3. East Tennessee Technology Park

ETTP was originally built during World War II as part of the Manhattan Project. 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. 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 and restoration operations, and the name was changed to the East Tennessee Technology Park. Environmental management and remediation operations consist of such operations as waste management, the cleanup of outdoor storage and disposal areas, the demolition and/or cleaning up of the facilities, land restoration, and environmental monitoring. Proper disposal of the 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 underutilized government facilities for use by the private sector) also became a major mission at ETTP. Reindustrialization allows private industry to lease underutilized facilities, thus providing both jobs and a new use for facilities that otherwise would have to be demolished. Bechtel Jacobs Company LLC (BJC) is the prime environmental contractor for the ETTP environmental monitoring and surveillance program, under which two main activities are performed: effluent monitoring and environmental surveillance. Federally mandated effluent monitoring and environmental surveillance at ETTP involve the collection and analysis of samples of air, water, soil, sediment, and vegetation from ETTP and the surrounding area. Data from the monitoring are used to assess exposures to members of the public and the environment, to assess the performance of treatment systems, to help identify areas of concern and plan remediation efforts, and to evaluate the efficacy of these remediation efforts. In 2009, there was better than 99% compliance with permit standards for emissions from ETTP operations.

3.1 Description of Site and Operations

Construction of ETTP, originally known as the K-25 site, began in 1943 as part of the World War II Manhattan Project (Fig. 3.1). 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 that operated for one 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 only low enriched uranium to be fabricated into fuel elements for nuclear reactors. Other missions during the latter part of this 20-year period included development and testing of the gas centrifuge method of uranium enrichment and the laser isotope separation research and development (R&D).

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 1990. In 1997, the K-25 Site was renamed the "East Tennessee Technology Park" to reflect its new mission.

The ETTP mission is to reindustrialize and reuse site assets through leasing excess or underutilized land and facilities and through incorporating commercial industrial organizations as partners in the ongoing environmental restoration, decontamination and decommissioning (D&D), and waste treatment and disposal.

DOE's long-term goal for ETTP is to convert as much as possible of the site into a private mixed-use business and industrial park. The site is undergoing environmental cleanup of its land as well as D&D of

most of its buildings. The reuse of key facilities through title transfer is part of the site's closure plan. 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. The facilities may then be subleased or sold, with the goal of stimulating private industry and recruiting business to the area.

Fig. 3.1. East Tennessee Technology Park.

Bechtel Jacobs Company LLC (BJC) is the environmental management contractor for ETTP. BJC also supports DOE in the reindustrialization program that transferred three building and two land parcels to the CROET as it continued its effort to transform ETTP into a private sector industrial park. In 2009, 11 buildings and 5 land parcels at ETTP were transferred to private companies. Construction was also started on speculative buildings on two of the parcels. Unless otherwise noted, information on non-DOE entities located on the ETTP site is not provided in this document.

3.2 Environmental Management System

As required by DOE Order 450.1A, the BJC Environmental Management System (EMS) is integrated with the Integrated Safety Management System (ISMS). BJC'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 14001:2004 (ISO 14001:2004). BJC is committed to incorporating sound environmental management, protection, and sustainability practices in all work processes and activities that are part of the DOE environmental management (EM) program in Oak Ridge, Tennessee. BJC's environmental policy states, "…it is inherent in our mission to complete environmental cleanup safely with reduced risks to the public, workers, and the environment." In order to achieve this, BJC's environmental policy adheres to the following principles:

- **Management Commitment**—Integrate responsible environmental practices into project operations.
- **Environmental Compliance and Protection**—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 customer and other stakeholders.

3.2.1 Environmental Stewardship Scorecard

The Environmental Stewardship Scorecard is used to track and measure site-level progress in EMS progress, performance, and successes. BJC continues to receive green scores for their EMS performance and 2009 Pollution Prevention Performance Measures. Figure 3.2 shows BJC's recycling data by types and quantities for 2009.

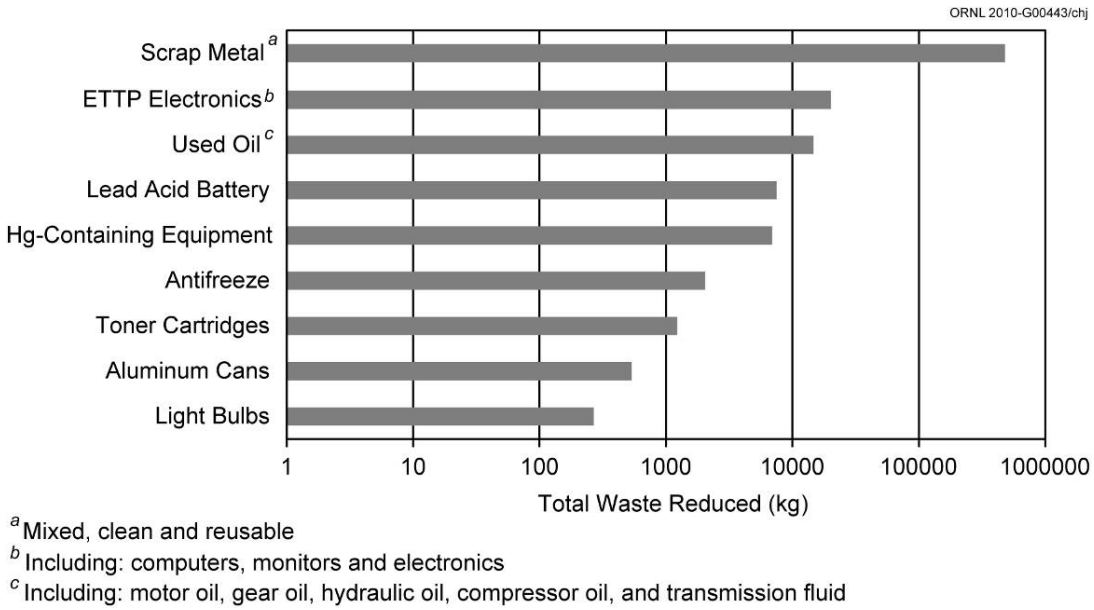


Fig. 3.2. Pollution prevention recycling activities at ETTP related to solid waste reduction.

3.2.2 Environmental Compliance

BJC maintains various layers of oversight to ensure compliance with legal and other requirements. The methods of evaluations range from 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 *Management Assessments*, BJC-PQ-1420, and *Independent Assessments*, BJC-PQ-1401. Assessments are scheduled in accordance with BJC-PQ-1420 on the BJC *Assessments* SharePoint Site. Records are maintained for all formal assessments and audits. Issues identified in assessments are handled as required by ISO 14001, Section 4.5.3, "Nonconformity, Corrective Action, and Preventive Action."

In addition, external assessments and regulatory inspections are performed by DOE and regulatory agencies such as the Tennessee Department of Environment and Conservation (TDEC) and the U.S. Environmental Protection Agency (EPA).

As required by DOE Order 450.1A, an independent assessment of BJC's EMS in accordance with BJC-PQ-1401 will be conducted every 3 years. In addition, during years when an independent assessment is not conducted, a management assessment of the EMS program will be performed in accordance with BJC-PQ-1420. Also, routine functional environmental compliance management assessments evaluate the

various elements of ISO 14001. Independent and management assessments are scheduled in advance, and the schedule is maintained on a SharePoint Site on BJC's intranet.

Results of all assessments are provided to management, and corrective actions (CAs) are tracked in BJC Issues and Corrective Action Tracking System (I/CATS) in accordance with *Issues Management Program*, BJC-PQ-1210, as required by ISO 14001, Section 4.5.3, "Nonconformity, Corrective Action, and Preventive Action."

Initial validation of BJC's EMS occurred in December 2005. An internal independent assessment was performed in September 2007, and an evaluation by an outside party, as required by DOE Order 450.1A, was conducted in March 2009. BJC formally declared conformance with EMS requirements contained in DOE Order 450.1A on May 6, 2009.

3.2.3 Environmental Aspects/Impacts

Using a graded approach appropriate for the Environmental Management Closure Contract, the 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 environmental, safety and health (ES&H) goals. BJC works continuously to improve the EMS in order to reduce impacts from activities and associated effects on the environment (i.e., *environmental aspects*) and to communicate and reinforce this policy to our internal and external stakeholders.

At the program/company level, environmental aspects are documented in the *Integrated Safety Management System Description* (BJC 2009, 2010). These aspects are reviewed at least annually and updated as necessary. Significant environmental aspects are identified using a systematic process that considers various risk factors (e.g., regulatory risk, environmental risk, mission impact, and probability) in determining significance. This process is described in *Evaluation of BJC Activities and Ranking of Environmental Aspects/Impacts* (BJC 2008). BJC's work activities, services, and products were initially reviewed to determine the associated environmental aspects and impacts and are reevaluated on an ongoing basis as new work activities are initiated.

Continuous improvement opportunities are identified in a number of ways including, but not limited to, ongoing independent and management assessments, external DOE assessments, regulatory inspections, worker feedback, and senior management reviews of BJC's EMS components. Figure 3.3 provides a model that illustrates the components and key steps of BJC's EMS.

The BJC corporate policy emphasizes the company's core values by promoting a commitment to an ISMS. The objective of the ISMS is to systematically integrate ES&H, pollution prevention, waste minimization, and quality assurance (QA) into management and work practices at all levels so that workers, the public, and the environment are protected while the missions are accomplished, in addition to obtaining feedback for continuous improvement.

The Environmental Compliance and Protection (EC&P) Oversight Program is an integral part of the BJC EMS mandated by Presidential Executive Order 13423, "Strengthening Federal, Environmental, Energy, and Transportation Management," and its implementing document, DOE Order 450.1A, *Environmental Protection Program*. This Order requires each DOE operation to implement an EMS as part of the existing ISMS that was established at pursuant to DOE P 450.4, *Safety Management System Policy*. BJC uses its ISMS to implement the EMS, including EC&P considerations, into the line Environment, Safety, and Health (ES&H) Oversight Program at DOE sites managed by BJC. DOE Order 450.1A also requires implementation and development of pollution prevention (P2) and sustainable environmental stewardship goals.

3.2.4 Environmental Performance Objectives and Targets

BJC conserves and protects environmental resources by incorporating environmental protection and the elements of an enabling EMS into the daily conduct of business; fostering a spirit of cooperation with federal, state, and local regulatory agencies; and using appropriate waste management, treatment, storage, and disposal methods. The environmental performance objectives are to achieve zero unpermitted discharges to the environment; comply with all conditions of environmental permits, laws, regulations,

and DOE orders; integrate EMS and environmental considerations as part of the ISMS; and, to the extent practicable, reduce waste generation, prevent pollution, maximize recycle and reuse potential, and encourage environmentally preferable procurement of materials with recycled and biobased content.

