3	1.2 E+1

The only screening criterion exceeded as part of this sampling effort was gross alpha radiation at Outfall 382. Outfall 382 receives storm water runoff from a portion of Bldg. K-131. Operations in this facility included uranium hexafluoride (UF_6) feed enrichment, as well as uranium recovery from decontamination solutions. Discharges from this outfall have historically contained radiological contaminants at levels above screening criteria due to past operations at the K-131 building.

No screening criteria were exceeded at Outfalls 198, 660, 750, or 760.

On January 4, 2018, a sanitary water line break occurred near the K-2500-H segmentation shop (the "seg shop"), which is located in the K-25 Building Footprint. Based on the type of operations that have been and continue to be conducted at the facility, the seg shop is known to contain radiological contamination. Water from the sanitary water line break entered the Outfall 240 drainage system. No samples of the water from the water line break could be collected at the time of the incident. To determine if there was any impact to the Outfall 240 network from this water line break, samples were collected from Outfall 240 for isotopic uranium and ^{99}technetium (^{99}Tc) at the outfall during the next rainfall event after the water line break, which occurred on February 7, 2018.

As shown in Table 3.9, no radiological parameters were detected at levels exceeding screening levels as part of this sampling effort. The sanitary water line break was determined not to have negatively impacted the discharge from the Outfall 240 drainage system.

Table 3.9. Analytical results for radiological monitoring at Outfall 240

Parameter	Screening level	Outfall 240
^{99}Tc (pCi/L)	1760	0.763 U
$^{233/234}$U (pCi/L)	28	20.7
$^{235/236}$U (pCi/L)	29	2.11
^{238}U (pCi/L)	30	3.4

3.6.3 D&D of the K-633 Test Loop Facility

K-633 was built in 1954 and operated until 1985 to test and evaluate performance of gaseous diffusion process equipment under production conditions. Isotopically depleted UF_6 inventory for various process loops was provided in via the distribution header from the K-31 building. Recirculating cooling water (RCW), R 114 process coolant, a recirculating compressor, motor lubrication systems, a compressor seal feed, and exhaust system were provided as auxiliary process support.

Demolition activities began at the K-633 facility in February 2018. Initial sampling was performed at Outfall 420 before demolition begins to provide baseline data. Sampling was also conducted following each qualifying rain event while D&D activities were being conducted. Storm water runoff monitoring was performed for the duration of demolition and waste handling activities, as well as for any potential post-demolition mitigation actions. A final monitoring event was conducted at the conclusion of demolition, waste handling, and potential post-demolition mitigation actions.

For collection of storm water samples at the K-633 D&D project, a qualifying rain event is defined as a rain event that: 1) produces 1 in. or greater measured rainfall within a 24-h period; 2) causes runoff to be present at the outfall; and 3) occurs after a dry period of at least 72 h. A dry period means no measurable rainfall (0.1 in. or greater) occurs within a 72-h period. Parameters that were sampled as part of the K-633 D&D storm water runoff monitoring activities include isotopic uranium, ^{99}Tc, PCBs, metals, mercury, hexavalent chromium, and TSS.

Initial sampling to provide baseline data for storm water Outfall 420 was performed on February 12, 2018, after a rainfall event of 5.3 in. (over a 2-day period). No screening criteria exceedances were noted in the analytical results from this sampling event. A sampling event was conducted on April 23, 2018, during D&D activities. These samples were collected after a rainfall event of 1.01 in., which occurred over a 2-day period. No screening criteria exceedances were noted in the analytical results from this sampling event.

Final D&D of the K-633 building was completed in June 2018. No qualifying rainfall events that created flow at Outfall 420 have occurred from the time of the completion of D&D activities at K-633 until September 2018. Post D&D monitoring was conducted at Outfall 420 on September 26, 2018, during a rainfall event of 5.1 in. over a 3-day period. PCB-1254 was detected at a level of 0.0714 ug/L. A follow-up sample was collected on November 6, 2018, to determine if PCB levels could still be detected in runoff from the K-633 area. Samples were collected during a rainfall event of 0.39 in. over 3 days. PCB-1254 was detected in this sample at a level of 0.087 ug/L. Additional PCB data will be collected at Outfall 420 as part of ongoing monitoring activities.

3.6.4 D&D of the K-1314-G, H, and J Facilities

In the 1990s, buildings K-1314-G, H, and J were constructed adjacent to the K-1066-E UF_6 cylinder yard. The buildings functioned as a location where UF_6 cylinders could be sandblasted and repainted. The paint that had originally been applied to the UF_6 cylinders contained PCBs; therefore, the K-1314 buildings and the concrete pad they were built on became contaminated with PCBs.

D&D of these buildings was initiated in the first quarter of CY 2018. These buildings are located in the storm water Outfall 387 drainage area. Outfall 387 is listed on the ETTP NPDES permit, but it is not a representative outfall. No samples had been collected from the outfall in almost 20 years. Because very limited analytical data was available on discharges from Outfall 387, a relatively wide range of background data was collected from the outfall before D&D actions began at the K-1314 buildings. Parameters that were sampled as part of the K-1314 facilities D&D storm water runoff monitoring activities include isotopic uranium, ^{99}Tc, PCBs, metals, mercury, hexavalent chromium, and TSS. Samples for PCBs and TSS were to be collected any time the outfall was observed to be discharging during demolition of these facilities. Also, samples were to be collected after all D&D activities had been completed at these buildings.

On February 26, 2018, samples of the discharge from Outfall 387 were collected before demolition of the K-1314 buildings was initiated. No qualifying rainfall events occurred during the time D&D activities were being conducted at these buildings. D&D activities at the K-1314 buildings were completed in early April 2018. Samples were collected on June 25, 2018, after demolition of the K-1314 buildings had been completed. Results over screening levels are presented in Table 3.10.

Table 3.10. Analytical results over screening levels from sampling at Outfall 387

	Date sampled	PCB-1260
		Screening level detectable
Outfall 387	2/26/18 (prior to D&D activities)	0.0555 µg/L
	6/25/18 (after completion of D&D activities)	0.0489 µg/L

Additional PCB data may be collected at Outfall 387 as part of ongoing storm water monitoring activities.

3.6.5 D&D of the TSCA Incinerator

As part of the Closure Certification Report (CCR) for the Toxic Substances Control Act of 1976 (TSCA) Incinerator (TSCAI) submitted to EPA by DOE, institutional controls were established for the closed TSCAI. One of these institutional controls mandated the monitoring of storm water runoff from the facility until it could be demolished under CERCLA. In order to meet the storm water monitoring requirement of the CCR, sampling of storm water runoff from the TSCAI area was conducted during the first quarter of CY 2018. Samples were collected from Outfall 142, which receives storm water drainage from the combustion portion of TSCAI, and from Outfall 144, which receives storm water drainage from the storage tank area of TSCAI.

To meet the requirements for this storm water sampling effort at the TSCAI area, grab samples were to be collected at Outfalls 142 and 144 for PCBs, isotopic uranium, and TSS during a storm event. These samples could be collected any time these outfalls were found to be flowing during a storm event and did not have to be first flush runoff samples.

Sampling at Outfall 142 was conducted during a storm event of 0.29 in. that occurred on January 8, 2018. No parameters exceeded screening levels as part of this sampling event. Sampling at Outfall 144 was conducted on January 29, 2018, after a storm event of 0.89 in. No parameters exceeded screening levels at Outfall 142 or Outfall 144 as part of this sampling effort. Storm water runoff from TSCAI will continue to be sampled on an annual basis as part of the CCR requirements.

Demolition activities began at the TSCAI facilities in June 2018 and were completed in September 2018. Environmental monitoring of storm water effluent for TSCAI facilities demolition was performed in accordance with UCOR-4028 (UCOR 2018b). A baseline sample from Outfall 140 was not able to be obtained prior to demolition activities due to insufficient flow at the outfall. Since a qualifying rainfall event did not occur prior to demolition, historical sampling data from Outfall 142 was used as baseline data.

Since demolition was initiated, monitoring was performed at Outfall 140 during each qualifying rain event for the duration of demolition activities if sufficient flow was present at the outfall. Samples were analyzed for PCBs, metals, mercury, TSS, hexavalent chromium, gross alpha/gross beta radiation, isotopic uranium, and transuranics. A qualifying rain event is defined as a rain event that (1) produces 1 in. or greater measured rainfall within a 24-h period, (2) causes runoff to be present at the outfall, and (3) occurs after a dry period of at least 72 h. A dry period means no measurable rainfall (0.1 in. or greater) occurs within a 72-h period.

As stated previously, no qualifying rainfall events occurred prior to initiation of D&D activities at TSCAI, so no pre-D&D baseline samples were collected at Outfall 140. The first monitoring event at Outfall 140 was conducted on August 20, 2018, while D&D activities were underway. Samples were collected during a rainfall of approximately 1 in. over a 5-day period. There were no screening level exceedances in any of the data received from the laboratory. Additional samples were collected at Outfall 140 on September 25, 2018, after a rainfall event of 1.64 in. There were no screening level exceedances in any of the data received from the laboratory. Final sampling after the D&D of the TSCAI was conducted on December 31, 2018, after a rainfall event of 0.62 in. Again, no screening level exceedances were observed in any of the data received from the laboratory.

3.6.6 D&D of K-1232 Facility

K-1232 was built in 1974. The facility was operated in conjunction with K-1231 to process uranium process material until 1980. Beginning in 1984, K-1232 was used to treat corrosive wastewaters from Y-12 by neutralization, metal removal, and carbon filtration. Two types of Y-12 wastes were treated, nitrate wastes and non-nitrate wastes. The nitrate wastes were basic solutions contaminated with nitrates, heavy metals, organics, and small amounts of uranium. The non-nitrate waste included plating wastewaters and cleaning solutions from production facilities.

For collection of storm water samples at the K-1232 D&D project, a qualifying rain event was defined as a rain event that (1) produced 1 in. or greater measured rainfall within a 24-h period, (2) caused runoff to be present at the outfall, and (3) occurred after a dry period of at least 72 h. A dry period means no measurable rainfall (0.1 in. or greater) occurs within a 72-h period. Parameters to be monitored include PCBs, metals, mercury, TSS, VOCs, SVOCs, isotopic uranium, and hexavalent chromium.

Demolition activities began at the K-1232 facility in September 2018. Initial sampling was performed at Outfall 380 on August 20, 2018, before demolition began in order to provide baseline data. Analytical results that exceeded screening levels are shown in Table 3.11.

Table 3.11. Results over screening levels for the K-1232 pre-D&D monitoring

Sampling location	Copper (pCi/L)	Lead (µg/L)	Mercury (ng/L)	Cadmium (µg/L)
Screening Level	7	1.8	51	Detectable
Outfall 380	7.72	28.2	119	0.626

Storm water monitoring was conducted on January 24, 2019, after the conclusion of demolition, waste handling, and post-demolition mitigation actions. No parameters were detected above screening levels as part of this monitoring effort.

3.6.7 D&D of the K-25 Building

Final D&D activities were completed for the K-25 building in July 2014. In order to assess any ongoing impacts, the remaining K-25 building slab has on the quality of the storm water runoff, monitoring of runoff from the slab is performed on an annual basis. Runoff samples are collected at Outfall 490 to monitor east wing slab runoff; runoff from Outfall 334 is sampled to monitor west wing slab runoff; and Outfall 230 was sampled to monitor north end slab runoff. Samples from each of these locations are analyzed for gross alpha/gross beta radiation, isotopic uranium, PCBs, metals, mercury, and total suspended solids. Because sampling of the K-25 building slab runoff requires a fairly heavy and intense rain event, samples were collected when runoff was sufficient to allow all of the samples for the given analytical parameters to be collected, regardless of the amount or intensity of the rainfall event. All samples collected as part of this effort were taken using the manual grab sampling method. Manual grab samples were collected according to the guidelines specified in Sects. 3.1.2 and 3.3.1 of the EPA's *NPDES Storm Water Sampling Guidance Document* (EPA 1992, EPA 833-B-92-001) and applicable procedures developed by the sampling subcontractor. Analytical results from this sampling effort that exceeded screening levels are shown in Table 3.12. None of the data from Outfall 230 exceeded the screening limit.

Table 3.12. Analytical results exceeding screening levels in samples of K-25 building slab runoff

Sampling location	Lead	Gross beta radiation
	Screening level 1.8 µg/L	Screening level 50 pCi/L
West wing (Outfall 334)	5.69 J	
East wing (Outfall 490)		60.8

In order to collect data that is to be reported in the remediation effectiveness report (RER) and the ASER, and to collect data that can be compared to information that is being gathered by TDEC on an ongoing basis, a sample for ^{99}Tc is collected at Outfall 190 each time a quarterly mercury sample is collected at this outfall. The analytical data from this sample will assist in determining if groundwater contaminated with ^{99}Tc from the K-25 D&D project could be migrating toward the Outfall 190 drainage area and discharging into Mitchell Branch via Outfall 190. Table 3.13 contains analytical data from CY 2016 through part of CY 2018 for this monitoring effort.

As shown in Table 3.13, the storm water results for the Mitchell Branch watershed area indicate that ^{99}Tc was not detected in samples collected at Outfall 190 during CY 2017 except during the third quarter of the FY. Technetium-99 was not detected at all during sampling conducted in CY 2018. Based on this data, it does not appear that ^{99}Tc-contaminated groundwater from the K-25 building D&D project is discharging to Mitchell Branch via storm water Outfall 190.

As shown in Figure 3-14, the cumulative radionuclide measurements at the Mitchell Branch exit weir K-1700 location are calculated to be less than 1 percent of the DCS sum of fractions (SOF) values. The maximum ^{99}Tc measurement at K-1700 was 19.8 pCi/L, which is orders of magnitude below the ^{99}Tc

DCS value of 44,000 pCi/L and the drinking water maximum contaminant level (MCL)-derived concentration (DC) of 900 pCi/L.

Table 3.13. Results from quarterly ^{99}Tc sampling at Outfall 190

Sampling location	^{99}Tc* (pCi/L) 1/12/16	^{99}Tc* (pCi/L) 4/19/16	^{99}Tc* (pCi/L) 10/17/16	^{99}Tc* (pCi/L) 1/9/17	^{99}Tc* (pCi/L) 4/18/17	^{99}Tc* (pCi/L) 7/13/17	^{99}Tc* (pCi/L) 10/12/17	^{99}Tc* (pCi/L) 1/9/18	^{99}Tc* (pCi/L) 4/26/18	^{99}Tc* (pCi/L) 7/10/18	^{99}Tc* (pCi/L) 10/15/18
Screening level	1760	1760	1760	1760	1760	1760	1760	1760	1760	1760	1760
Outfall 190	13.4	6.37 U	3.26 U	4.38 U	-3.27 U	6.71	2.96 U	8.12 U	7.44 U	1.07 U	6.38 U

*Technetium-99 results are provided as a reference. They do not exceed screening criteria.

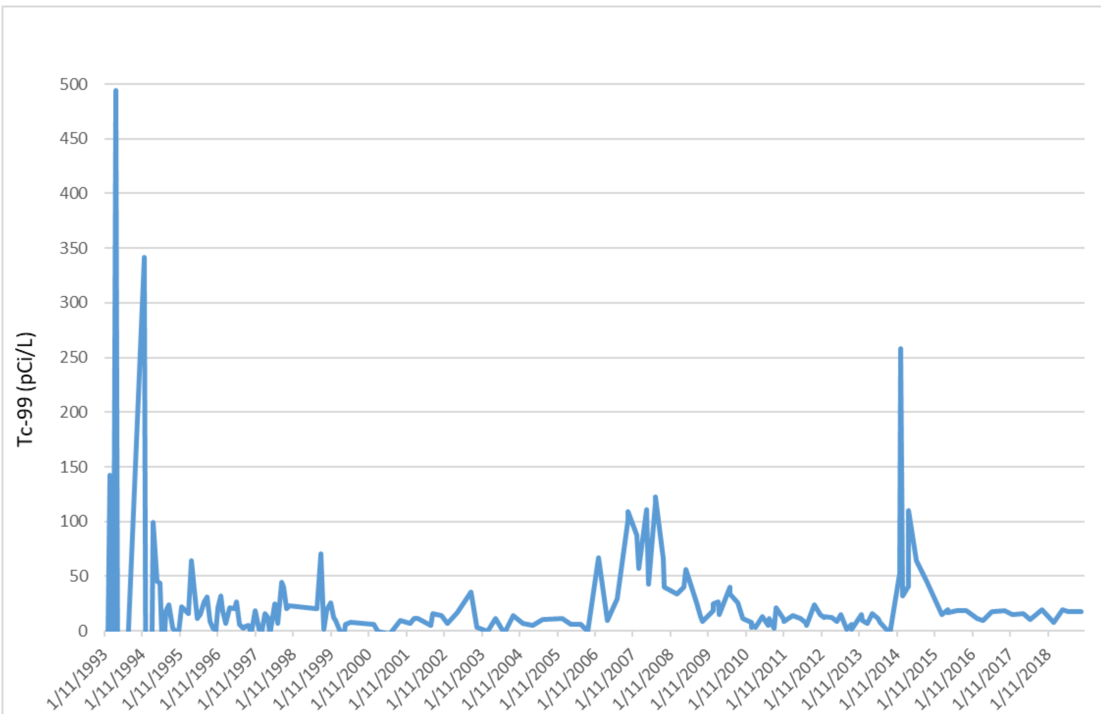


Figure 3.14. ^{99}Tc levels at K-1700 Weir

3.6.8 Mercury Investigation Monitoring

Activities involving mercury that were conducted at ETTP included usage, handling, and recovery operations. Mercury usage and handling were common in such equipment as manometers, switches, mass spectrometers, mercury diffusion pumps, mercury traps, and laboratory operations. Large quantities of mercury-bearing wastes from the on-site gaseous diffusion plant operations and support buildings, ORNL, and Y-12 were processed and stored at ETTP. Mercury from soils and spill cleanups was processed on site as well. Mercury recovery operations were conducted in a number of buildings. Many buildings were located in watersheds that discharged primarily to Mitchell Branch.

Mercury levels that exceed the ambient water quality criterion (AWQC) of 51 ng/L at ETTP have been identified in the Mitchell Branch watershed, as well as in a number of storm water outfalls, surface water locations, and groundwater monitoring wells at ETTP. In addition, knowledge of known historical mercury processes at the facility has increased substantially. These factors have led to an ongoing facility investigation to more precisely detect and quantify the extent of any mercury contamination that may exist.

Factors considered as part of the mercury investigation include weather conditions (wet versus dry), remedial activities (before, during, and after demolition of ETTP facilities), and types of monitoring locations chosen for sampling (in-stream, outfall, ambient, catch basin). For the investigation activities, a dry-weather period was defined as being at least 72 h after a storm event of 0.1 in. or more. Wet weather conditions were defined as a storm event greater than 0.1 in. that occurs within a period of 24 h or less and which occurs at least 72 h after any previous rainfall greater than 0.1 in. in 24 h. In addition, manual grab samples were defined as samples collected according to the guidelines specified in Sects. 3.1.2 and 3.3.1 of EPA 833-B-92-001 (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor. All mercury samples collected as part of the ETTP SWPPP sampling effort were analyzed using the low-level mercury method, *Method 1631, Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Absorption Fluorescence Spectrometry* (EPA 2002, EPA-821-R-02-019).

3.6.8.1 Mercury Sampling Conducted as Part of the Previous NPDES Permit

As part of the previous NPDES permit compliance program, mercury was sampled on a quarterly basis at Outfalls 05A, 180, and 190. These locations were selected because information gathered as part of the permit application process indicated that mercury levels at these outfalls occasionally exceeded the AWQC level of 51 ng/L. Outfalls 180 and 190 collect storm water from large areas on the north side of ETTP and discharge to Mitchell Branch. Outfall 05A is the discharge point for the former K-1203-10 overflow sump. This sump, which is part of the former K-1203 STP, collects storm water runoff from a large portion of the K-1203 area and discharges it into Poplar Creek.

The current NPDES permit no longer requires quarterly mercury monitoring. However, to continue collecting data for the analysis of trends in mercury discharges from these outfalls, quarterly mercury sampling is conducted as part of the ETTP SWPP Program. Data from this sampling effort is used as part of the RER and may provide information that will be used in upcoming CERCLA cleanup decisions.

Table 3.14 contains analytical data from mercury sampling performed at Outfalls 180, 190, and 05A from CY 2017 through the fourth quarter of CY 2018.

Table 3.14. Quarterly NPDES/SWPP Program mercury monitoring results—CY 2017 through CY 2018

Sampling location	1st Quarter CY 2017 (ng/L)	2nd Quarter CY 2017 (ng/L)	3rd Quarter CY 2017 (ng/L)	4th Quarter CY 2017 (ng/L)	1st Quarter CY 2018 (ng/L)	2nd Quarter CY 2018 (ng/L)	3rd Quarter CY 2018 (ng/L)	4th Quarter CY 2018 (ng/L)
Outfall 180	44.3	**117**	**93.5**	**63.7**	28.4	**235**	33.5	**61**
Outfall 190	16.1	**74.5**	15.2	16.6	39.1	29.1	23.2	15.5
Outfall 05A	**75.2**	**186**	**127**	**427**	**68.4**	**87.3**	**232**	**333**

*Results in **bold** exceed the screening criteria for mercury (51 ng/L).

3.6.8.2 Mercury Graphs for Outfall 180, Outfall 190, and the K-1700 Weir

There are numerous legacy mercury historical operations within the Outfall 180 and 190 network areas and overall Mitchell Branch watershed. Collectively, these are potential contributors to the continuing legacy mercury discharges to Mitchell Branch due to contaminated sediment within storm water networks and potential infiltration sources into the piping. These include mercury recovery operations at the K-1401 and K-1420 buildings that led to downstream waste disposal areas such as the K-1407 Ponds and K-1070-B Burial Ground. Additionally, the K-1035 building instrument shop with associated mercury activities discharged liquids through building acid pits to the storm drain network. In addition to the continuing contributions from the storm drain outfalls, the instream sediments within Mitchell Branch are a potential contributor to water column measurements and fish bioaccumulation. Figures 3-15 and 3-16 indicate mercury discharges to Mitchell Branch from storm water Outfalls 180 and 190 from CY 2010 through CY 2018, respectively.

Outfalls 180 and 190 are two of the major outfalls that contribute flow to Mitchell Branch. Because the discharges from Outfalls 180 and 190 routinely contain mercury at levels above screening criteria, these outfalls are thought to be the major contributors of mercury to Mitchell Branch as well. Mitchell Branch mercury levels are monitored routinely at the K-1700 weir as part of the ETTP Environmental Monitoring Program. Please note that Figs. 3-15 and 3-16 indicate results from the quarterly monitoring performed at Outfalls 180 and 190, respectively, as well as other SWPP Program sampling that was conducted at the outfall during the period covered by these graphs. Figure 3.17 shows mercury levels at the K-1700 Weir from CY 2010 through CY 2018.

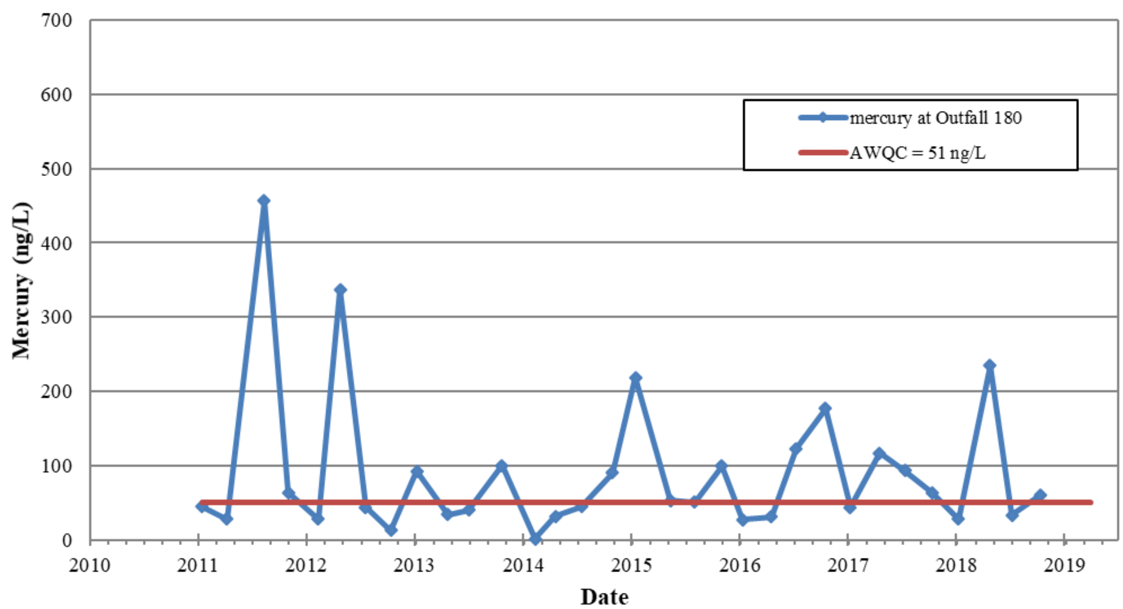


Figure 3.15. Mercury concentrations at Outfall 180

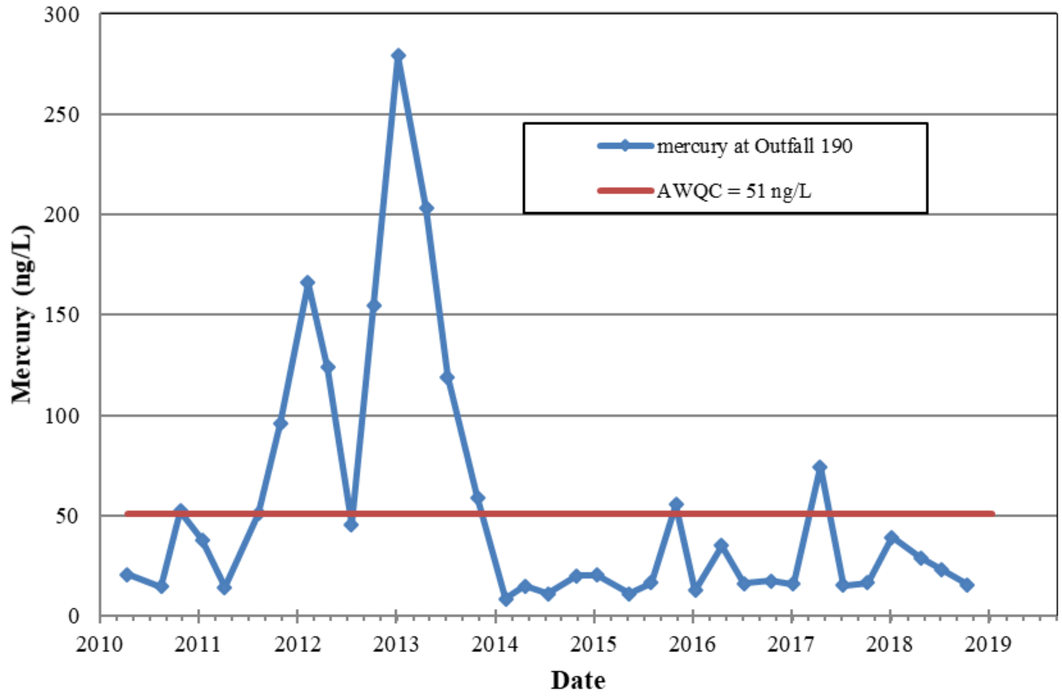


Figure 3.16. Mercury concentrations at Outfall 190

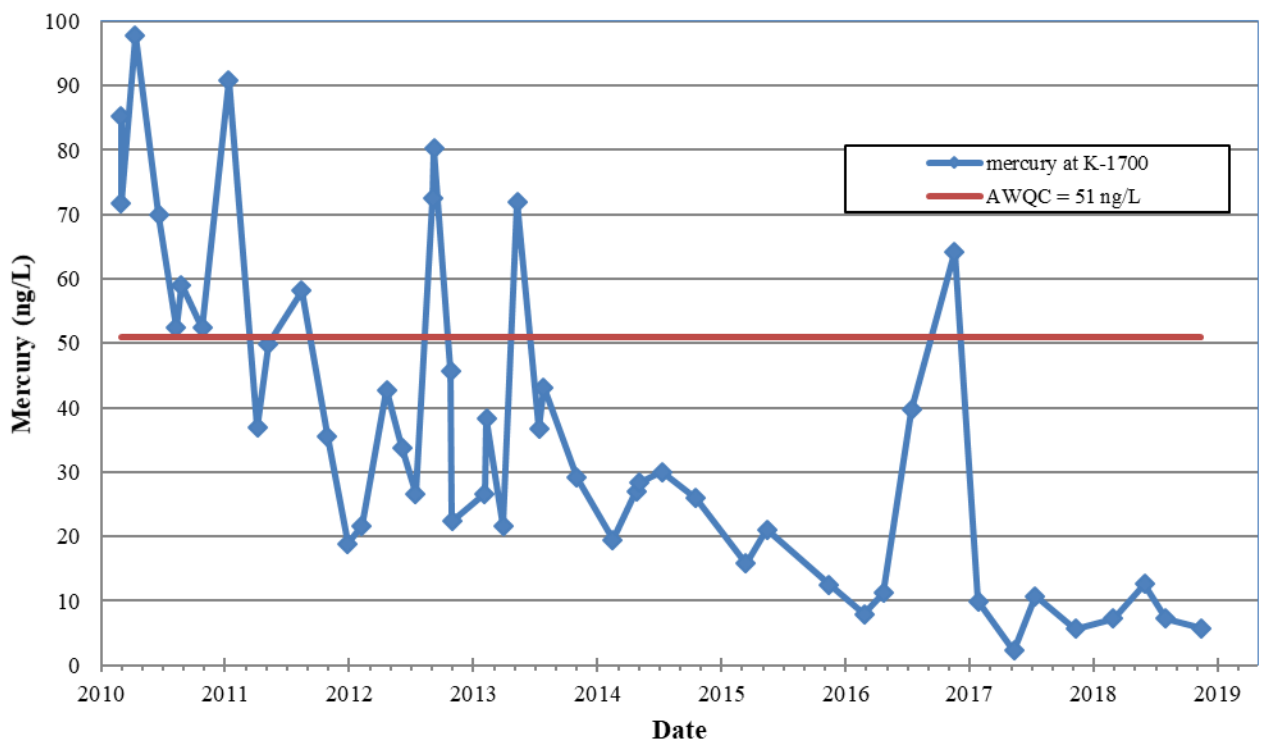


Figure 3.17. Mercury concentrations at the K-1700 Weir

3.6.8.3 Mercury Graph for Outfall 05A

Storm water Outfall 05A drains portions of the former K-1203 STP that discharge into the K-1203-10 sump. Soils and inactive piping from the K-1203 STP are contaminated with mercury from historical treatment operations from sources such as the plant laboratory discharges. The D&D of the former K-1203 STP was completed in early CY 2018. The D&D work conducted at the former K-1203 STP did not include the K-1203-10 sump, which collects the water that discharges through Outfall 05A. Additional monitoring of water, sediments, and soil was conducted at the K-1203-10 sump and other former K-1203 STP facilities and structures as part of the D&D activities, as described in Sect. 2.2.2 of this report. Figure 3.18 shows mercury concentrations at storm water Outfall 05A from CY 2010 through CY 2018.

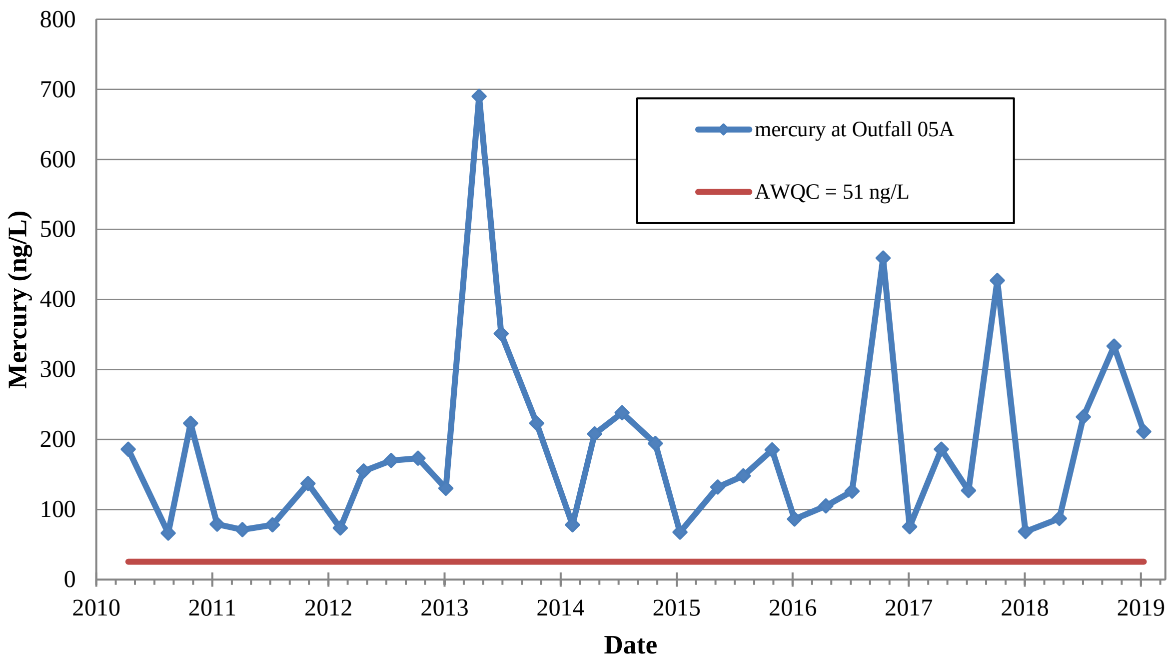


Figure 3.18. Mercury concentrations at Outfall 05A

3.6.8.4 Additional Mercury Sampling at Selected Storm Water Outfalls

Mercury levels that exceed the state of Tennessee AWQC of 51 ng/L at ETTP have been identified in the Mitchell Branch watershed, as well as in a number of storm water outfalls, surface water locations, and groundwater monitoring wells. Updated analytical techniques for mercury have resulted in much lower detection limits than were previously attainable. In addition, knowledge of known historical mercury processes at the facility has greatly expanded. These factors have led to an ongoing facility investigation to more precisely detect and quantify the extent of any mercury contamination that may exist.

Factors being considered as part of the mercury investigation are the weather conditions (wet versus dry), D&D activities (before, during, and after demolition of ETTP facilities), and types of monitoring locations chosen for sampling (in-stream, outfall, ambient, catch basin). Additionally, mercury is being sampled in other programs such as ETTP Environmental Monitoring Program (EMP), groundwater monitoring, the BMAP, D&D and RA activity support, and the NPDES permit application sampling efforts.

For the purpose of the mercury investigation activities, a dry-weather period was defined as being at least 72 h after a storm event of 0.1 in. or more. Wet weather conditions were defined as a storm event greater than 0.1 in. that occurred within a period of 24 h or less, and which occurred at least 72 h after any previous rainfall greater than 0.1 in. in 24 h. In addition, manual grab samples were defined as samples collected according to the guidelines specified in Sects. 3.1.2 and 3.3.1 of EPA 833-B-92-001 (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor.

The mercury results from the samples collected at these outfalls are presented in Table 3.15.

Table 3.15. Analytical results from mercury sampling at storm water outfalls

Location	Mercury
	Screening level 51 ng/L
Outfall 200	15.4
Outfall 220	2.05
Outfall 250	**58.7**
Outfall 380	16.8
Outfall 382	7.78
Outfall 390	8.02
Outfall 410	25.1
Outfall 440	6.75
Outfall 530	46.1
Outfall 532	5.88
Outfall 570	11.3
Outfall 760	5.02
Outfall 780	**691**

*Results in bold exceed the screening criteria for mercury (51 ng/L).

As shown in Table 3.15, the only mercury results from this sampling effort that exceeded screening levels came from storm water Outfalls 250 and 780.

A mercury sample was collected at Outfall 250 in June 2018. Outfall 250 is an open ditch that receives storm water runoff from the K-802 area, which is located northwest of the K-25 building. An investigation into the potential sources of mercury at this outfall was undertaken, but no conclusive results were obtained. It is believed that the mercury at Outfall 250 may have come from historical discharge of mercury-contaminated sediments from Poplar Creek into the Outfall 250 drainage area as part of the operation of the K-802 pumphouse.

A mercury sample was collected at Outfall 780 in March 2018. Outfall 780 once carried storm water runoff from Bldgs. K-724 and K-725, which were located in the Powerhouse Area. These buildings were originally part of the S-50 Fercleve Thermal Diffusion Plant. Building K-725 was used for beryllium processing in its later life. However, K-725 also contained mercury traps that occasionally released mercury. The mercury was reportedly “swept down the floor drains” in cleanup activities performed at the building in the 1970s. Mercury may have also been present in the dust collection system of the building.

The floor drains of the building were likely tied to the storm drain system, so any mercury swept to the floor drains likely wound up in the storm drain network. In addition, any mercury present in the dust collection system of the building was likely disturbed during demolition of the building in the mid-1990s and may have been transported to the storm drain system via storm water runoff from the building dust collection system debris. Therefore, the mercury analyzed in the March 1, 2018, sample from Outfall 780 could have been present in sediments contained in the piping system for many years and flushed from the piping system with the > 5 in. of rain that fell in the week before this sample was collected.

No recent activities conducted in this area are suspected to have led to this elevated mercury level. The only ongoing activity being conducted in this drainage area is the Oak Ridge Forest Products wood chip mill, and it is extremely unlikely that the activities conducted at this facility would use mercury in their operations.