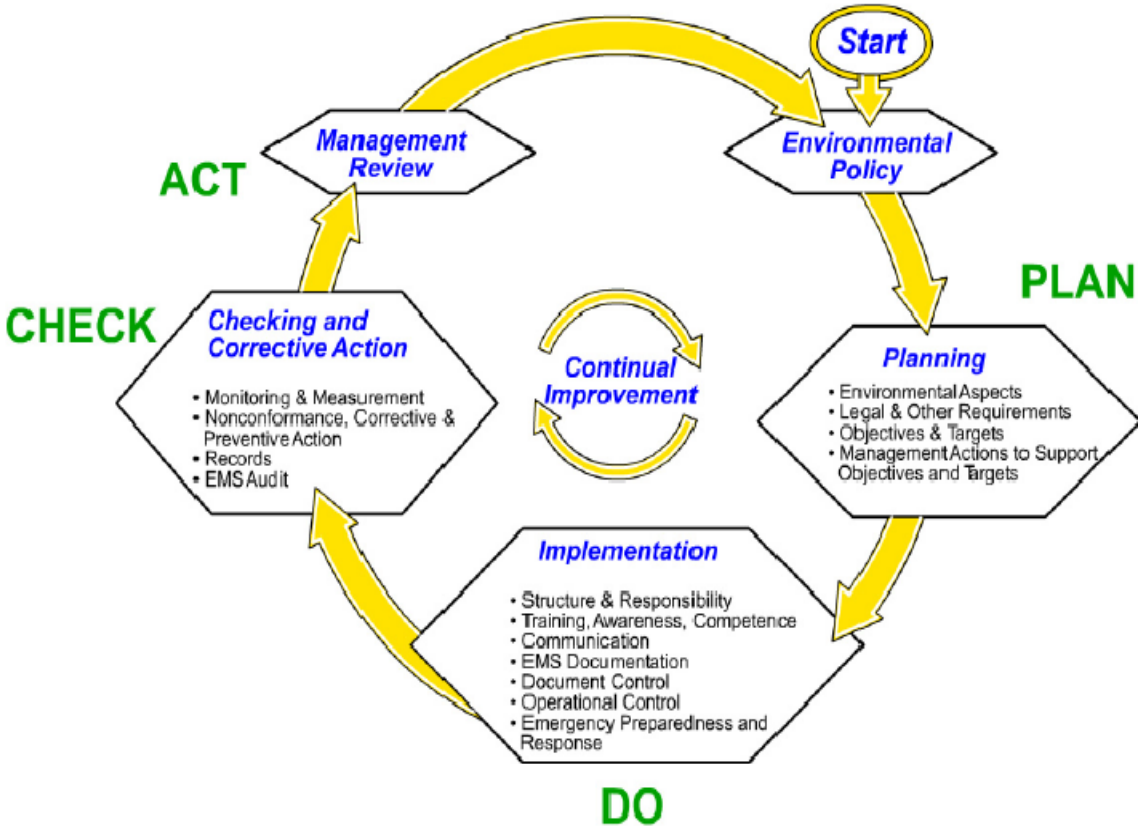


Fig. 3.3. BJC EMS key elements.

BJC has established a set of core EMS objectives that remain relatively unchanged from year to year and are included in the *Integrated Safety Management System Description* (BJC 2009, 2010). These objectives are generally applicable to all operations and activities throughout BJC's work scope. The core environmental objectives are based on complying with applicable legal requirements and sustainable environmental practices contained in DOE Order 450.1A and include the following:

- comply with all environmental regulations, permits and regulatory agreements
- encourage reducing or eliminating the generation and/or toxicity of waste and other pollutants at the source through P2 and maximize recycle and reuse potential
- encourage reducing or eliminating acquisition, use, and release of toxic, hazardous, and radioactive materials by acquiring environmentally preferable products and conduct of operations
- reduce degradation and depletion of environmental resources through post–consumer material recycling and energy, fuel, and water conservation efforts
- reduce or eliminate the environmental impact of electronics assets

In addition to the core objectives listed above, BJC establishes company-level ad hoc objectives and targets each year that are established based on changing priorities, changing legal requirements and other areas of emphasis. Each year, the complete list of core and ad hoc environmental objectives and targets are distributed by the BJC President for the upcoming calendar year. The list also includes designation of responsibility and timeframes by which actions are to be taken to facilitate achievement of the objectives

and targets. The status of objectives and targets are periodically reviewed throughout the year at EC&P leads meetings and management reviews.

Project-specific EMS objectives and targets are developed annually near the beginning of each calendar year and are based on company-level objectives and targets taking into consideration significant environmental aspects and legal requirements of their project operations. The status of the environmental objectives and targets at the project level are reviewed periodically by the EC&P lead with project management as well as with the EC&P Program Manager during EC&P leads meetings.

The EMS is part of the ISMS in that it relies on the existing ISMS five core functions, seven guiding principles, and worker participation to fully integrate EC&P considerations into all work processes. As previously stated, BJC's EMS is based on the elements and framework contained in ISO 14001. Each element is addressed in BJC's *EMS Implementation Description—General Requirements, Environmental Policy, Environmental Planning, Implementation and Operations, Checking, and Management Review* (BJC 2009a). For each element, this document provides the related implementing documents, implementation description, and roles and responsibilities. Depending on the scope of work involved, there are EMS attributes or actions related to the environment that an individual could apply at each of the five core functions. Such actions are specifically relevant to environmental compliance, protection of natural resources, prevention of pollution, and minimization of waste. When EMS attributes or actions are applied through the ISMS process, the elements of the EMS Program become an integral part of a continuing cycle of planning, implementing, evaluating, and improving processes and actions. The EMS is supported at each of the five core functions of ISMS, and the ISMS provides the framework for implementing EMS policies, processes, and tools in all phases of work. BJC's definition of "safety" embodies protection of workers and the public health as well as the environment.

3.2.5 Implementation and Operations

BJC protects the safety and health of workers and the public by identifying, analyzing, and mitigating aspects, hazards, and impacts and by implementing sound work practices. All BJC 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. BJC internal management assessments also provide a measure of how well EMS attributes are integrated into work activities through the ISMS. BJC has embodied its program for environmental compliance and protection of natural resources in a company-wide environmental management and protection policy. The policy is BJC's fundamental commitment to incorporating sound environmental management practices into all work processes and activities.

3.2.6 Pollution Prevention/Waste Minimization

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

BJC recycles office and mixed paper, cardboard, phone books, newspapers, magazines, aluminum cans, antifreeze, engine oils, batteries (lead 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 (CRT and LCD). Other recycling opportunities include unique structural steel, stainless steel structural members, transformers, and electrical breakers. Figure 3.2 shows the P2 recycling activities at ETTP related to solid waste reduction.

BJC's electronic stewardship is award winning. For 2009, the Information Technology (IT) department's electronic stewardship and life cycle management program won a DOE Environmental Management "Best in Class" award and a DOE EStar Award.

3.2.7 Competence, Training, and Awareness

The BJC 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 the procedure *Training Program*, BJC-HR-0702. Completion and documentation of training, including required reading, are managed by the Local Education Administration Requirements Network (LEARN).

A number of training modules and awareness tools have been developed and used to increase general knowledge and awareness of BJC's environmental policy and to communicate roles and responsibilities for all employees. For example, the following training modules contain specific information regarding BJC's environmental policy and EMS:

- Consolidated Annual Training (Module #28307)
- EMS Delta Briefing (Module #28848)
- ISMS EMS Leadership Workshop Training (Module #26930)
- PWT3 Park Worker Training (Module #21221)

Additionally, employees and subcontractors involved in a work activity that may have a significant impact on the environment are provided additional information through review of work packages, procedures, pre-job briefings, and review of Safety Task Analysis Risk Reduction Talk (STARRT) cards, which address potential environmental issues and concerns.

In addition to the formal training modules and project-specific work briefings, BJC uses a number of tools and mechanisms to constantly reinforce awareness and knowledge of BJC's EMS. Some examples of these tools include the following:

- "Green Light" on EMS
- BJC "Notes"
- Employee information monitors
- EMS brochures
- EMS crossword puzzle
- EMS fact sheets
- Environmental pagers
- Internal BJC EMS website
- Internal BJC home page web content
- Meeting safety topics
- "Safety Pause" meetings

3.2.8 Communication

BJC has a written communication plan that addresses both internal and external communication of important company information, including information related to EMS.

BJC has decided to communicate externally regarding environmental aspects on the BJC public website, which includes a summary environmental policy statement and a list of environmental aspects as well as a link to the *ISMS Description* (BJC 2009, 2010). A number of other documents and reports are also published and made available to the public that address environmental aspects and cleanup progress (e.g., the *Annual Site Environmental Report*, *Annual Clean-Up Progress Report*). BJC participates in a number of public meetings related to environmental activities at the site [e.g., Site Specific Advisory Board meetings, permit review public meetings, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) decision document public meetings]. Written communications from external parties are tracked using the weekly Open Action Report.

3.2.9 Benefits and Successes of EMS Implementation

BJC utilizes EMS objectives and targets, a 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 BJC's P2/Waste Minimization (WMin) Program Plan (BJC 2009b).

BJC has initiated energy conservation measures that saved money, energy, and, subsequently, pollution from power generation or vehicle emissions as follows.

- The reindustrialization organization is in the process of purchasing and installing sensors that will automatically turn lights off when people are not present, as well as reminding personnel to turn off lights when leaving a room.
- Energy Star appliances are purchased whenever possible. These appliances meet strict energy-efficient guidelines set by EPA and DOE. Energy Star is an international standard for energy-efficient consumer products.
- The IT department purchases only Electronic Product Environmental Assessment Tool (EPEAT) silver- or gold-certified computers and monitors. EPEAT is an easy-to-use online tool that helps institutional purchasers evaluate, compare, and select electronic products based on their environmental attributes. Additionally, the IT department is creating awareness and is implementing desktop energy-saving measures for computers, monitors, printers, and copiers.
- The Space Consolidation/Utilization Project implemented during FY 2009 eliminated 45 facility/trailer types resulting in an 805,000-kW/hr energy use avoidance.
- The RFID Shipping Project implemented during FY 2009 avoided the use of 10,332 gal of diesel fuel due to a significant decrease in idling time, in addition to improving the truck-loading process of the K-1070-B Burial Ground project and saving 1,667 gal of diesel fuel.
- General Maintenance purchases WaterSense replacement parts when performing repairs. WaterSense is an EPA program designed to encourage water efficiency through the use of a special label on consumer products such as toilets, flushing urinals, bathroom sink faucets, and accessories.
- Garage personnel use recycled content coolant (ethylene glycol) that is a 50/50 blend of recycled/new coolant and several bio-based products including oils and cleaners, which result in less toxic or non-toxic waste generation.

3.2.10 Management Review

Senior management review of the EMS is performed at several layers and frequencies. A formal annual review/presentation with BJC senior management is conducted at least once per year that addresses the requirement elements contained in this section. BJC senior management includes the President/General Manager, Vice President/Deputy General Manager, and Manager Of Safety Systems Integration. At least two of the senior managers are present for management reviews. Also, as part of the ISMS annual report, a narrative report of the EMS and its effectiveness is published that addresses each requirement element. The *ISMS Description* (BJC 2009, 2010) is updated annually and signed by the BJC President to address improvements, lessons learned, and to update objectives and targets as necessary. The environmental policy is also reviewed during the management review annually and revised as necessary.

In addition to the formal annual reviews, monthly review of key DOE metrics are submitted to DOE and discussed with senior management in the monthly Zero Accident Council meeting. These metrics relate to the compliance-based EMS objectives and targets. On a periodic basis, the status of EMS objectives and targets are reviewed at the monthly EC&P Leads meetings and project meetings as appropriate.

ETTP achieved 17 of 21 environmental targets on schedule in 2009. Highlights included increased recycling and recycling initiatives, 100% purchase of EPEAT silver-or gold-certified computer equipment, zero reportable releases to the environment, and zero unpermitted discharges. Four environmental targets were not achieved, such as zero notices of violations.

3.3 Compliance Programs and Status

3.3.1 Environmental Permits

Table 3.1 contains a list of environmental permits that were effective in 2009 at ETTP.

Table 3.1. Permit actions at East Tennessee Technology Park

Regulatory driver[a]	Permit title/description	Permit No.	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	Operating permit—Tennessee Air Quality Act for K-1407-U VOC Air Stripper.	045253P	06-20-96	10-01-00	DOE	BJC	BJC
CAA	Operating permit—Tennessee Air Quality Act for K-1425 Waste Oil/Solvent Storage Tank Farm	029895P	09-21-90	10-01-95	DOE	BJC	BJC
CAA	Operating permit—Tennessee Air Quality Act for K-1435-C Liquid Waste Tank Farm	037460P	03-31-94	10-18-98	DOE	BJC	BJC
CAA	Permit to construct—Tennessee Air Quality Act for K-1423 TSCA Solids Waste Repack Facility	958435P	10-10-05	10-10-06	DOE	BJC	BJC
CAA	Permit to construct—Tennessee Air Quality Act for TSCA Incinerator	957808I	01-25-05	03-31-10	DOE	BJC	BJC
CWA	National Pollutant Discharge Elimination System (NPDES) permit for the Central Neutralization Facility Wastewater Treatment System	TN0074225	10-01-03	09-30-08	DOE	BJC	BJC
CWA	NPDES permit for treated liquid effluent	TN0002950	03-01-04	03-31-08	DOE	DOE	BJC
CWA	State operating permit—Waste Transportation Project; Blair Road and Portal 6 Sewage Pump and Haul Permit	SOP-05068	02-28-06	02-28-09	DOE	URS	URS
CWA	State operating permit—K-1310-DF and K-1310-HG Trailers	SOP-99033	04-29-05	04-29-10	DOE	BJC	BJC

Table 3.1 (continued)

Regulatory driver[a]	Permit title/description	Permit No.	Issue date	Expiration date	Owner	Operator	Responsible contractor
CWA	State operating permit—K-1065 Facility; Trailer K-1310-BS added in March 2009	SOP-01042	11-30-06	05-31-10	DOE	BJC	BJC
CWA	State operating permit—EMWMF. 5000 gallon holding tank and trailers 998T-74 and 998T-75	SOP-01043	07-31-07	07-31-12	DOE	BJC	BJC
CWA	TSCA Incinerator PCB treatment authorization	Not applicable	05-27-08	Ongoing	DOE	BJC	BJC
CWA	Authorized/certified USTs at K-1414 Garage	Customer ID 30166 Facility ID 073008	03-20-89	Ongoing	DOE	BJC	BJC
RCRA	TSCA Incinerator	TNHW-015	09-28-87	09-28-97	DOE	BJC	BJC
RCRA	Container and tank storage and treatment units	TNHW-133	09-28-07	09-28-17	DOE	BJC	BJC
RCRA	Container storage and treatment	TNHW-117	09-30-04	09-30-14	DOE	BJC	BJC
RCRA	Hazardous waste corrective action permit (encompasses the entire ORR)	TNHW-121	09-28-04	09-28-14	DOE	DOE/All[b]	DOE/All[b]

[a]CAA Clean Air Act
CWA Clean Water Act
EMWMF Environmental Management Waste Management Facility
RCRA Resource Conservation and Recovery Act
TSCA Toxic Substances Control Act
PCB polychlorinated biphenyl
UST underground storage tank

[b]DOE and all Oak Ridge Reservation (ORR) co-operators of hazardous waste permits.

3.3.2 Notices of Violations and Penalties

ETTP did not receive any notices of violations or penalties from regulators in 2009. However, a NOV was issued to BJC on November 5, 2009, associated with a groundwater monitoring well at an ORR landfill of which BJC is the responsible party. This is discussed in greater detail in Section 2.5.

3.3.3 Audits and Oversight

Table 3.2 presents a summary of environmental audits conducted at ETTP in 2009.

Table 3.2. Regulatory oversight, assessments, inspections, and site visits at East Tennessee Technology Park, 2009

Date	Reviewer	Subject	Issues
February 9–11	TDEC	Annual RCRA Storage Area	0
February 13	TDEC-Nashville	NPDES permitting—new permit discussions	0
April 16–7	TDEC-Nashville	NPDES permitting—new permit discussions	0
May 14	TDEC-Nashville	NPDES permitting—new permit discussions	0
August 6	TDEC-Nashville	NPDES permitting—new permit discussions	0
September 24	TDEC-Knoxville	NPDES compliance evaluation inspection	0
October 7	TDEC	TSCA Incinerator —RCRA	0
October 8	EPA/TDEC	TSCA Incinerator —PCB inspection	0
Monthly (Jan–Dec)	TDEC—Division of Solid Waste	Active Y-12 Landfill inspection	0
Semiannual	TDEC—Division of Solid Waste	Inactive Y-12 Landfill inspection	0

Abbreviations

EPA	Environmental Protection Agency
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
TDEC	Tennessee Department of Environment and Conservation
TSCA	Toxic Substances Control Act

3.3.4 National Environmental Policy Act/National Historic Preservation 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 establish NEPA as a key consideration in the formative stages of project planning.

During 2009, 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 to the environment. To streamline the NEPA review and documentation process, DOE-ORO has approved generic categorical exclusions (CXs) that cover certain proposed activities (i.e., maintenance activities, facilities upgrades, personnel safety enhancements). A CX is one of a category of actions defined in 40 CFR 1508.4 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. BJC 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 operations, generic CXs have been issued. During 2009, no CXs were issued, and 13 review reports (for reindustrialization projects) were prepared. A review report is generated when a NEPA review is conducted and the activity is found to fall within one of the DOE-ORO generic CXs.

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 *Cultural Resource Management Plan* (DOE 2001). At ETTP, there are 135 facilities eligible for inclusion on the National Register of Historic Places. A memorandum of agreement states that two of these facilities will be maintained (the north end of K-25 and Portal 4). The other facilities are scheduled to be demolished as part of the site-wide remediation project. To date, more than 200 facilities have been demolished. Artifacts of historical and/or cultural significance are identified prior to demolition and are cataloged in a database to aid in historic interpretation of the ETTP.

3.3.5 Clean Air Act Compliance Status

The Clean Air Act (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 four major regulatory programs: the National Ambient Air Quality Standards, State Implementation Plans (SIPs), New Source Performance Standards (NSPS), 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.

In 2009, there was one source requiring continuous monitoring of criteria pollutants, and there were two major radionuclide sources with continuous sampling systems, five minor radionuclide sources, and numerous demonstrations of compliance with generally applicable air quality protection requirements (asbestos, stratospheric ozone, etc.). TDEC personnel did not inspect ETTP in 2009. In summary, there were no ETTP CAA violations or exceedances in 2009. Section 3.4 provides detailed information on 2009 ETTP activities conducted in support of the CAA.

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 our waters from pollutants. (See Appendix D for water reference standards). One of the strategies developed to achieve the goals of the CWA was EPA's establishment of limits on specific pollutants allowed to be discharged to U.S. waters by municipal sewage treatment plants and industrial facilities. The 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. ETTP discharges to the waters of the state of Tennessee under two individual NPDES permits: NPDES Permit No. TN0002950, which regulates storm water discharges, and NPDES Permit No. TN0074225, which regulates industrial discharges from the Central Neutralization Facility (CNF).

In 2009, compliance with the ETTP NPDES storm water permit was determined by approximately 835 laboratory analyses and field measurements. The NPDES permit compliance rate for all discharge points for 2009 was nearly 100% with only one measurement exceeding numeric NPDES storm water permit limits. The noncompliance occurred on January 6, 2009, at storm water outfall 340, where a measured value of 9.1 standard units (SU) exceeded the maximum pH limit of 9.0 SU. No harm to aquatic species was seen during investigation of the incident. The exceedance did not result in any discernable ecological impact. Section 3.5 contains detailed information on the activities and programs carried out at 2009 by ETTP in support of the CWA.

In 2009, compliance with the ETTP NPDES permit for industrial wastewater from CNF was determined by more than 2000 laboratory analyses and field measurements. The CNF NPDES permit compliance rate for 2009 was 100% with no noncompliances.

3.3.7 Safe Drinking Water Act Compliance Status

ETTP's water distribution system is designated as a non-transient, non-community water system by TDEC's Division of Water Supply. The *Tennessee Regulations for Public Water Systems and Drinking Water Quality*, Chap. 1200-5-1 (TDEC 2009a), sets limits for biological contaminants and for chemical activities and chemical contaminants. TDEC requires sampling for the following constituents for compliance with state and federal regulations:

- chlorine residual levels,
- bacteriological (total coliform),
- lead and copper, and
- disinfectant by-products (trihalomethanes and haloacetic acids).

The city of Oak Ridge supplies potable water to the ETTP water distribution system and meets all regulatory requirements for drinking water. The water treatment plant, located on the ORR, southwest of the ETTP, is owned and operated by the city of Oak Ridge.

In 2009, sampling results for chlorine residue, bacterial constituents, disinfectant by-products, lead, and copper were all within acceptable limits for the ETTP water system.

3.3.8 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 2009, ETTP had approximately nine generator accumulation areas for hazardous or mixed waste.

ETTP is also regulated as a handler of universal waste (e.g., fluorescent lamps, batteries, and other items regulated under 40 CFR 273). Mercury-containing equipment at ETTP is managed as universal waste.

Additionally, some batteries are managed according to 40 CFR Part 266.80. This applies to the management of spent lead-acid batteries that are being reclaimed.

ETTP is registered as a large-quantity generator under EPA ID No. TN 0890090004 and is permitted to transport hazardous wastes and to operate Resource Conservation and Recovery Act (RCRA)-permitted hazardous waste treatment and storage units. During 2009, 20 units operated as permitted units.

ETTP's RCRA storage and treatment facilities (or units) operate under three permits: TNHW-117, TNHW-133, and TNHW-015. The permits are modified when necessary. TDEC approved one permit modification in 2009.

3.3.9 RCRA Underground Storage Tanks

Underground storage tanks (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA (40 CFR 280). EPA granted TDEC authority to regulate USTs containing petroleum under TDEC Rule 1200-1-15; however, EPA still regulates hazardous-substance USTs.

ETTP has two USTs registered with TDEC under Facility ID Number 0730088.

3.3.10 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.

In 1989, the ORR was placed on the NPL. In 1992, the ORR Federal Facility Agreement among EPA, TDEC, and DOE became effective and established the framework and schedule for developing, implementing, and monitoring remedial actions on the ORR. ETTP's primary mission is D&D of surplus facilities. The on-site CERCLA Environmental Management Waste Management Facility (EMWMF), located in Bear Creek Valley, is used for disposal of waste resulting from CERCLA cleanup actions on the ORR. The EMWMF is an engineered landfill that accepts low-level radioactive, hazardous, asbestos, and polychlorinated biphenyl (PCB) wastes and combinations of the aforementioned wastes in accordance with specific waste acceptance criteria under an agreement with state and federal regulators.