3.6.9 PCB Monitoring at ETTP Storm Water Outfalls

An evaluation of PCB data collected as part of the ETTP SWPP Program from CY 2000 to the present was performed to identify locations where PCBs have been detected at storm water outfall locations. Non-representative outfalls that have been grouped with representative outfalls where PCBs have been identified and have not been sampled in several years were selected to be sampled as part of the ETTP SWPP sampling program. This sampling effort was performed to determine if non-representative outfalls may be contributing PCBs to site waterways.

Manual grab samples were collected for PCB analysis at each of the outfalls selected for this sampling effort. Manual grab samples were collected according to the guidelines specified in Sections 3.1.2 and 3.3.1 of EPA 833-B-92-001 (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor.

Analytical results from samples collected as part of this sampling effort are shown in Table 3.16.

Table 3.16. Analytical results from ETTP SWPP Program PCB sampling effort

Location	Parameter[a]	Date sampled	Screening level - Detectable Quantity
Outfall 144	Individual PCBs	1/29/18	No detectable PCBs
Outfall 220	Individual PCBs	4/16/18	No detectable PCBs
Outfall 382	Individual PCBs	3/12/18	No detectable PCBs
Outfall 440	Individual PCBs	3/12/18	No detectable PCBs
Outfall 530	Individual PCBs	6/28/18	No detectable PCBs
Outfall 720	Individual PCBs	4/24/18	No detectable PCBs
Outfall 780	Individual PCBs	3/1/18	**PCB-1260—0.626 µg/L**
Outfall 880	Individual PCBs	3/1/18	No detectable PCBs

*Results in bold exceed the screening criteria for PCBs (detectable quantity).

PCB-1260 was detected in samples collected from Outfall 780 in March 2018. Outfall 780 once carried storm water runoff from Buildings K-724 and K-725, which were located in the Powerhouse area. Outfall 780 also receives storm water runoff from the K-722 area. Approximately 1000 gal of oil was landfarmed for dust suppression in 1982 on the roads in the vicinity of the K-722 area. Oil used for landfarming in this area was required only to have a PCB content of 5 ppm or less. The analytical results from this sampling event may be showing the presence of low-level PCBs that could have been present in some of the oil that was landfarmed. In addition, the presence of PCBs at Outfall 780 could be due to the historic use of PCB-containing electrical equipment in the drainage area.

3.6.10 Investigative Sampling of Storm Drain Near Former K-1066-K UF_6 Cylinder Yard

A blue/greenish storm water drainage pipe is located south of the K-1065 complex near the former K-1066-K UF_6 Cylinder Yard. The pipe has never been given a designated storm drain number as other storm drains at ETTP have been given. In addition, the pipe is not listed individually as a storm water outfall on the current ETTP NPDES permit. It is believed that this pipe discharges to the Outfall 710 drainage system and is sampled for compliance with the ETTP NPDES permit as part of the Outfall 710 drainage area. The pipe appears to have been installed to assist in removing storm water that collects in a low grassy and graveled area on the west side of the former K-1066-K UF_6 Cylinder Storage Yard.

The pipe has been observed flowing on a routine basis during heavier rainfall events. In order to determine if the discharge from the pipe contained contaminants of concern, sampling of the pipe was conducted.

Samples from this pipe were collected on January 29, 2018, after a storm event of 0.89 in. Samples were analyzed for TSS, isotopic uranium, PCBs, and metals. No parameters exceeded screening levels as part of this sampling event.

3.6.11 Investigative Sampling in the Outfall 992 Drainage Area

A total of 5.97 million tons of coal were burned at the K-701 Powerhouse during its operation from 1944–1962. Bottom ash, coal fines, slag, and other by-products of coal combustion were buried at the K-720 coal ash pile. The K-720 coal ash pile is approximately 9 acres in size. In the mid-1990s, the coal ash pile was spread out, covered with soil, limed, and seeded.

Runoff and leachate from the K-720 coal ash pile have resulted in elevated levels of various heavy metals at storm water Outfall 992 for several years. Elevated levels of metals commonly identified in coal, including arsenic, selenium, etc., have been detected in storm water samples from the area. In order to obtain current information on possible contaminants that may be entering the Outfall 992 runoff from sources in the K-720 coal ash pile, samples were collected in two locations in the Outfall 992 drainage area. One of the locations that was sampled was the drainage system for the K-720 coal ash pile that was installed in the mid-1990s (location 3 on Figure 3.19). The second location that was sampled was the ash sluice ditch (location 4 on Figure 3.19). Both of these locations combine with other smaller flows to make up the total discharge that is monitored at Outfall 992.

No parameters exceeded screening levels as part of this sampling event. Arsenic and selenium, which are major contaminants of concern in coal ash, were not measured in detectable quantities in samples from either of the monitored locations.

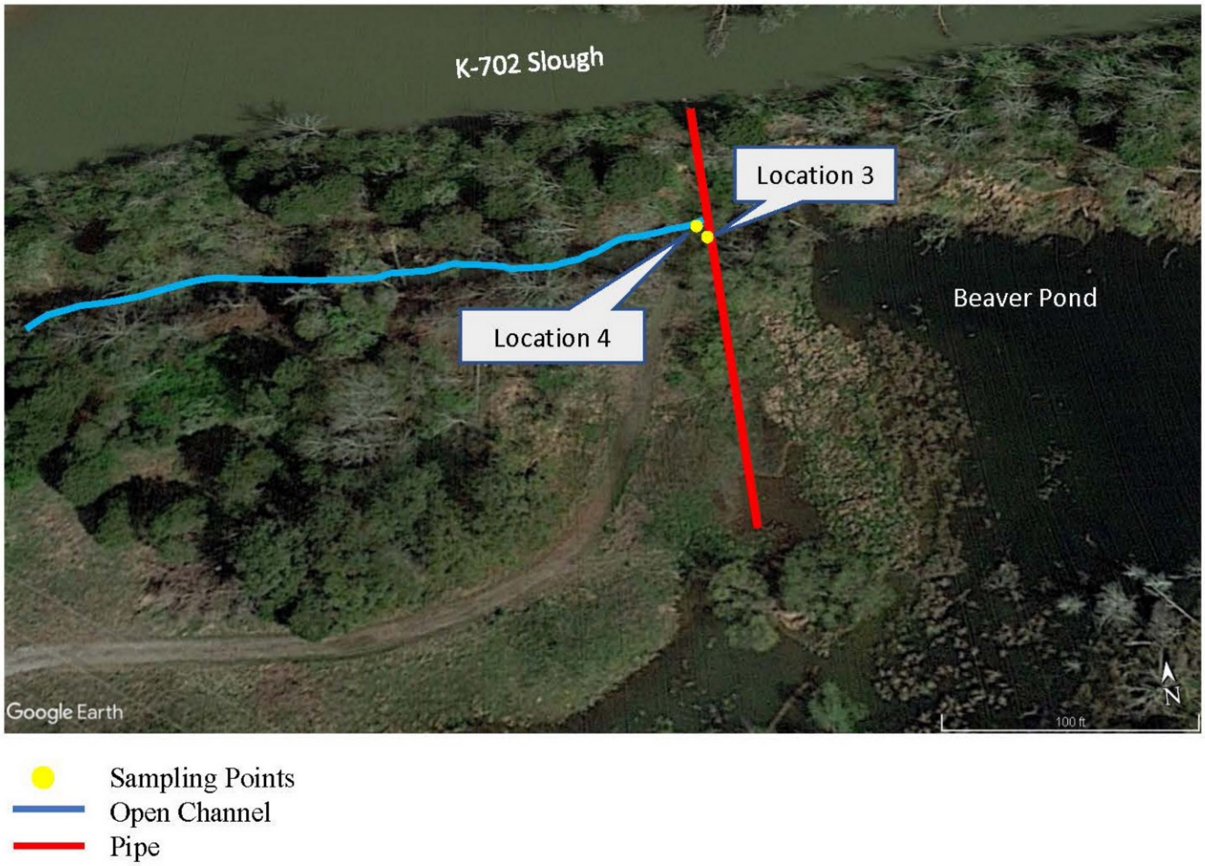


Figure 3.19. Sampling locations for Outfall 992 investigation

3.6.12 Chromium Water Treatment System and Plume Monitoring

In 2007, the release of hexavalent chromium into Mitchell Branch from Storm Water Outfall 170 and from seeps at the headwall of Outfall 170 resulted in levels of hexavalent chromium that exceeded state of Tennessee AWQC. Immediately below Outfall 170, hexavalent chromium levels were measured at levels as high as 780 µg/L, which exceeded the state of Tennessee hexavalent chromium water quality chronic criterion of 11 µg/L for the protection of fish and aquatic life. The levels of total chromium were at approximately the same value, indicating that the bulk of the release was almost entirely hexavalent chromium at the release point. The reason that the chromium was still in a hexavalent state is unknown, considering that hexavalent chromium has not been used in ETTP operations in over 30 years. On November 5, 2007, DOE notified EPA and TDEC of their intent to conduct a CERCLA time-critical removal action to install a grout barrier wall and groundwater collection system to intercept this discharge. This action reduced the level of hexavalent chromium in Mitchell Branch from 780 µg/L to levels consistently below the AWQC value of 11 µg/L. The time-critical removal action is documented in DOE/OR/01-2598&D2 (DOE 2013), *Removal Action Report for the Long-Term Reduction of Hexavalent Chromium Releases into Mitchell Branch at the East Tennessee Technology Park, Oak Ridge, Tennessee*.

In 2012, the treatment of the chromium collection system water was transitioned from the Central Neutralization Facility (CNF) to the CWTS. To monitor both the continued effectiveness of the collection system, as well as the effectiveness of the new CWTS, periodic monitoring is performed as part of the

ETTP SWPP Program. In CY 2018, samples were collected at Monitoring Well TP-289, the chromium collection system wells, Outfall 170, and Mitchell Branch kilometer (MIK) 0.79. Samples are collected at TP-289 to monitor the concentrations of chromium in the contaminated groundwater plume. Samples are collected from the chromium collection system wells to monitor the chromium in the water recovered by the groundwater collection system. Samples collected at Outfall 170 monitor the concentrations of the chromium and hexavalent chromium plume being discharged directly to Mitchell Branch. Figures 3.20 and 3.21 show the results for the analyses for total chromium and hexavalent chromium, respectively.

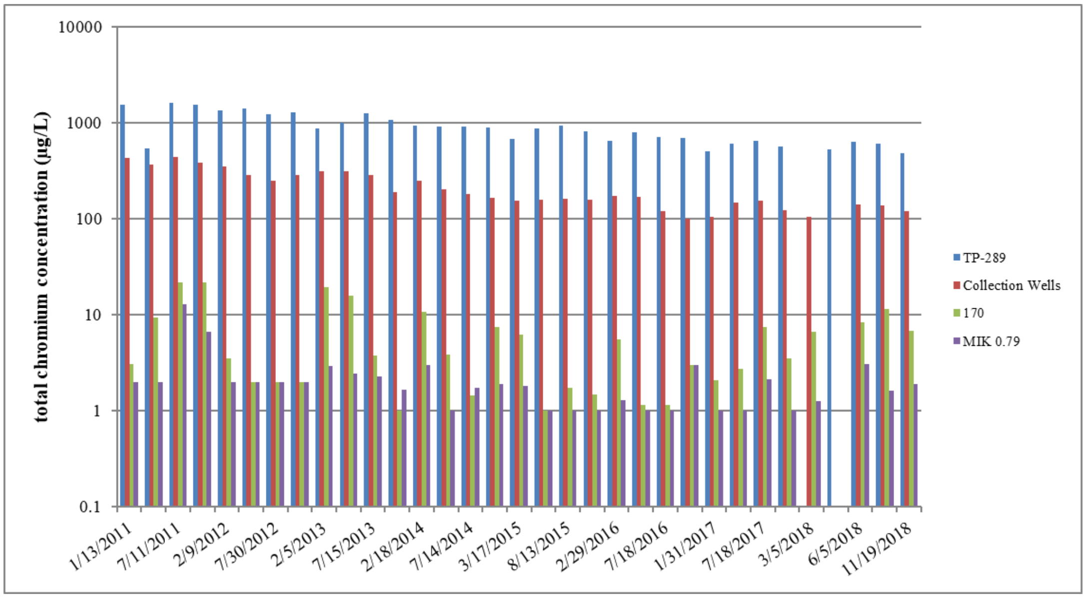


Figure 3.20. Total chromium sample results for the chromium collection system

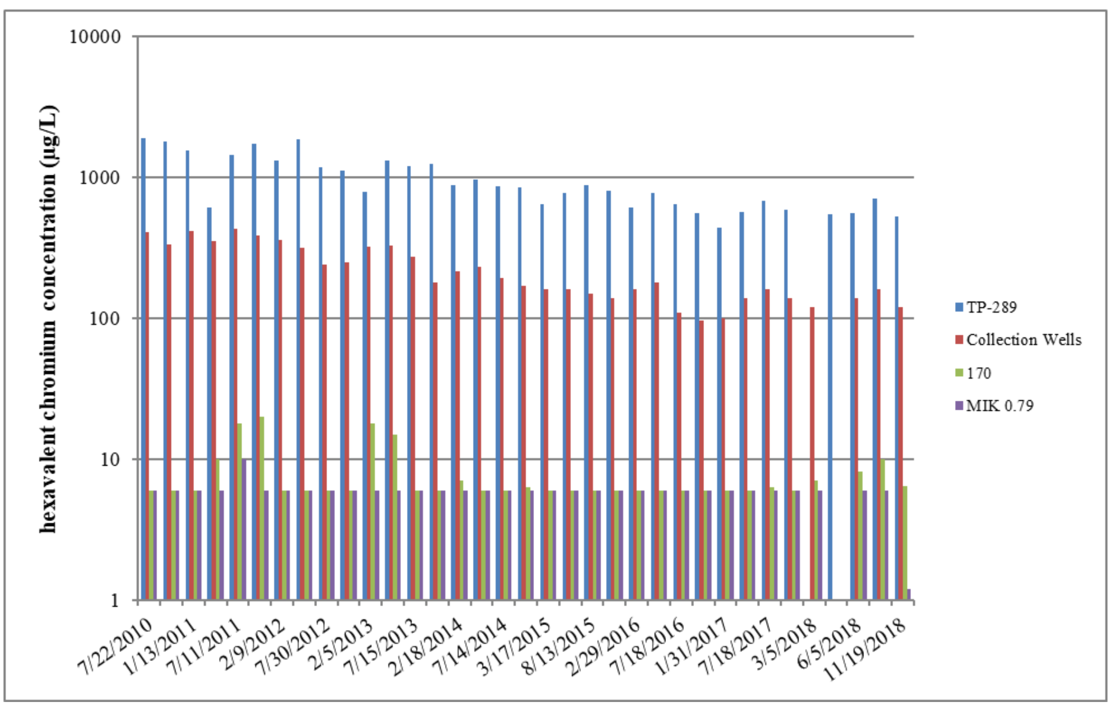


Figure 3.21. Hexavalent chromium sample results for the chromium collection system

The analytical data indicate that both total and hexavalent chromium levels may fluctuate slightly at TP-289 and the collection wells but are relatively consistent over the long term. Total chromium values at Outfall 170 and MIK 0.79 are slightly more variable. This is most likely due to the greater variability in flow rates at these two locations. Hexavalent chromium levels at Outfall 170 and MIK 0.79 have remained remarkably consistent since 2010, as shown earlier in Figure 3.21.

Additional monitoring of the CWTS will be performed as indicated in UCOR-4259, *East Tennessee Technology Park Chromium Water Treatment System Sampling and Analysis Plan, Oak Ridge, Tennessee* (UCOR 2018a). In addition to chromium treatment, the upgraded CWTS also has provisions for air stripping of the VOCs that are also found in the groundwater. The air stripper has demonstrated a removal efficiency of greater than 98 percent over the last several monitoring periods.

3.6.13 NPDES Permit Renewal Monitoring

Preparations for the NPDES permit application that will be submitted to TDEC in CY 2019 are being made. Additionally, DOE will require time to review the permit application before it is submitted to TDEC. In order for all of the required monitoring to be conducted in time for the permit application to be prepared and submitted, sampling required for the completion of the permit application was initiated as part of the FY 2015/2016 SWPP Program and continued as part of the FY 2017 and 2018 SWPP Programs. In CY 2018, NPDES permit application samples were collected at Outfall 210. Table 3.17 indicates results from the NPDES permit renewal sampling at Outfall 210 that exceeded screening levels.

Table 3.17. Analytical results exceeding screening levels for NPDES permit renewal sampling—CY 2018

Location	Copper	Cadmium	Lead	Mercury	Zinc	4-4′-DDT	Endosulfan
	Screening level 7 μg/L	Screening level Detectable	Screening level 1.8 μg/L	Screening level 51 ng/L	Screening level 75 μg/L	Screening level Detectable	Screening level Detectable
Outfall 210	17.6	1.33	197	80.6	310	0.00546	0.00536

Outfall 210 has been a representative outfall on previous ETTP NPDES permits, but was not selected as a representative outfall for the current ETTP NPDES permit. However, it was determined that all appropriate sampling would be performed to allow an EPA 2F form (EPA Form 2F) to be submitted for Outfall 210 as part of the ongoing application process for the next ETTP NPDES permit. Outfall 210 may become a representative outfall under the next ETTP NPDES permit. Outfall 210 collects runoff from the exterior portion of the northwest corner of the K-25 building slab. D&D activities for the K-25 building were completed in July 2014. Activities conducted in the K-25 building during its operation included the isotopic enrichment of uranium by gaseous diffusion. In addition, the building was known to be contaminated with various metals (copper, lead, cadmium, zinc, etc.) and with mercury due to the large numbers of electrical switches, gauges, and other instruments used while the building was operational. The source(s) of the herbicide contamination detected at Outfall 210 as part of this sampling effort have not yet been determined.

3.6.14 Sampling of Outfalls in the K-31/K-33 Area

D&D and RA activities that are ongoing at ETTP will likely result in a status change for several of the storm water outfalls. The outfalls that are currently present on the ETTP NPDES permit are the responsibility of DOE. After RAs have been completed in an area and the actions have been verified as being effective and approved through the CERCLA process, the parcel and its associated storm water outfalls will be managed under the DOE S&M Programs and can be considered for transfer by DOE to a private or municipal entity.

Storm water outfalls associated with the transferred properties will be evaluated for permitting as a commercial private property by applicable regulatory agencies such as TDEC and COR, as appropriate, under storm water-permitting programs. The entities that own or operate the properties will be responsible for obtaining the required permits and maintaining compliance with the issued permits. These outfalls will no longer be considered DOE's responsibility and will be removed from the ETTP NPDES permit. Outfalls may also be proposed for removal from the ETTP NPDES storm water permit 1) if it is determined that they discharge only uncontaminated storm water that is primarily sheet flow, or 2) where outfalls are plugged or removed as part of a RA. The continued reduction of permitted outfalls from the ETTP NPDES permit is consistent with the DOE ETTP cleanup program objectives, which are to clean up the site and eliminate ongoing DOE operations.

As the RAs are completed, a formal request will be made to TDEC by DOE to propose the removal of storm water outfalls from the ETTP NPDES permit. An outfall will remain on the ETTP NPDES permit until official notice to remove the outfall from the permit has been received from TDEC. For situations where the CERCLA actions are complete and the area has transitioned into the DOE S&M Program, the criteria that will be followed to evaluate when it is appropriate to remove outfalls from the ETTP NPDES permit are outlined in the following discussion. A criterion for a second scenario is also provided below where the cleanup actions are complete and the property is being transitioned to commercial entities or COR.

Criteria for storm drains within a subwatershed to be removed from the ETTP NPDES permit in areas managed under the DOE S&M Program include the following:

- No ongoing DOE operations, such as waste treatment facilities or maintenance work areas (office buildings, parking lots, and roads are not defined as ongoing industrial operations).
- Final DOE D&D and soil RAs are complete and has achieved "No Further Action" status (legacy soil contamination, storm water runoff, and CERCLA groundwater releases to the storm drains are not a concern based upon dry-weather and wet-weather sampling events).
- No reindustrialization lessee or property transfer industrial operations are located within the subwatershed.

At the point when the criteria have been completed, DOE can submit a request to TDEC for candidate outfalls to be removed from the ETTP NPDES permit. The outfalls being removed from the permit may then be regulated directly by TDEC through a separate permitting action or through the COR Stormwater Program.

Criteria for storm drains to be removed from the ETTP NPDES permit in areas where the only industrial operations within the storm drain network are being conducted by private companies within a property transfer area include the following:

- No ongoing DOE operations such as waste treatment facilities or maintenance work areas (office buildings, parking lots, and roads are not defined as ongoing industrial operations).
- Final DOE D&D and soil RAs are complete and has achieved "No Further Action" status (legacy soil contamination, storm water runoff, and CERCLA groundwater releases to the storm drains are not a concern based upon dry-weather and wet-weather sampling events).

- Land area where private industrial operations are being conducted has been transferred to a private entity.

At the point where the criteria are completed as noted above, DOE can submit a request to TDEC for candidate outfalls to be removed from the ETTP NPDES permit. As TDEC approves the outfalls to be removed from the ETTP NPDES permit, the outfalls may then be regulated directly by TDEC through a separate permitting action or through the COR Stormwater Program.

The K-31 parcel, which is comprised of 46.8 acres, was recently made available by DOE EM for transfer to CROET.Each of the outfalls that are located in the K-31/K-33 area were considered to determine whether they should be sampled as part of the investigation of storm water discharges from the area. Factors that were considered in determining which outfalls should be sampled included:

- Whether or not the outfall was designated as a representative outfall that is sampled for compliance with the ETTP NPDES permit.
- The size and extent of the drainage area served by the outfall.
- The past uses of the area or building that contributed storm water runoff to the outfall based on process knowledge.
- Analytical data from past sampling events that indicate the potential presence of contaminants of concern at the outfall.

In order to determine if storm water outfalls in the K-31/K-33 areas could be removed from the ETTP NPDES permit, sampling was performed at outfalls within the drainage areas of these building footprints. The following outfalls were samples as part of this effort: 510, 530, 560, 590, 600, 610, 660, 690, 694, 700, 710, and 720. The following parameters were analyzed in samples from each of these locations: gross alpha/gross beta radiation, polycyclic aromatic hydrocarbons, PCBs, metals, mercury, hexavalent chromium, TSS, and flow.

Because the sampling of the K-31/K-33 outfalls was time-critical, outfall sampling was designated as being weather dependent and did not require the occurrence of a qualifying rainfall event. These samples were collected when storm water runoff was observable from the outfalls that were to be sampled. The criteria for storm event sampling used for other SWPP Program sampling did not have to be met for this sampling effort. Even though the K-31/K-33 outfall samples did not have to be collected during a qualifying rainfall event, rainfall data for the periods when the samples are collected was noted. Precipitation data from the rain gauge on the K-1209 meteorological tower, which is present on site at ETTP, were used for the official measurement of the magnitude of a storm event. Meteorological information from these towers is sent electronically to the ETTP Park Shift Superintendent office, which is responsible for providing this information upon request. Rainfall readings from rain gauges operated by the Sampling Subcontract Organization (SSO) were used as a backup to the readings from the meteorological towers.

All samples from the K-31/K-33 sampling effort were collected as manual grab samples using guidelines specified in Sects. 3.1.2 and 3.3.1 of EPA 833-B-92-001 (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor.

Table 3.18 contains information on the analytical results collected from the K-31/K-33 area storm water outfalls that exceeded screening criteria as part of this sampling effort. No other parameters exceeded screening levels at any of the outfalls sampled.

Table 3.18. Analytical results over screening criteria from K-31/K-33 area sampling effort

Location	Lead	PCB-1254
	Screening level 1.8 µg/L	Screening level Detectable
Outfall 510	5.68	
Outfall 660	3.68	0.0456

As part of the K-31/K-33 sampling effort, instantaneous manual flow measurements were collected at each of the outfalls sampled. These flow measurements were collected in accordance with the latest revision of PROC-ES-2200, *Surface Water Flow Measurements.* Information collected as part of these flow measurements is included in Table 3.19.

Table 3.19. Flow data collected as part of the K-31/K-33 sampling effort

Outfall	Date of manual flow measurement	Precipitation on date of manual flow measurement	Manual flow measurement (gallons per min)	Manual flow measurement (gallons per day)
510	4/23/2018	0.62	9.25	13320
530	6/28/2018	2.06	10	14400
560	4/24/2018	0.87	15.9	22896
590	4/24/2018	0.87	no flow	—
600	4/24/2018	0.87	no flow	—
610	4/24/2018	0.87	6.5	9360
660	4/23/2018	0.62	0.26	374
690	4/24/2018	0.87	22.5	32400
694	4/23/2018	0.62	0.2	288
700	4/23/2018	0.62	9.4	13536
710	4/23/2018	0.62	6.6	9504
720	4/24/2018	0.87	6.6	9504

At Outfall 510, analytical data from this sampling event indicated the presence of screening criteria exceedances; therefore, additional follow-up sampling was conducted. Outfall 510 was resampled for lead on November 6, 2018. Lead was not detected above screening criteria in this sample. In addition, catch basin 6014, which is located immediately upstream of Outfall 510, was also sampled for lead. Lead at basin 6014 exceeded screening levels with a result of 5.43 ug/L. To determine if lead exceeded screening criteria in the Outfall 510/Poplar Creek mixing zone, a corresponding lead sample was also collected from Poplar Creek at the K-1250-4 bridge. The lead result for this sample was well below screening levels.

Based on historical information, Outfall 600 is unlikely to flow except in the most extreme storm events. This outfall will likely be recommended for removal from coverage under the ETTP NPDES permit based on the criteria provided earlier in this section.

Several of the outfalls that were sampled as part of this effort meet the criteria for removal from the ETTP NPDES permit and have been proposed to be plugged and abandoned. These outfalls include 590, 650, 660, 670, and 694. Outfall 690 may also be plugged and abandoned if an evaluation of the outfall drainage area shows that this action will not adversely affect runoff flow. Cleanup actions to remove lead may be taken in the Outfall 510 piping network based on the results of this sampling. The responsibility for NPDES permitting of the K-31/K-33 portion of the ETTP storm drain system, including Outfalls 510, 520, 522, 530, 560, 600, 610, 690, 700, and 720, has not been determined. However, these outfalls have been included as part of the ETTP NPDES permit renewal application that is currently being prepared.

3.6.14.1 Flow and Flux Monitoring at Storm Water Outfalls Associated With NPDES Permit Requirements

In addition to periodic monitoring requirements specified in the ETTP NPDES permit, several additional monitoring efforts were included as part of the current ETTP NPDES permit to support the CERCLA actions that are ongoing at ETTP. This monitoring are being conducted as part of the SWPP Program.

Flow monitoring will be conducted at several outfalls, including Outfalls 100, 170, 180, and 190.Field-installed flow meters are used to gauge flows for various ranges of rainfall events at each of these outfalls. These flows are compared against ones generated by NRCS TR-55 (NRCS 1986), which is the current flow modeling technique in use at ETTP. These comparative values are used to increase the accuracy of the TR-55 flow modeling process. Mercury is sampled at Outfalls 180 and 190 using the flow-weighted sampling technique. The calibrated flow model will be used with the flow-paced mercury sampling results to determine mercury flux at the respective outfalls.

Flow data and rainfall data for the period from December 5, 2015–March 31, 2017, were collected at Outfall 190. All rainfall events that occurred during this time period were evaluated. As with Outfall 100, an ISCO tipping bucket type rainfall gauge that actuates after the first 0.01 in. of rainfall occurs was used for the collection of rainfall data. Flow and rainfall data was collected in 5-min intervals during this period of time. The data was divided up into 24-h periods based on the occurrence of rainfall events. These 24-h periods did not necessarily coincide with “midnight-to-midnight” daily intervals. In most instances, a 24-h data period began at the same time that the first recordable rainfall (0.01 in.) was measured.

A new base flow for Outfall 190 was determined by using the average of the flows measured by the ISCO flow meter immediately before the start of rainfall events that occurred in the December 5, 2015–March 31, 2017, timeframe. The flow measurements that were used for this calculation were made after a period of at least 72 h after the last previous rainfall of 0.1 in. or more. The newly recalculated base flow was 23,500 gpd. D&D actions that may have affected the base flow of Outfall 190 include demolition of the K-1401 building, remediation of the K-1070-B burial ground, etc. Each of these facilities provided additional flow to Outfall 190 from various sources, including impermeable surfaces such as roof drains and parking areas, discharges from sumps, etc.

In addition to the recalculation of base flow, the Soil Conservation Service (SCS) curve number for Outfall 190, which also must be considered in the TR-55 flow calculations, was refigured for Outfall 190. The SCS curve number is based on the runoff area’s hydrologic soil group, land use, treatment, and hydrologic condition. The previously used SCS curve number for Outfall 190 was 74, and the revised SCS curve number for the Outfall 190 drainage area is 86.

By using the newly calculated base flow of 23,500 gpd and the new SCS curve number of 86, a relatively close match was accomplished between the actual flow measured at Outfall 190 using ISCO flow measurement equipment and the calculated flow at Outfall 190 derived by using the TR-55 model. Both the newly calculated base flow and the newly refigured SCS curve number will be used with the TR-55 program to provide flow estimates that will be reported to TDEC in the ETTP NPDES Discharge Monitoring Report (DMR) on an annual basis. The base flow will be modified as additional flow information becomes available for Outfall 190. Furthermore, seasonal base flows may be recalculated to indicate potential changes due to events such as water table fluctuations, water retention in soil, etc.

As part of the flow-paced sampling effort at Outfall 190, aliquots were collected during a representative storm for the first three hours of the storm. Each aliquot collection was separated by a minimum of 15 min. Three sample aliquots were collected within each hour of discharge. The flow-paced composite mercury sample from Outfall 190 was analyzed using the low-level mercury detection method (EPA 2002, EPA-1631).

On February 2, 2016, a flow-paced composite mercury sample was collected at Outfall 190 after a storm event of 0.50 in. that occurred on February 1, 2016. This storm event meets the criteria for collection of mercury samples during a rainfall event of 0.1–0.5 in., as described in the ETTP NPDES permit. The result from the sample collected on February 2, 2016, is shown in Table 3.20.

On January 12, 2017, a flow-paced composite mercury sample was collected at Outfall 190 after a storm event of 0.73 in. that occurred on January 11, 2017. This storm event meets the criteria for collection of mercury samples during a rainfall event of 0.5–1.5 in., as described in the ETTP NPDES permit. The result from the sample collected on January 12, 2017, is shown in Table 3.20.

On September 7, 2017, a flow-paced composite mercury sample was collected at Outfall 190 after a storm event of 2.06 in. that occurred on September 5, 2017. This storm event meets the criteria for collection of mercury samples during a rainfall event of greater than 1.5 in., as described in the ETTP NPDES permit. The result from the sample collected on September 7, 2017, is shown in Table 3.20.

No flow-proportional composite samples were collected from Outfall 190 during calendar year 2018.

Table 3.20. Analytical results from flow-proportional composite sampling at Outfall 190

Location	Parameter	Date sampled	Rainfall event sampled	Results (ng/L)
Outfall 190	Mercury	2/2/16	0.1–0.5 in.	96.5
Outfall 190	Mercury	1/12/17	0.5–1.5 in.	162
Outfall 190	Mercury	9/7/17	Greater than 1.5 in.	566

Figure 3.22 shows the relationship between rainfall amounts and mercury concentrations that was determined from this sampling effort. The data indicates that mercury concentrations found in the samples collected at Outfall 190 went up as rainfall amounts went up. This may be due to an increased amount of mercury-contaminated sediments being flushed from the outfall during heavier rainfall events and the heavier flows from the outfall that are associated with these rainfall events. Additional flow-proportional sampling will be conducted to indicate potential changes due to seasonal events.

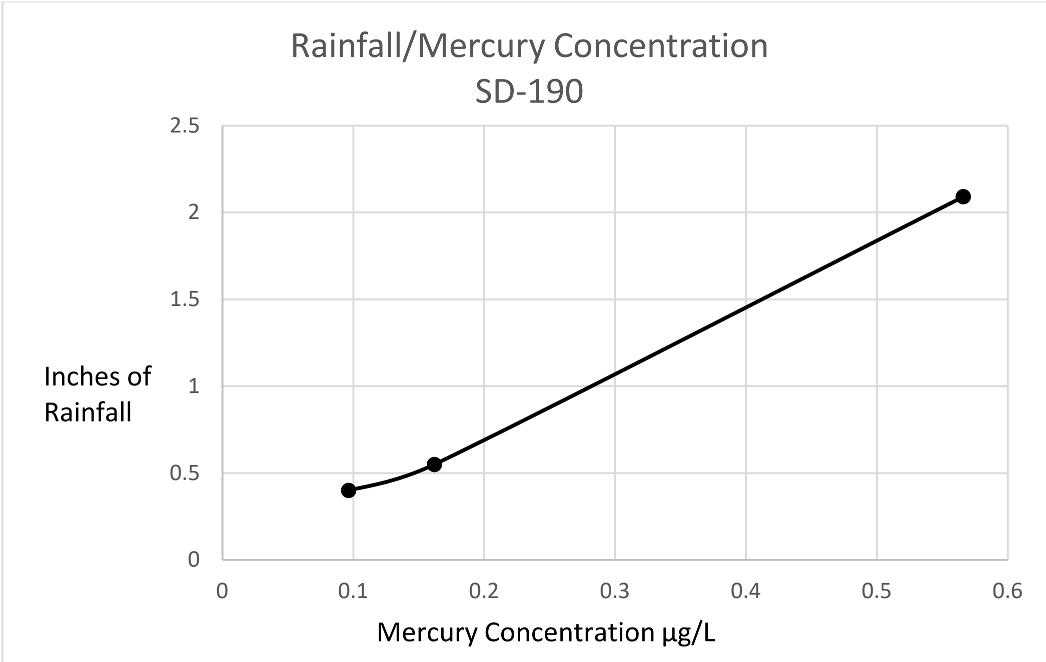


Figure 3.22. Mercury concentration at Outfall 190 as related to rainfall

Specifications for a flume to be installed at Outfall 180 were developed in late summer of 2016. This flume was purchased during FY 2017. Installation of the flume was completed in the summer of 2018, and flow data has been collected since that time.

Flow and rainfall data have been collected at Outfall 180 since August 30, 2018. An ISCO bubbler-type flow meter was used to obtain flow measurements at Outfall 180. An ISCO tipping bucket-type rainfall gauge that actuates after the first 0.01 in. of rainfall occurs was used for the collection of rainfall data. Flow and rainfall data have been collected in 5-min intervals during this time. The data are divided into 24-h periods based on the occurrence of rainfall events. These 24-h periods do not necessarily coincide with "midnight-to-midnight" daily intervals. In most instances, a 24-h data period began at the same time that the first recordable rainfall (0.01 in.) was measured.

Using the rainfall and flow data generated by the ISCO equipment, a new base flow for Outfall 180 will be determined by using the average of the flows measured by the ISCO flow meter immediately before the start of rainfall events that occurred within a selected timeframe. The flow measurements to be used for this calculation will be made after a period of at least 72 h, immediately following a rainfall of 0.1 in. or more.

The newly calculated base flow will be used with the TR-55 program to provide flow estimates that will be reported to TDEC in the ETTP NPDES DMR on an annual basis. The base flow will be modified as additional flow information becomes available for Outfall 180. Moreover, seasonal base flows may be recalculated to indicate potential changes due to events such as water table fluctuations, water retention in soil, etc.

In addition to recalculation of base flow at Outfall 180, other input for entry into the TR-55 model will be considered that will allow flow calculations from the model to better coincide with the actual flow measurements collected by the ISCO flow meter at Outfall 180. The final result of this effort is to match the flow calculated by TR-55 for a specified rainfall event as closely as possible to the flow measured by the ISCO flow meter for the corresponding rainfall event. Other information used by TR-55, such as the percentage of impermeable surfaces in the Outfall 180 drainage area, will also be recalculated.

As part of the flow-paced sampling effort at Outfall 180, aliquots were collected during a representative storm for the first 3 h of the storm. Each aliquot collection was separated by a minimum of 15 min. Three sample aliquots were collected within each hour of discharge. The flow-paced composite mercury sample from Outfall 180 was analyzed using the low-level mercury detection method (EPA 2002, EPA-1631).

On September 11, 2018, a flow-paced composite mercury sample was collected at Outfall 180 after a storm event of 0.33 in. that occurred on September 10, 2018. This storm event meets the criteria for collection of mercury samples during a rainfall event of 0.1–0.5 in., as described in the ETTP NPDES permit. The result from the sample collected on September 11, 2018, is shown in Table 3.21.

On September 25, 2018, a flow-paced composite mercury sample was collected at Outfall 180 after a storm event of 1.02 in. that occurred on September 24, 2018. This storm event meets the criteria for collection of mercury samples during a rainfall event of 0.5–1.5 in., as described in the ETTP NPDES permit. The result from the sample collected on September 25, 2018, is shown in Table 3.21.

On January 25, 2019, a flow-paced composite mercury sample was collected at Outfall 180 after a storm event of 1.57 in. that occurred on January 23, 2019. This storm event meets the criteria for collection of mercury samples during a rainfall event of greater than 1.5 in., as described in the ETTP NPDES permit. The result from the sample collected on January 25, 2019, is shown in Table 3.21.

Table 3.21. Analytical results from flow-proportional composite sampling at Outfall 180

Location	Parameter	Date sampled	Rainfall event sampled	Results (ng/L)
Outfall 180	Mercury	9/11/18	0.1–0.5 in.	497
Outfall 180	Mercury	9/25/18	0.5–1.5 in.	342
Outfall 180	Mercury	1/25/19	Greater than 1.5 in.	39.5

Specifications for a flume to be installed at Outfall 100 were developed in late summer of 2016. This flume was purchased during FY 2017. Installation of the flume was completed in early 2018, and flow data has been collected since that time.

Flow data and rainfall data have been collected at Outfall 100 since February 17, 2018. An ISCO bubbler-type flow meter was used to obtain flow measurements at Outfall 100. An ISCO tipping bucket-type rainfall gauge that actuates after the first 0.01 in. of rainfall occurs was used for the collection of rainfall data. Flow and rainfall data have been collected in 5-min intervals during this time. The data are divided into 24-h periods based on the occurrence of rainfall events. These 24-h periods do not necessarily coincide with “midnight-to-midnight” daily intervals. In most instances, a 24-h data period began at the same time that the first recordable rainfall (0.01 in.) was measured.

Using the rainfall and flow data generated by the ISCO equipment, a new base flow for Outfall 100 will be determined by using the average of the flows measured by the ISCO flow meter immediately before the start of rainfall events that occurred within a selected timeframe. The flow measurements to be used for this calculation will be made after a period of at least 72 h after the last previous rainfall of 0.1 in. or more.

The newly calculated base flow will be used with the TR-55 program to provide flow estimates that will be reported to TDEC in the ETTP NPDES DMR on an annual basis. The base flow will be modified as additional flow information becomes available for Outfall 100. Seasonal base flows may be recalculated to indicate potential changes to the base flow related to seasonal events such as water table fluctuations, water retention in soil, etc.

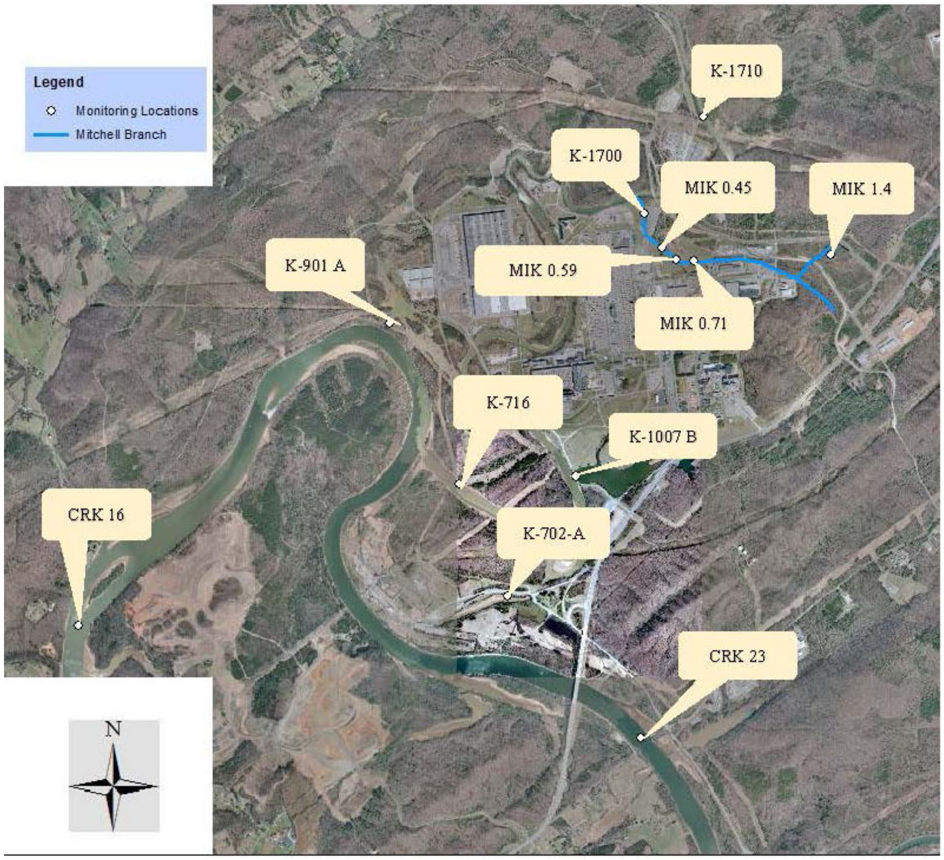
In addition to recalculation of base flow at Outfall 100, other input for entry into the TR-55 model were considered that will allow flow calculations from the model to better coincide with the actual flow measurements collected by the ISCO flow meter at Outfall 100. The final result of this effort is to match the flow calculated by TR-55 for a specified rainfall event as closely as possible to the flow measured by the ISCO flow meter for the corresponding rainfall event. Other information used by TR-55, such as the percentage of impermeable surfaces in the Outfall 100 drainage area, will also be recalculated.

3.6.15 Surface Water Monitoring

During 2018, the ETTP EMP personnel conducted environmental surveillance activities at 12 surface water locations (Figure 3.23) to monitor groundwater and storm water runoff at watershed exit pathway locations (K-1700, K-1007-B, and K-901-A) or ambient stream conditions (Clinch River kilometers [CRKs] 16 and 23; K-1710; K-716; the K-702-A slough; and MIKs 0.45, 0.59, 0.71, and 1.4). As part of monitoring the ambient stream conditions, K-1700 and MIKs 0.45, 0.59, 0.71, and 1.4 were sampled quarterly; and CRKs 16 and 23, K-716, and the K-702-A slough were sampled semiannually.

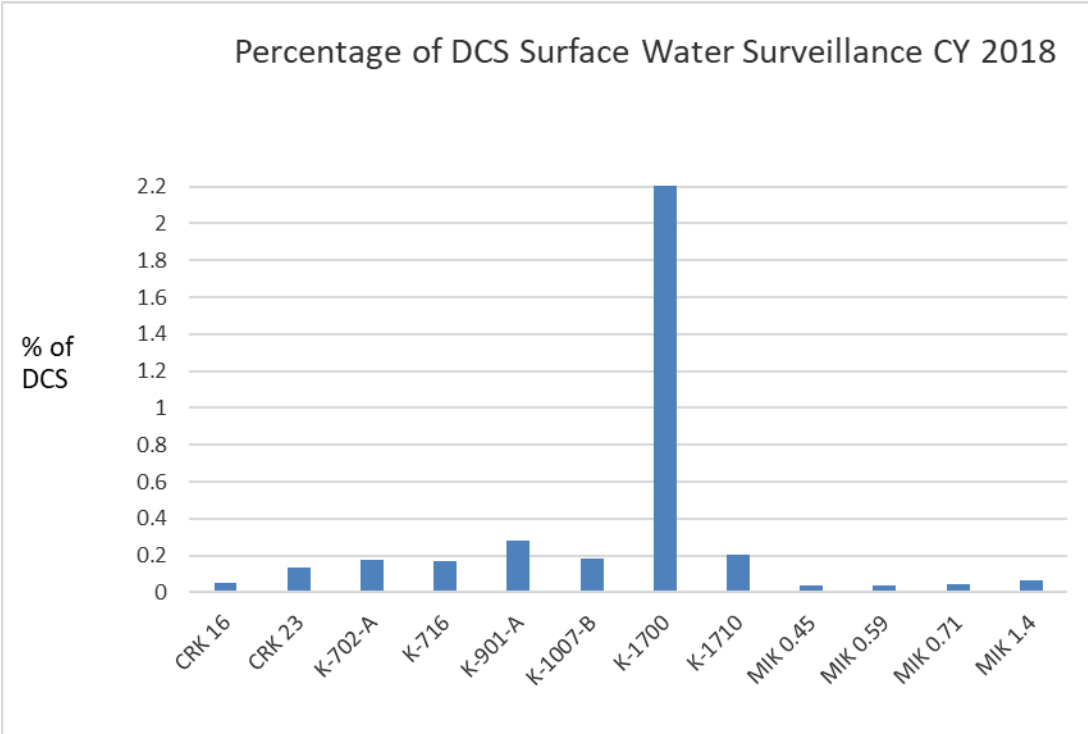
At MIKs 0.45, 0.59, and 0.71, quarterly monitoring is conducted for ^{99}Tc only. Results of radiological monitoring were compared with the DCS values in DOE Standard 1196 (DOE 2011b). Radiological data are reported as fractions of DCSs for reported radionuclides, and the fractions for all of the isotopes are added together to produce the SOF and averaged to produce a rolling 12-month average. The average SOF is recalculated whenever new data become available. If the average SOF for a location exceeds the DCS requirement of remaining below 1.0 (100 percent) for the year, a formal source investigation is required. Sources exceeding DCS requirements would need an analysis of the best available technology to reduce the SOF of the radionuclide concentrations to less than 1.0 (100 percent). In 2018, the monitoring results yielded SOF values of less than 0.01 (1 percent of the allowable DCS) at all surface water surveillance locations at ETTP, with the exception of monitoring location K-1700 (Figure 3.24). At K-1700, the annual average SOF was 0.022 (2.2 percent).

Depending on the monitoring location, water samples may be analyzed for pH, selected metals, and VOCs. In 2018, results for most of these parameters were well within the appropriate AWQC. There were nine exceptions in 2018. During the second quarter of 2018, there was an exceedance of the AWQC for mercury. At K-1710, which monitors Poplar Creek, mercury was measured at 62.9 ng/L, which exceeds the AWQC for mercury of 51 ng/L. During the third quarter, there were six failures to meet the minimum level of dissolved oxygen (5.0 mg/L). Dissolved oxygen levels were measured at 3 mg/L at K-901-A, at 2.9 mg/L at K-1700, at 4.5 mg/L at MIK 0.45, at 4.2 mg/L at MIK 0.59, at 4.1 mg/L at MIK 0.71, and at 4.8 mg/L at MIK 1.4. These readings were collected at a time of elevated temperatures and very low flow due to the drought conditions, which favor high biological activity and the resulting depletion of dissolved oxygen. In the fourth quarter, elevated levels of mercury were detected at both K-716 (66 ng/L) and K-1710 (96.3 ng/L). Both of these locations monitor Poplar Creek. No obvious signs of distress (e.g., dead fish) were observed to be associated with any of these exceedances in 2018.



CRK = Clinch River kilometer
MIK = Mitchell Branch kilometer

Figure 3.23. East Tennessee Technology Park Environmental Monitoring Program surface water monitoring locations

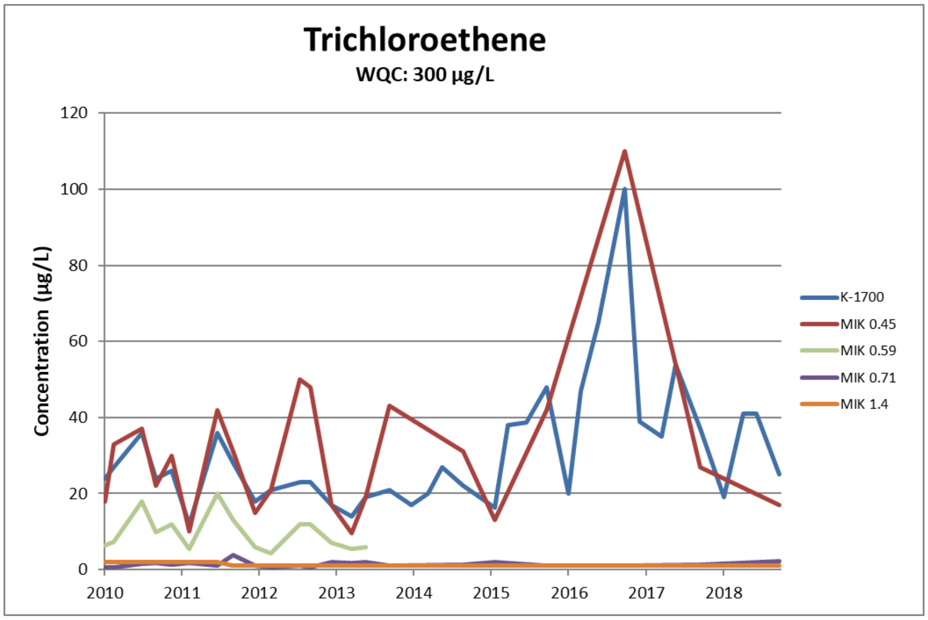


CRK = Clinch River kilometer
DCS = derived concentration standard
MIK = Mitchell Branch kilometer

Figure 3.24. Annual average percentage of derived concentration standards at surface water monitoring locations, 2018

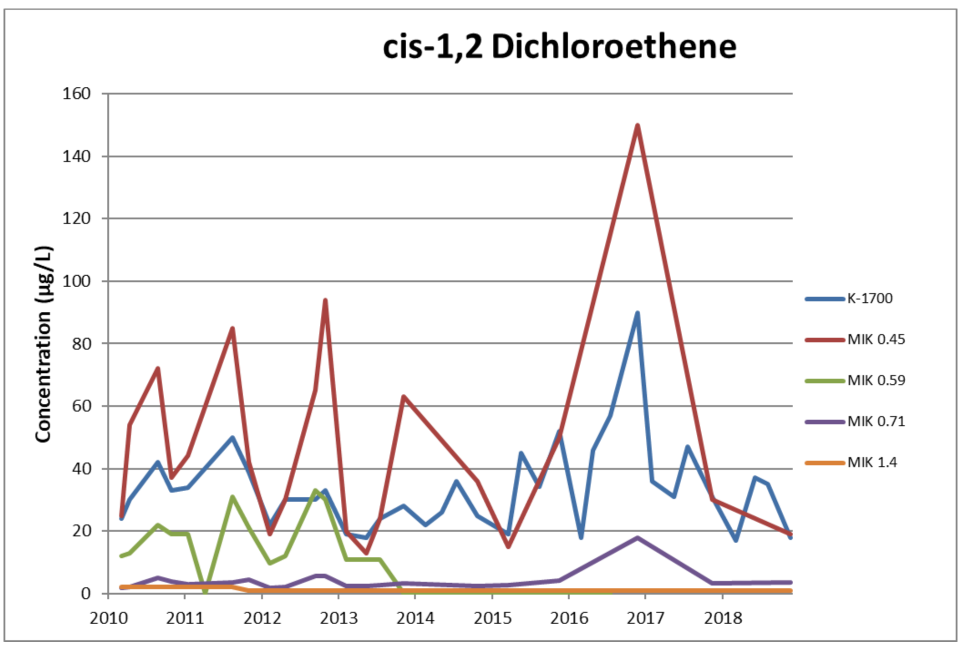
Figures 3.25 and 3.26 illustrate the concentrations of TCE (trichloroethene) and cis-1,2-dichloroethene (cis-1,2-DCE) from the Mitchell Branch monitoring locations., Although VOCs are routinely detected at K-1700 and MIK 0.45, they are rarely detected at other surface water surveillance locations across the ETTP. In the samples collected on November 22, 2016, results for several VOCs, including TCE and cis-1,2-dichloroethene, at several of the Mitchell Branch monitoring locations were reported at levels significantly higher than seen in recent monitoring. It should be noted that the November 22, 2016 sample date was at the end of an extended dry weather period that began in August of 2016. Although there had been a short 48-hour test of the CWTS in October 2016, in which the collection well pumps had been intentionally stopped, the test had been completed and the pumps restarted over a month before these samples were collected. The Sample Management Office (SMO) has reviewed these data points and they did not discover any indication of a laboratory error, and all other sources of error have been ruled out, leaving the investigation inconclusive. It should be noted that even at the increased levels, the results are still well within the AWQC. Concentrations of TCE and total 1,2-DCE are below the AWQCs for recreation, organisms only (300 µg/L for TCE and 10,000 µg/L for trans-1,2-DCE), which are appropriate standards for Mitchell Branch. Moreover, the standards for 1,2-DCE apply only to the “trans” form of 1,2-DCE; almost all of the 1,2-DCE is in the cis- isomer. In addition, vinyl chloride has sometimes been detected in Mitchell Branch water (Figure 3.27). VOCs have been detected in groundwater in the vicinity of Mitchell Branch and in building sumps discharging into storm water outfalls that discharge into the stream; however, storm drain network monitoring generally has not detected these compounds in the storm water discharges. Therefore, it appears that the primary source of these compounds is contaminated groundwater.

Since CWTS was installed, chromium levels in Mitchell Branch have dropped dramatically, with levels of total chromium being routinely measured at less than 6 µg/L (Figure 3.28). In 2018, hexavalent chromium levels in Mitchell Branch were all below the detection limit of 6 µg/L.



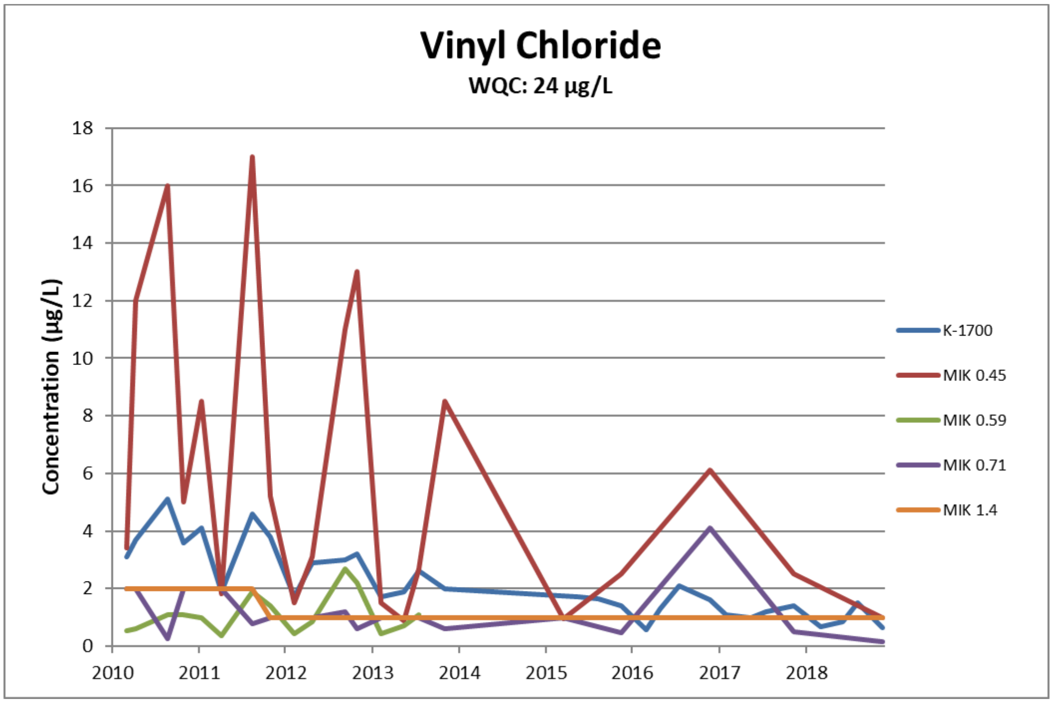
MIK = Mitchell Branch kilometer

Figure 3.25. Trichloroethene concentrations in Mitchell Branch



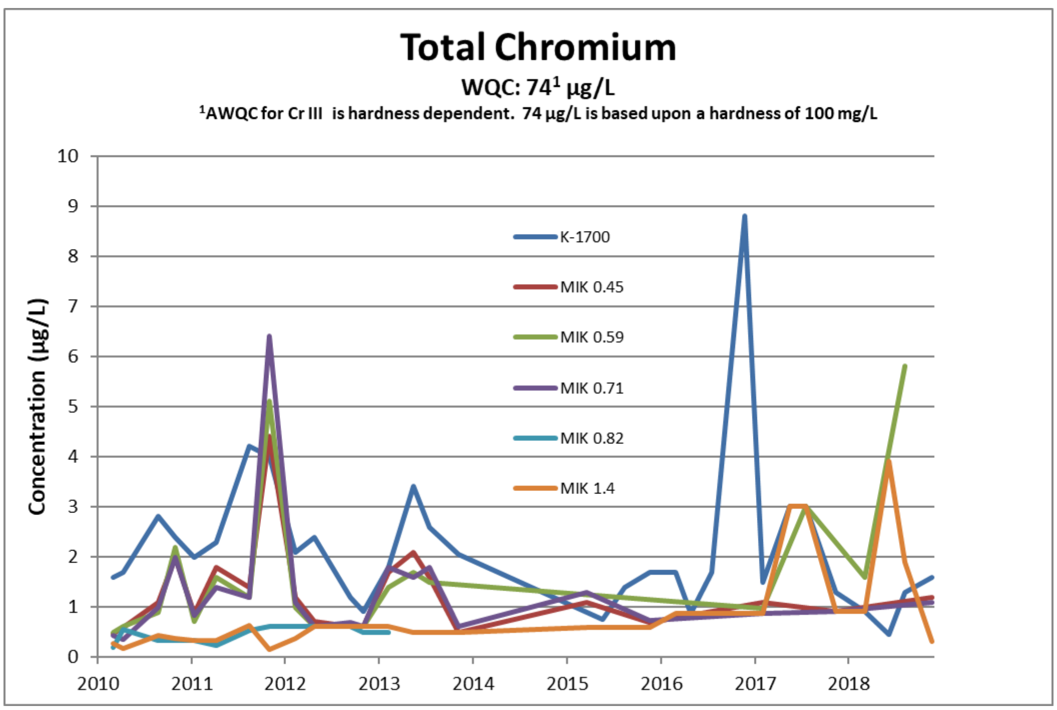
MIK = Mitchell Branch kilometer

Figure 3.26. Concentrations of cis-1,2-dichloroethene in Mitchell Branch



MIK = Mitchell Branch kilometer

Figure 3.27. Vinyl chloride concentrations in Mitchell Branch



The AWQC for Cr(III), which is hardness-dependent, is 74 µg/L, based on a hardness of 100 mg/L. The AWQC for Cr(IV) is 11 µg/L.

AWQC = ambient water quality criterion, MIK = Mitchell Branch kilometer

Figure 3.28. Total chromium concentrations in Mitchell Branch

3.6.16 Groundwater Monitoring

3.6.16.1 General Groundwater Monitoring at ETTP

VOC concentrations in wells monitored downgradient of K-1070-C/D show that a broad area is affected by releases from the past disposal of liquid VOCs at G-Pit. While concentrations along one portion of the affected area associated with Wells UNW-114 and UNW-064 continue to decrease, there remains a known area with very high concentrations that affect Wells DPT-K1070-5 and DPT-K1070-6. The persistent, high concentrations of these VOCs suggest an ongoing contaminant source release.

Contaminant conditions in the groundwater exit pathway areas are generally stable and similar to conditions in recent years. In the K-31/K-33 area, chromium continues to be measured at levels near or slightly above screening level MCLs although during FY 2018, all chromium results were less than the 0.1 mg/L MCL. Nickel is present in groundwater samples from one well (UNW-043) at concentrations greater than the state of Tennessee screening criterion of 0.1 mg/L.

In the K-1064 Peninsula, arsenic exceeded its screening level MCL in groundwater samples collected during FY 2018. TCE concentrations continued to decrease with a maximum detected concentration less than the screening level MCL in FY 2018.

In the K-27/K-29 area, chromium continues to exceed its 0.1 mg/L MCL screening level in unfiltered samples from Wells UNW-038 and UNW-096, although concentrations in filtered samples are less than the MCL screening level. Nickel exceeds the state of Tennessee water quality screening criterion in Wells UNW-038 and UNW-096. TCE continues to gradually decrease in Wells UNW-038 and UNW-096.

Samples from spring PC-0, which discharges groundwater into Poplar Creek, had TCE concentrations greater than the 5 µg/L MCL during November 2017 and February 2018, but concentrations were less than the MCL in April 2018. At spring 10-895, TCE was detected at concentrations less than the MCL screening level during FY 2018.

In the K-770 area, alpha activity concentrations have decreased to levels less than the 15 pCi/L screening level.

At wells near the K-1007-P1 Holding Pond, alpha activity was detected at a concentration less than the 15 pCi/L screening concentration in Well UNW-108 and TCE was not detected, although in previous years it was measured at concentrations greater than its 0.005 mg/L screening concentration.

Monitoring results from wells in the K-1407-B/C Ponds area are generally consistent with results from previous years and show several fold concentration fluctuations in seasonal and longer-term periods. The detection of VOCs at concentrations well above 1,000 µg/L and the steady concentrations over recent years suggest the presence of dense nonaqueous phase liquid (DNAPL) in the vicinity of Well UNW-003 (Figure 3.29).