3.3.10.1 ETTP RCRA-CERCLA Coordination

The ORR Federal Facility Agreement is intended to coordinate the corrective action processes of RCRA required under the Hazardous and Solid Waste Amendments permit with CERCLA response actions.

RCRA groundwater monitoring data are reported yearly to TDEC and EPA in the annual CERCLA *Remediation Effectiveness Report* (DOE 2009) for the ORR.

Periodic updates of proposed construction and demolition activities and facilities at ETTP have been provided to managers and project personnel from the TDEC DOE Oversight Division and EPA Region 4. A CERCLA screening process is used to identify proposed construction and demolition projects and facilities that warrant CERCLA oversight. The goal is to ensure that modernization efforts do not adversely impact the effectiveness of previously completed CERCLA environmental remedial actions or future CERCLA environmental remedial actions.

3.3.11 Toxic Substances Control Act Compliance Status

3.3.11.1 Polychlorinated Biphenyls

On April 3, 1990, DOE notified EPA Headquarters (as required by 40 CFR 761.205) that ETTP is a generator with on-site storage, a transporter, and an approved disposer of PCB wastes.

PCB waste generation, transportation, disposal, and storage at ETTP is regulated under the EPA ID number TN0890090004. In 2009, ETTP operated approximately 35 PCB waste storage areas in ETTP generator buildings and, when longer-term storage of PCB/radioactive wastes was necessary, RCRA-permitted storage buildings. The continued use of authorized PCBs in electrical systems and/or equipment (e.g., transformers, capacitors, rectifiers) is regulated at ETTP. Most Toxic Substances Control Act (TSCA)-regulated equipment at ETTP has been disposed of. However, some ETTP facilities continue to use (or store for future reuse) PCB-contaminated equipment (i.e., transformers).

Because of the age of many of ETTP's 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, the DOE Oak Ridge Office and EPA Region 4 consummated a major compliance agreement known as the "Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement," which became effective December 16, 1996. The agreement 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 records and reporting requirements on the ORR. A major focus of the agreement is the disposal of PCB waste. As a result of that agreement, DOE and BJC continue to notify EPA when additional unauthorized uses of PCBs, such as PCBs in paint, adhesives, electrical wiring, or floor tile, are identified at ETTP.

ETTP is home to the TSCA Incinerator (See Fig. 3.4). On December 2, 2009, the TSCA Incinerator ceased operations as a waste incinerator and transitioned to a facility closure and decommissioning mode.

Fig. 3.4. TSCA Incinerator.

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

The Emergency Planning and Community Right-to-Know Act (EPCRA) and Title III of SARA require that facilities report inventories and releases of certain chemicals that exceed specific release thresholds. The reports are submitted to the local emergency planning committee and the state emergency response commission. ETTP complied with these requirements in 2009 through the submittal of reports under EPCRA Sections 302, 303, 311, and 312. ETTP had no releases of extremely hazardous substances, as defined by EPCRA, in 2009.

3.3.12.1 Material Safety Data Sheet/Chemical Inventory (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 the Sect. 312 requirements. Of the chemicals identified for CY 2009 on the ORR, 11 were located at ETTP.

Private-sector lessees associated with the reindustrialization effort were not included in the 2009 submittals. Under the terms of their lease, lessees must evaluate their own inventories of hazardous and extremely hazardous chemicals and must submit information as required by the regulations.

3.3.12.2 Toxic Chemical Release Reporting (Section 313)

DOE submits annual toxic release inventory reports to EPA and TDEC on or before July 1 of each year. The reports cover the previous calendar year and address releases of certain toxic chemicals to air, water, and land as well as waste management, recycling, and pollution prevention activities. Threshold determinations and reports for each of the ORR facilities are made separately. Operations involving toxic release inventory 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 one or more of the thresholds.

3.4 Air Quality Program

The EPA Mandatory Reporting of Greenhouse Gases (GHGs) Rule was enacted September 30, 2009, under 40 Code of Federal Regulations (CFR) Part 98.2. According to the rule, in general, the emissions threshold for reporting requirement is 25,000 metric tons or more of carbon dioxide equivalent (CO2e) per year. A 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 calendar year 2010 reporting period. Based on projected GHG emissions from all remaining sources not to exceed the annual threshold limit, ETTP would not be subject to mandatory annual reporting under the GHG Rule beginning with the 2010 calendar year.

Prior to December 2, 2009, and the subsequent ceasing of operations, ETTP airborne discharges from the TSCA Incinerator were generated while treating solid and liquid wastes from residual contamination, waste storage and treatment operations, site remediation and demolition activities, and site maintenance support activities. The primary source of radiological emissions at ETTP was the TSCA Incinerator, which was the major active airborne radionuclide emission source at ETTP regulated under 40 CFR 61 National Emission Standards for Hazardous Air Pollutants: Department of Energy facilities (rad NESHAP). The TSCA Incinerator was equipped with extensive exhaust gas pollution control equipment, enabling it to operate in regulatory compliance with both CAA and the Tennessee air pollution control regulations.

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 rad NESHAP emission standard. Source emissions used to calculate the dose are determined using EPA-approved methods ranging from continuous stack sampling systems to conservative estimations based on process and waste characteristics. Continuous sampling systems are required for radionuclide-emitting sources that have the potential dose impact of not less than 0.1 mrem per year to any member of the public. The TSCA Incinerator and the K-1423 Solid Waste Repack Facility (K-1423) are the only ETTP sources that require continuous sampling systems. ETTP rad NESHAP sources—K-1093/K-1094 Waste Sorting Tent, K-1407 CNF, K-1423, and the K-2500-H Segmentation Shops A and D—are considered minor based on emissions evaluations using EPA-approved calculation methods.

During 2009 the TSCA Incinerator was the only operating source at ETTP required to continuously measure radionuclide emissions. The TSCA Incinerator contributed approximately 8% of the total 2009 ETTP dose to the ETTP-specific theoretically most exposed member of the public. Figure 3.5 conservatively illustrates the estimated monthly and annual dose from TSCA Incinerator operations during 2009. During this reporting period, tritium (31%) was the major dose contributor, followed by ^{238}U (22%) and ^{234}U (18%). The total estimated airborne dose for all ETTP rad NESHAP stack emission sources to the theoretically most exposed member of the public specific to ETTP facility was 0.06 mrem/year.

The CNF was the highest contributor to radiological from airborne emission with approximately 70% of the total ETTP specific dose impact. The emissions of radionuclides showed a dose increase as compared to the 2008 reporting period. This result, a lower TSCA Incinerator dose impact, and the close proximity of the public identified CNF as the highest ETTP contributor for 2009.

The K-1423 operation air permit does not require direct monitoring of stack radionuclide emission. Compliance is demonstrated using onsite ambient air environmental sampling for determining the dose impacts on members of the public. The annual dose as measured by environmental sampling at Station K11 (see Fig. 3.6) was 0.14 mrem. This conservatively represents the exposure of a member of the public if located at this station. The station is conservatively located and collects samples that are potentially impacted by all ETTP sources of radionuclide emissions, including both stack and fugitive emissions, to ensure conservative reporting of the estimated dose to an actual onsite member of the public.

Both sources are far below the 10-mrem/year effective dose (ED), which is the rad NESHAP regulatory limit and the applicable standard for combined radionuclide emissions from all ORR facilities. Emissions from these sources as well as all other ETTP minor stationary sources of radionuclides are included in the annual dose assessment report submitted Jun 24, 2010 as required under Radioactive NESHAP (Rad-NESHAP) regulations.

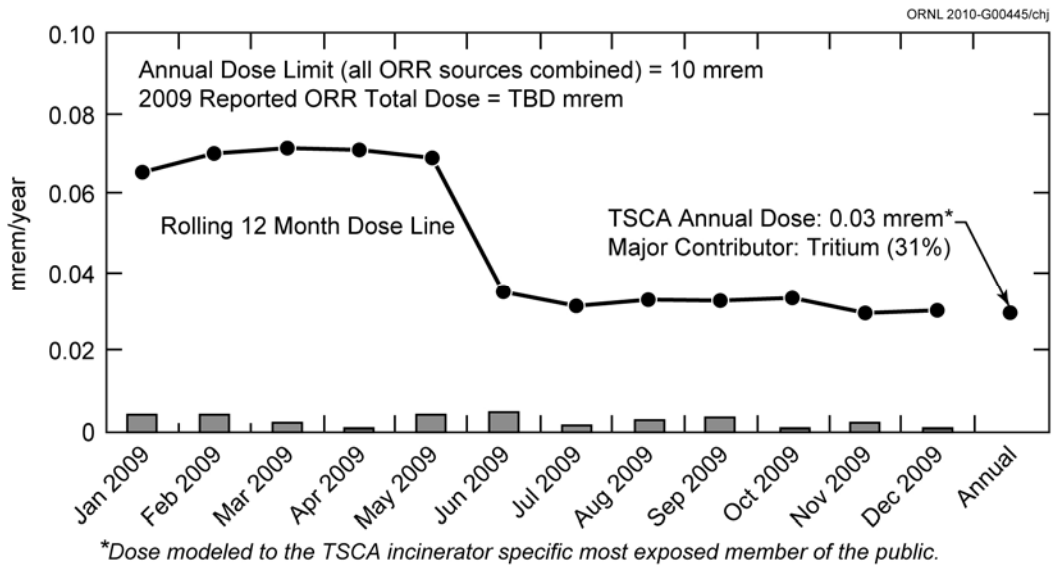


Fig. 3.5. Dose from TSCA Incinerator operations.

ETTP operations during 2009 included two stationary sources with permits restricting non-radiological emissions: the TSCA Incinerator and the CNF volatile organic compound (VOC) air stripper. All other stationary sources were evaluated and determined to be below any emission level that would require permitting.

The TSCA Incinerator was the largest permitted operating nonradionuclide air emissions source and the largest source of criteria pollutant emissions such as nitrogen oxides (NO*x*) and carbon monoxide (CO) for all sources listed in the DOE ETTP Major Source Operating Permit application. Total NO*x* emissions for 2009 were 15.7 tons (31,347 lb). Total CO emissions were 3.9 tons (7,837 lb). Emissions of all nonradiological regulated air pollutants from TSCA Incinerator operations are noted in Figs. 3.7–3.9. In the three categories of data presented, emissions are compared with EPA ambient air quality standards and are identified as criteria pollutants (including particulate matter [PM]); hazardous air pollutants as regulated under 40 CFR 63, Subpart EEE, "National Emission Standards for Hazardous Air Pollutants for Source Categories (Maximum Achievable Control Technology [MACT])" and other pollutants regulated under Permit No. 957808I, as issued by TDEC. Each data point on these figures represents the accumulated pollutant emissions for a continuous 12-month period. Table 3.3 lists all TSCA Incinerator emission limits that include those pollutant parameters associated with Figs. 3.7–3.9. All graphical information is based on the allowable rates identified in the TSCA Incinerator air permit. Actual emissions are conservatively calculated using removal efficiencies as determined from the most recent permit-required air test or other previously approved compliance demonstration test.

All reported emission data for the TSCA Incinerator were within permitted limits. For criteria pollutants, the highest emissions result against the permitted limit and based on an annualized comparison was mercury at 29.6%. Emissions of the combination of lead and cadmium were 23.3% of the permitted limit. The highest emissions result of any other regulated pollutant was for carbon monoxide (CO) at 19.3%.