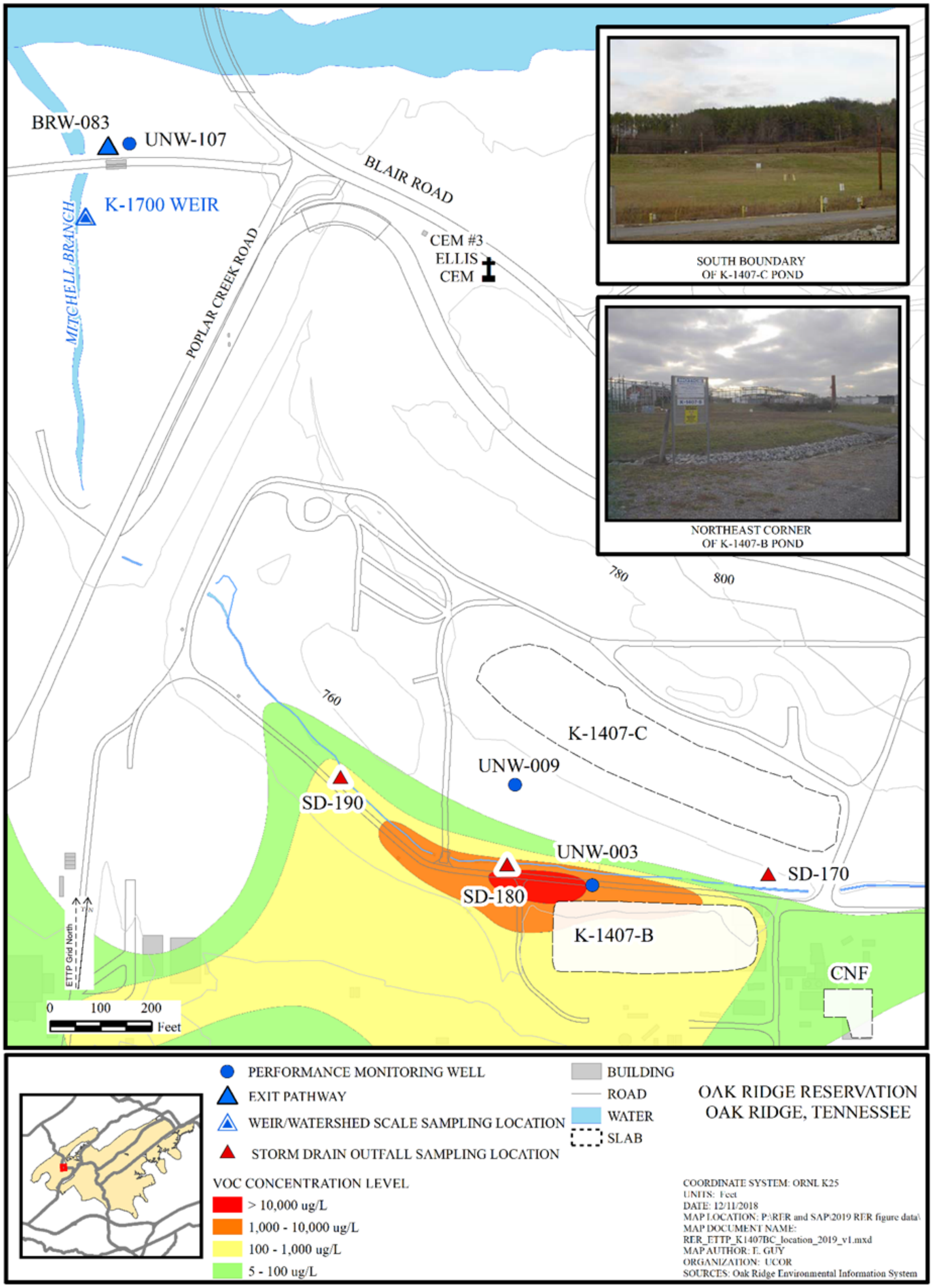


Figure 3.29. Location of K-1407-B/C Ponds

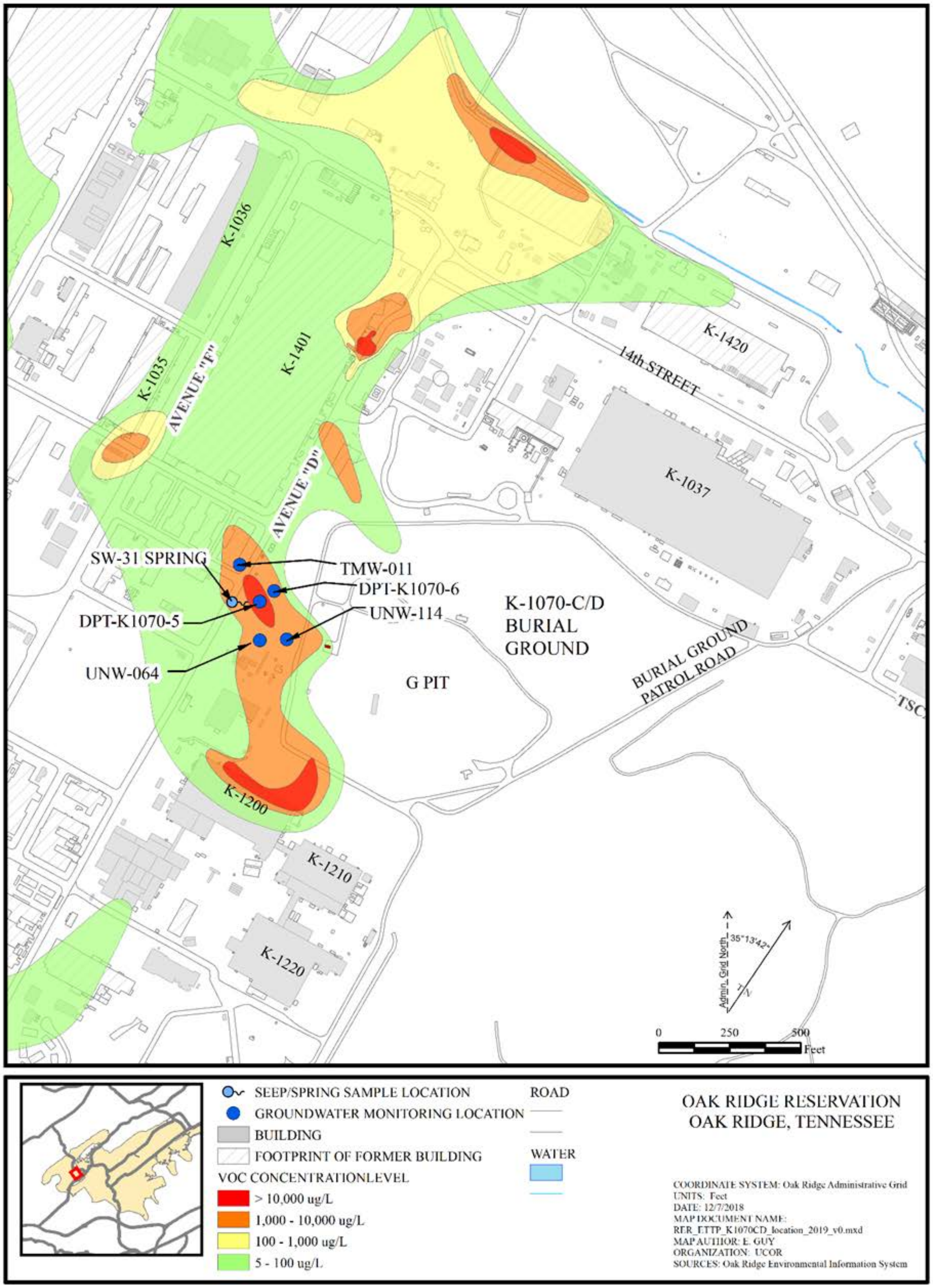


Figure 3.30. Location map for K-1070-C/D Burial Ground

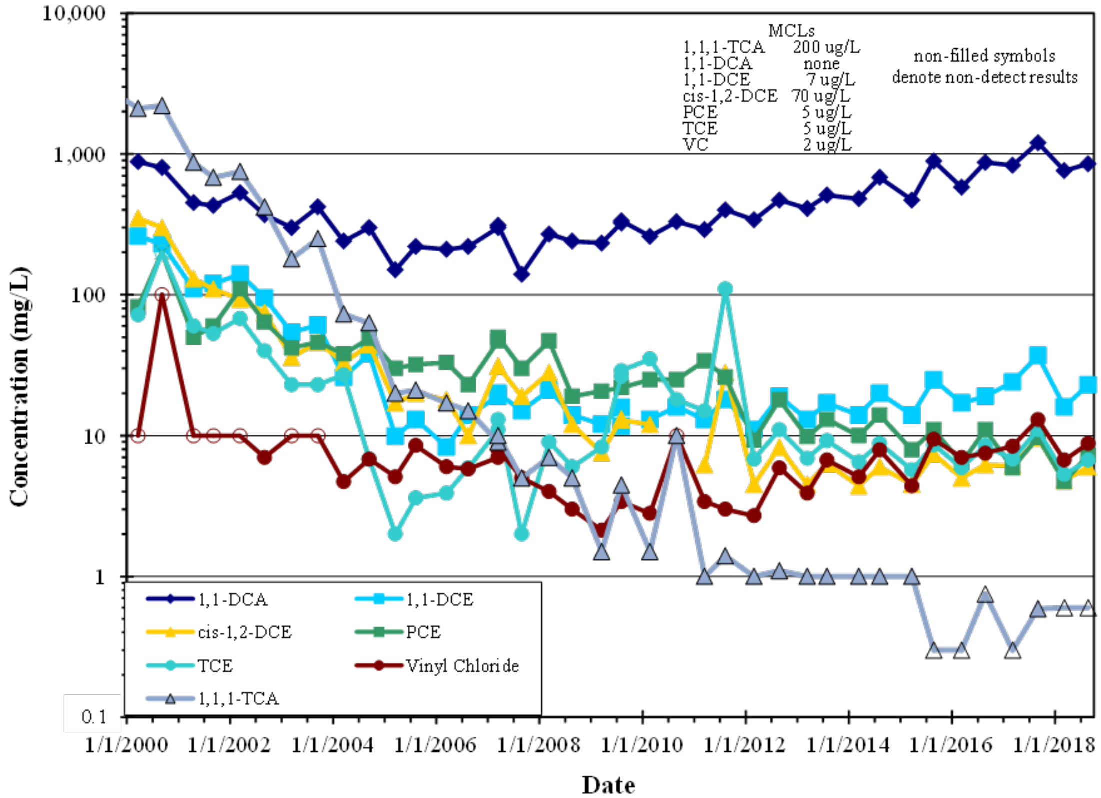


Figure 3.31. VOC concentrations in Well UNW-114, FYs 2000–2018

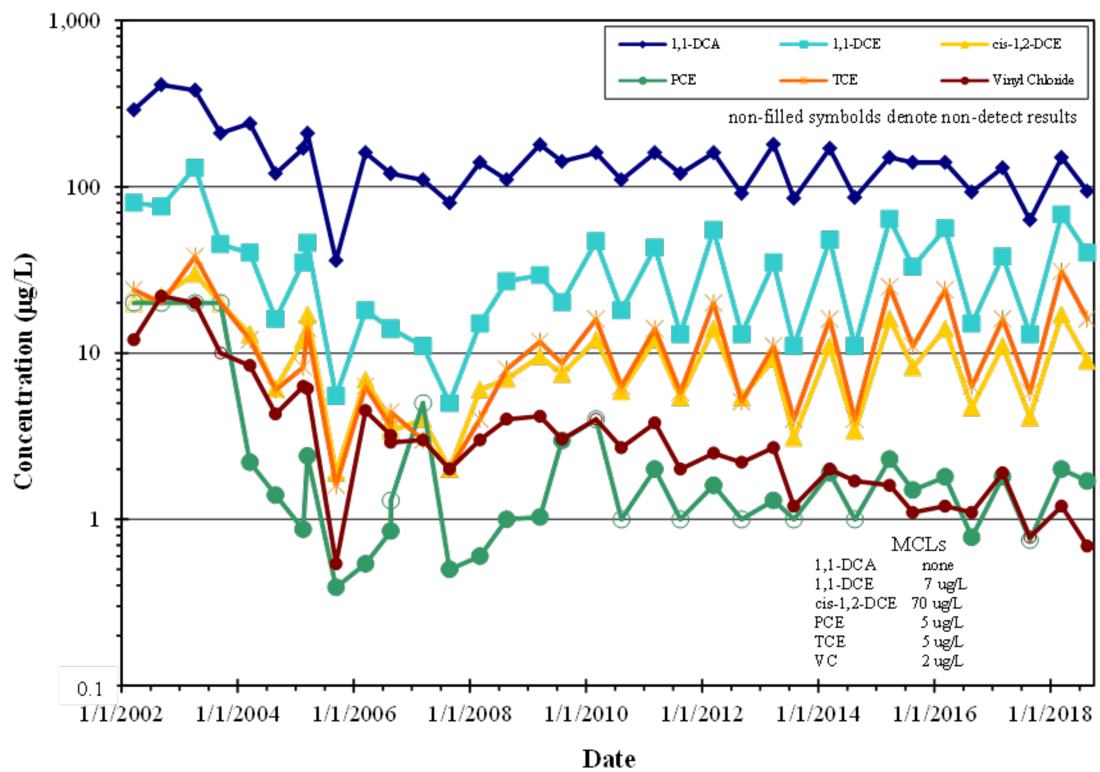


Figure 3.32. VOC concentrations in Well UNW-064, FYs 2002–2018

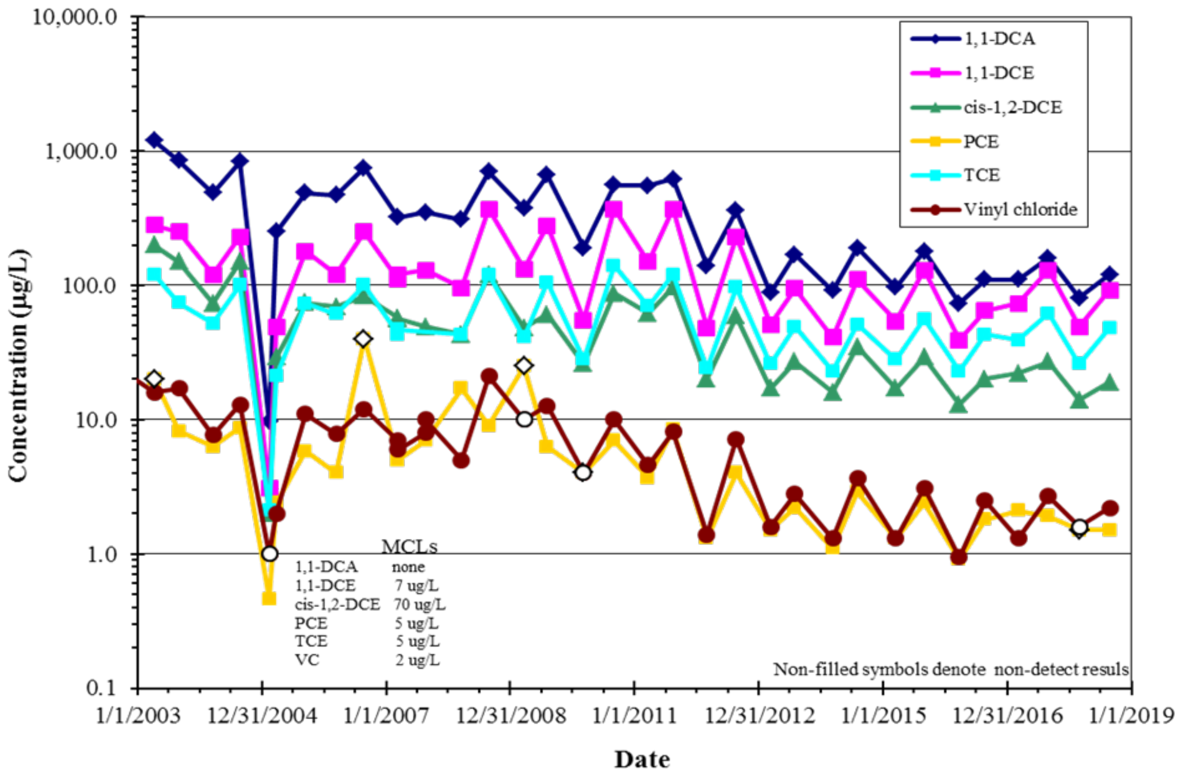


Figure 3.33. VOC concentrations in Well TMW-011, FYs 2002–2018

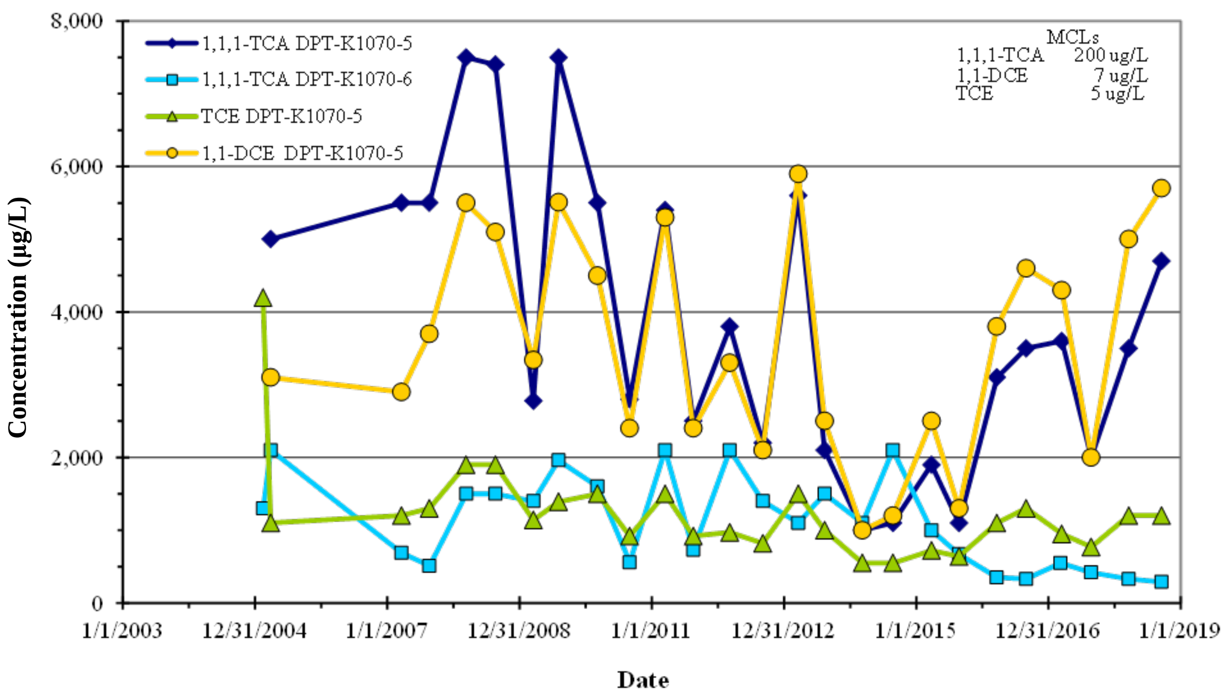


Figure 3.34. VOC concentrations in DPT-K-1070-5 and DPT-K-1070-6, FYs 2002–2018

Monitoring requirements for completed CERCLA includes monitoring for sites—such as the K-1070-C/D Burial Grounds, K-1407-B/C Ponds, K-901-A and K-1007-P1 Holding Ponds—and monitoring to determine the effectiveness of the Chromium Water Treatment Facility. Monitoring results of these actions are discussed in the following sections.

K-1407-B/C Ponds

The K-1407-B Pond (Figure 3.29), constructed in 1943, was primarily used for settling metal hydroxide precipitates generated during neutralization and precipitation of metal-laden solutions treated in the K-1407-A Neutralization Unit. It also received discharge from the K-1420 Metals Decontamination Building and wastes from the K-1501 Steam Plant. The K-1407-C Pond, constructed in 1973, was primarily used to store potassium hydroxide scrubber sludge generated at K-25. It also received sludge from the K-1407-B Pond. When the K-1407-B Pond reached maximum sludge capacity, it was dredged, and the sludge was transferred to the K-1407-C Pond. The primary groundwater contaminants in the K-1407-B/C Ponds area are VOCs. VOCs are widespread in this portion of ETTP, including contaminant sources upgradient of the ponds. Groundwater samples were collected at Wells UNW-003 and UNW-009 in March and August 2018. VOCs are infrequently detected in shallow groundwater north of Mitchell Branch in Well UNW-009 because the upgradient K-1407-C Pond was principally used as a sludge holding area rather than as primary wastewater holding unit. During FY 2018, cis-1,2-DCE was detected at concentrations of 0.82 J µg/L and 0.98 µg/L in March and August, respectively, and TCE was detected at 0.5 J µg/L in August in Well UNW-009. Alpha activity has a history of measurements greater than 80 percent of its 15 pCi/L MCL although maximum measured concentrations within the past five years have been less than 10 pCi/L. Arsenic also has a history of being present in groundwater in Well UNW-003 although it was apparently associated with filterable particulates as indicated by non-detect results in filtered sample aliquots. Over the past five years, VOC concentration trends have been predominantly stable with decreasing trends for 1,1-DCE and vinyl chloride (VC). DOE suspects a DNAPL source exists somewhere beneath the former pond site based on persistent, high VOC concentrations in both shallow and deeper groundwater wells. The K-1407-C Pond was excavated in accordance with the Zone 2 record of decision (ROD) (DOE 2005b, DOE/OR/01-2161&D2) in 2017, and therefore, performance inspections are no longer necessary and are no longer performed. Inspections of K-1407-B Pond will continue until RA is taken. Components of K-1407-B Pond inspected in FY 2018 by the ETTP S&M Program include: access controls and sign conditions; condition of vegetation exhibiting dead spots, excessive weeds or deep-rooted vegetation, grass mowing, and discoloration or withering vegetation; and soil/surface conditions with evidence of soil erosion, gullies or rills, staining, and debris or trash. The site underwent routine mowing. Maintenance included cleaning the K-1407-B Pond sign so contact information is legible.

K-1070-C/D G-Pit and Concrete Pad

The K-1070-C/D G-Pit is the primary source of organic contaminant releases to soil and groundwater in the area. The K-1071 Concrete Pad, located in the southeastern portion of the K-1070-C/D area, was determined to pose an unacceptable health risk to workers from future exposure to soil radiological contaminants. Monitoring locations, analytical parameters, and cleanup levels were not specified for groundwater monitoring at the K-1070-C/D Burial Ground, although the primary contaminants of concern (COCs) in that area are VOCs. Semiannual samples collected at wells and surface water locations outside the perimeter of the K-1070-C/D Burial Ground are analyzed for VOCs and general water quality parameters (Figure 3.30). Monitoring at the site is focused on providing data for evaluating changes in contaminant concentrations near the source units or potentially discharging to surface water within the boundaries of ETTP. Approximately 9,100 gal of mixed volatile organic liquids were disposed in G-Pit during its period of use between 1977 and 1979. Site characterization data collected at G-Pit in the mid-1990s showed the presence of 1,1,1-TCA (840 mg/L); 1,1-DCA (43 mg/L); toluene (74 mg/L); and TCE (220 mg/L). A RA was conducted in December 1999 − January 2000 to remove container remnants from

G-Pit (DOE 2002b, DOE/OR/01-1964&D2). The pit was backfilled with soil following the excavation. DOE's conceptual model for the G-Pit site includes probable DNAPL permeation of the unconsolidated and bedrock zones beneath the former liquid waste disposal site. The 1,1,1-TCA is amenable to biodegradation to 1,1-DCA by microbes in the *Dehalobacter* genus. Although 1,1-DCA is also amenable to degradation by some species of *Dehalobacter*, the presence of cis-1,2-DCE and VC tend to inhibit the biodegradation of 1,1-DCA. Cis-1,2-DCE and VC are common biodegradation products of PCE and TCE, which are also present in groundwater at the site, along with 1,1-DCE, another biodegradation product of PCE and TCE.

Following remediation of G-Pit, Monitoring Wells UNW-114, TMW-011, and UNW-064 (Figure 3.30) were selected to monitor the VOC plume leaving the K-1070-C/D Burial Grounds because they were located in the principal known downgradient groundwater pathway. Results of monitoring at these wells show elevated VOC concentrations. VOC concentrations at these three wells were decreasing prior to the excavation of the G-Pit contents (during FY 2000) and continue to decrease. Although 1,1,1-TCA was formerly present at concentrations far greater than its 200 µg/L MCL, natural biodegradation has reduced 1,1,1-TCA concentrations to less than the drinking water standard. Several direct push technology (DPT) monitoring points were installed to the west of UNW-114 during investigations conducted in support of a Sitewide Groundwater remedial investigation (RI) in 2005. The purpose of these monitoring points was to investigate groundwater contamination in an area along potential geologically controlled seepage pathways that may have connected the G-Pit contaminant source to the former SW-31 spring. DOE continues to monitor two of these points (DPT-K1070-5 and DPT-K1070-6) to measure VOC concentrations and their fluctuations.

Long-term contaminant concentration graphs are provided for three wells monitored closest to the G-Pit contaminant source. Well UNW-114 is closest to the source area and has a screen interval elevation of 774.95–784.95 ft above mean sea level (aMSL) in unconsolidated material. Monitoring data for Well UNW-114 show that concentrations of most VOCs have been variable since 2005 (Figure 3.31). Contaminant concentration trends in Well UNW-114 show that 1,1-DCE and VC exhibited increasing concentration trends in the 10-year evaluation period, although concentration variability of both these compounds has been great enough over the most recent five years so that a statistically confident trend direction could not be assigned. PCE and TCE both exhibit a decreasing trend in the 10-year evaluation. PCE continued that decreasing trend in the 5-year evaluation, although the trend for TCE was stable. The increasing trend for 1,1-DCE and VC is attributed to natural degradation of chlorinated VOCs at the site. Metals analysis was added to UNW-114 fairly recently and nickel exceeds the state of Tennessee water quality criterion (WQC) in both unfiltered and filtered sample aliquots, which indicate that nickel is present as a dissolved contaminant in Well UNW-114.

Well UNW-064 (Figure 3.30; well screen elevation 783.87 – 788.87 ft aMSL) is located slightly further downgradient from the contaminant source area than UNW-114 and its monitoring data exhibit a slightly different behavior. Similar to the overall trend observed at UNW-114, the majority of VOC concentrations at UNW-064 decreased from about 2002 through 2005 (Figure 3.32). Although 1,1-DCE and TCE are always detected in samples from Well UNW-064, their concentrations are sufficiently variable to prevent assignment of concentration trend direction with statistical confidence. VC concentration trends have been decreasing in both the 10-year and 5-year evaluations. The FY 2018 maximum measured VC concentration in Well UNW-064 was less than the MCL. At UNW-064, the 1,1-DCA, 1,1-DCE, cis-1,2-DCE, and TCE exhibit seasonal concentration fluctuations with higher concentrations during winter than during summer. This seasonal fluctuation suggests that contaminant mass transport responds to increased groundwater recharge and seepage through the plume. DOE suspects that increased seasonal recharge drives mass transfer in the plume through two combined mechanisms. One mechanism is a rise in groundwater elevation in the source area (residuals from liquid waste beneath G-Pit), which allows groundwater seepage through fractures of higher permeability at a somewhat shallower depth. The second mechanism is simply a higher flow volume through the source area and downgradient fractures caused by the higher head imposed on the whole saturated zone.

Well TMW-011 (Figure 3.30; screen just above bedrock at elevation 762.8 ft aMSL) is located furthest from the contaminant source area near the base of the hill below K-1070-C/D. VOC concentrations at TMW-011 tend to fluctuate in a fashion similar to those at UNW-064 except that the seasonal signature is reversed, with higher concentrations in summer than during winter (Figure 3.33). This relationship suggests that groundwater recharge during winter tends to dilute the VOCs near TMW-011 rather than cause a pulse of higher concentration groundwater as was observed at the mid-slope location near UNW-064. Trend evaluations in Well TMW-011 show a decrease for cis-1,2-DCE and VC for the 10-year evaluation although the trends are stable in the 5-year evaluations for these two contaminants. Although the maximum measured TCE concentrations progressively decrease in the 10-year, 5-year, and FY 2018 results, the TCE trend evaluations are stable over the 10-year period and no statistically confident trend could be assigned over the most recent five years. Since 2012, VC has fluctuated, with wet season concentrations below the MCL and dry season concentrations exceeding the MCL.

Monitoring locations DPT-K1070-5 and DPT-K1070-6 (Figure 3.30; screened intervals 776.93 – 781.93 and 777.48 – 782.48 ft aMSL, respectively) were installed using DPT and therefore they sample groundwater just at, and somewhat above, the top of bedrock downgradient of the G-Pit VOC source. Both sample locations exhibit a fairly wide range of VOC contaminants, with DPT-K1070-5 being more highly contaminated than DPT-K1070-6. Figure 3.34 shows the concentration history for those constituents with the highest concentrations in the monitored K-1070-C/D DPT wells. Seasonal fluctuation signatures are apparent in the contaminant concentrations in these DPT wells prior to about 2016, before there was an unexplained change in behavior evidenced by increases in 1,1-DCE and 1,1,1-TCA in DPT-K1070-5, which coincided with decreases in 1,1,1-TCA at DPT-K1070-6 and an increase in TCE at DPT-K1070-5. No activities other than grounds maintenance (mowing) occurred in the area upgradient of these wells during that time period.

Contaminant trends over the past 10 years have been predominantly decreasing or stable while nine results have been sufficiently variable to preclude assignment of a concentration trend. Three contaminants (1,1-DCE and VC at UNW-114 and cis-1,2-DCE at DPT-K1070-5) have exhibited increasing trends. Increasing trends for degradation products of the parent solvent compounds is an indication that natural degradation processes are ongoing in the area. Within the most recent five years, somewhat more variability in trend directions has been observed with 10 decreasing trends, 8 increasing trends, 11 stable trends, and 10 indeterminate trends.

The elevation and VOC concentration relationships among the monitoring wells demonstrate that the G-Pit plume is a heterogeneous flow system and that DPT-K1070-5 and DPT-K1070-6 lie in a different flow path from the area monitored by UNW-064 and UNW-114. Although the screen elevations of the two DPTs and Well UNW-114 are essentially the same, the VOC concentrations in the DPT samples are much higher than those in Well UNW-114. Bedrock wells have not been installed in the area to date to evaluate deeper groundwater conditions.

Extensive groundwater monitoring at the ETTP site, using the Safe Drinking Water Act (SDWA) MCLs as groundwater screening values, has identified VOCs as the most significant groundwater contaminant on site. The principal chlorinated hydrocarbon chemicals that were used at ETTP were PCE, TCE, and 1,1,1-TCA. While preparing a remedial investigation/feasibility study (RI/FS) in 2007 to support CERCLA decision-making for the ETTP site, the human health risk assessment summarized "*priority COCs in groundwater . . . for the industrial worker, which is the most likely of the future scenarios assessed for exposure to groundwater*." (DOE 2007, DOE/OR/01-2279&D3) The evaluation of priority groundwater COCs identified the major groundwater contaminant source areas and associated plumes.

Figure 3.35 shows the distribution and generalized concentrations of the sum of the primary chlorinated hydrocarbon chemicals and their degradation products at ETTP. Specific compounds included in the summation of chlorinated VOCs include chloroethenes (PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and VC), chloroethanes (1,1,1-TCA, 1,1,2-TCA, 1,2-DCA, 1,1-DCA, and chloroethane), and chloromethanes (carbon tetrachloride, chloroform, and methylene chloride). Several plume source areas are identified within the regions of the highest VOC concentrations. In these areas, the primary chlorinated hydrocarbons have been present for decades and mature contaminant plumes have evolved. The degree of degradation, of the primary chlorinated hydrocarbon compounds is highly variable across the site. In the vicinity of the K-1070-C/D source (G-Pit and Concrete Pad, Section 3.6.17.1), a high degree of degradation has occurred, although a strong source of contamination still remains in the vicinity of the G-Pit, where approximately 9,000 gal of chlorinated hydrocarbon liquids were disposed in an unlined pit. Other areas where degradation is significant include the K-1401 Acid Line leak site, and the K-1407-B Pond area. Degradation processes are weak or inconsistent at the K-1004 and K-1200 area, K-1035, K-1413, and K-1070-A Burial Ground, and little degradation of TCE is observed in the K-27/K-29 source and plume area.

VOC plumes shown on Figure 3.35 include significant revisions in the K-1401 area where subsurface characterization activities in support of the *Design Characterization Completion Report for the Sitewide Groundwater Treatability Study at the East Tennessee Technology Park, Oak Ridge, Tennessee* (DOE 2018a, DOE/OR/01-2768&D1) completed during FY 2018 defined the nature and extent of DNAPL and high concentrations of chlorinated solvent compounds in groundwater. In addition, ongoing soil characterization identified an area of TCE contaminated soil and groundwater within the footprint of the former K-25 building. Figure 3.35 also shows the locations of monitoring wells throughout the ETTP site that are routinely sampled for known COCs. Designated groundwater exit pathway monitoring wells are identified and general facility areas are shown within which groundwater contaminant trends are discussed later in this section.

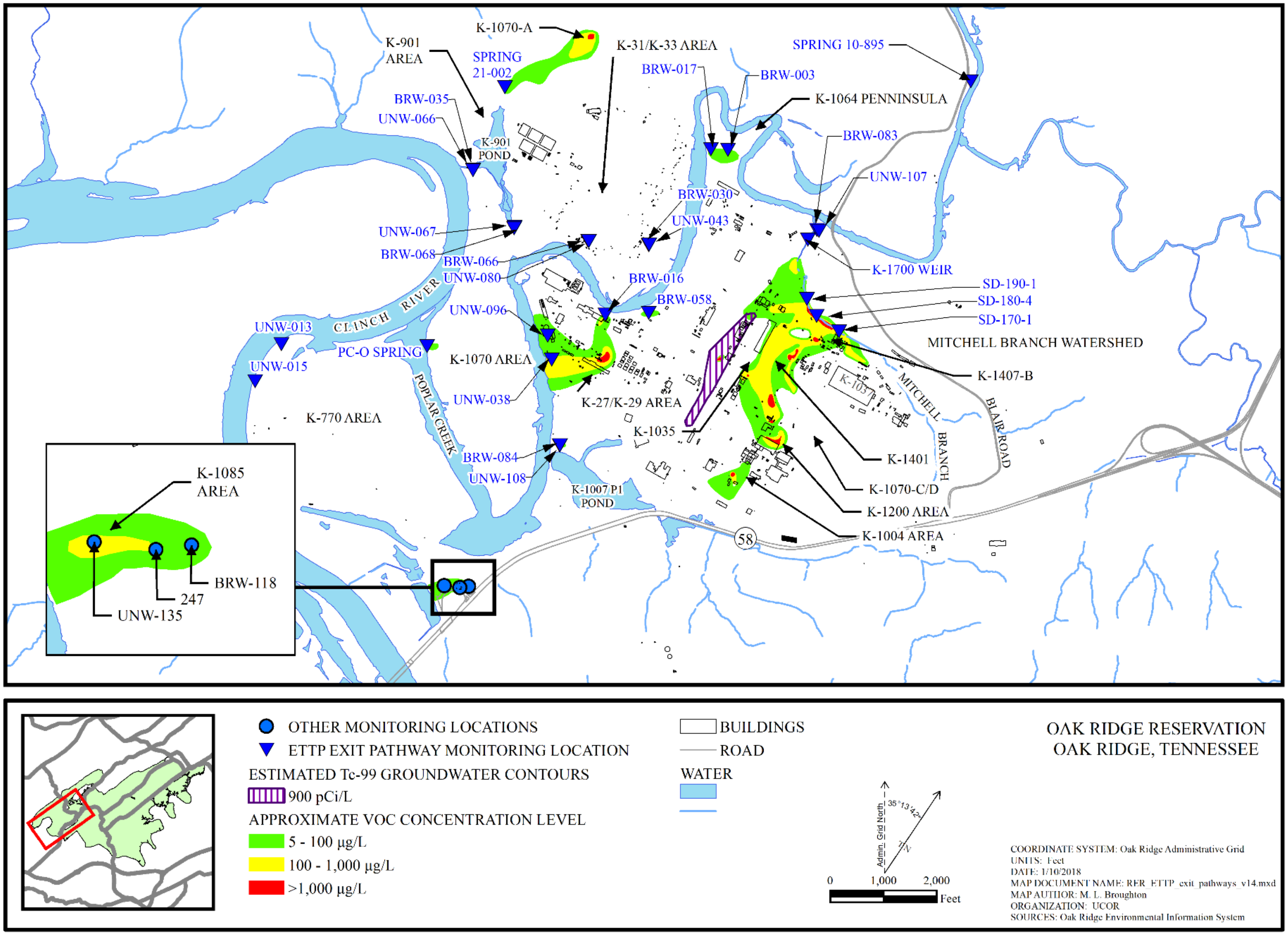


Figure 3.35. ETTP exit pathways monitoring locations

Mitchell Branch

The Mitchell Branch groundwater exit pathway is monitored using surface water data from the K-1700 Weir on Mitchell Branch and Wells BRW-083 and UNW-107.

Wells BRW-083 and UNW-107, located near the mouth of Mitchell Branch, have been monitored since 1994. Detection of VOCs in groundwater near the mouth of Mitchell Branch is considered an indication of the migration of the Mitchell Branch VOC plume complex. The intermittent detection of VOCs in this exit pathway is thought to be a reflection of variations in groundwater flow paths that can fluctuate with seasonal hydraulic head conditions that are strongly affected by rainfall. During FY 2018, no chlorinated VOCs were detected in Wells BRW-083 or UNW-107 and no concentrations of VOCs in the 5-year evaluation period exceeded 80 percent of their respective MCLs (Table 3.22).

K-1064 peninsula area

Wells BRW-003 and BRW-017 monitor groundwater at the K-1064 peninsula burn area. Metals and VOCs are monitored at the site. Metals detected in groundwater at the site include antimony, zinc, chromium, and arsenic, however, only arsenic concentrations exceeded 80 percent of its MCL. Arsenic was detected in both wells with maximum concentrations of 15 µg/L in Well BRW-003 in the filtered sample in March 2018 and 14 µg/L in the filtered sample from Well BRW-017 in September 2018. Arsenic concentrations in both unfiltered and filtered samples from Well BRW-003 have shown long-term decreases during the period between 2004 and 2018 (Figure 3.36, Table 3.22). In the past, VOC contaminants exceeded MCLs in Wells BRW-003 and BRW-017; however, regulated VOC concentrations have declined to levels below screening levels with the exception of TCE, which has not exceeded its 0.005 mg/L MCL within the past five years (Table 3.22).

K-31/K-33 area

Groundwater is monitored in four wells (BRW-066, BRW-030, UNW-080, and UNW-043) that lie between the K-31/K-33 area and Poplar Creek. VOCs are not COCs in this area. Within the past 10 years, five metals (antimony, arsenic, chromium, lead, and nickel) have exceeded 80 percent of their MCLs. Antimony, arsenic, chromium, and lead have decreased to concentrations less than their respective MCLs or have become non-detectable. Nickel exceeds the state of Tennessee water quality concentration (0.1 mg/L) in Well UNW-043 in both the unfiltered and field filtered sample aliquots. Table 3.22 shows the trends of chromium concentrations in the groundwater in this area.

K-27/K-29 area

Groundwater discharges toward Poplar Creek in both a northward pathway beneath the K-1232 area and in a south to westward pathway as shown on Figure 3.35. Two wells (BRW-016 and BRW-058) in the northern plume near K-27/29 and two wells (UNW-038 and UNW-096) in the south/western plume have been designated for exit pathway monitoring. VOCs have exceeded MCLs in the K-27/K-29 area northern pathway (Table 3.22). TCE has decreased to concentrations less than its 0.005 mg/L MCL although cis-1,2-DCE and VC continue to exceed their respective MCLs. The presence of cis-1,2-DCE and VC in the area are indicative that natural degradation of the parent TCE is occurring in this part of the ETTP site. In the south/west exit pathway from the K-27/K-29 area, TCE is persistent in the exit pathway wells with decreasing or indeterminate trends. Chromium and nickel exceed their respective MCLs. An increasing concentration in the unfiltered sample chromium content has been detected for the 5-year evaluation although the filtered aliquot data from that well have been below the 0.1 mg/L MCL. Nickel exceeds the state of Tennessee water quality criterion of 0.1 mg/L in unfiltered samples from Wells UNW-038 and UNW-096 and also exceeds that criterion in the filtered samples from UNW-096, indicating that nickel is a dissolved phase contaminant at that location. Filtered and unfiltered nickel concentrations in Well UNW-096 have increasing trends in both the 10-year and most recent 5-year evaluations.

Table 3.22. Exit pathway groundwater contaminant screening results and trend evaluations

Chemical	Well	Units	Freq. of detection		Maximum detection limit[a]	Maximum detected			MCL[b]	Freq. > MCL[b]		Freq. > 80% of MCL[b]		Significant trend[c]	
			10 yr	5 yr		10 yr	5 yr	FY 2018		10 yr	5 yr	10 yr	5 yr	10 yr	5 yr
Mitchell Branch Exit Pathway															
Alpha activity	UNW-107	pCi/L	16 / 20	10 / 10	2.61	14.3	14.3	2.48	15	0 / 20	0 / 10	1 / 20	1 / 10	No trend	No trend
Chromium	UNW-107	mg/L	10 / 20	5 / 10	0.005	**0.11**	0.064	0.002	0.1	1 / 20	0 / 10	1 / 20	0 / 10	No trend	No trend
	UNW-107(F)	mg/L	9 / 20	4 / 10	0.005	0.027	0.009	0.002	0.1	0 / 20	0 / 10	0 / 20	0 / 10	No trend	No trend
Tetrachloroethene	BRW-083	mg/L	3 / 20	0 / 10	0.003	**0.007**	ND	ND	0.005	2 / 20	0 / 10	2 / 20	0 / 10	No trend	--
Trichloroethene	BRW-083	mg/L	4 / 20	0 / 10	0.001	**0.022**	ND	ND	0.005	3 / 20	0 / 10	3 / 20	0 / 10	Down	--
K-1064 Peninsula Exit Pathway															
Arsenic	BRW-003	mg/L	20 / 20	10 / 10	--	**0.035**	**0.024**	**0.011**	0.01	18 / 20	8 / 10	19 / 20	9 / 10	Down	Down
	BRW-003(F)	mg/L	20 / 20	10 / 10	--	**0.031**	**0.023**	**0.015**	0.01	19 / 20	9 / 10	20 / 20	10 / 10	Down	Stable
	BRW-017	mg/L	8 / 20	8 / 10	0.005	**0.016**	**0.016**	0.008	0.01	2 / 20	2 / 10	2 / 20	2 / 10	Up	No trend
	BRW-017(F)	mg/L	6 / 20	6 / 10	0.005	**0.014**	**0.014**	**0.014**	0.01	1 / 20	1 / 10	3 / 20	3 / 10	Up	Up
Trichloroethene	BRW-017	mg/L	20 / 20	10 / 10	--	**0.005**	0.004	0.003	0.005	2 / 20	0 / 10	6 / 20	0 / 10	Down	Down
K-31/K-33 Area Exit Pathway															
Alpha activity	UNW-080	pCi/L	2 / 6	2 / 6	4.72	**16.1**	**16.1**	2.35	15	1 / 6	1 / 6	1 / 6	1 / 6	No trend	No trend
Antimony	UNW-043	mg/L	5 / 20	4 / 10	0.003	**0.02**	0.00045	ND	0.006	1 / 20	0 / 10	1 / 20	0 / 10	No trend	No trend
	UNW-043(F)	mg/L	4 / 20	4 / 10	0.003	3.7E-04	0.00037	0.00034	0.006	0 / 20	0 / 10	0 / 20	0 / 10	Stable	No trend
	UNW-080	mg/L	2 / 20	2 / 10	0.003	**0.026**	**0.026**	0.00005	0.006	1 / 20	1 / 10	1 / 20	1 / 10	No trend	No trend
	UNW-080(F)	mg/L	2 / 20	2 / 10	0.003	0.00017	0.00017	0.00008	0.006	0 / 20	0 / 10	0 / 20	0 / 10	Stable	No trend
Arsenic	UNW-043	mg/L	3 / 20	2 / 10	0.025	**0.035**	0.006	0.006	0.01	1 / 20	0 / 10	1 / 20	0 / 10	No trend	No trend
	UNW-043(F)	mg/L	1 / 20	1 / 10	0.005	**0.011**	**0.011**	--	0.01	1 / 20	1 / 10	1 / 20	1 / 10	No trend	No trend
Chromium	BRW-030	mg/L	20 / 20	10 / 10	--	**0.11**	**0.11**	0.091	0.1	1 / 20	1 / 10	7 / 20	3 / 10	Stable	No trend
	BRW-030(F)	mg/L	20 / 20	10 / 10	--	0.12	0.12	0.096	0.1	2 / 20	2 / 10	6 / 20	3 / 10	Stable	No trend
	UNW-043	mg/L	20 / 20	10 / 10	--	**21**	**3.6**	0.057	0.1	17 / 20	7 / 10	17 / 20	7 / 10	Down	Down
	UNW-043(F)	mg/L	18 / 20	10 / 10	0.005	0.046	0.046	0.046	0.1	0 / 20	0 / 10	0 / 20	0 / 10	No trend	No trend
	UNW-080	mg/L	20 / 20	10 / 10	--	**1.2**	**1.2**	0.019	0.1	4 / 20	4 / 10	4 / 20	4 / 10	No trend	Down
	UNW-080(F)	mg/L	20 / 20	10 / 10	--	0.027	0.022	0.015	0.1	0 / 20	0 / 10	0 / 20	0 / 10	Stable	Stable

Table 3.22. Exit pathway groundwater contaminant screening results and trend evaluations (continued)

Chemical	Well	Units	Freq. of detection		Maximum detection limit[a]	Maximum detected			MCL[b]	Freq. > MCL[b]		Freq. > 80% of MCL[b]		Significant trend[c]	
			10 yr	5 yr		10 yr	5 yr	FY 2018		10 yr	5 yr	10 yr	5 yr	10 yr	5 yr
Lead	UNW-080	mg/L	4 / 20	4 / 10	0.003	**0.015**	**0.015**	ND	0.015	0 / 20	0 / 10	2 / 20	2 / 10	No trend	No trend
	UNW-080(F)	mg/L	0 / 20	0 / 10	0.003	ND	ND	ND	0.015	0 / 20	0 / 10	0 / 20	0 / 10	--	--
Nickel	UNW-043	mg/L	20 / 20	10 / 10	--	**3.4**	**1.3**	**0.55**	0.1	20 / 20	10 / 10	20 / 20	10 / 10	Stable	No trend
	UNW-043(F)	mg/L	20 / 20	10 / 10	--	**0.96**	**0.74**	**0.53**	0.1	20 / 20	10 / 10	20 / 20	10 / 10	Stable	Stable
	UNW-080	mg/L	8 / 20	8 / 10	0.01	0.099	0.099	0.005	0.1	0 / 20	0 / 10	1 / 20	1 / 10	No trend	No trend
	UNW-080(F)	mg/L	6 / 20	6 / 10	0.01	0.004	0.004	0.003	0.1	0 / 20	0 / 10	0 / 20	0 / 10	Stable	Stable
Trichloroethene	BRW-066	mg/L	1 / 20	0 / 10	0.003	0.004	ND	ND	0.005	0 / 20	0 / 10	1 / 20	0 / 10	No trend	--
						K-27 North Exit Pathway									
cis-1,2-Dichloroethene	BRW-058	mg/L	20 / 20	10 / 10	--	**0.11**	**0.11**	**0.11**	0.07	4 / 20	4 / 10	9 / 20	8 / 10	Up	Up
Trichloroethene	BRW-058	mg/L	15 / 20	9 / 10	0.003	**0.006**	**0.006**	0.00067	0.005	2 / 20	1 / 10	3 / 20	1 / 10	No trend	Stable
Vinyl chloride	BRW-016	mg/L	6 / 22	5 / 12	0.001	**0.002**	**0.002**	**0.002**	0.002	0 / 22	0 / 12	1 / 22	1 / 12	No trend	No trend
	BRW-058	mg/L	20 / 20	10 / 10	--	**0.028**	**0.028**	**0.028**	0.002	19 / 20	10 / 10	20 / 20	10 / 10	Up	No trend
						K-27 South/West Exit Pathway									
Chromium	UNW-038	mg/L	20 / 20	10 / 10	--	**0.46**	**0.13**	**0.018**	0.1	3 / 20	1 / 10	4 / 20	1 / 10	Down	No trend
	UNW-038(F)	mg/L	15 / 20	10 / 10	0.005	0.014	0.013	0.01	0.1	0 / 20	0 / 10	0 / 20	0 / 10	No trend	No trend
	UNW-096	mg/L	20 / 20	10 / 10	--	**0.16**	**0.16**	**0.16**	0.1	3 / 20	3 / 10	12 / 20	8 / 10	No trend	Up
	UNW-096(F)	mg/L	20 / 20	10 / 10	--	0.092	0.092	0.081	0.1	0 / 20	0 / 10	9 / 20	5 / 10	Stable	Stable
Nickel	UNW-038	mg/L	16 / 20	7 / 10	0.01	**0.86**	**0.13**	**0.13**	0.1	4 / 20	2 / 10	5 / 20	3 / 10	No trend	No trend
	UNW-038(F)	mg/L	13 / 20	5 / 10	0.01	**0.85**	0.093	0.067	0.1	2 / 20	0 / 10	4 / 20	2 / 10	No trend	No trend
	UNW-096	mg/L	8 / 20	8 / 10	0.01	**0.27**	**0.27**	**0.27**	0.1	3 / 20	3 / 10	3 / 20	3 / 10	Up	Up
	UNW-096(F)	mg/L	6 / 20	6 / 10	0.01	**0.23**	**0.23**	**0.23**	0.1	3 / 20	3 / 10	3 / 20	3 / 10	Up	Up
Trichloroethene	UNW-038	mg/L	20 / 20	10 / 10	--	**0.135**	**0.1**	**0.083**	0.005	20 / 20	10 / 10	20 / 20	10 / 10	Down	Down
	UNW-096	mg/L	20 / 20	10 / 10	--	**0.026**	**0.026**	**0.026**	0.005	20 / 20	10 / 10	20 / 20	10 / 10	Down	No trend
						K-1007-P1 Holding Pond Exit Pathway									
Alpha activity	UNW-108	pCi/L	15 / 20	8 / 10	3.7	**18.6**	**18.6**	9.28	15	1 / 20	1 / 10	1 / 20	1 / 10	Stable	No trend
Trichloroethene	BRW-084	mg/L	1 / 20	1 / 10	0.003	**0.007**	**0.007**	ND	0.005	1 / 20	1 / 10	1 / 20	1 / 10	No trend	No trend

Table 3.22. Exit pathway groundwater contaminant screening results and trend evaluations (continued)

Chemical	Well	Units	Freq. of detection		Maximum detection limit[a]	Maximum detected			MCL[b]	Freq. > MCL[b]		Freq. > 80% of MCL[b]		Significant trend[c]	
			10 yr	5 yr		10 yr	5 yr	FY 2018		10 yr	5 yr	10 yr	5 yr	10 yr	5 yr
K-901 Holding Pond Area Exit Pathway															
Alpha activity	UNW-066	pCi/L	15 / 20	8 / 10	3.75	**68.7**	**68.7**	7.16	15	4 / 20	3 / 10	4 / 20	3 / 10	No trend	No trend
	UNW-067	pCi/L	8 / 20	5 / 10	4.06	**52.8**	**52.8**	ND	15	1 / 20	1 / 10	1 / 20	1 / 10	No trend	No trend
K-770 Area Exit Pathway															
Alpha activity	UNW-015	pCi/L	15 / 15	10 / 10	--	**45.4**	12.7	8.02	15	**3 / 15**	0 / 10	**4 / 15**	**1 / 10**	Stable	**Up**

[a]The maximum detection limit is highest value assigned to a non-detect over the 10-year evaluation period. Dashes "--" for the maximum detection limit indicates that all results were detections and the maximum detection limit does not apply. Detection limits assigned to non-detects were used in evaluation of the M-K trends.
[b]MCL as of May 2018
[c]Significant linear trend from the M-K test at the 0.10 significance level. Dashes "--" for significant trends indicates that all results were non-detect and no trend analysis was conducted.

Notes:
1. **Bold** table entries indicate results that exceed MCL or MCL-DC values.
2. (F) denotes metals analysis results from field filtered sample aliquots from the designated sample location.
3. The M-K Test statistic (S) for each time series trend is calculated and plotted on a 90% confidence level chart. When the calculated S statistic (positive or negative) plots above the equivalent 90% confidence interval for the applicable number of sampling events, the time-series data define an *Increasing* trend if S >0, or a *Decreasing* trend if S <0. When the calculated S statistic plots below the equivalent 90% confidence interval and the associated CV is <1, then the time series data define a *Stable* trend. When the calculated S statistic is > 0 but confidence is < 90% or S is ≤0 and CV is ≥0 the conclusion is no trend can be confidently assigned to the data.

-- = not applicable
CV = coefficient of variation
Freq. = frequency
FY = fiscal year
MCL = maximum contaminant level
MCL-DC = maximum contaminant level derived concentration
M-K = Mann-Kendall
ND = not detected

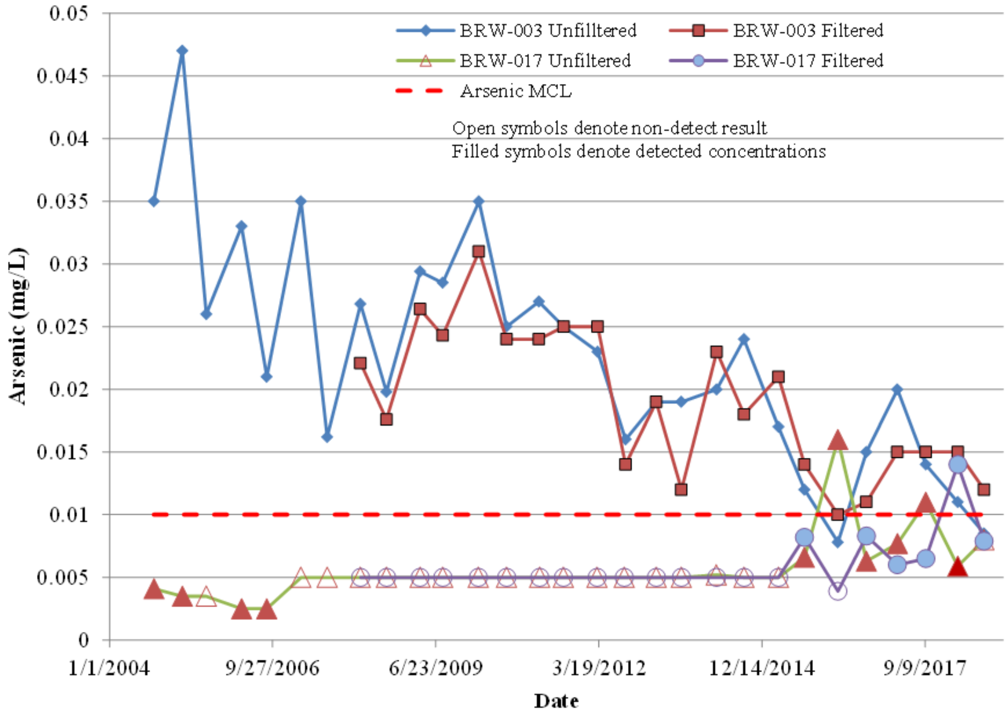


Figure 3.36. Arsenic concentrations in groundwater in the K-1064 peninsula area

K-1007-P1 Holding Pond area

Wells BRW-084 and UNW-108 are exit pathway monitoring locations at the northern edge of the K-1007-P1 Holding Pond (Figure 3.35). Within the past 10 years, alpha activity and TCE have exceeded 80 percent of their respective MCLs. Alpha activity in Well UNW-108 is measureable in nearly all samples and although the FY 2018 maximum concentration was substantially below the 15 pCi/L MCL, the alpha activity levels are sufficiently variable to prevent assignment of a trend direction with statistical confidence. No trend can be assigned to a single, detected concentration.

K-901-A Holding Pond area

Exit pathway groundwater in the K-901-A Holding Pond area (Figure 3.35) is monitored by four wells (BRW-035, BRW-068, UNW-066, and UNW-067) and two springs (21-002 and PC-0). Alpha activity is the only regulated contaminant that exceeded 80 percent of its 15 pCi/L MCL at Wells UNW-066 and UNW-067. The maximum measured FY 2018 alpha activity in the semiannual samples from Well UNW-066 was 7.16 pCi/L and alpha activity was not detected in the samples from Well UNW-067. TCE is the most significant groundwater contaminant detected in the springs, and the historic TCE concentrations are shown in Figure 3.37. Spring PC-0 was added to the sampling program in 2004. During April through October each year, spring PC-0 is submerged beneath the Watts Bar Lake level. In the late winter of 2012, DOE installed a sampling pump in the spring mouth to allow year-round sampling. The contaminant source for the PC-0 spring is presumed to be disposed waste at the former Construction Spoil Area (K-1070-F) located on Duct Island. The TCE concentrations in PC-0 spring have varied between non-detectable levels and 26 µg/L and have decreased from their highest measured value in 2006 to concentrations less than or several times the drinking water standard.

TCE that originates from the now-remediated K-1070-A Burial Ground is the principal contaminant detected at spring 21-002, as well as the TCE at spring 10-895 located on the Poplar Creek floodplain along Blair Road (Figure 3.35). The TCE concentration at spring 21-002 tends to vary between less than 5 and 25 µg/L, and this variation appears to be related to rainfall, which affects groundwater discharge from the K-1070-A VOC plume. During FY 2018, the TCE detected concentrations ranged from a high of 19 µg/L detected in December 2017 to a low of 4.9 µg/L measured in April 2018.

Since the water that discharges from the springs monitored in the ETTP area originates mostly from shallow flow systems, the flow rates and dissolved contaminant concentrations are highly variable. For this reason no contaminant trend direction can be confidently assigned to the spring data.

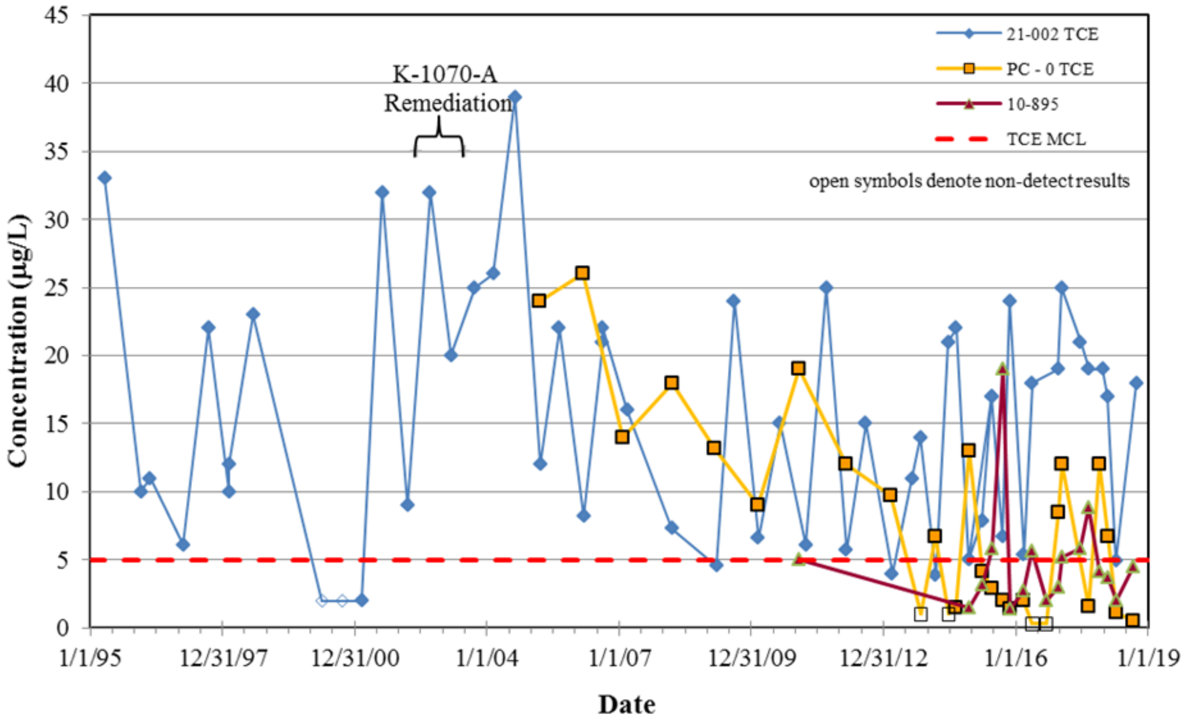


Figure 3.37. TCE concentrations in selected East Tennessee Technology Park area springs

K-770 area

Exit pathway groundwater monitoring is also conducted at the K-770 area, where Wells UNW-013 and UNW-015 are used to assess radiological groundwater contamination along the Clinch River (see earlier Figure 3.35). Alpha activity measured in samples from Well UNW-015 within the past 10 years have exceeded the 15 pCi/L MCL. Although the maximum measured alpha activities in Well UNW-015 appear to have decreased sequentially in the 10-year, 5-year, and FY 2018 screening periods an upward trend is assigned for the most recent five years. Figure 3.38 shows the history of measured alpha activity in Wells UNW-013 and UNW-015.

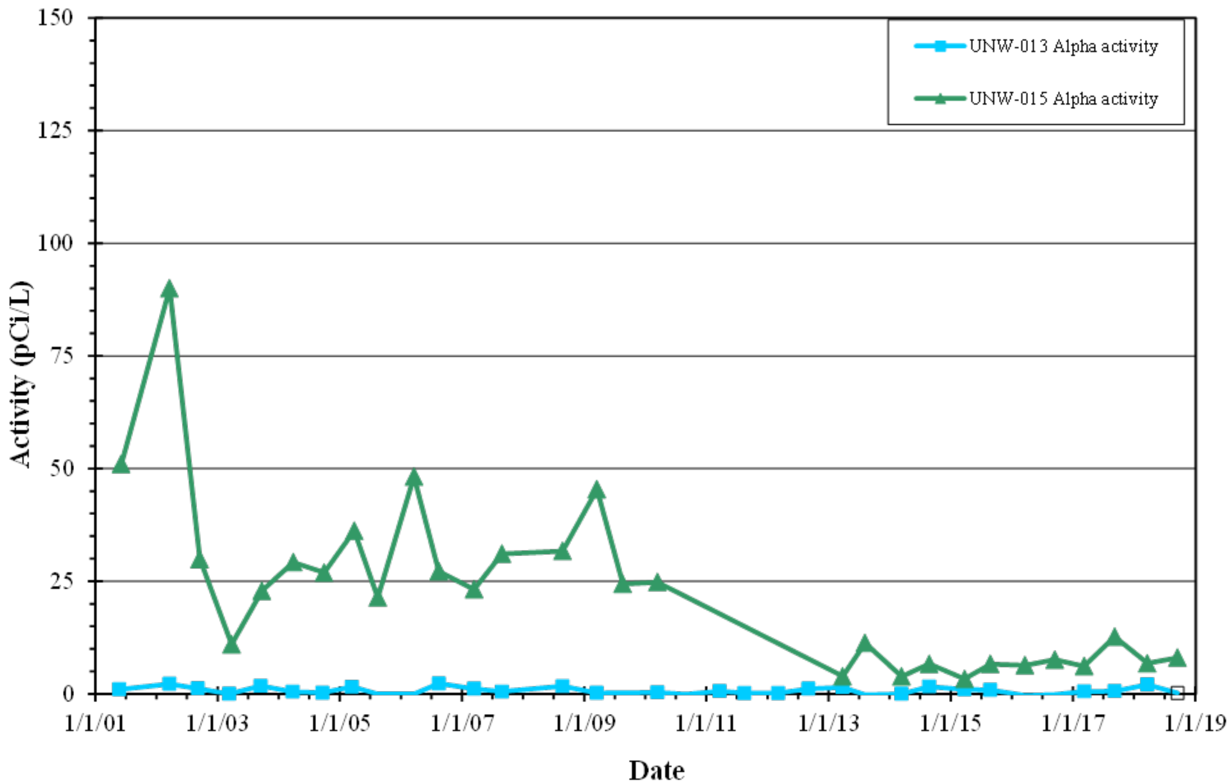


Figure 3.38. History of measured alpha and beta activity in the K-770 area

3.6.16.2 Technetium-99 in ETTP Site Groundwater

Technetium-99 is a beta particle-emitting radionuclide. There is not a specific drinking water MCL for ^{99}Tc, but its MCL-DC concentration is 900 pCi/L. Technetium-99 has been a known groundwater contaminant at the ETTP site for many years. Past CERCLA investigations have sampled and analyzed for ^{99}Tc in groundwater. In the past, the highest ^{99}Tc activity levels (as high as 6,000+ pCi/L) have been observed beneath the K-1070-A Burial Ground, where concentrations at a couple of wells remain in the 200–500 pCi/L range. The area along Mitchell Branch near the former K-1407 Ponds has residual ^{99}Tc-contaminated groundwater from the operational era of the ponds, and possibly from K-1420, with much lower activity levels (< 100 pCi/L). The K-25 building also contained some areas with elevated levels of ^{99}Tc. These areas were exposed to the environment during the demolition of the building.

The environmental fate of some metal contaminants in groundwater is strongly dependent on the pH and oxidation-reduction potential state of the water. A summary review of the environmental behavior of ^{99}Tc in the environment was published by Pacific Northwest National Laboratory (PNNL 2005; PNNL-15372) related to tank wastes at Hanford. Background information from that report is used in preparation of the following interpretation of potential ^{99}Tc mobility in groundwater at the ETTP site.

In summary, the report concluded that microbial processes often occur in very localized regions in the subsurface where chemical conditions are favorable. This fact is evident in groundwater at the ETTP site where intrinsic microbial communities are known to slowly degrade chlorinated organic compounds in some areas but not in other areas. Factors that may favor microbial reduction of dissolved compounds include relatively slow groundwater movement, which limits influx of dissolved oxygen via groundwater recharge; presence of organic carbon that can serve as electron donor material; and presence of microbes capable of affecting the required molecular transformations.

During demolition of the K-25 building east wing in the winter of 2013, fugitive dust suppression misting and rainfall carried ^{99}Tc off the work area. Contaminated runoff apparently percolated through soil and into subsurface utility lines and probably into backfill surrounding the buried utilities. Groundwater sampling for ^{99}Tc was increased in wells in the general vicinity of the east wing and where wells were available along potential groundwater transport pathways.

Investigations conducted to understand the movement of ^{99}Tc away from the K-25 building east wing area documented that contamination entered and traveled through the sanitary sewer and the storm drain that discharges to the K-1007-P1 Holding Pond and that the amount of ^{99}Tc transport in backfill outside those pipes was minimal. The investigation also found that ^{99}Tc transport through the abandoned underground electrical duct bank was an important transport pathway along the east side of the K-25 building, as far south as duct bank manhole row 21. RAs conducted in Zone 1 included plugging the duct bank manholes with cement grout from row 21 to the south and west to the former steam plant located near the Clinch River in the K-770 Area. To minimize the remaining available transport flow path, 38 additional manholes in Zone 2 were grouted starting with manhole row 22, moving northward all the way through the demolition area and beyond.

Consistent with requirements of the ETTP Zone 2 ROD for soil cleanup, ^{99}Tc contaminated soils beneath the K-25 building east wing slab are being excavated to protect groundwater from further contamination. The ^{99}Tc plume extent shown on Figure 3.39 is based on current data and understanding of areas where ^{99}Tc exceeds the 900 pCi/L MCL-DC. Most of the area where the ^{99}Tc MCL is exceeded lies beneath, or very near, the source area at the K-25 east wing.

During FY 2018, groundwater was analyzed by the Water Resources Restoration Program (WRRP) for ^{99}Tc in samples from 49 wells and two springs across the ETTP area. Figure 3.39 shows the resulting maximum FY 2018 ^{99}Tc concentration ranges in groundwater. Technetium-99 concentrations have decreased significantly in the area along the inactive electrical duct bank as the ^{99}Tc contamination either disperses or is attenuated through geochemical adsorption or other attenuation processes.

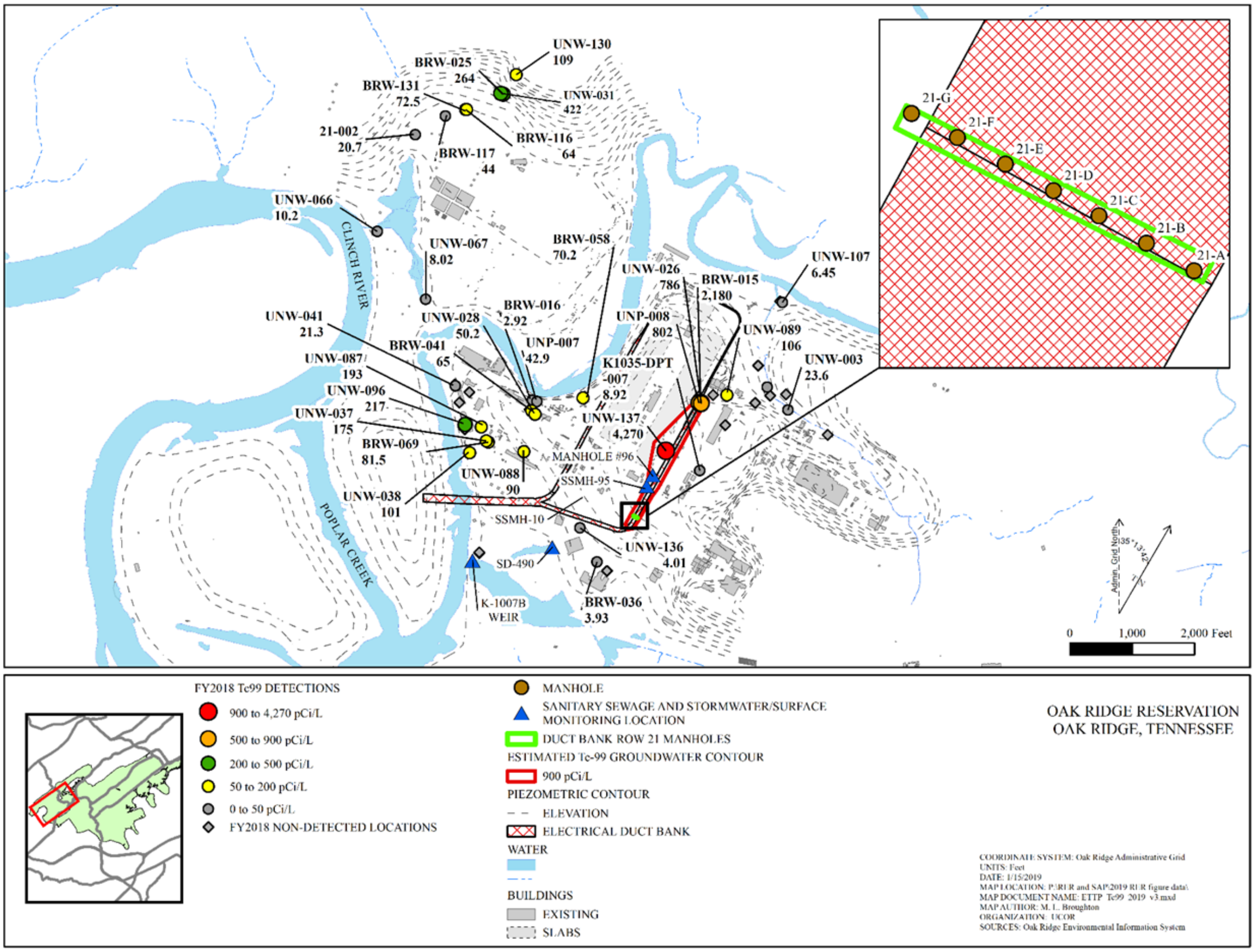


Figure 3.39. Sample locations and maximum detected ^{99}Tc in ETTP groundwater

3.7 Biological Monitoring

The ETTP BMAP consists of two tasks designed to evaluate the effects of ETTP legacy operations on the local environment, identify areas where abatement measures would be most effective, and test the efficacy of the measures. The results from this program will support future CERCLA cleanup actions. These tasks are (1) bioaccumulation studies, and (2) instream monitoring of biological communities. Figure 3.40 shows the major water bodies at ETTP and Figure 3.41 shows the BMAP monitoring locations along Mitchell Branch.

3.7.1 Bioaccumulation Studies

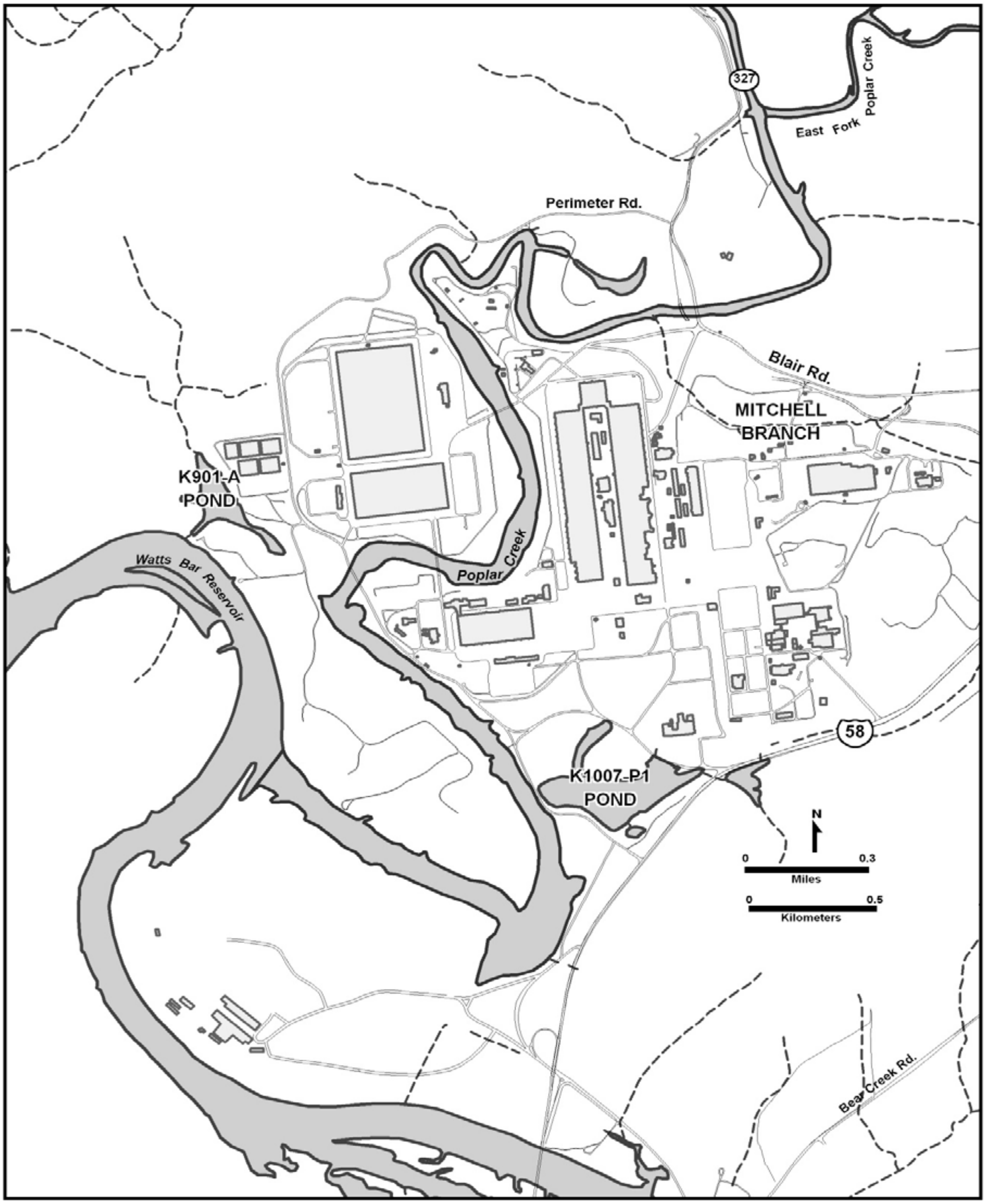
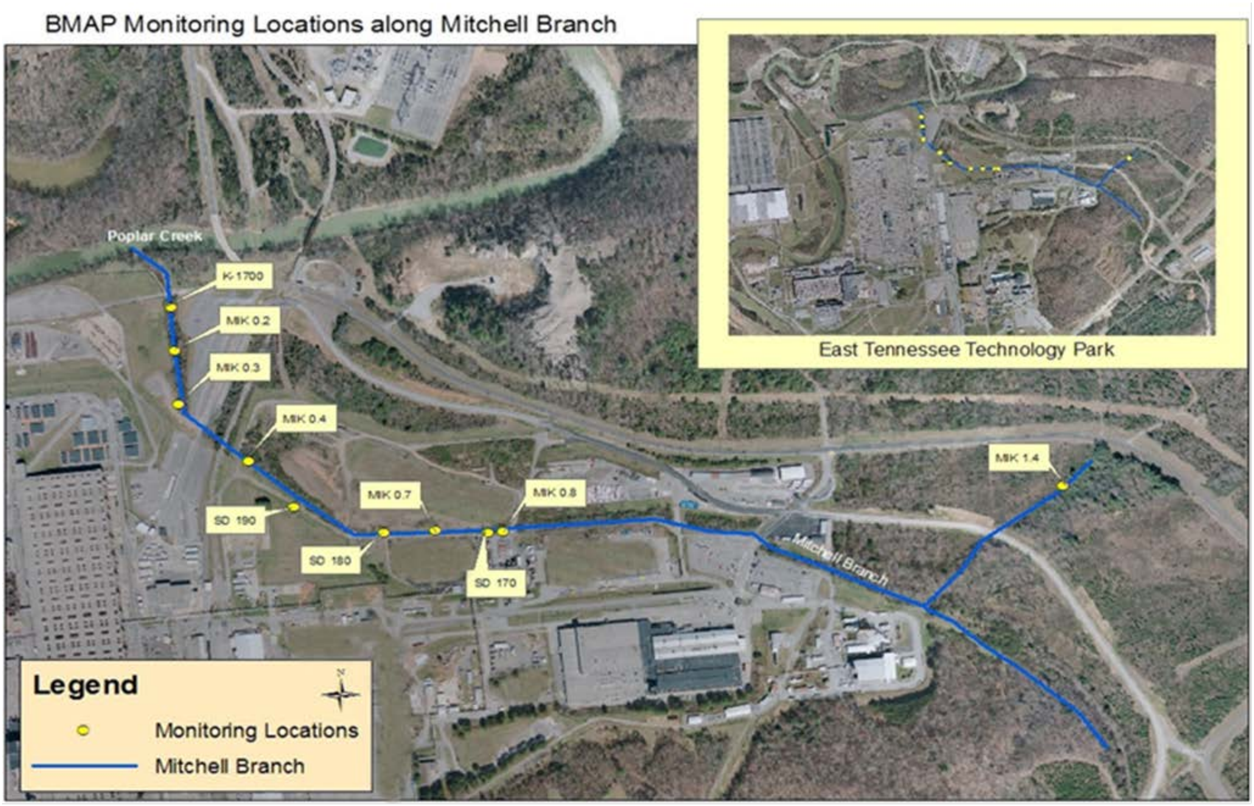


Figure 3.40. Water bodies at the East Tennessee Technology Park



BMAP = Biological Monitoring and Abatement Program
MIK = Mitchell Branch kilometer
SD = storm drain/storm water outfall

Figure 3.41. Major storm water outfalls and biological monitoring locations on Mitchell Branch

3.7.2 Task 1: Bioaccumulation Monitoring

Bioaccumulation monitoring for the ETTP BMAP has focused on evaluating the impact of polychlorinated biphenyl (PCB) discharges into the environment because of historical operations at the ETTP complex. It was previously assumed that mercury (Hg) flux into Poplar Creek and the Clinch River originated largely from Y-12 Complex discharges into East Fork Poplar Creek (EFPC). However, more recently monitoring has shown that water in ETTP storm drains and biota from lower Mitchell Branch have elevated mercury concentrations. Mercury bioaccumulation monitoring is routinely conducted in the watersheds adjacent to ETTP by the Y-12 and ORNL BMAPs, both on and off the Oak Ridge Reservation (ORR). The available Hg bioaccumulation monitoring data will be presented in the following subsections with long-term trends in PCB contamination in resident fish and caged clams from ETTP waters. Recent tabular results were provided in the FY 2018 ETTP BMAP Report.

Because the consumption of contaminated fish represents the largest dose of Hg and many other bioaccumulative contaminants to humans, fish fillet concentrations are relevant to assessing human health risks, whereas whole body fish are relevant to assessing ecological risks. Largemouth bass (*Micropterus salmoides*) and various sunfish species are used to monitor Hg and PCB fillet concentrations, and gizzard shad (*Dorosoma cepedianum*) and bluegill (*Lepomis macrochirus*) are used to monitor whole body concentrations at various locations over time. Largemouth bass are larger, upper trophic level predatory fish and are, therefore, susceptible to Hg and PCB bioaccumulation. Fillet concentrations in these fish represent the near maximum potential dose to humans, if eaten. Largemouth bass tend to live in larger, deeper pools of water and are collected in the ponds at ETTP (K-1007-P1 Pond, K-901-A Pond, and K-720 Slough) as well as in offsite river and reservoir locations. Sunfish are short-lived and have small home ranges, so fillet Hg and PCB concentrations in these fish are representative of exposure at the site of collection. These fish are used in long-term studies to monitor changes in bioaccumulation at a given site over time. Collections of sunfish are restricted to sizes large enough to be taken by sport anglers (generally 50–150 g total weight) to minimize effects of covariance between size and contaminant concentrations, as well as for spatial and temporal comparability. The target sunfish species for bioaccumulation studies in Mitchell Branch and other ORR stream sites is redbreast sunfish (*Lepomis auritus*), but where these fish are not present, other species with similar feeding habits (e.g., bluegill sunfish [*Lepomis macrochirus*]) are collected.

For bioaccumulative contaminants such as Hg and PCBs, US fish bioaccumulation data have become important measures of compliance for both the Clean Water Act and the Comprehensive Environmental Response, Compensation, and Liability Act. For Hg, the US Environmental Protection Agency's (EPA's) National Recommended Water Quality Criterion for Hg in fish (0.3 µg/g) is used as the trigger point for fish consumption advisories in Tennessee, the target concentration for National Pollutant Discharge Elimination System permit compliance, and the threshold for impairment designations that require a Total Maximum Daily Load (TMDL) assessment. In addition to fish Hg limits, the State of Tennessee continues to use the statewide Ambient Water Quality Criterion (AWQC) for Hg of 51 ng/L in water, based on organisms only, and 50 ng/L for recreation-water and organisms (Tennessee Department of Environment and Conservation 2013). Regulatory guidance and human health risk levels have varied more widely for PCBs, depending on the regulatory program and the assumptions used in the risk analysis. The Tennessee water quality criteria for individual Aroclors and total PCBs are both 0.00064 µg/L under the recreation designated use classification and are the target for PCB-focused TMDLs, including for local reservoirs (Melton Hill, Watts Bar, and Fort Loudon) (Tennessee Department of Environment and Conservation 2010a, 2010b, 2010c). However, most conventional PCB water analyses have detection limits much higher than the PCB AWQC. Therefore, in Tennessee and in many other states, assessments of impairment for water body segments as well as public fishing advisories for PCBs are based on fish tissue concentrations. Historically, the US Food and Drug Administration threshold limit of 2 µg/g in fish fillet was used for PCB advisories; then for many years in Tennessee, an approximate range of 0.8 to 1 µg/g was used, depending on the data available and factors such as the fish species and size. The remediation goal for fish fillet at the ETTP K-1007-P1 Pond is 1 µg/g. Most recently, the water quality criterion has been used by the Tennessee Department of Environment and Conservation (TDEC) to calculate the fish tissue concentration triggering a determination of impairment and a TMDL, and this concentration is 0.02 µg/g in fish fillet (Tennessee Department of Environment and Conservation 2010a, 2010b, 2010c). The fish PCB concentrations at and near ETTP are well above this most conservative concentration.

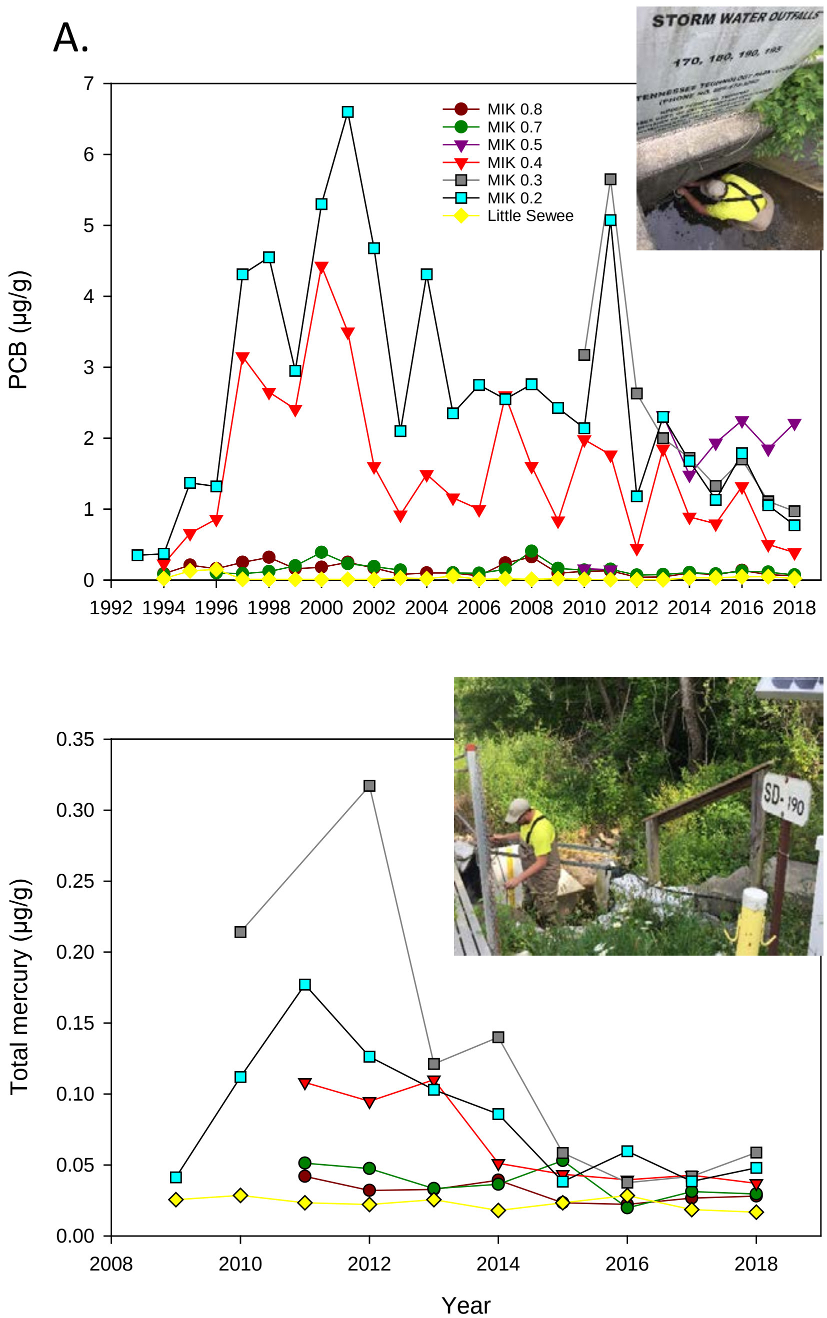
In addition to monitoring for human health and ecological risks as well as long-term trends, bioaccumulation monitoring also includes investigations of sources of contamination to ETTP waterways. Caged Asiatic clams (*Corbicula fluminea*) are used as bioindicators of contaminant sources in Mitchell Branch and other sites around ETTP. These clams are collected from an uncontaminated reference site (Little Sewee Creek in Sweetwater, Meigs County, Tennessee) and are divided into groups of 10 clams of equal mass. In 2018, clams were placed in baskets to be deployed at strategic locations around ETTP (i.e., in and around storm drains) for a 4 week exposure period (May 10-June 7, 2018). Two clam baskets were placed at each site with 10 clams in each basket.