The CNF air stripper is the only other ETTP air pollutant source under BJC authority that is permitted for non-radionuclide emissions. All process data records and the calculated maximum VOC emission rate

for the CNF air stripper were within permitted limits for 2009. The calculated maximum VOC emission rate was only 0.09 lb/hr as compared to the permitted limit of 1.0 lb/hr.

ETTP operations released airborne pollutants from a variety of other minor pollutant emitting sources, such as stacks, vents, and fugitive and diffuse activities. With the exception of the TSCA Incinerator and the CNF air stripper, all other stack and vent emissions are calculated as allowed based on their low emissions to document the verification of their minor source permit exempt status under all

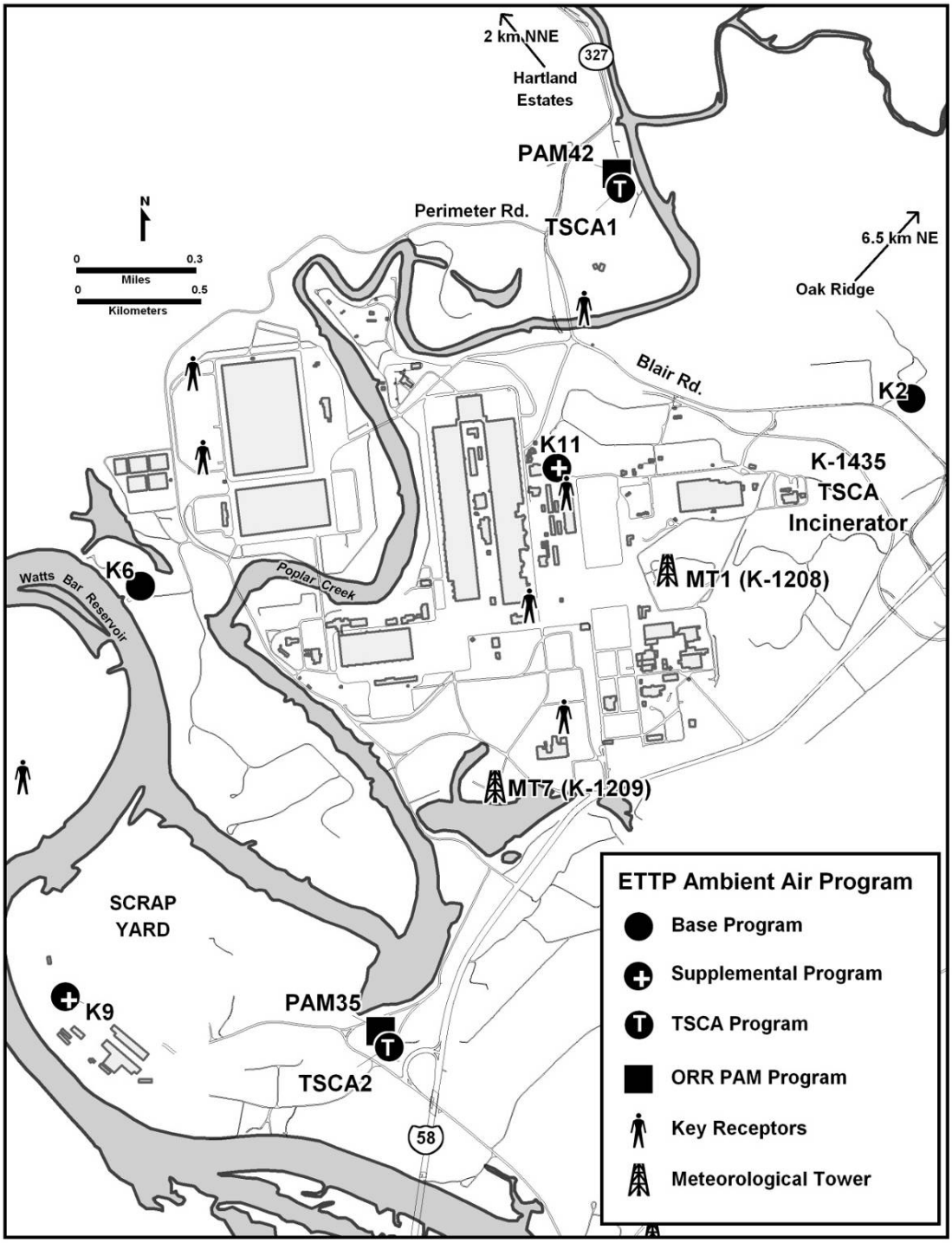
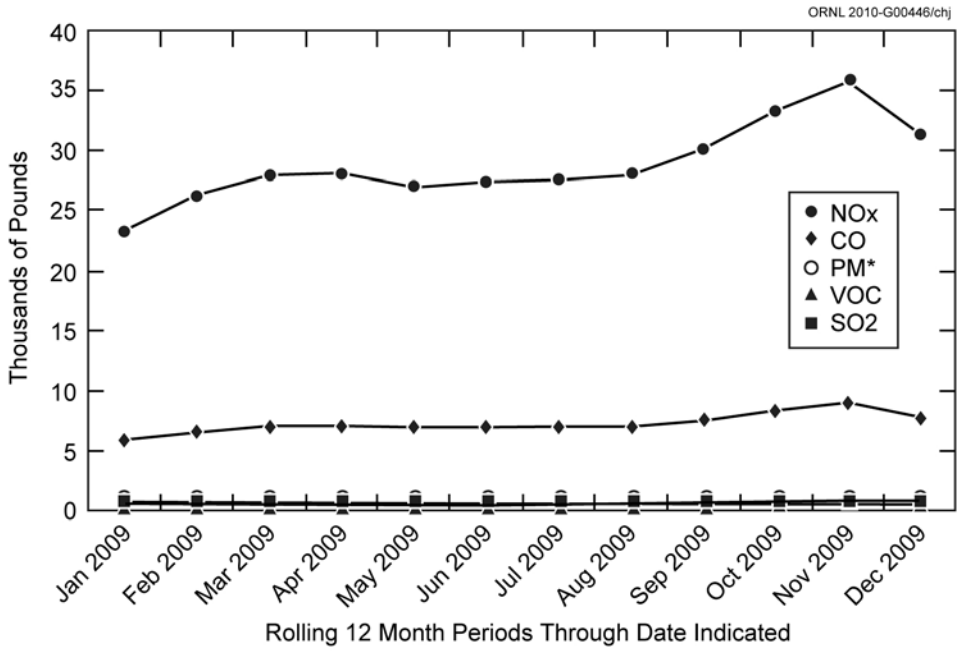
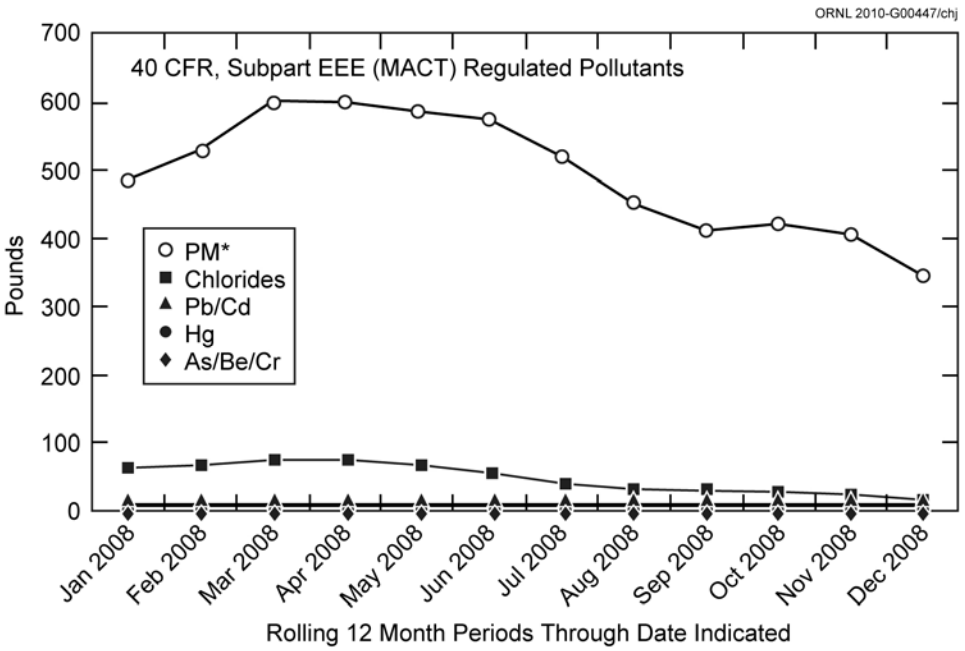


Fig. 3.6. ETTP ambient air monitoring station locations.



*PM is also regulated under 40 CFR 63, Subpart EEE (MACT).

Fig. 3.7. TSCA Incinerator criteria pollutant emissions.



*PM is also regulated as a criteria pollutant.

Fig. 3.8. TSCA Incinerator pollutant emissions regulated under maximum achievable control technology standards.

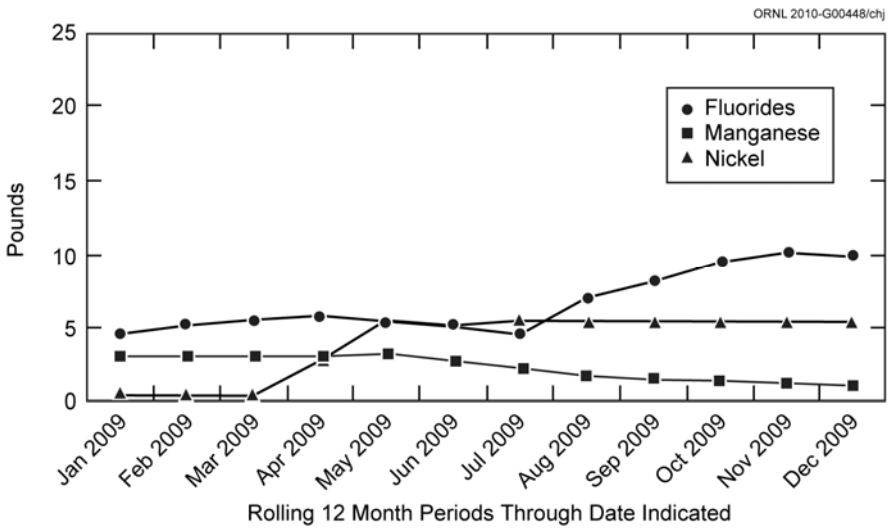


Fig. 3.9. TSCA Incinerator other regulated pollutant emissions.