Because these animals are sedentary filter feeders, they accumulate contaminants that are present in the water and in suspended particles at a given site. They are useful indicators of the bioavailable (and therefore potentially toxic) portion of contaminants that enter the environment at a given location, and they provide spatial resolution of contamination on a finer scale than is possible with fish bioaccumulation studies. Caged clams have been used for more than 20 years to evaluate the importance of storm drains and other inputs of PCBs into the waterways around ETTP and for the past 10 years to monitor total mercury (Hg_T) and methylmercury (MeHg) inputs to Mitchell Branch. Whereas most of the Hg in the environment is inorganic mercury (Hg^{2+}), a small fraction of Hg^{2+} is converted to the more toxic and bioaccumulative MeHg. Because MeHg biomagnifies in aquatic systems, increasing in concentration as it moves up through the food chain, more than 90 percent of the Hg in upper trophic level fish is MeHg. Clams, which feed on periphyton and detritus at the base of the food chain, have a much smaller proportion of MeHg in their tissues but are still good indicators of MeHg hotspots and sources. The soft tissues of the clams from each cage were homogenized, and aliquots were taken for PCB and Hg analysis.

To assess spatial and temporal variability in exposure to PCBs following remediation activities, water samples have been collected for analysis of aqueous PCBs and total suspended solids (TSS) from the outfall of K-1007-P1 and an uncontaminated reference site (upper First Creek, ORNL). Samples from K-1007-P1 are collected four times each year (March, June, July, and August) and twice each year from First Creek (June and August). In 2018, a water sample was also collected from storm drain 100, to evaluate PCB inputs into the K-1007-P1 Pond. For PCBs, 2 L of water are collected in certified clean 1-L amber glass bottles and held in a secure refrigerator until delivery to a subcontract laboratory for analysis of 209 congeners using US EPA method 1668. TSS samples are collected concurrently with PCB samples in clean 1-L Nalgene bottles and processed at ORNL the same day.

Mitchell Branch

Figure 3.42 shows long-term monitoring results in caged clams at various sites in Mitchell Branch. The lower portion of this stream (MIK 0.5, SD 190, MIK 0.2) has historically been a “hot spot” for both Hg and PCB contamination, and in 2018 PCB concentrations continued to be elevated (~1–2 µg/g) with respect to other Mitchell Branch and reference sites with concentrations remaining comparable to those seen in recent years. Although there is considerable interannual variability, PCB concentrations in clams placed in lower Mitchell Branch appear to be generally trending downward since peak years in 2000-2001. While there was a slight bump up in PCB concentrations at Mitchell Branch sites in 2016, concentrations since then have dropped back down, continuing the overall decreasing trend. The only exception to this recent trend was a slight increase at MIK 0.5 in 2018 (from 1.8 to 2.2 µg/g). PCB concentrations in the upper portion of Mitchell Branch were similar to previous years’ concentrations and were slightly elevated (0.08 µg/g) with respect to the reference site (0.05 µg/g). PCB concentrations in clams deployed in two skimmers serving the storm drain (SD) 600 and 510 networks, K-897-D and K-897-E (respectively), were comparable to, or slightly elevated (0.01 and 0.20 µg/g, respectively) with respect to the reference site.



MIK = Mitchell Branch kilometer

Notes:

1. N = 2 composites of 10 clams each per year.
2. Shown in yellow are data for clams collected from the reference site, Little Sewee Creek (Sweetwater, Tennessee).
3. Figure A shows total PCBs defined as the sum of Aroclors 1248, 1254, and 1260.

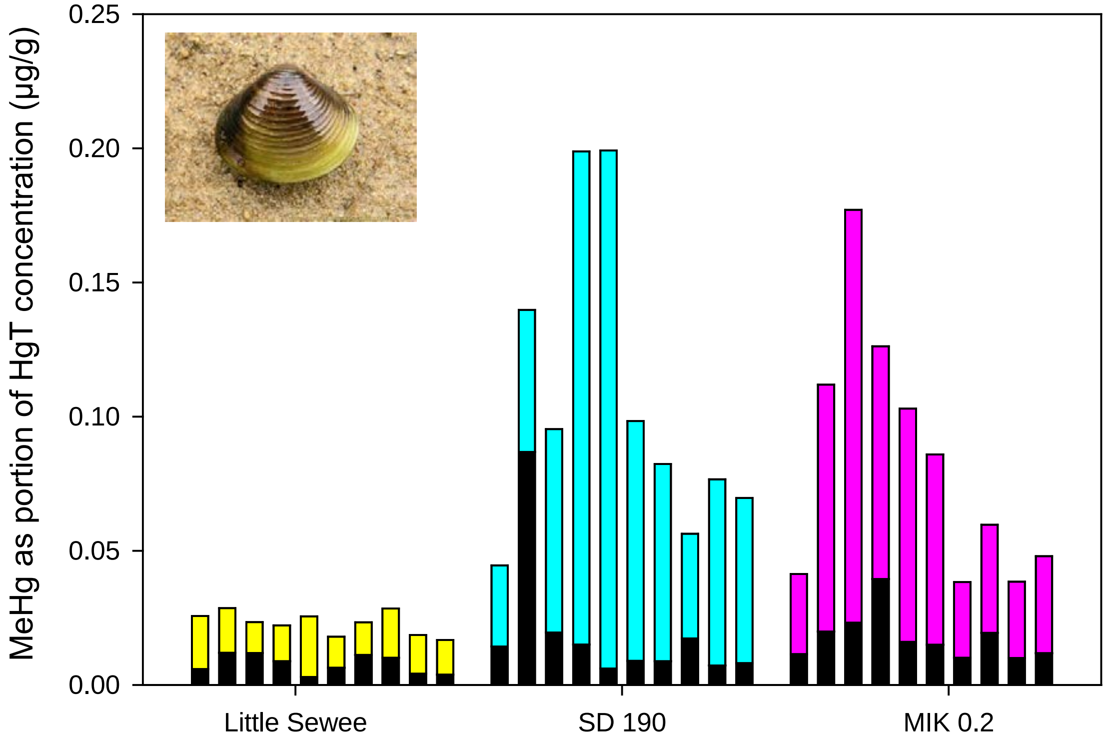
Figure 3.42. Mean total polychlorinated biphenyl (PCB) (A; µg/g, wet wt; 1993–2018) and mercury (B; µg/g wet wt; 2009–2018) concentrations in the soft tissues of caged Asiatic clams deployed in Mitchell Branch

Surface water monitoring conducted by various programs (e.g., ETTP Compliance, WRRP) has shown that aqueous Hg concentrations in Mitchell Branch fluctuate significantly, with concentrations often exceeding the AWQC. This level of variability is typical of stream systems because aqueous Hg concentrations can change with various environmental factors (e.g., flow, suspended solids, etc.) as well as with sample collection methods. Variation in aqueous Hg concentrations is not uncommon and illustrates that aqueous concentrations in a grab sample taken on a certain day reflect a snapshot of the conditions during that sampling period. Research at ORNL has found changes in aqueous Hg concentrations between day and night, for example. In addition, the relationship between aqueous Hg concentrations and MeHg concentrations is not a straightforward one, leading to further complexities with respect to Hg bioaccumulation. Although monitoring aqueous concentrations is still indicative of gauging the relative importance of different Hg sources to a given watershed, bioaccumulation data are informative in that they reflect an integrative measure of the bioavailable portion of Hg exposure at a given site. Monitoring MeHg concentrations in clams is illustrative in that they highlight the complexity of Hg bioaccumulation—whereas Hg_T concentrations in clams varied greatly between sites, MeHg concentrations in Mitchell Branch were elevated with respect to the reference site but did not vary as much as total Hg between sites or between years.

Mercury concentrations in clams deployed in Mitchell Branch in 2018 were similar to concentrations seen in 2017. Concentrations were only slightly higher than the reference site throughout Mitchell Branch in 2018. Mercury concentrations in clams deployed at the K-1007-P1 and K-901-A ponds were again comparable to reference site concentrations. Within the Mitchell Branch system, the highest Hg concentrations were seen in clams deployed at SD 180 (0.12 μg/g), and SD 190 (0.07 μg/g). Clams deployed at two skimmers serving the SD 510 network, K897-D and K-897-E, had Hg concentrations similar to those of the reference site. Unlike in fish tissue, MeHg generally makes up a small proportion of Hg_T found in soft tissues of clams (Figure 3.43). Although MeHg concentrations in clams remained low in 2018, they were either comparable to or slightly higher than concentrations in 2017.

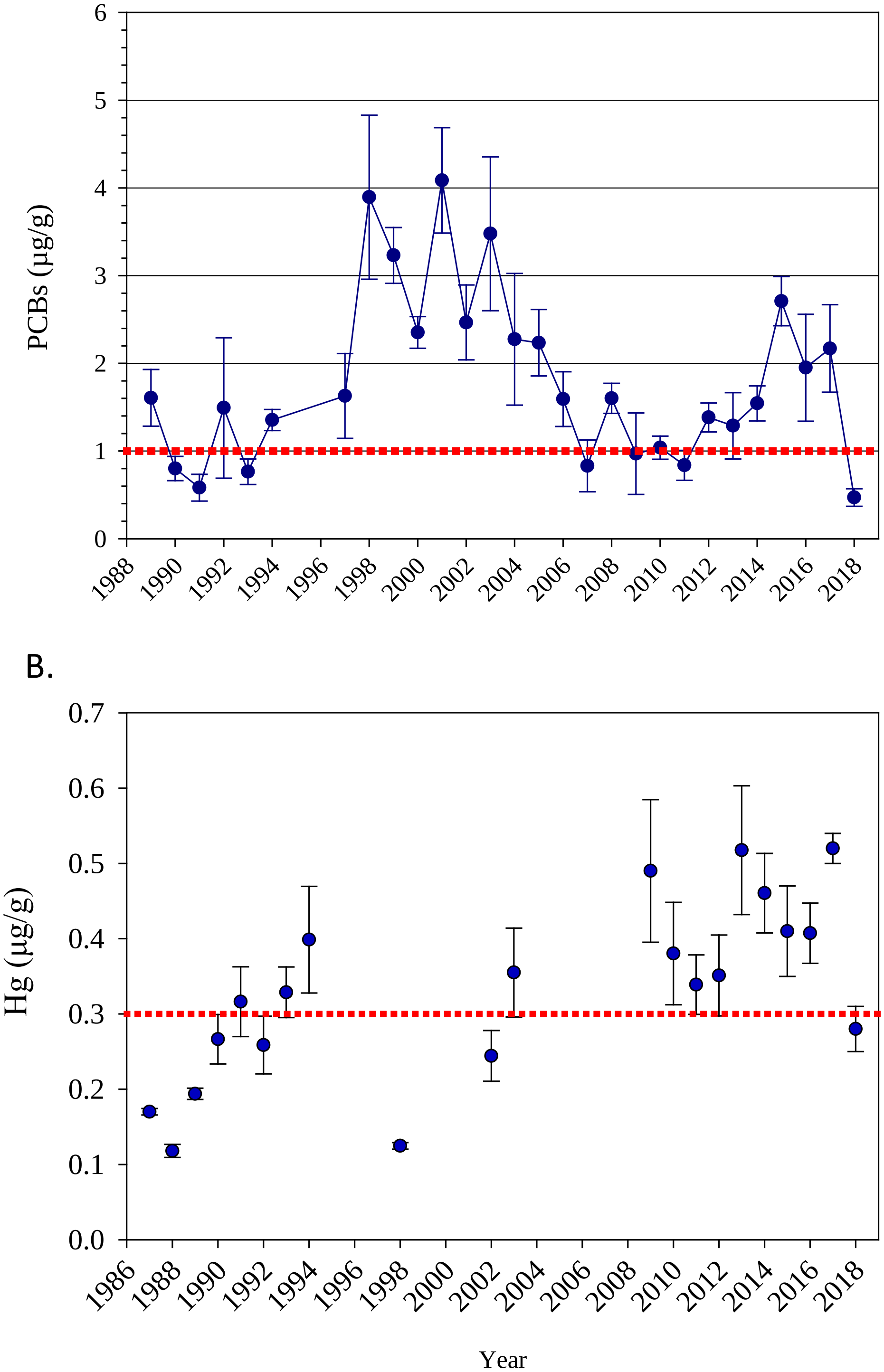
Figure 3.44 shows long-term monitoring results in redbreast sunfish (*Lepomis auritus*) at MIK 0.2. Average PCB concentrations in fish collected at MIK 0.2 in 2018 (0.48 ± 0.10 μg/g) were significantly lower than those seen in 2017 (2.17 ± 0.50 μg/g) and were among the lowest concentrations reported for the past 30 years at this site (Figure 3.44A). Although there is not a regulatory limit for PCBs in fish, the level most often used in practice to issue fish consumption advisories in the state of Tennessee, as previously stated, is 1 μg/g. In 2018, the mean PCB concentration in sunfish fillets was below this limit. While the observed fish tissue concentrations in Mitchell Branch are lower than they have historically been, they are still 2-3 orders of magnitude higher than concentrations seen in the same species at the Hinds Creek reference site.

Total mercury has been monitored more sporadically in redbreast sunfish fillets at MIK 0.2. Figure 3.44B shows long-term trends in Hg_T concentrations (μg/g) in these fish. A rapid increase in fillet Hg_T concentrations was observed in the early 1990s and generally remained elevated, with mean concentrations exceeding the AWQC (0.3 μg/g) in most years. Similar to the PCB concentrations in fish from this site, Hg_T concentrations at MIK 0.2 have been oscillating around the EPA's recommended AWQC for the past several years. Similar to the trends seen for PCBs, mean mercury concentrations in redbreast at this site decreased significantly, dropping slightly below the criterion in 2018, averaging 0.28 ± 0.03 μg/g.



SD = storm drain
MIK = Mitchell Branch kilometer
Notes:
1. N = 2 composites of 10 clams each per year.
2. Shown in yellow are data for clams collected from the reference site, Little Sewee Creek (Sweetwater, Tennessee).
3. Black bars denote MeHg concentrations, where the total height of bars (color and black band) represents Hg_T concentration.

Figure 3.43. Methylmercury (MeHg) as a portion of total mercury (Hg_T) concentrations in the soft tissues of caged Asiatic clams deployed in Mitchell Branch (µg/g wet wt; 2009–2018)



Notes:
1. 1989–2018, N = 6 fish per year.
2. Shown in red is the fish advisory level for PCBs (1 µg/g) and mercury (0.3 µg/g).
3. The photograph shows fish electrofishing activities in lower Mitchell Branch.

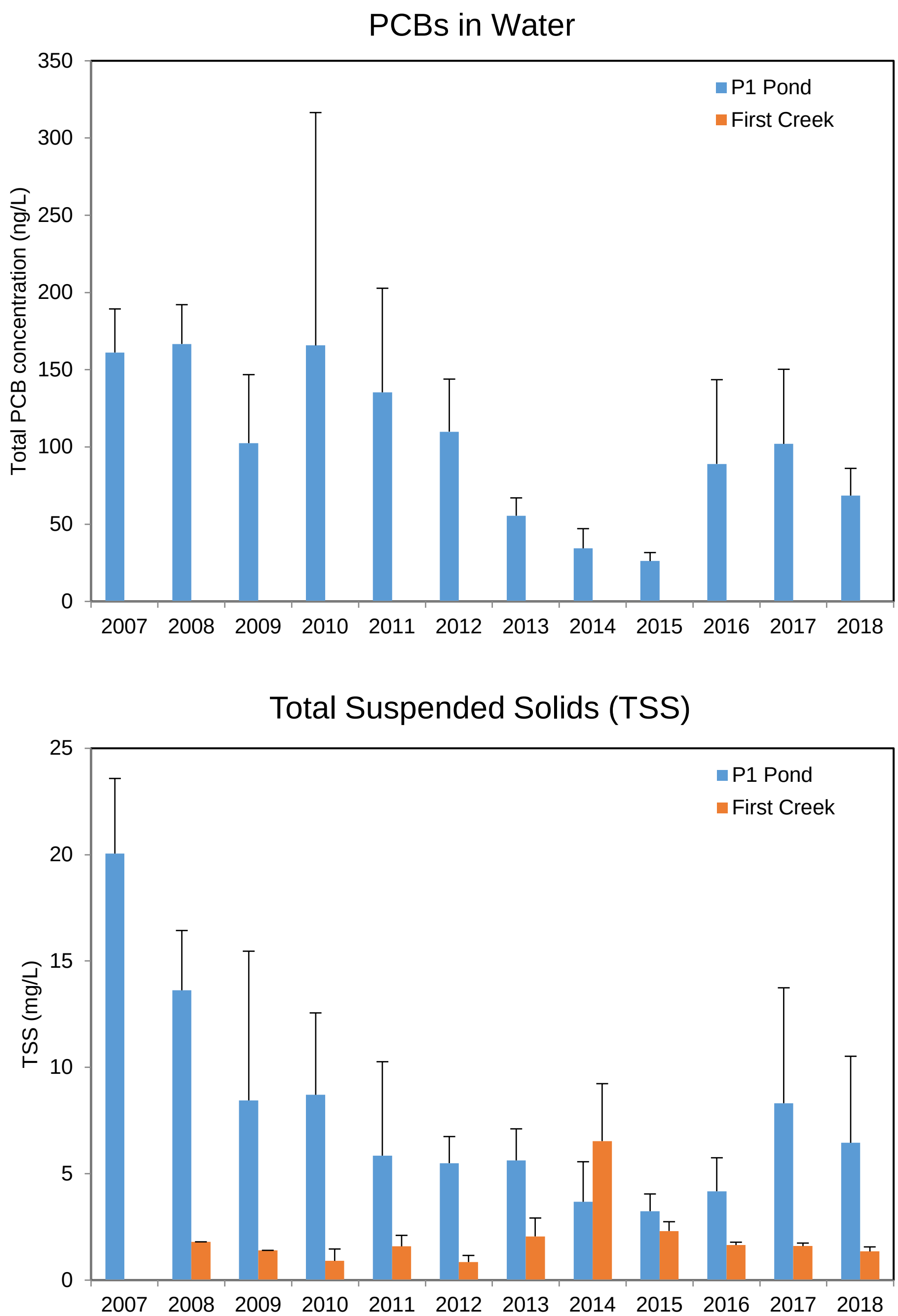
Figure 3.44. Mean polychlorinated biphenyl (PCB; A) and mercury (Hg; B) concentrations (µg/g, wet wt) in redbreast sunfish fillets in Mitchell Branch (MIK 0.2)

K-1007-P1 Pond

Aqueous PCB concentrations in the K-1007-P1 Pond have fluctuated significantly over the past decade, but have generally been lower (68 ng/L in 2018) than concentrations seen prior to 2009 remediation activities (e.g. 161 ng/L in 2007) (Figure 3.45). While concentrations decreased steadily from 2010 to a low of 26 ng/L in 2015, they have been higher the past 3 years. PCBs tend to be particle associated. Aqueous PCB concentrations are correlated with total suspended solids, with increases in TSS seen over the past three years when increases in PCBs were observed. The increase in PCB and TSS concentrations in water in since 2016 could be related to a reduction in rooted plants in the pond, leading to less stability in sediment. Another possibility is that increases in PCBs could also be due, in whole or in part, to increased aqueous PCB inputs from SD100.

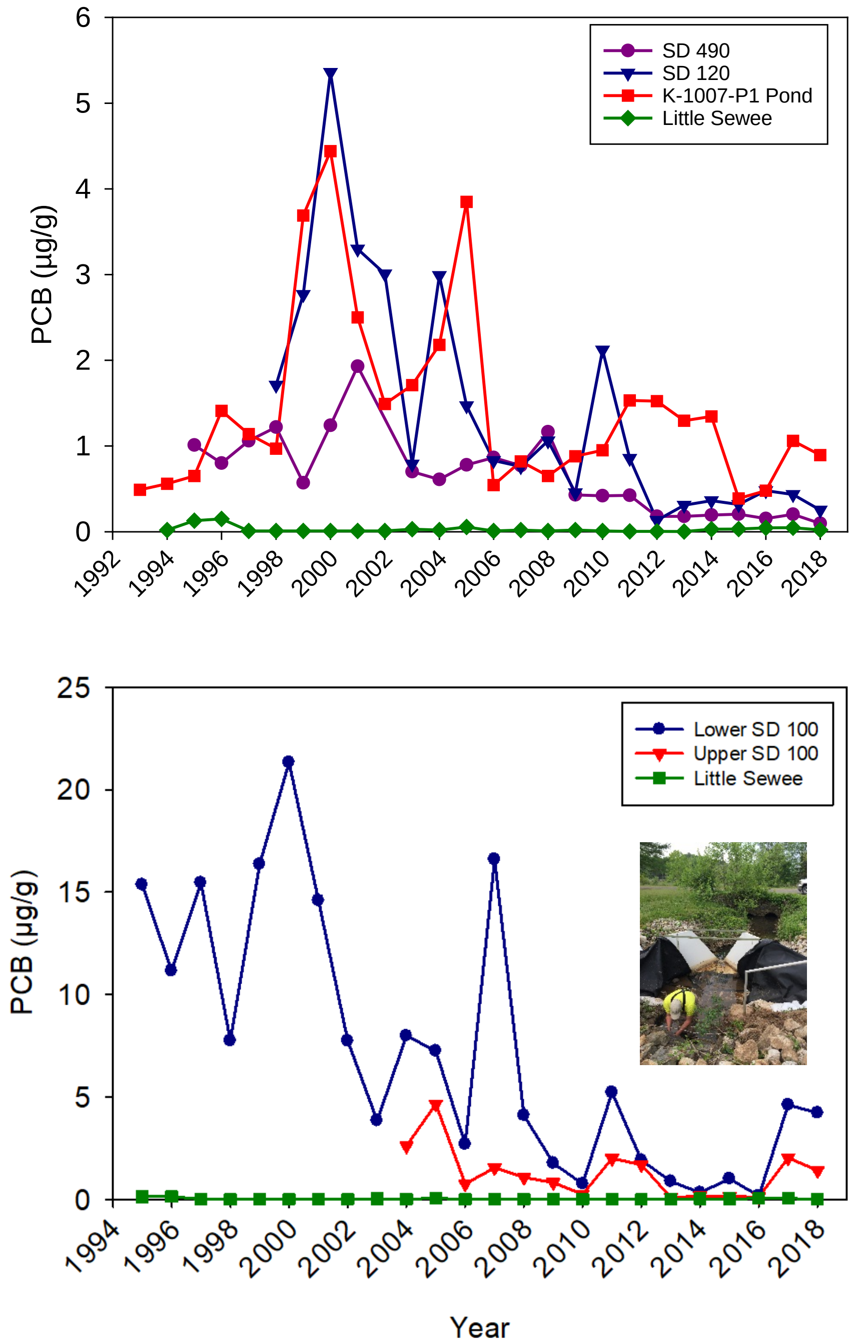
PCB concentrations in clams placed at lower and upper SD-100 locations have fluctuated significantly since remediation actions in 2009, and were on an overall decreasing trajectory until the significant increases seen in 2017 and 2018 (Figure 3.46). PCB concentrations in clams placed at the K-1007-P1 outfall were also higher the past two years, but were comparable to concentrations seen just after remediation actions in this pond (Figure 3.46).

Similar trends have been observed in fish tissue PCB concentrations in the K-1007-P1 Pond. Since 2009, the target species for bioaccumulation monitoring in the K-1007-P1 Pond has been bluegill sunfish (*Lepomis macrochirus*). As in previous years, fillets from 20 individual bluegill and six whole body composites (10 bluegill per composite) from the K-1007-P1 Pond were analyzed for PCBs in 2018 to assess the ecological and human health risks associated with PCB contamination in this pond. Average PCB concentrations in fish fillets and whole body composites have decreased significantly over the past 10 years since remediation activities, with significant fluctuations. Concentrations were lowest in the 2013-2015 time period, but have slightly increased over the past three years. The mean concentration in whole body composites of bluegill collected from the K-1007-P1 Holding Pond was significantly higher in 2018 (4.00 µg/g) than in 2017 (2.58 µg/g), this concentration is still below whole body concentrations seen at the time of pre-remediation activities at this site (>5 µg/g) (Table 3.23, Figures 3.47 and 3.48). The mean concentration (1.21 µg/g) in bluegill fillets in 2018 increased above the remediation goal of 1 µg/g after a falling below this level in 2017. The interannual fluctuations in PCB concentrations could be due to water quality changes that have taken place in this pond, (e.g. higher TSS, PCB inputs; Figures 3.47 and 3.48). The observed fluctuations in PCB concentrations seen in biota suggest that this system is still in transition and that as the fish and plant communities stabilize, further decreases in PCB bioaccumulation may become apparent.



Notes:
1. Means for PCBs in water and TSS are based on results across all collections made each year.
2. Note that mean concentrations of PCBs in water from First Creek were <0.3 ng/L in all years.

Figure 3.45. Means (± standard deviation) for total polychlorinated biphenyl (PCB) concentrations in water (top) and total suspended solids (TSS; bottom), 2007–2018

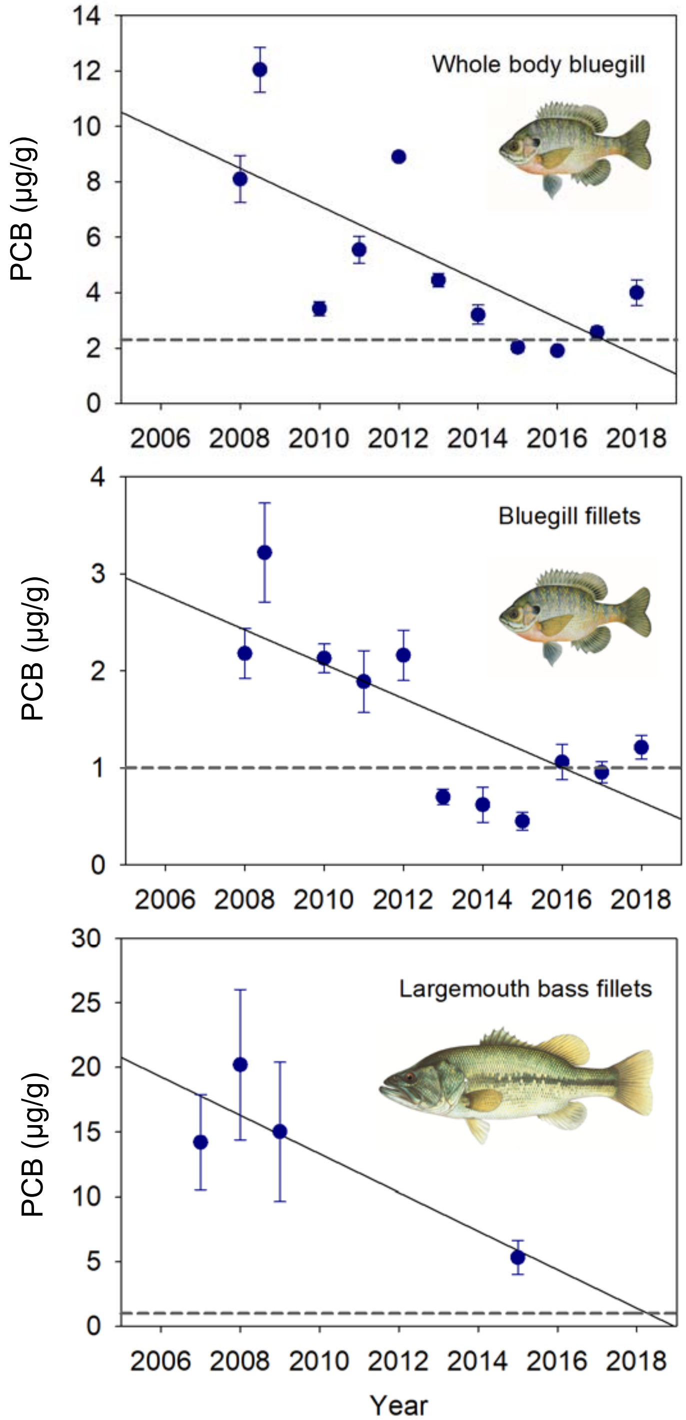


SD = storm drain

Notes:

1. N = 2 clam composite samples per site/year.
2. Total PCBs defined as the sum of Aroclors 1248, 1254, and 1260.
3. Photos upper graph show a clam basket in a storm drain, and Little Sewee Creek, lower graph photos show placement of clam cages in Upper SD-100 (upper photo) and Lower SD-100 locations.

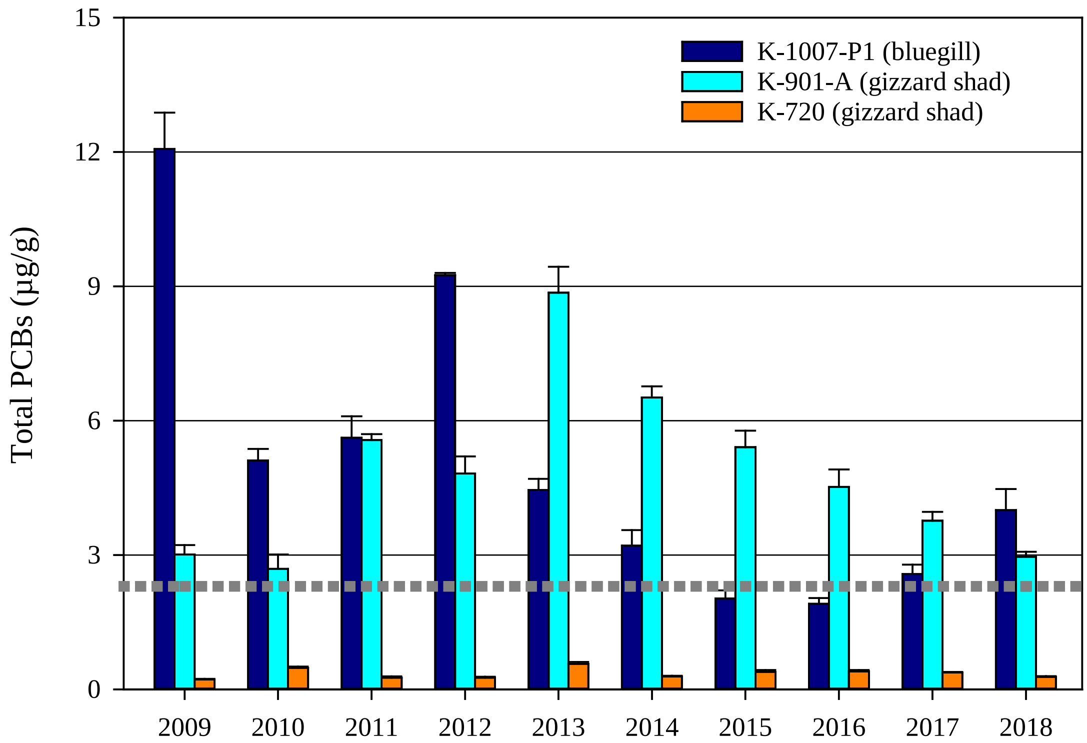
Figure 3.46. Mean total polychlorinated biphenyl (PCB) concentrations (µg/g, wet wt) in caged clams placed at K-1007-P1 outfalls compared with reference stream clams (Little Sewee Creek), 1993–2018



Notes:

1. For largemouth bass, N = 6 fish per site/year. For bluegill sunfish, N = 20 for fillets and N = 6 composites of 10 whole body fish.
2. The target for fillet (1 µg/g) and whole body concentrations (2.3 µg/g) is shown with the gray dotted lines.

Figure 3.47. Mean polychlorinated biphenyl (PCB) concentrations (µg/g, wet wt) in fish from the K-1007-P1 Pond, 2007–2018



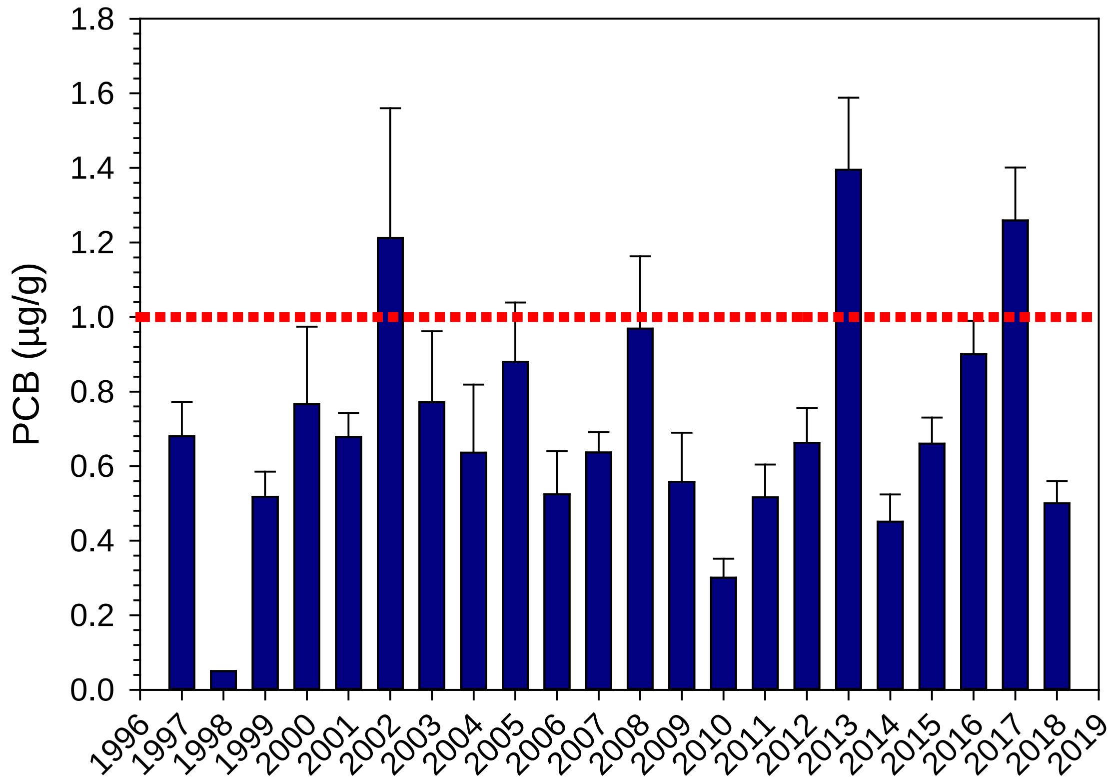
Notes:
1. Total PCBs are defined as the sum of Aroclors 1248, 1254, and 1260.
2. The dotted line signifies the target PCB concentration of 2.3 µg/g in whole body fish.

Figure 3.48. Mean (+ 1 standard error) total polychlorinated biphenyl (PCB) concentrations (µg/g, wet wt) in whole body fish from K-1007-P1 Pond, K-901-A Holding Pond, and K-720 Slough, 2009–2018

K-901-A Pond

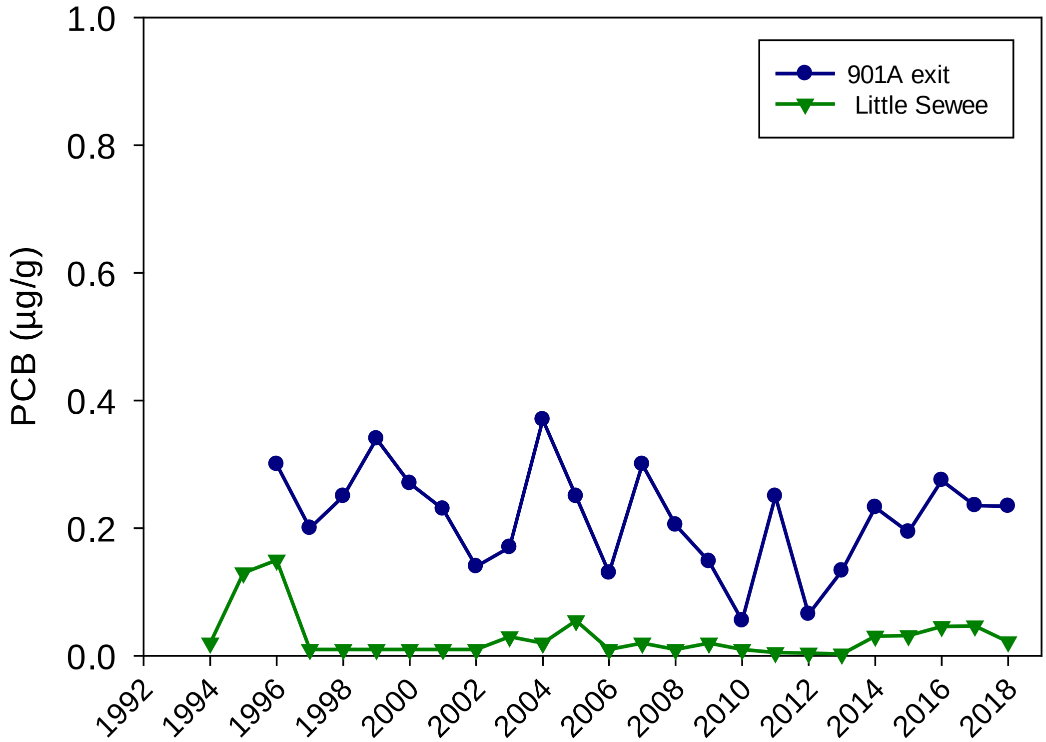
The target fish species for analysis of PCBs in the K-901-A Holding Pond and K-720 Slough were gizzard shad (*Dorosoma cepedianum*) and largemouth bass (*Micropterus salmoides*). It was not possible to collect the target number of 20 bass from each body of water, so common carp (*Cyprinus carpio*) also were collected to provide a combined total of 20 fish. Carp were selected as a surrogate species for bass because they are widely distributed, are present at both locations, and have been used historically in other monitoring efforts on the ORR for contaminant analyses.