Table 3.3. Allowable and actual emissions for the Toxic Substances Control Act Incinerator

Pollutant	Limitation	Annual equivalent	Actual emissions	Percent of Limit
Radionuclides	10 mrem/year—all DOE ORR emission sources	10 mrem/year—all DOE ORR emission sources	0.03 mrem/year	0.3
	TSCA administrative limit	7.5 mrem/year		0.4
Particulate matter (PM)	30 mg/dscf	5.0 ton/year	0.17 ton/year	3.1
Sulfur dioxide (SO_2)	8.8 lb/h	38.5 ton/year	0.03 ton/year	0.1
Oxides of nitrogen (NO_x)	Not applicable (N/A)	N/A	15.7 ton/year	N/A
Volatile organic compounds (VOCs)	1.15 lb/h	5.0 ton/year	0.39 ton/year	7.6
Carbon monoxide (CO)/total hydrocarbons (HC)	100 ppmv CO/10 ppmv HC	20.3 ton/year CO/2.03 ton/year HC	3.9 ton/year CO	19.3
Low-volatile metals:	92 µg/dscm combined As-Be-Cr	31.5 lb/year	4.0 lb/year	12.3
Beryllium (normal operations)	0.02 lb/d	7.3 lb/year	0.06 lb/year	0.8
Beryllium (compliance testing)	0.075 lb/d	N/A	N/A	N/A
Semivolatile metals:	230 µg/dscm combined Cd-Pb	76.7 lb/year	17.8 lb/year	22.2
Manganese	N/A	N/A	1.1 lb/year	N/A
Nickel	N/A	N/A	5.27 lb/year	N/A
Mercury	130 µg/dscm	43.1 lb/year	12.8 lb/year	29.0
Hydrogen chloride/chlorine	77 ppmv	6.5 ton/year	0.01 ton/year	0.1
Hydrogen fluoride	0.68 lb/h	5,957 lb/year	3.3 lb/year	0.2
Destruction and removal efficiency	99.99% each principal organic pollutant/99.9999% each principal organic hazardous pollutant	N/A	N/A	N/A
Dioxin/furan	0.4 ng/dscm (toxic equivalent for dioxin)	0.00013 lb/year	N/A	N/A

Abbreviations

DOE	U. S. Department of Energy
ORR	Oak Ridge Reservation
TEQ	toxic equivalent for dioxin

Units of measure

dscf	dry standard cubic foot
dscm	dry standard cubic meter
ppmv	parts per million by volume

applicable state and federal regulations. 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 and to accomplish the following:

- track long-term trends of airborne concentration levels of selected air contaminant species,
- measure the highest concentrations of the selected air contaminant species that occur in the vicinity of ETTP operations, and
- evaluate the impact of air contaminant emissions from ETTP operations on ambient air quality.

The sampling stations in the ETTP area are designated as base, supplemental, TSCA, or ORR perimeter air monitoring (PAM) stations. The base program consists of two locations using high-volume ambient air samplers. Supplemental locations are typically temporary, project-specific stations that would utilize samplers specific to a type of potential emissions. Samplers typically include high-volume systems, depending on the source emission evaluation of the project. All base, supplemental, and PAM samplers operate continuously with exposed filters collected weekly. The TSCA stations were only triggered during designated operational upsets at the TSCA Incinerator. Whenever activated, these units would run for no less than 4 h to ensure any potential plume from an event would be sampled. The TSCA Incinerator ambient air monitors were deactivated when the TSCA Incinerator combustion unit was shut down in December 2009.

The radiological monitoring results for samples collected at the two ETTP area PAM stations were provided by UT-Battelle Oak Ridge National Laboratory (ORNL) staff and are included in the ETTP network for comparative purposes. Figure 3.6 shows the location of all ambient air sampling stations that were active at some point during the CY 2009 reporting period. Figure 3.10 shows an example of a typical ETTP air monitoring station.

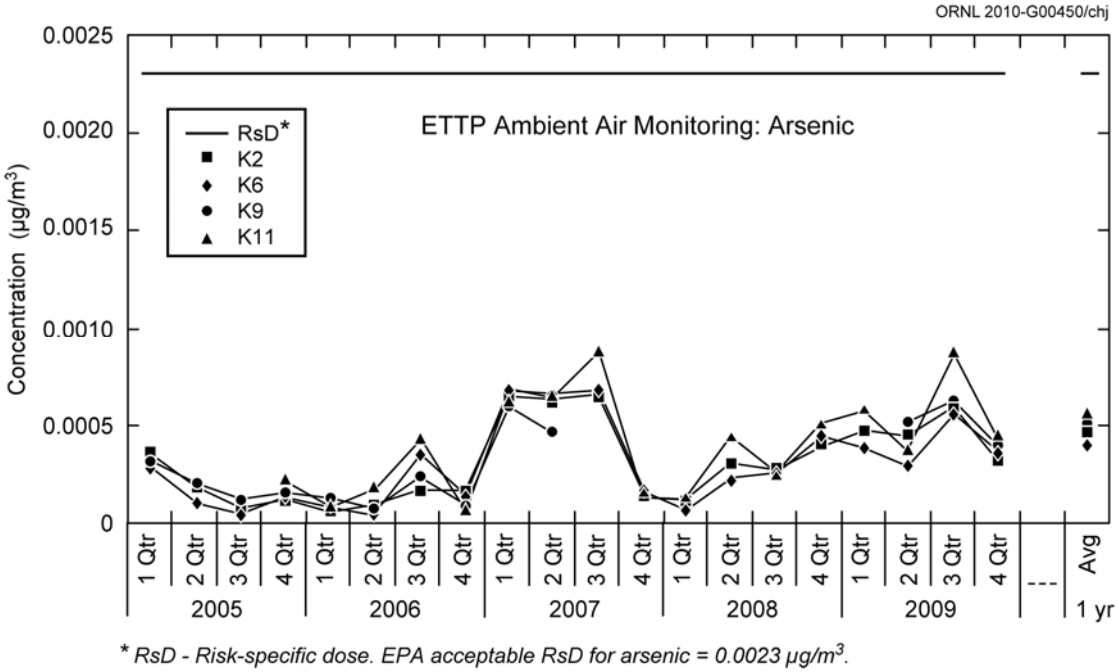
All base and supplemental stations collect continuous samples for radiological and selected metals analyses. Inorganic analytical techniques are used to test samples for the following nonradiological pollutants: As, Be, Cd, Cr, and Pb, and total uranium. Radiological analyses of samples from the ETTP stations test for the isotopes ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, ^{234}U, ^{235}U, ^{236}U, and ^{238}U; samples from ORR stations are analyzed for ^{234}U, ^{235}U, and ^{238}U.

Figures 3.11 through 3.15 illustrate the air concentrations of As, Be, Cd, Cr, and Pb for the past 5 years based on quarterly composites of weekly continuous samples. All samples were analyzed by the inductively coupled plasma-mass spectrometer (ICP-MS) analytical technique. The results are compared with any applicable air quality standards for each pollutant. Also, the minimum detectable concentration is shown for all metals, including uranium. The annualized levels of As, Be, Cd, and Pb all show results well below the indicated annual standards. Results for 2009 are slightly higher than results reported for 2008 but are within historical trends. The chromium results are conservatively compared with the EPA standard for hexavalent chromium. Lead measurement results indicate that all levels are well within the National Ambient Air Quality Standard (NAAQS) of 0.15 $\mu g/m^3$.

Total uranium metal was measured as a quarterly composite of continuous weekly samples from stations K2, K6, K9 and K11. The total uranium mass for each sample was determined by ICP-MS. Figure 3.16 illustrates the air concentrations of uranium metal for the past 5 years based on quarterly composites of weekly continuous samples. The uranium averages and maximum individual concentration measurements for all sites are presented in Table 3.4. The averaged results ranged from a minimum of approximately 0.000024 $\mu g/m^3$ up to 0.000122 $\mu g/m^3$. The highest 12-month average result (0.000122 $\mu g/m^3$) was measured at Station K2. The annual average value for all stations due to uranium was 0.000074 $\mu g/m^3$.

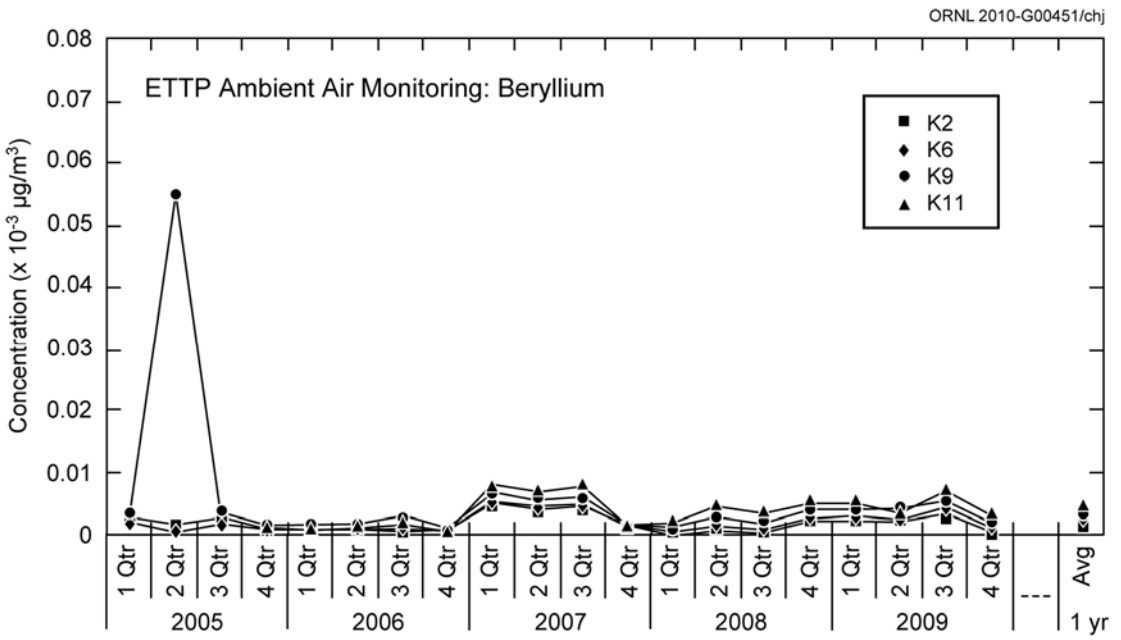
The ICP-MS results are compared with the derived concentration guide (DCG) for natural uranium as listed in DOE Order 5400.5. The DCG is based on an annual air concentration exposure that would give a dose of 100 mrem.

Fig. 3.10. Ambient air monitoring station.



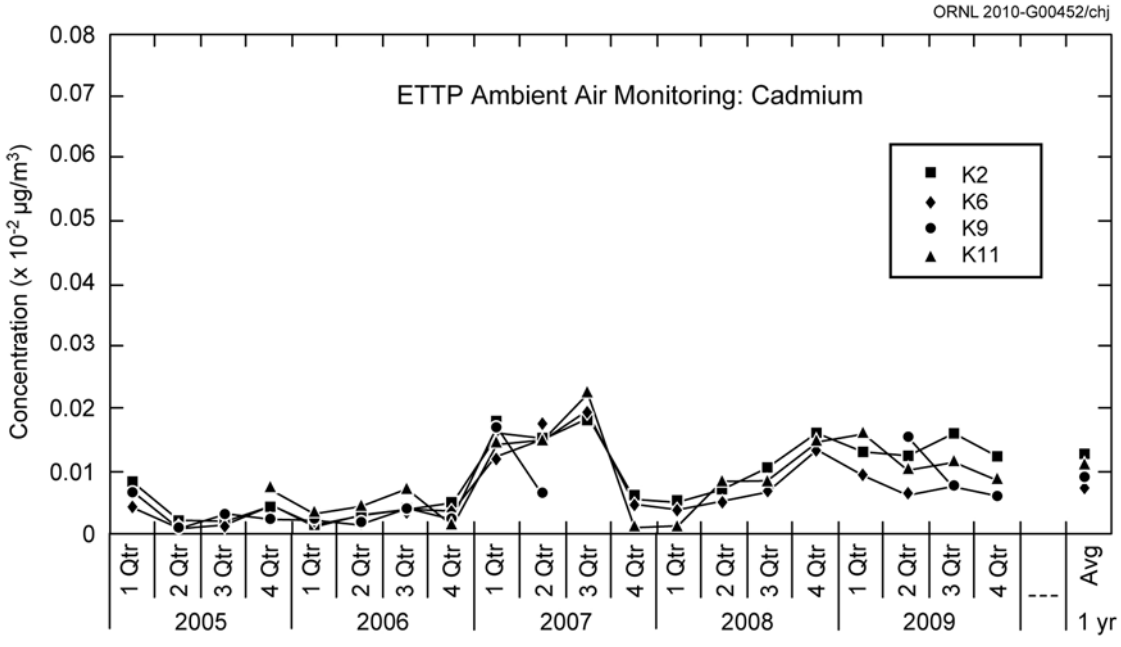
* *RsD - Risk-specific dose. EPA acceptable RsD for arsenic = 0.0023 µg/m^3.*

Fig. 3.11. Arsenic monitoring results: 5-year history through 2009.