At the K-901-A Holding Pond, mean PCB concentrations in largemouth bass fillets in 2018 were significantly lower (0.50 µg/g) than those in 2017 (1.26 µg/g) and in other recent years, and were below the target level of 1 µg/g for fillet concentrations at the K-1007-P1 Pond (Figure 3.49). The average concentrations of PCBs in carp fillets in this pond were similar in 2018 (1.31 µg/g) to 2017 (1.28 µg/g), as were concentrations in clams deployed in this pond (Figure 3.50).



SE = standard error
Notes:
1. Mean PCBs (± 1 SE) in largemouth bass fillets, 1993–2017 (µg/g).
2. N = 6 fish per year, when possible.
3. The dotted red line shows the advisory level for PCBs in fish fillets (1 µg/g).

Figure 3.49. Mean total polychlorinated biphenyl (PCB) concentrations in largemouth bass from the K-901-A Pond

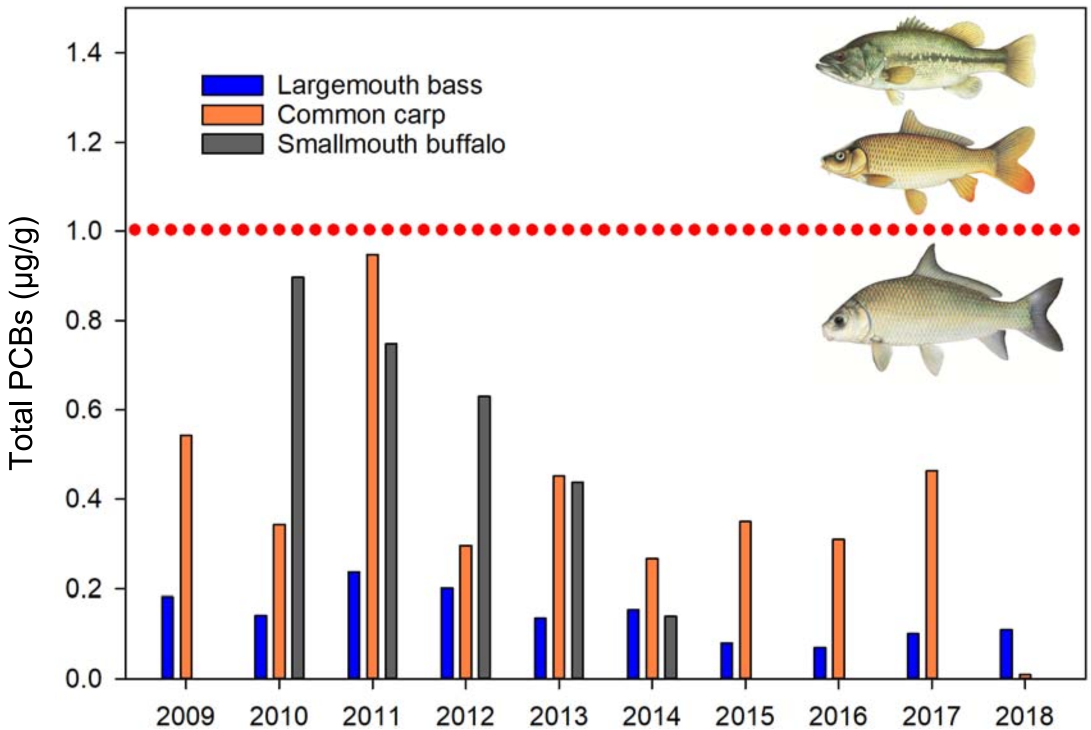


Notes:
1. Total PCBs defined as the sum of Aroclors 1248, 1254, and 1260.
2. N = 2 composites of 10 clams each per year.
3. Shown in green are data for clams collected from the reference site, Little Sewee Creek (Sweetwater, Tennessee).

Figure 3.50. Mean total polychlorinated biphenyl (PCB; µg/g, wet wt; 1993–2018) concentrations in the soft tissues of caged Asiatic clams deployed in the K-901-A Pond for a 4 week period

K-720 Slough

Routine bioaccumulation monitoring in the K-720 Slough began in 2009. Although the target species for fish fillet monitoring in this slough is largemouth bass, as in the K-901-A Pond it has been difficult to collect a full sample of 20 fish of this species; to complete the collection, common carp also are collected for a total of 20 fish. Figure 3.51 shows the temporal trends in fish fillet concentrations in the slough. In 2018, PCB concentrations in both fish species monitored were below the state advisory limit of 1 µg/g. In all cases PCB levels in fish collected from the K-720 Slough were significantly lower than in the K-901-A Holding Pond for the same species (Table 3.23). PCB concentrations in largemouth bass collected from the K-720 Slough were significantly lower than those in the other monitored ponds, averaging 0.11 µg/g in 2018. Concentrations in carp and smallmouth buffalo collected from the slough were higher than concentrations in bass, averaging 0.51 µg/g and 0.28 µg/g, respectively. Total PCBs in whole body gizzard shad from the K-720 Slough were similar to those seen in recent years and were lower than those seen in whole body fish collected from the other monitored ponds, averaging 0.28 µg/g in 2018.



Notes:

1. Total PCBs defined as the sum of Aroclors 1248, 1254, and 1260.
2. The target sample was 20 largemouth bass, but because these fish are not abundant in the slough, carp and smallmouth buffalo were collected to complete the sample size of 20 fish.
3. Dotted red line shows the advisory level for PCBs in fish fillets (1 µg/g).

Figure 3.51. Mean total polychlorinated biphenyl (PCB; µg/g, wet wt; 2009–18) concentrations in the fillets of largemouth bass, common carp, and smallmouth buffalo collected from the K-720 Slough

Table 3.23. Average concentrations (µg/g, wet wt) of total polychlorinated biphenyl (PCBs; Aroclors 1248, 1254, and 1260) and total mercury (µg/g, wet wt) in fillets and whole-body composites of fish collected in 2018 near the East Tennessee Technology Park and Hinds Creek, a reference stream

Site	Species	Sample type	Sample size (n)	Total PCBs (mean ± SE)	Range of PCB values	No. > target[a] (PCBs)/n
K-1007-P1 Pond	Bluegill	Fillets	20	1.21 ± 0.12	0.34 – 2.49	10/20
		Whole body composites	6	4.00 ± 0.47	3.32 – 6.30	6/6
K-901-A Pond	Largemouth bass	Fillets	3	0.50 ± 0.06	0.44 - 0.61	0/3
	Common carp	Fillets	17	1.31 ± 0.20	0.44 - 2.25	11/17
	Bluegill	Fillets	20	0.48 ± 0.09	0.13 - 1.83	3/20
		Whole body composites	6	1.22 ± 0.05	0.98 - 1.43	0/6
	Gizzard shad	Whole body composites	6	2.96 ± 0.11	2.79 - 3.48	6/6
K-720 Slough	Largemouth bass	Fillets	4	0.11 ± 0.01	0.09 - 0.14	0/4
	Smallmouth buffalo	Fillets	6	0.28 ± 0.11	0.03 - 0.60	0/6
	Common carp	Fillets	12	0.51 ± 0.12	0.05 - 1.53	1/12
	Gizzard shad	Whole body composites	6	0.28 ± 0.02	0.23 – 0.33	0/6
CRM 11.0	Bluegill	Whole body composites	6	0.05 ± 0.001	0.04 - 0.05	0/6
	Gizzard shad	Whole body composites	6	0.15 ± 0.02	0.11 - 0.22	0/6
PCM 1.0	Bluegill	Whole body composites	6	0.17 ± 0.01	0.14 - 0.20	0/6
	Gizzard shad	Whole body composites	6	0.41 ± 0.03	0.33 - 0.51	0/6

CRM = Clinch River mile
No. = number
PCB = polychlorinated biphenyl
PCM = Poplar Creek mile
SE = standard error
Notes:
1. Values are mean concentrations (µg/g) ± 1 SE.
2. Each whole body composite sample is composed of 10 individual fish.
3. Also shown are the ranges of values observed for PCBs and the number of fish whose fillet PCB concentrations exceeded 1 ppm out of the total number of fish (or composites) sampled (n).

3.7.3 Task 2: Instream Benthic Macroinvertebrate Communities

Benthic macroinvertebrate communities in Mitchell Branch are sampled using ORNL and TDEC protocols (Figs. 3.52 and 3.53). Evaluation of long-term trends of macroinvertebrate communities in the stream make it possible to document the effectiveness of pollution abatement activities or remediation efforts as well as to assess the potential consequences of unanticipated events as site-wide remediation continues (e.g., chromium release into Mitchell Branch).

Figure 3.52. Emptying an invertebrate sample collected with Tennessee Department of Environment and Conservation protocols

Figure 3.53. Sampling for benthic macroinvertebrates with TDEC protocols

Benthic Macroinvertebrates

The major objectives of the benthic macroinvertebrate task are (1) to help assess the ecological condition of Mitchell Branch and (2) to evaluate changes in stream ecology associated with changes in facilities operations and remedial actions within the Mitchell Branch watershed. To meet these objectives, the condition of the benthic macroinvertebrate community of Mitchell Branch has been monitored routinely since late 1986. This summary includes results of samples collected each April from 1987 to 2018 following ORNL BMAP quantitative sampling protocols and samples collected annually (August/September) with TDEC semi-quantitative sampling protocols for estimating the Tennessee Stream Biotic Index and Habitat Biotic Index (TDEC 2011; TDEC 2017). TDEC protocol guidance was updated in August of 2017 and the most recent 2017 guidance was used for the 2018 invertebrate and habitat surveys. For both sets of protocols, four sites were assessed in Mitchell Branch— MIKs 0.4, 0.7, 0.8, and 1.4. MIK 1.4 serves as the primary reference site, but narrative Biotic Index results for TDEC protocols are based on reference conditions established by TDEC from a suite of reference sites in the same ecoregion as Mitchell Branch. Finally, also included in this summary is a comparison between the macroinvertebrate community structure at the four Mitchell Branch sites and five other reference sites on the ORR. Most of these reference sites - spanning a range of stream sizes both smaller and larger than Mitchell Branch (based on watershed area) - have been monitored using ORNL protocols since the mid-1980s for other biological monitoring projects on the ORR (ORNL BMAP and WRRP/Bear Creek Biological Monitoring Program) (Table 3.24). This summary provides information on how invertebrate community structure at Mitchell Branch sites, including MIK 1.4, compares with the community structure of a range of relatively unaffected reference sites on the ORR.

Table 3.24. Stream sites included in the comparison between Mitchell Branch and other reference sites on the Oak Ridge Reservation (ORR)

Site	Location		Watershed area (km^2)	Program
	Latitude (N)	Longitude (W)		
Mitchell Branch				
MIK 0.4	35.93786	84.38792	1.554	ETTP BMAP
MIK 0.7	35.93786	84.38682	1.347	ETTP BMAP
MIK 0.8	35.93802	84.38560	1.269	ETTP BMAP
MIK 1.4 (reference)	35.93790	84.37662	0.311	ETTP BMAP
Other ORR reference sites				
First Creek (FCK 0.8)	35.92671	84.32327	0.596	ORNL BMAP
Fifth Creek (FFK 1.0)	35.93251	84.31741	0.596	ORNL BMAP
Gum Hollow Branch (GHK 2.9)	35.96385	84.31594	0.777	Bear Creek BMP/WRRP
Walker Branch (WBK 1.0)	35.95805	84.27953	1.010	ORNL BMAP
White Oak Creek (WCK 6.8)	35.94106	84.30145	2.072	ORNL BMAP

BMAP = Biological Monitoring and Abatement Program
BMP = Biological Monitoring Program
ETTP = East Tennessee Technology Park
MIK = Mitchell Branch kilometer
ORNL = Oak Ridge National Laboratory
WRRP = Water Resources Restoration Program

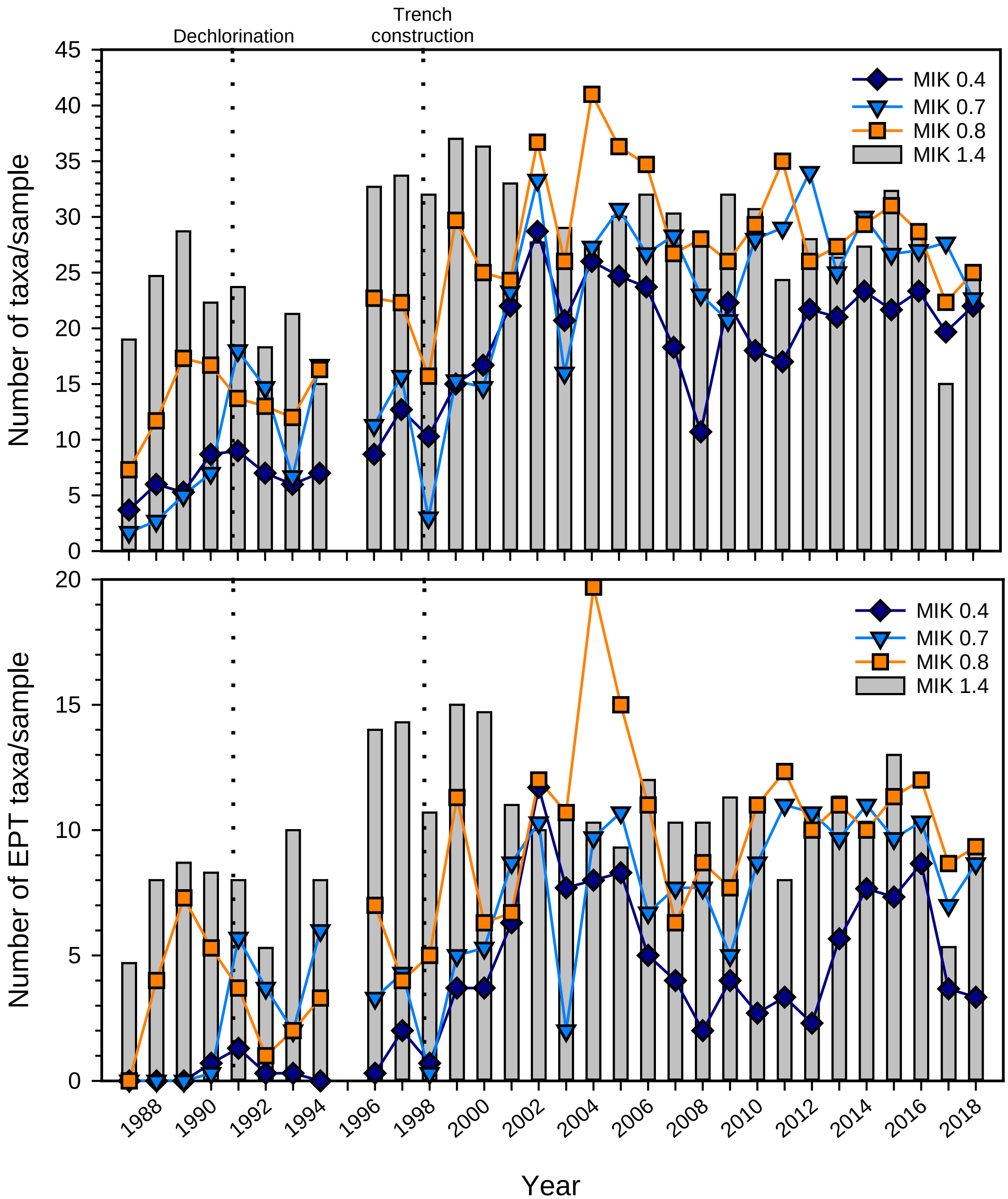
Mitchell Branch—ORNL and TDEC Protocols

Based on ORNL protocols in April 2018, all Mitchell Branch sites, except MIK 1.4, showed similar patterns to those observed in May 2017 for taxa richness (i.e., the total number of taxa per sample) and Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa richness (i.e., the total number of pollution-intolerant EPT taxa per sample). EPT are mayflies, stoneflies, and caddisflies, respectively. At MIK 1.4, both total and EPT taxa richness increased in 2018. EPT richness patterns among sites regained a resemblance of past patterns observed in 2010–2016, where EPT richness was highest upstream at MIK 1.4 and lowest at MIK 0.4 (Figure 3.54).

The percent density of the pollution-intolerant taxa (higher values are indicative of good condition) was highest at MIK 1.4, the reference site, and lowest at MIK 0.4 (Figure 3.55). Similarly, the percent density of pollution-tolerant taxa (lower values are indicative of good conditions) was lowest at MIK 1.4 and highest at MIK 0.4 (Figure 3.55). These results suggest the invertebrate community in Mitchell Branch continues to be mildly to moderately degraded downstream of MIK 1.4.

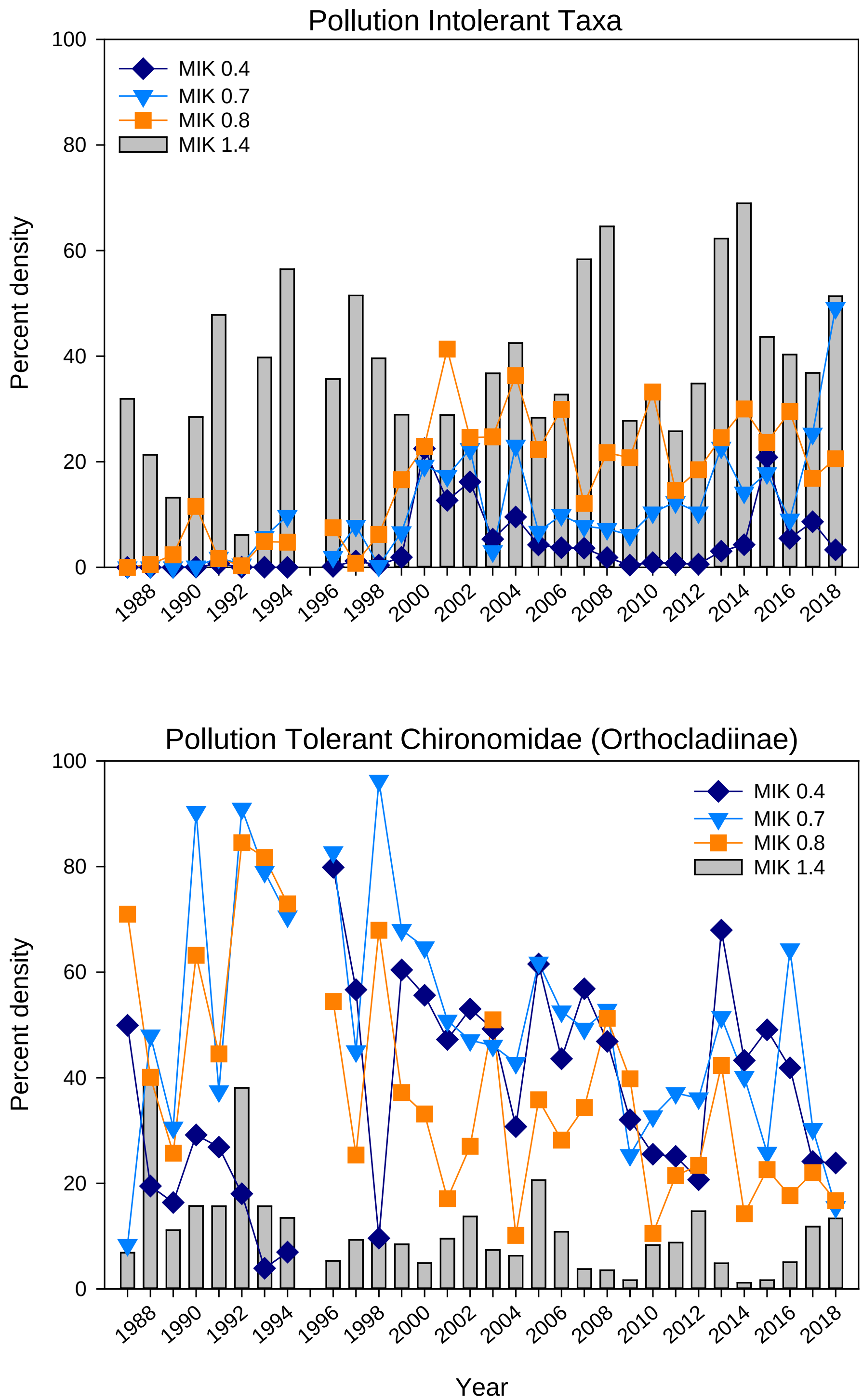
Based on TDEC 2017 protocols, scores for the Tennessee Macroinvertebrate Biotic Index in 2018 rated the invertebrate community as non-impaired at MIK 1.4 and slightly-impaired at MIKs 0.4, 0.7, and 0.8 (Figure 3.56). Scores at MIK 0.4 and 0.7 decreased in 2018 due to the low number of EPT taxa collected using TDEC protocols. MIK 0.8 remained at the same biotic index score as 2017.

Based on TDEC stream habitat protocols, habitat quality was rated as non-impaired at MIK 0.8 and moderately impaired at MIKs 0.4, 0.7, and 1.4 (Figure 3.56). Habitat scores increased at all sites from 2017 to 2018, except at MIK 1.4 where the score dropped slightly due to a decrease in bank stability and increase in non-native vegetation.



MIK = Mitchell Branch kilometer
Note:
Samples were not collected in April 1995, as indicated by the gap in the lines.

Figure 3.54. Mean total taxonomic richness (top) and taxonomic richness of the pollution-intolerant Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies, or EPT) taxa per sample (bottom) for the benthic macroinvertebrate community in Mitchell Branch, 1987–2018

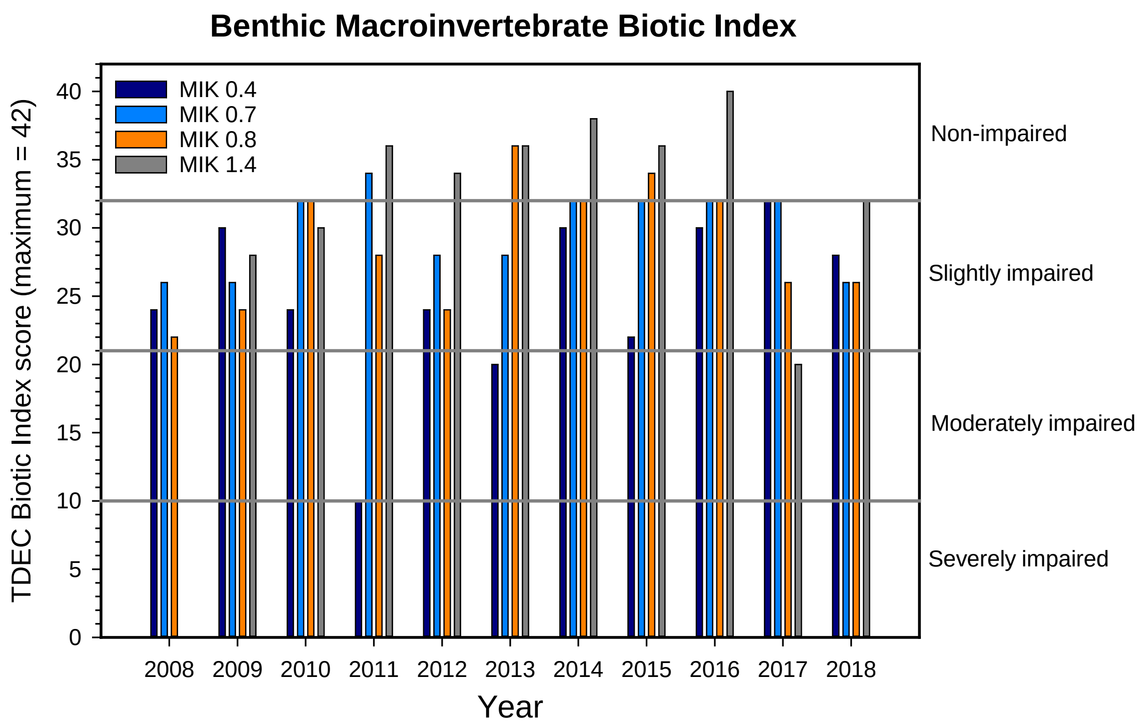


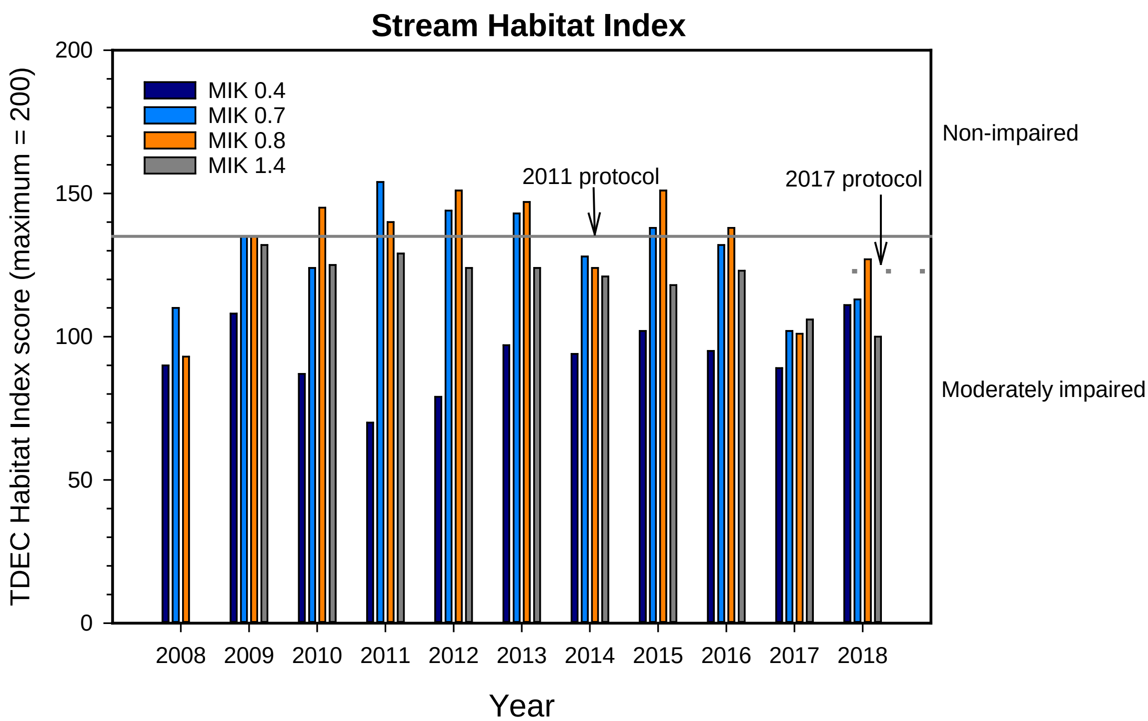
MIK = Mitchell Branch kilometer

Notes:

1. Percentages were based on total densities for each site.
2. Samples were not collected in April 1995, as indicated by the gap in the lines.

Figure 3.55. Mean percent density of the pollution-intolerant Ephemeroptera, Plecoptera, and Trichoptera taxa (i.e., stoneflies, mayflies, and caddisflies), and percent density of the pollution-tolerant Orthocladiinae midge larvae (Chironomidae) in Mitchell Branch, 1987–2018





Notes:
1. Mitchell Branch site MIK 1.4 was not sampled with TDEC protocols in 2008.
2. The horizontal lines on each graph show the rating thresholds for each index; respective narrative ratings for each threshold are shown on the right side of each graph.
3. TDEC 2011 guidance used 2008-2017, TDEC 2017 guidance used in 2018.

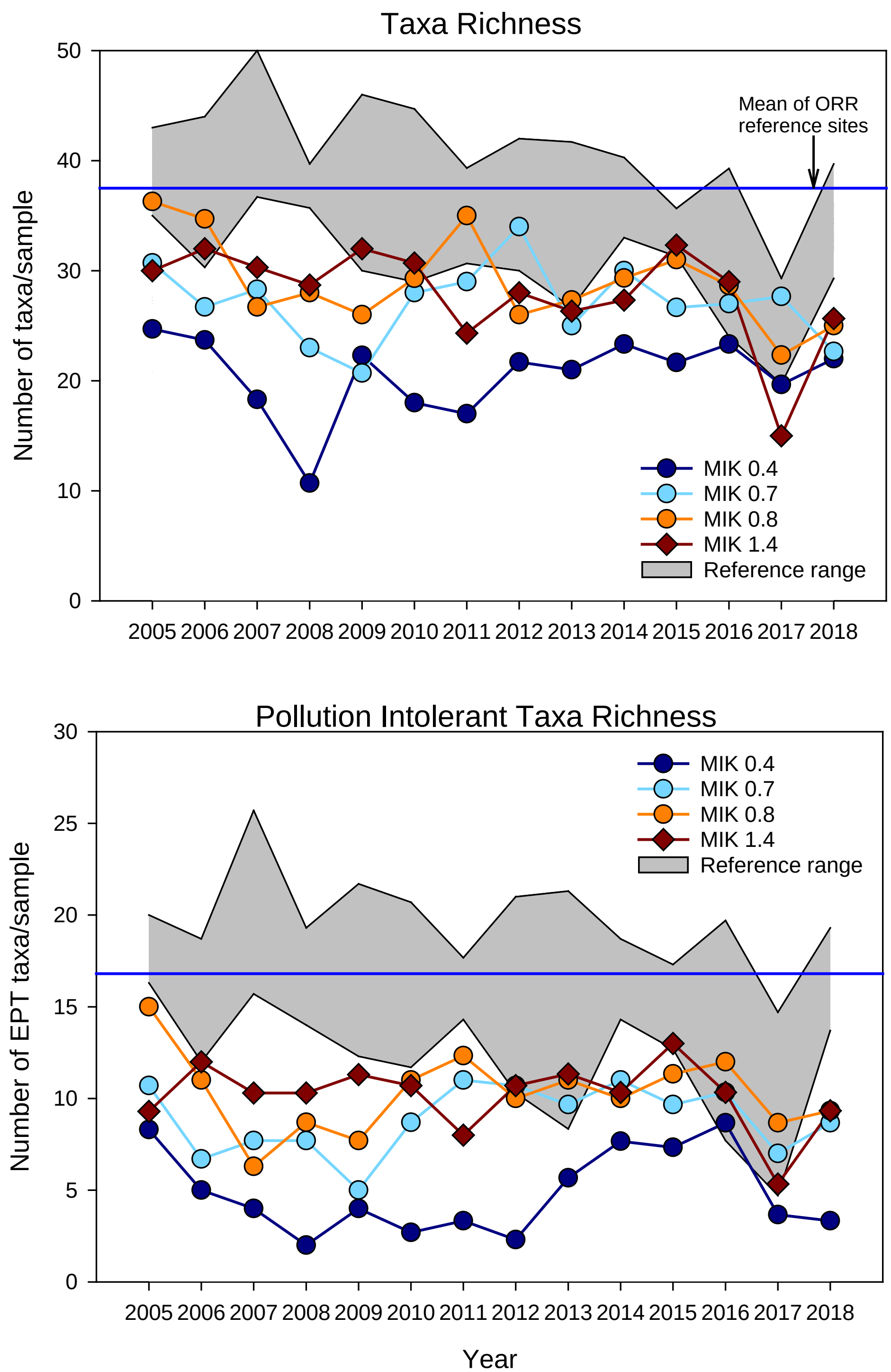
Figure 3.56. Temporal trends in the Tennessee Department of Environment and Conservation (TDEC) Biotic Index (top) and Stream Habitat Index (bottom) scores for Mitchell Branch, August 2008–2018

Comparison Between Mitchell Branch and Other Reference Sites on the Oak Ridge Reservation

Here the benthic macroinvertebrate communities in Mitchell Branch are compared to ORR reference streams over a 14-year period since 2005. Mean values for total and mean taxa richness of pollution-intolerant taxa for Mitchell Branch are shown in Figure 3.57, and percent density of the pollution-intolerant and pollution-tolerant taxa are shown in Figure 3.58. Also shown in Figs. 3.57 and 3.58 is the range of metric means for the five reference sites, First Creek kilometer 0.8, Fifth Creek kilometer 1.0, White Oak Creek kilometer 6.8, Walker Branch kilometer 1.0, and Gum Hollow Branch kilometer 2.9, in gray shading.

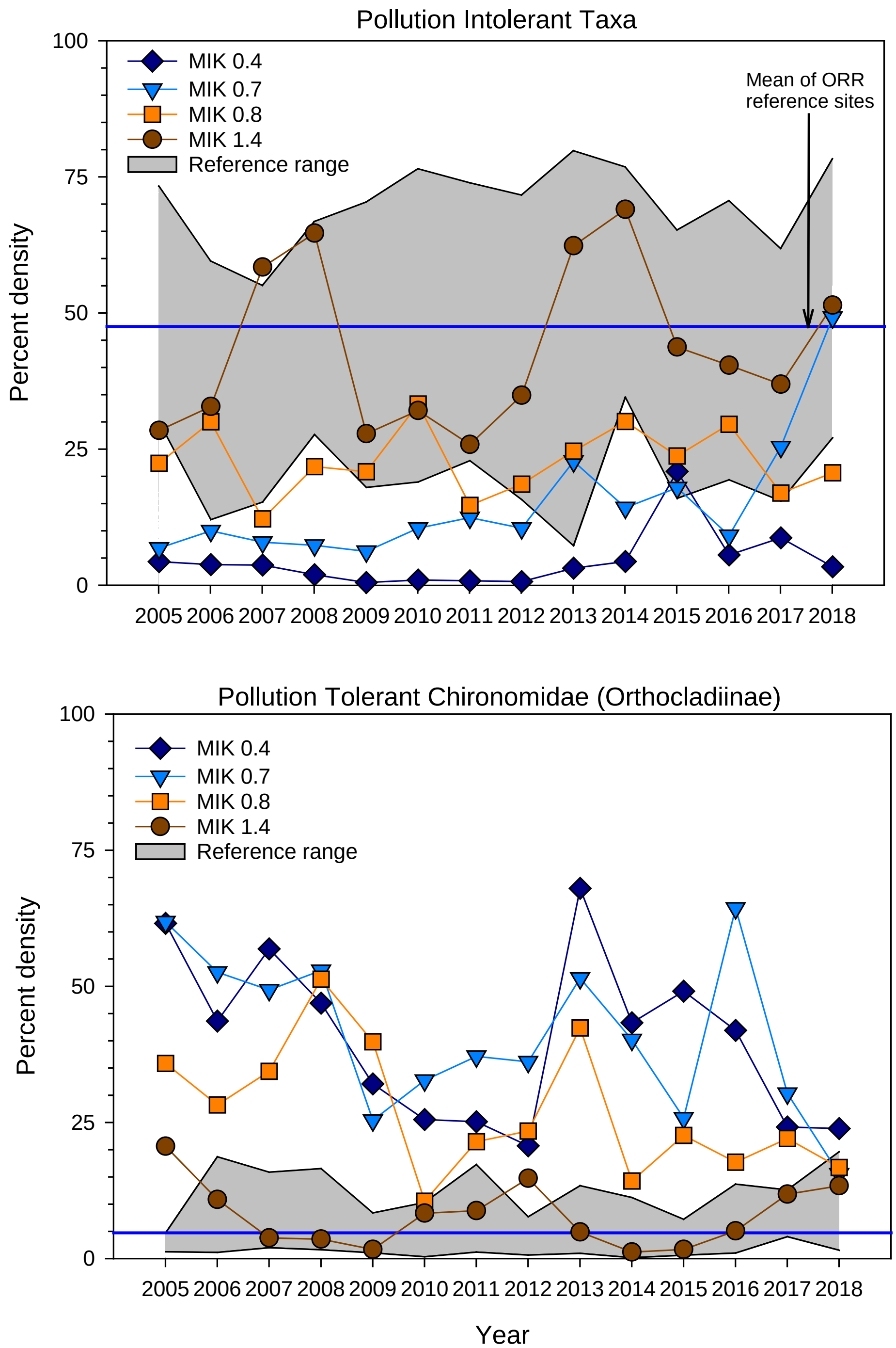
With few exceptions, total taxa richness and taxa richness of pollution-intolerant taxa at Mitchell Branch sites, including MIK 1.4, were less than what was present at the other reference sites from 2005 to 2018. Additionally, means for both richness metrics at all Mitchell Branch sites were less than the 14-year mean for the reference sites (Figure 3.57). In contrast to richness metrics, the mean percent densities of pollution-intolerant and pollution-tolerant taxa at MIK 1.4 were rarely outside of the range for the reference sites. Mean percent density of pollution-intolerant taxa at MIK 0.8 fluctuated in and out of the reference range, while the percent density of pollution-tolerant taxa fell within the reference range. MIK 0.7 showed marked improvement in percent density of both pollution-intolerant and pollution-tolerant taxa in 2018. Except for 2015, percent densities of both groups were outside of the reference range at MIK 0.4 in every year.

These results from the comparison of Mitchell Branch sites with the reference sites, combined with the long-term results for all Mitchell Branch sites discussed above, suggest that from the standpoint of reference sites, MIK 1.4 falls within the lower range of expected reference conditions on the ORR. Factors potentially contributing to frequent excursions of invertebrate community metrics outside of the range of other reference sites include the somewhat smaller size of MIK 1.4 compared with the other reference sites (based on watershed area; Table 3.24), which may limit the range of invertebrate species that can colonize and thrive at the site, as well as habitat characteristics that have typically contributed to the lower quality habitat at the site, such as low flow and poor substrate quality (see results above for the TDEC Habitat Index). These results also support the contention that sites downstream of MIK 1.4 continue to exhibit evidence of mild to moderate degradation.