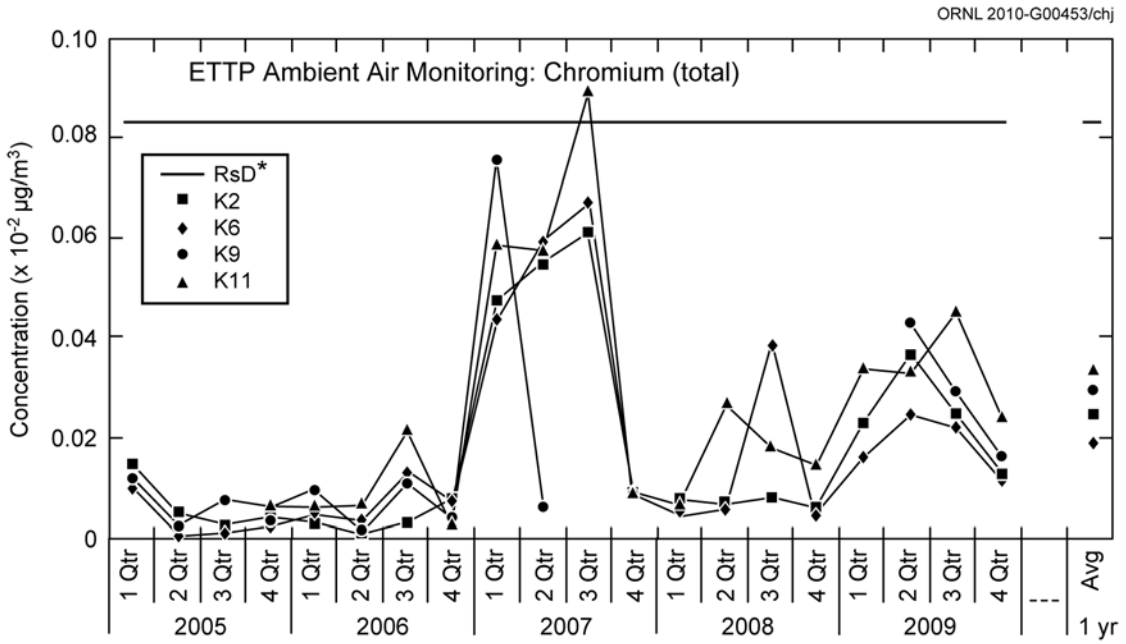
* *RsD - Risk-specific dose. EPA regulatory annual RsD for beryllium = 0.0042 µg/m^3 (40 CFR 266, App. V).*

Fig. 3.12. Beryllium monitoring results: 5-year history through 2009.



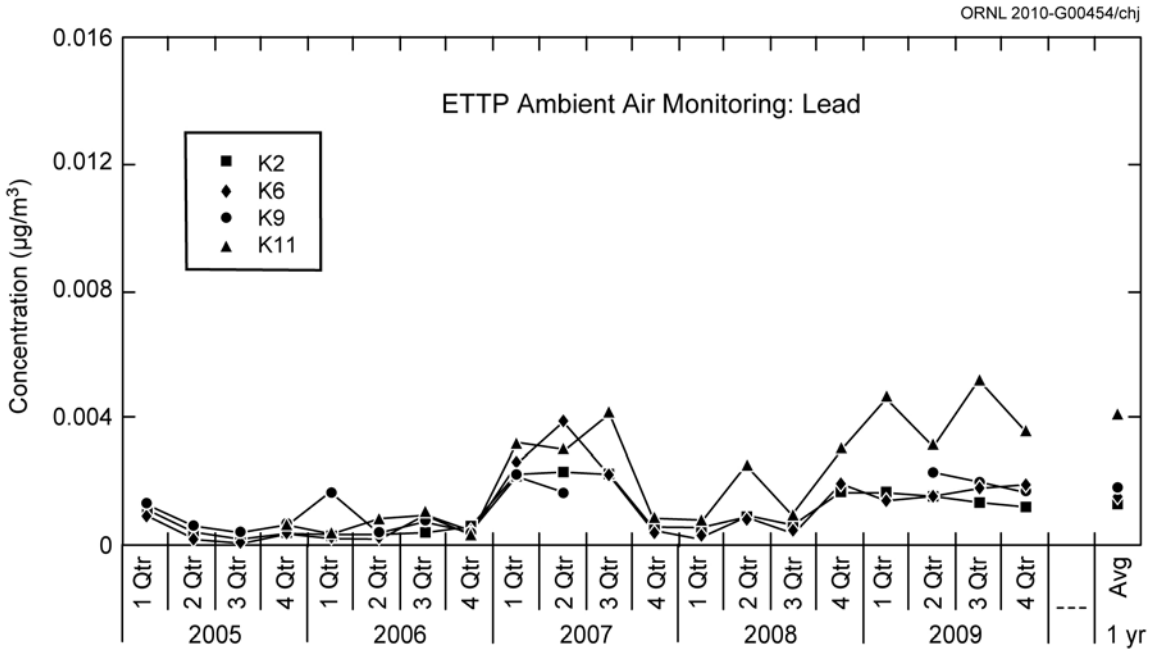
* *RsD - Risk-specific dose. EPA acceptable RsD for cadmium = 0.0056 µg/m^3.*

Fig. 3.13. Cadmium monitoring results: 5-year history through 2009.



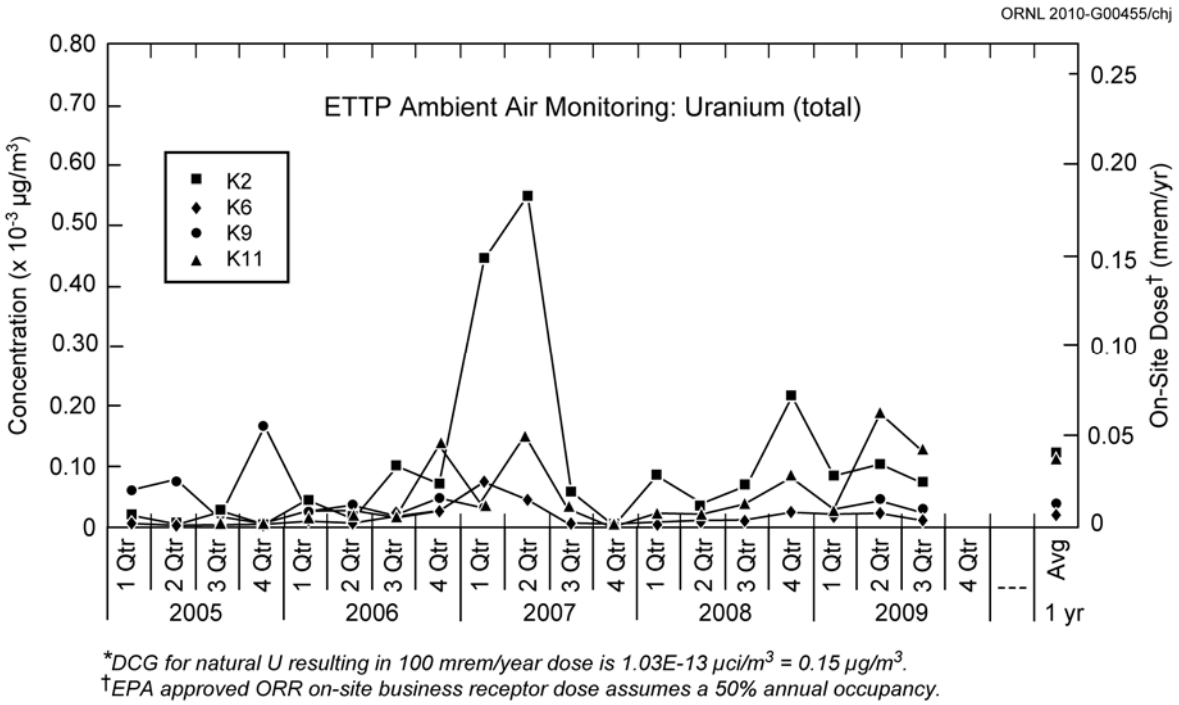
* *RsD - Risk-specific dose. EPA acceptable RsD for chromium-VI = 0.00088 µg/m^3.*

Fig. 3.14. Chromium monitoring results: 5-year history through 2009.



**National Ambient Air Quality Standard (NAAQS) for lead = 1.5 µg/m^3 per quarter through Sept. 2008.*
†*NAAQS for lead = 0.15 µg/m^3 per quarter beginning Oct. 2008.*

Fig. 3.15. Lead monitoring results: 5-year history through 2009.



*DCG for natural U resulting in 100 mrem/year dose is 1.03E-13 µci/m^3 = 0.15 µg/m^3.
†EPA approved ORR on-site business receptor dose assumes a 50% annual occupancy.

Fig. 3.16. Uranium metal monitoring results: 5-year history through 2009.

Table 3.4. Total uranium in ambient air by inductively coupled plasma analysis at ETTP, 2009

Station	No. of Samples	Concentration[a]				Percentage of DCG[b] (%)	
		µg/m^3		µCi/mL			
		Average	Max[c]	Average	Max	Average	Max
K2	4	0.000122	0.000218	8.12E–17	1.45E–16	0.08	0.15
K6	4	0.000024	0.000031	1.60E–17	2.06E–17	0.02	0.02
K9[d]	3	0.000038	0.000051	2.51E–7	3.38E–7	0.03	0.03
K11	4	0.000112	0.000194	7.49E–17	1.29E–16	0.07	0.13
ETTP total	15	0.000074	0.000218	4.93E–17	1.45E–6	0.05	0.15

[a] Mass-to-curie concentration conversions assume a natural uranium assay of 0.717% ^{235}U.
[b] DOE Order 5400.5 derived concentration guide (DCG) for naturally occurring uranium is an annual concentration of 1E–13 µCi/mL, which is equivalent to a 100-mrem annual dose.
[c] Maximum individual sample analysis result with dose calculations conservatively assuming the value to be an annual concentration.
[d] Station K9 resumed operations April 2009.