MIK = Mitchell Branch kilometer
Note:
The gray shading on each graph shows the range of values at five additional reference stream sites on the Oak Ridge Reservation (ORR) from 2005 to 2018, and the solid blue horizontal line on each graph is the mean of the reference sites for the same period.

Figure 3.57. Mean total taxonomic richness (top) and taxonomic richness of the pollution-intolerant Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies, or EPT) taxa per sample (bottom) for the benthic macroinvertebrate community at sites in Mitchell Branch, 2005–2018



MIK = Mitchell Branch kilometer

Notes:

1. Percentages were based on total densities for each site.
2. The gray shading on each graph shows the range of values at five additional reference stream sites on the Oak Ridge Reservation (ORR) from 2005 to 2018, and the solid blue horizontal line in each graph is the mean of the reference sites for the same period.

Figure 3.58. Mean percent density of the pollution-intolerant taxa (i.e., stoneflies, mayflies, and caddisflies; top), and percent density of the pollution-tolerant Orthocladiinae midge larvae (Chironomidae; bottom) in Mitchell Branch, 2005–2018

3.7.4 Task 3: Fish Community

Fish population and community studies are used to evaluate the biotic integrity (or general ecological health) of Mitchell Branch. The fish community is sampled quantitatively at two sites in Mitchell Branch, MIK 0.4 (downstream of SD 190) and MIK 0.7 (downstream of SD 170) and at local reference streams.

Historically, the fish community in Mitchell Branch was most severely impacted in the late 1980s and early 1990s. After some recovery in the mid-1990s, Mitchell Branch was impacted negatively again in 1998 in association with a remedial activity that replaced a large section of stream bottom with a liner and interlocking rock substrate (Figure 3.59). In recent years, this reach of stream appears to be developing more natural habitat, including a more robust riparian plant community and some instream riffle/pool sequences as substrate is slowly beginning to accumulate throughout the reach. Since 2000, the fish community has had relatively stable species diversity but rather large variations in fish density and biomass (Figs. 3.60-3.62), which are often reflective of unstable, impaired streams. Streams that experience high density and biomass of tolerant fish species are often indicative of either high nutrient influences on a fish community (i.e., more algal growth means more food at the base of the food chain) or poor instream habitat—and often a combination of both. Of the two sites sampled for fish community, MIK 0.7 has experienced the greatest fluctuations in these community parameters. This is likely due to the modified riparian areas and poor instream habitat associated with the remediation work in this reach. Similar conditions are seen in other area streams on the ORR, including sections of EFPC where tolerant species dominate the concrete- and bedrock-lined channel, which supports little riparian protection. In addition, extremely low precipitation amounts in the summer of 2016 resulted in very low flows in many area streams. Small first and second order streams without springs or groundwater influence were most severely affected by these conditions. This may partially explain the decreased density and biomass numbers observed in spring 2017 samples and the apparent return of higher values in spring 2018.

Figure 3.59. Construction of lined section of Mitchell Branch, MIK 0.7, in 1998 (top) and more recent habitat conditions in 2018 (bottom)

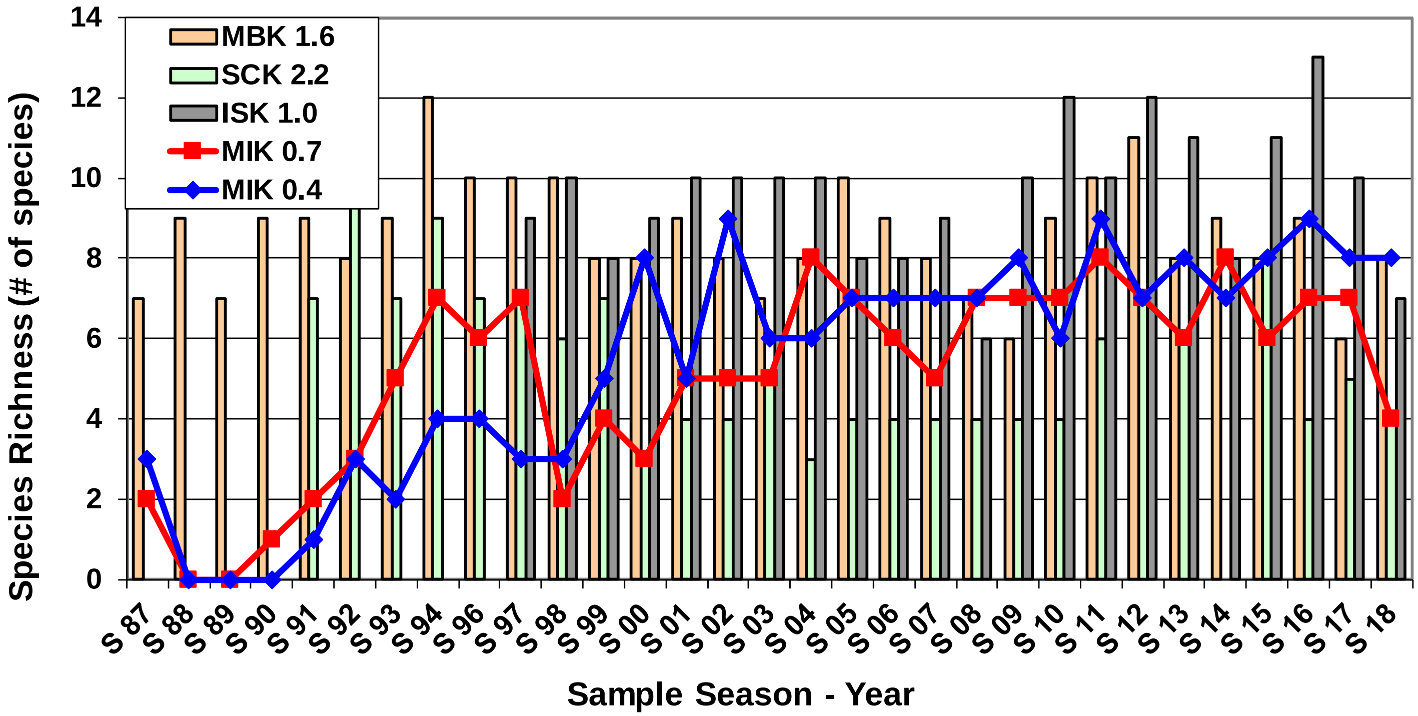


Figure 3.60. Species richness for the fish communities at sites in Mitchell Branch (MIK) and in reference streams Mill Branch (MBK), Scarboro Creek (SCK), and Ish Creek (ISK), 1987–2018

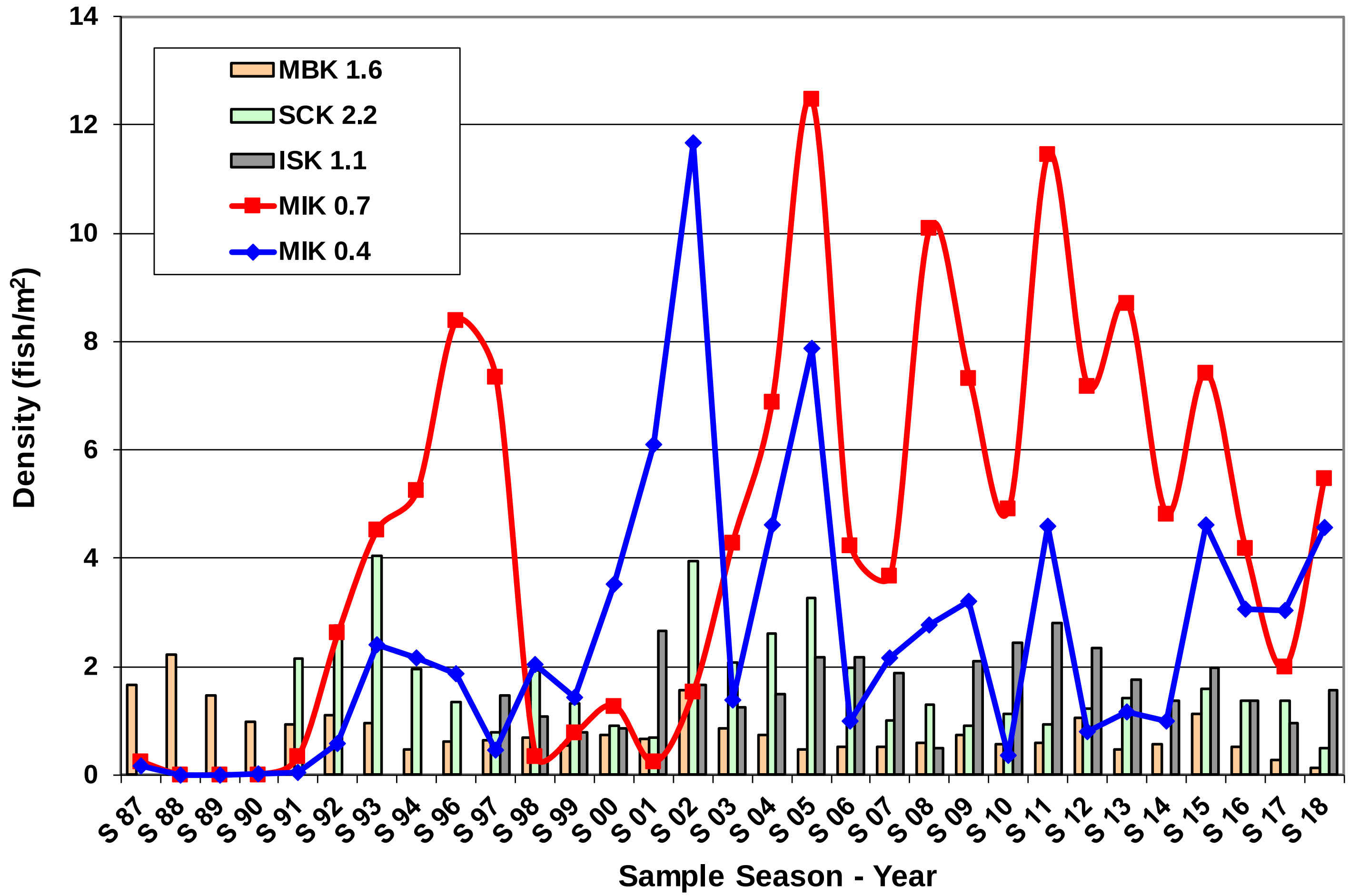


Figure 3.61. Density for the fish communities at sites in Mitchell Branch (MIK) and in reference streams Mill Branch (MBK), Scarboro Creek (SCK), and Ish Creek (ISK), 1987–2018

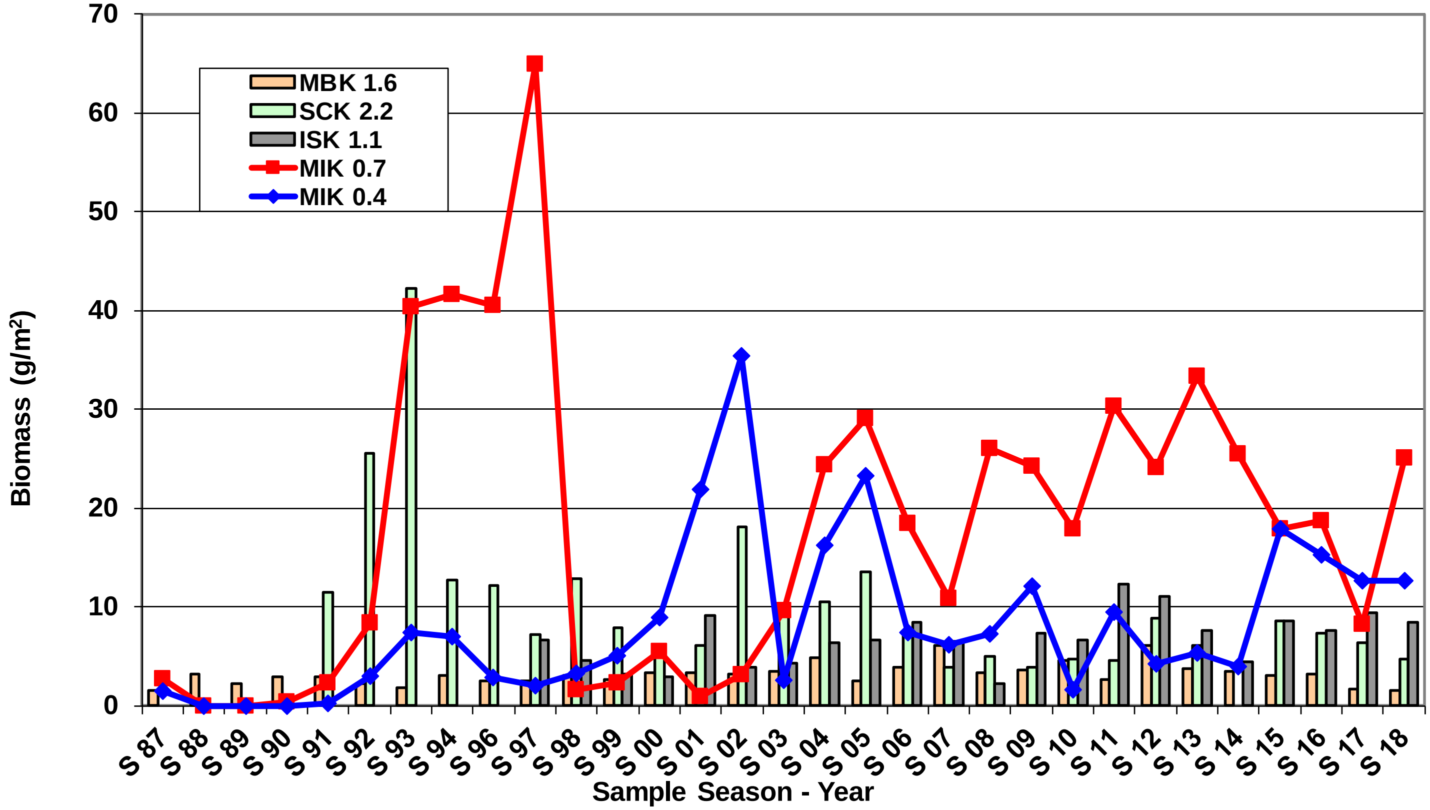


Figure 3.62. Biomass for the fish communities at sites in Mitchell Branch (MIK) and in reference streams Mill Branch (MBK), Scarboro Creek (SCK), and Ish Creek (ISK), 1987–2018

At both MIK 0.4 and MIK 0.7, the 2018 sample of community parameters indicated continued variation. There was a substantial decrease in fish species richness (number of species) at MIK 0.7 from 2017 to 2018 (7 species to 4). In contrast MIK 0.4 species richness remained comparable with reference streams. As mentioned above, density (number of fish) at both sites increased from 2017 and still remains well above reference conditions. Biomass (weight) also increased at the upper site while remaining stable at the lower site. Both the lower Mitchell Branch site and the upper site had reduced diversity of sensitive fish species in 2018, and both sites also experienced a slight decrease in sensitive species density (Figs. 3.63 and 3.64). Overall the last five years, there has been a slight uptick in sensitive species diversity and density at both sampled sites which can be attributed to the presence of fish such as banded sculpin (*Cottus carolinae*), which appear to be a resident species in Mitchell Branch, and also occasional occurrences of other more sensitive fish.

In general, the Mitchell Branch fish communities at MIK 0.4 and MIK 0.7 continue to lack diverse resident species that are sensitive to stress or that have specialized feeding or reproductive requirements, such as darters or suckers that occur consistently at higher frequencies in the reference streams. Like the benthic communities, fish community monitoring provides an integrated response to *all* of the various water chemistry and habitat influences in a stream. Identifying the major stressor influences on the community (i.e., causal analysis) would require additional investigatory strategies coupled with the monitoring data.

During routine bioaccumulation sampling, several species of fish are collected regularly at MIK 0.2 that are almost never observed in the Mitchell Branch fish community monitoring activities at the upstream sites. These included four pollution-sensitive species: snubnose darter (*Etheostoma simoterum*), greenside darter (*Etheostoma blennioides*), black redhorse (*Moxostoma duquesnei*), and northern hogsucker (*Hypentelium nigricans*) (Figure 3.63-3.65). Future monitoring will help determine if these species are becoming established farther upstream in Mitchell Branch or are merely seasonal migrants to the stream's lower section, which is easily accessible from the much larger Poplar Creek.

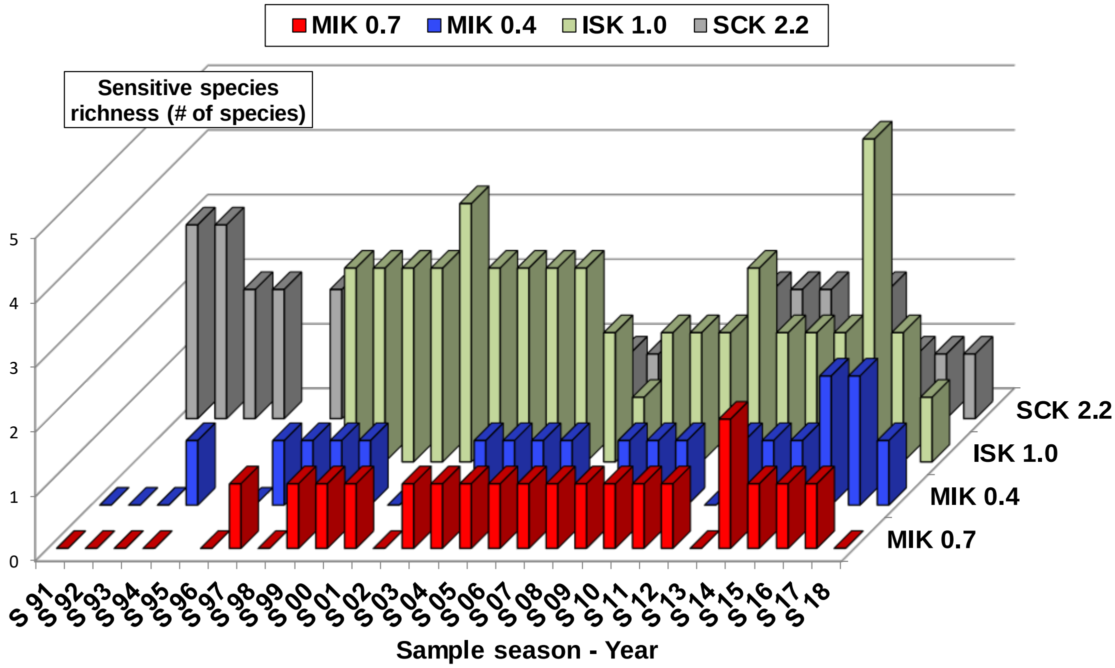


Figure 3.63. Sensitive species (e.g., banded sculpin and snubnose darter) richness of the fish communities at sites in Mitchell Branch (MIK) and in reference streams Scarboro Creek (SCK) and Ish Creek (ISK), 1991–2018

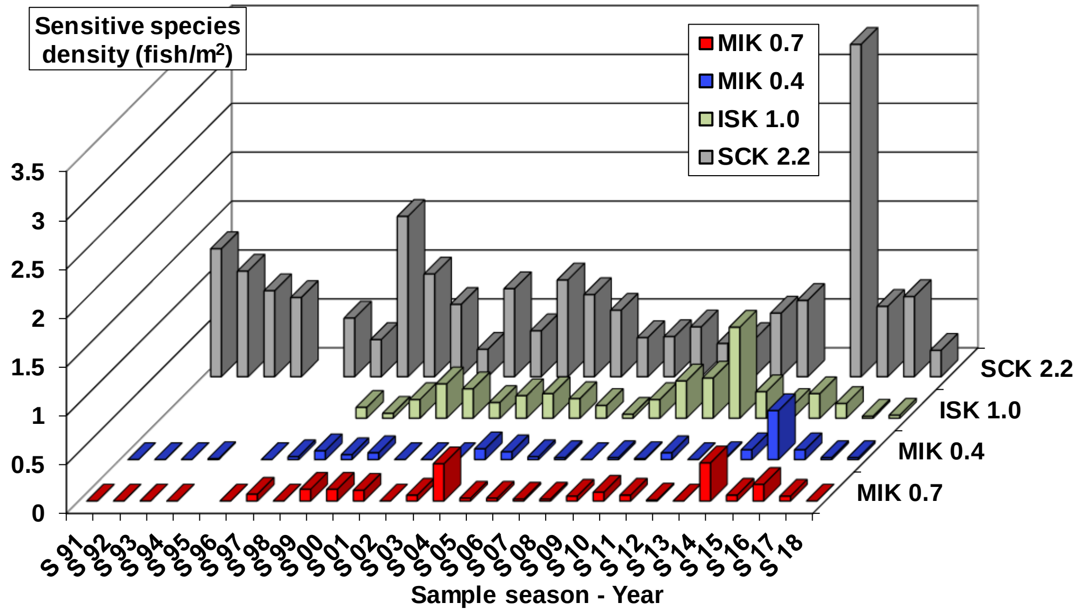
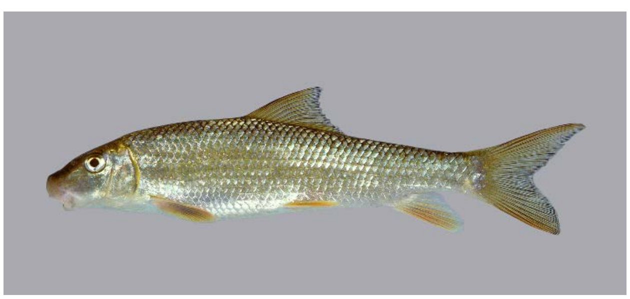


Figure 3.64. Sensitive species (e.g., banded sculpin and snubnose darter) density of the fish communities at sites in Mitchell Branch (MIK) and in reference streams Scarboro Creek (SCK) and Ish Creek (ISK), 1991–2018



Black redhorse (*Moxostoma duquesnei*)

Snubnose darter (*Etheostoma simoterum*)

Northern hogsucker (*Hypentelium nigricans*)

Greenside darter (*Etheostoma blennioides*)

Photos: Chris Bryant

Figure 3.65. Sensitive fish species observed in lower Mitchell Branch

3.7.5 K-1007-P1 Pond Fish Community

The fish communities in the K-1007-P1 pond are assessed annually. This sampling is conducted to evaluate the effectiveness of remediation efforts implemented in 2009 and is aimed at reducing the PCBs available for transfer out of the pond via natural routes (i.e., trophic transfer). The remedial actions included capping contaminated sediment with fill dirt, planting native aquatic vegetation to stabilize sediment, and removing potentially contaminated fish from the pond. Fish initially were removed from the pond using a piscicide (Rotenone), and uncontaminated native fish were stocked in the pond with the goal of establishing a sunfish-dominated community. Sunfish have a shorter lifespan than many other species of fish, especially higher trophic level fish, and they have a prey source that is generally varied but consistently lower on the aquatic food chain compared with species such as largemouth bass, thus reducing the likelihood that contaminants would biomagnify within the system.

Despite efforts to remove all unwanted fish from the pond, an unexpected breach in the weir separating the K-1007-P1 pond from the adjacent Poplar Creek in May 2010 allowed numerous fish to enter the pond during high waters. These unwanted fish constituted several species that were unfavorable to the pond action—including (1) nonnative species and (2) species with life history traits that undermined the remediation efforts, such as being long-lived and having feeding habits that disturb potentially contaminated sediments. Continued work to remove these unwanted fish has been productive, and only limited numbers of the most long-lived species, such as common carp (*Cyprinus carpio*) and smallmouth buffalo (*Ictiobus bubalus*), are encountered in annual monitoring.

Two additional species that returned to the pond after the weir breach were gizzard shad (*Dorosoma cepedianum*) and largemouth bass (*Micropterus salmoides*). Gizzard shad feed on phytoplankton and zooplankton in natural environments such as larger reservoirs, but in smaller ponds such as P1, they often turn to feeding on algal growth at the surface of the pond sediment, which can disturb soils and potentially resuspend contaminants in the pond substrate. Largemouth bass tend to be a long-lived species and are a top predator in aquatic environments, making them particularly susceptible to bioaccumulation. They also are a game fish highly prized by many anglers as well as a common table fare. These two species also have been targeted for removal during continued remediation efforts and fish surveys.

Overall, the K-1007-P1 Pond fish community surveys conducted in February 2018 revealed the presence of 12 species of fish (Figure 3.66). An observation of particular importance from previous surveys is the abundance of sunfish species (bluegill, redear sunfish, and warmouth), which constitute approximately 80 percent of the total fish population. Bluegill, the most prevalent of these species, were historically the dominant sunfish species in the pond, and they are the desired bioindicator fish species to have in the remediated pond. Although largemouth bass continue to persist in the pond, their abundance remains relatively low. Despite removal efforts, their presence is expected to continue, given the habitat conditions currently in the pond (i.e., abundant prey sources and open water). Gizzard shad continue to be present in the pond and are suspected of reproducing; however, they constitute only approximately 13 percent of the fish population at present.

A few additional strategies were utilized in 2017-2018 in an effort to further manipulate the fish population and overall pond ecosystem to better reflect the desired end state. These included: more strategic and targeted fish removal efforts, stocking of 41,000 juvenile bluegill over two years, and aquatic and terrestrial plantings of native plants in various areas around the pond. These efforts were designed to reduce nuisance fish presence through removal, adjust the fish community through inundation of specific fish age classes, and increase vegetative cover in areas of the pond that currently lack vegetation. Future monitoring will provide insight on the effectiveness of these efforts and provide guidance for future management techniques.

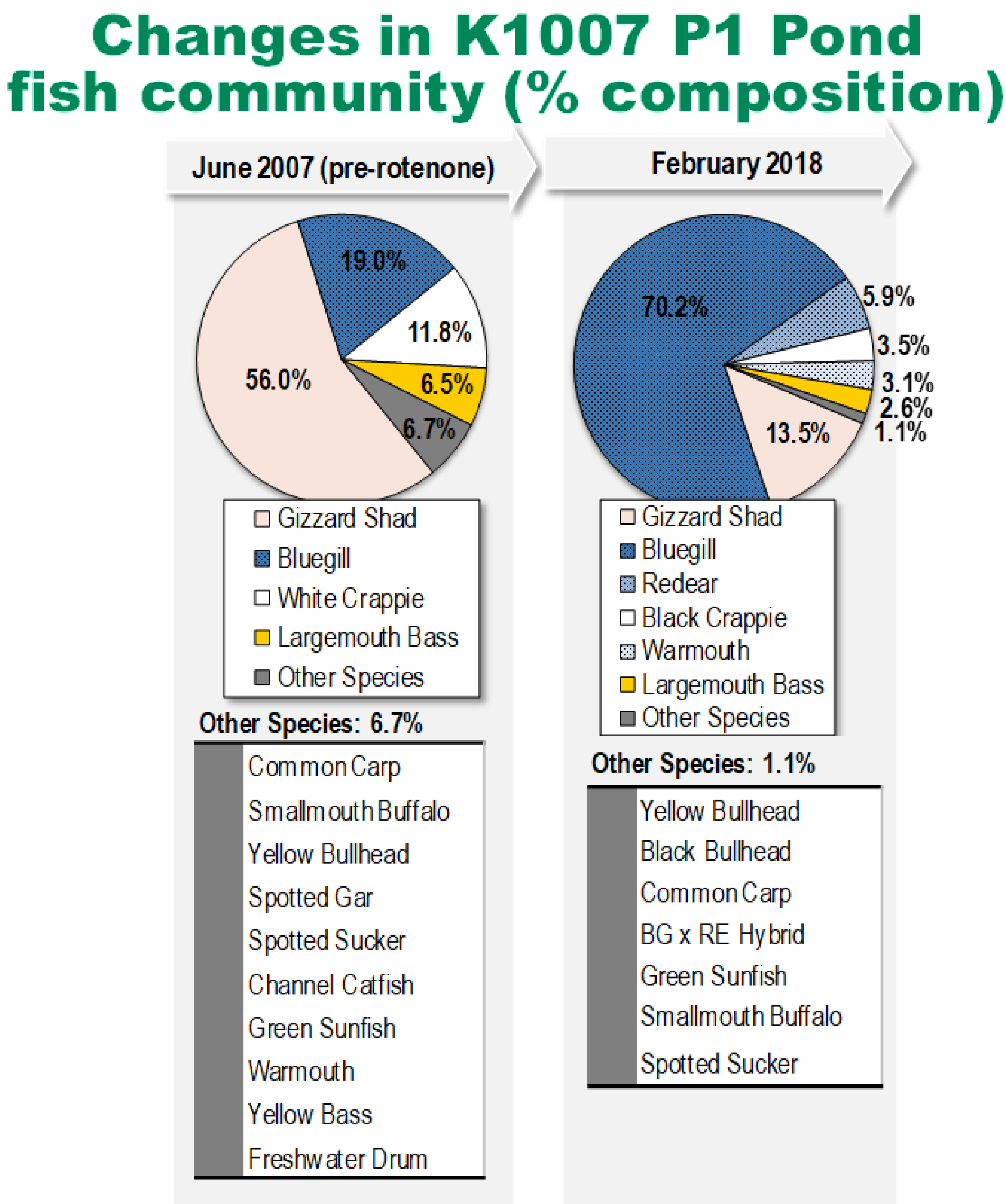


Figure 3.66. Changes in the K-1007-P1 Pond fish community (% composition) from 2007 to 2018

3.8 Environmental Management and Waste Management Activities

3.8.1 Waste Management Activities

Restoration of the environment, D&D of facilities, and management of legacy wastes constitute the major operations at ETTP.

CWTS is a small water treatment unit for chromium-contaminated groundwater that sits within the existing CNF footprint. CWTS came online in late 2012, and handles purge water from groundwater monitoring, as well as the chromium collection system water. Effluent from CWTS discharges into the Clinch River through an existing CNF discharge line. Section 3.6.12 provides a more detailed discussion of CWTS operations.

3.8.2 Environmental Remediation Activities

UCOR's soil remediation efforts at ETTP are helping to prepare the site for future commercial industrial use. The site is divided into two cleanup regions: Zone 1, a 1,400-acre area outside the main plant area, and Zone 2, the 800-acre area that comprises the main plant area. The areas in these zones are divided into exposure units (EUs) that vary in size.

3.8.2.1 Zone 1

The Interim ROD, which documents the cleanup method for Zone 1 (DOE 2002a, DOE/OR/01-1997&D2), requires the DOE Oak Ridge Office of Environmental Management (OREM) to remediate soil for the protection of groundwater and a future industrial workforce, and to maintain land use controls (LUCs). In FY 2018, remediation of the duct bank was completed. The duct bank, constructed in 1944, was an underground power transmission system that provided power from the former K-704 Switchhouse to the gaseous diffusion plant uranium enrichment facilities. The duct bank was abandoned in the early 1970s.

Also in FY 2018, remediation of two areas on Duct Island was completed to ensure there were no ecological risks to wildlife. Duct Island, which is actually a peninsula, is a stretch of land located between the old Powerhouse area and the main plant site. Its name is derived from the numerous underground electrical ducts that crossed the peninsula to deliver power to the site.

3.8.2.2 Zone 2

The Zone 2 ROD (DOE 2005b) requires OREM to remediate soil for the protection of an industrial workforce and groundwater and divides the zone into 44 EUs that range in size from 6 to 38 acres. In FY 2018, OREM and UCOR completed characterization of EUs Z2-19 and remediation of EUs Z2-11, 12, 14, and 17. Three separate RAs were completed in EU-22 (two were associated with removing soil contaminated with concentrations of ^{234}U exceeding the groundwater soil screening level, and the third was associated with removing PCB-contaminated soil with concentrations exceeding the Zone 2 ROD maximum remediation level for PCBs). Also within EU-22 (K-25 Building Footprint), a major RA was initiated to excavate soil contaminated with concentrations of ^{99}Tc exceeding the Zone 2 groundwater soil screening level criterion. The soil contaminated with ^{99}Tc poses a threat to groundwater, but crews are working to address and remove those risks.

Alternatives were evaluated for the remediation of TCE-contaminated soil within the footprint of the former K-25 building because the soil could pose a threat to groundwater. The remedy in the Zone 2 ROD is soil excavation, but due to several factors, including the volume of soil to be excavated and the structural integrity of surrounding buildings, other alternatives were considered. The recommendation was to excavate the soil as required by the Zone 2 ROD.

3.8.2.3 K-1200 Centrifuge Complex Demolition

The buildings of the K-1200 Centrifuge complex have been undergoing deactivation to prepare them for safe demolition. Demolition will take place in the next few years.

The deactivation process includes asbestos abatement, utility disconnection, equipment and waste removal, and other necessary steps to ensure demolition can be performed safely. Deactivation in the Centrifuge complex began in FY 2018. The facility was used to gauge the reliability of test centrifuges.

3.8.2.4 TSCA Incinerator Demolition

Demolition of the TSCA Incinerator was completed in 2018 ahead of schedule and under budget. The incinerator began operating in 1991, treating radioactive and hazardous wastes (mixed wastes) contaminated with PCBs. As the only US facility permitted to incinerate these types of waste, it accepted material from ORR and other facilities across the nationwide DOE complex.

The incinerator was shut down in December 2009 after treating 35.6 million pounds of waste. Workers then began preparing the facility for demolition, which included cleaning, rinsing, and filling sumps; encapsulating PCB and radioactive contamination; disconnecting pipes; and removing and disposing of carbon vessels, which were part of the water management system.

3.8.2.5 Building K-1037 Deactivation Continues

UCOR continued deactivation work in Building K-1037 in FY 2018. Deactivation is the initial step that prepares the facility for eventual demolition. The facility manufactured all of the barrier material used in the gaseous diffusion process since 1947. This material was a key component of the gaseous diffusion process when workers separated the ^{235}U and ^{238}U isotopes.

K-1037 was once a warehouse, which was later converted into a facility that produced the porous barrier material used in the separation process.

Crews completed asbestos-abatement activities identified in the original scope; however, as items such as loose equipment were removed throughout the building, additional asbestos was uncovered, so abatement work and loose equipment removal activities continued into 2018. In addition, a tremendous amount of effort was dedicated to the removal of excess chemicals throughout the facility. Over 1400 chemicals have been collected, sampled, and prepared for disposal. Demolition is scheduled to begin in 2019.

3.8.2.6 K-633 Test Loop Facility Demolition Completed

Demolition of ETTP's K-633 Test Loop Facility, one of several radiologically contaminated facilities in ETTP's Poplar Creek area, has been completed. The building consisted of four separate and independent testing loops that have common auxiliary systems and utilities. The first three loops were built to test and evaluate gaseous diffusion plant stage equipment performance under production conditions. In 1981, a fourth test loop was installed, which evaluated prototype equipment designed for withdrawal of depleted uranium hexafluoride tails from the gas centrifuge enrichment plant. The 18,100-square-foot facility was shut down in 1984. The radiological contaminants in the building were affixed inside piping and equipment using fixatives and foam, allowing for safe demolition of the structure.

3.8.2.7 Central Neutralization Facility Deactivation Continues

The CNF was a wastewater treatment facility for industrial wastewater generated at ETTP. CNF was constructed in stages from 1945 to 2000. In 2013, CNF was decommissioned and the NPDES-permitted facility water treatment equipment was cleaned of all hazardous waste contamination. All operations at CNF ceased in 2013.

In 2018, demolition was completed ahead of schedule and under budget.

3.8.2.8 Commemoration of the K-25 Site

National historic preservation initiatives at ETTP reached a milestone in FY 2018 with the procurement of the services of construction and exhibit fabrication and installation support subcontractors for the History Center work. Construction of the K-25 Site commemorative facilities have begun.

The K-25 History Center will be located on the second floor of the COR-owned Fire Station # 4 at ETTP. The K-25 History Center is expected to open in 2019. Visitors to the K-25 History Center will be invited to explore the rich history of this Manhattan Project site. This facility will feature a theatre experience, period artifacts, equipment replicas, and workers' oral histories, placing K-25 in its proper historical context in World War II and the Cold War. An in-depth look at gaseous diffusion, the thousands of equipment stages housed in K-25, and the people who sacrificed to make it a reality, will be highlighted. The Equipment Building and Viewing Tower design replicates the exterior appearance of the K-25 building, and will house a representative cross-section of gaseous diffusion technology. An enclosed observation deck will provide a 360-degree view of the site.

3.8.3 Reindustrialization

As cleanup has progressed extensively at ETTP, more large parcels are becoming available for transfer to the private and commercial industrial sectors. In 2018, DOE completed transfer of Duct Island, a 207-acre parcel on the western portion of ETTP, to CROET. This transfer is the second largest transfer in the history of the program, and the largest at ETTP Heritage Center. This brings the total acreage of land transferred to 1,280 acres, with 789 of those acres at the Heritage Center. Additionally, a large area of 170 acres at the southeast corner of ETTP has been approved for transfer to Metropolitan Knoxville Airport Authority for a potential regional airport project. The general aviation airport runway would accommodate small corporate jets, private airplanes, and EMS aircraft. A final decision from the Federal Aviation Administration (FAA) on this project is anticipated in 2019.

DOE completed an Environmental Assessment to support the property transfer and potential construction and operation of the airport. DOE has also received EPA and TDEC approval for future property transfer of the former Powerhouse area, which is over 400 acres. The transfer of large parcels, as more of the site cleanup is completed, provides the best opportunities to date for industrial and commercial development of ETTP.

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