The highest annual result (K2) only corresponds to 0.08% of the DCG. The single sampling location with the highest quarterly concentration (0.000218 µg/m^3) was at station K2. If this concentration were extrapolated to a 12-month exposure, it would only represent 0.15% of the DCG. Radiochemical analyses were initiated during CY 2000 on quarterly composite samples collected at all stations. The selected isotopes of interest were ^{237}Np, ^{238}Pu, ^{239}Pu, ^{99}Tc, and isotopic uranium (^{234}U, ^{235}U, ^{236}U, and ^{238}U). Table 3.5 presents the concentration and dose results for each of the nuclides for 2009.

Table 3.5. Radionuclides in ambient air at ETTP, 2009

Station	Concentration (µCi/mL)								
	Total U	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{236}U	^{238}U
K2	5.49E–7	ND[a]	7.57E–8	7.20E–8	4.78E–7	2.25E–7	4.54E–9	ND	3.20E–7
K6	2.58E–7	ND	4.41E–8	7.46E–9	6.21E–7	2.01E–7	ND	ND	5.70E–8
K9[b]	3.71E–7	ND	2.28E–8	8.90E–9	7.16E–7	2.77E–7	ND	ND	9.42E–8
K11	2.26E–6	ND	5.68E–8	4.81E–8	3.16E–6	1.83E–6	9.36E–8	3.31E–8	3.12E–7
Station	**40 CFR 61, Effective dose equivalent (mrem/year)[c]**								
	Total U	^{237}Np	^{238}Pu	^{239}Pu	^{99}Tc	^{234}U	^{235}U	^{236}U	^{238}U
K2	0.027	ND	0.016	0.015	<0.001	0.012	<0.001	ND	0.015
K6	0.013	ND	0.009	0.002	<0.001	0.011	ND	ND	0.003
K9	0.014	ND	0.005	0.001	<0.001	0.011	ND	ND	0.003
K11	0.118	ND	0.012	0.010	0.001	0.097	0.005	0.002	0.015

[a] ND = not detected.

[b] Station K9 resumed operations April 2009.

[c] 40 CFR 61, Subpart H limit = 10 mrem per year for DOE ORR combined radionuclide airborne emissions to the most exposed member of the public.

All pollutant parameters were chosen with regard to existing and proposed regulations and with respect to activities at ETTP. Station K9 was reactivated due to new remediation activities during this reporting period that have the potential to produce fugitive airborne emissions. Changes of emissions from ETTP may warrant periodic reevaluation of the parameters being sampled. Ongoing ETTP reindustrialization efforts also introduce new locations for members of the public that may require monitoring site locations to be modified.

Figure 3.17 is a 5-year historical summary chart of dose-calculation results. Each quarterly result is the total dose from all measured radionuclides during the applicable measurement period. The 12-month rolling dose total is the summation of the previous four quarterly results. All data show potential doses well below the 10-mrem annual dose limit.

3.5 Water Quality Program

3.5.1 ETTP NPDES Permit History

The CWA/NPDES Program at ETTP ensures compliance with applicable state and federal regulations, DOE orders, and site-specific policies and procedures for ETTP activities that produce discharges to waters of the United States. It also provides management, oversight, and guidance to ETTP organizations to ensure compliance with applicable regulations and requirements.

Because the ETTP is an operating facility that discharges wastewater to several bodies of surface water, it is required to have a NDPES permit. EPA issued ETTP its first NPDES permit in 1975; the permit was to remain in effect until 1980. This permit established technology-based effluent limitations for nine outfalls.

In 1980, the site submitted an application for renewal of the permit within the required 180 days of the expiration date of the permit. The permit was not renewed, and the site operated under the expired permit until 1984. EPA issued the site a new NPDES permit in 1984 that remained in effect until February 1989. Under this permit, ETTP had eight NPDES monitoring locations, including the K-1700 weir, K-1203 Sewage Treatment Plant (STP), K-1007-P1 Pond, K-901-A Pond, K-710 STP, K-1515-C Holding Lagoon, K-1407-E/F Ponds, and the CNF.

EPA granted the state of Tennessee primacy for administration of the NPDES permitting program in 1986. The ETTP submitted an application for renewal of the NPDES permit to TDEC in August 1988. Because of staffing shortages at TDEC, permit negotiations were delayed until early 1992. Written approval was granted by TDEC to allow the site to continue operating under the conditions of the expired permit until a renewed permit could be issued.

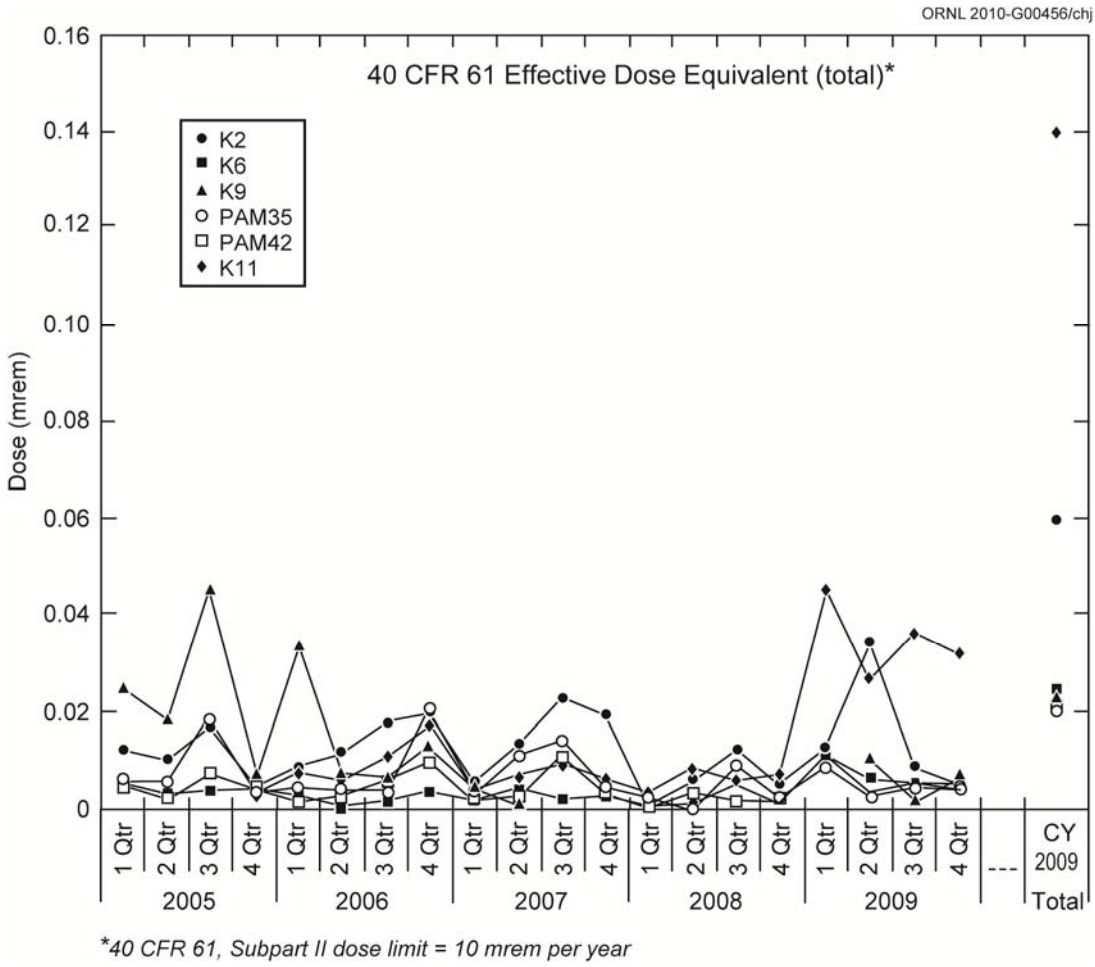


Fig. 3.17. Radionuclide monitoring results: 5-year history through 2009.

On October 1, 1992, NPDES Permit TN0002950 became effective. Several of the eight monitoring locations specified in the previous ETTP NPDES permit were re-designated as ambient surface water monitoring locations. Effluent limitations in the 1992 NPDES permit were water quality based, which reflected the trend toward considering the effects of industrial discharges on the quality of the receiving streams. In accordance with the federal regulations requiring the inclusion of storm water discharges in the NPDES permitting program, each of the 137 storm water outfalls that had been identified at ETTP were included in this permit, in addition to several other major outfalls. Also, the development of a Storm Water Pollution Prevention Program (SWP3) sampling and analysis plan was required. TDEC issued a major modification to this NPDES permit that became effective June 1, 1995. This modification included (1) removal of outfalls 010 and 012; (2) changes to monitoring requirements for outfall 014 to allow for treatment of contaminated groundwater; (3) changes to outfall 005 permit limits to make them more consistent with other sewage treatment plants; (4) clarification of some ambiguous permit language; and (5) updating of storm water outfall numbers.

ETTP NPDES Permit TN0002950 expired on September 29, 1997. An application for renewal of the ETTP NPDES permit was submitted to TDEC in March 1997. To facilitate the privatization of ETTP facilities, separate permits were requested for the K-1203 STP, the CNF, the K-1515 Sanitary Water Plant and the ETTP storm water outfalls. A general permit for the K-1515 Sanitary Water Plant (permit number TN0074233) was issued by TDEC and became effective on March 1, 2000. A permit for the K-1203 STP (permit number TN0074241) was issued by TDEC and became effective on August 1, 2003. A permit for the CNF (permit number TN0074225) was issued by TDEC and became effective on November 1, 2003. During 2009, the ETTP operated under NPDES permit TN0002950 that was issued by TDEC and became

effective on April 1, 2004 for the ETTP storm water outfalls. Although this permit expired on March 31, 2008, submission of the application for a new permit in October, 2007, allowed ETTP to continue to discharge storm water under the expired NPDES permit until issuance of a new permit.

Management of the sanitary sewer system at ETTP has been turned over to the city of Oak Ridge as part of an agreement among DOE, CROET, and the city of Oak Ridge. Under this agreement, sewage from ETTP is now being piped to the Rarity Ridge sanitary sewage treatment plant located approximately 1 mile west of ETTP. The NPDES permit for this facility is assigned to the city of Oak Ridge, which performs all monitoring and reporting required by the permit.

All BJC connections to the sewage colleciton system are covered by a "No Discharge Certification" process derived from the city of Oak Ridge wastewater control requirements in accordance with the City Sewage Treatment Plant NPDES permit. The No Discharge Certification states that BJC Operations will only discharge waste associated with normal quantities of material associated with normal human habitation to the city of Oak Ridge sewage collection system. These discharges primarily include waste from break rooms, rest rooms, change houses, etc. As part of the No Discharge Certification process, notification is provided to the city of Oak Ridge by BJC when planned operational changes are made to BJC facilities that could affect the city of Oak Ridge sewage collection system. ETTP is also subject to the provisions of the city of Oak Ridge's sewer use ordinance, which defines the terms and conditions under which the city of Oak Ridge accepts discharges to its sewage collection system.

3.5.1.1 ETTP NPDES Permit Requirements

The ETTP NPDES permit regulates the discharge from ETTP of storm water runoff, groundwater infiltration, and groundwater from sumps to Mitchell Branch, Poplar Creek, and the Clinch River. Unless otherwise stated, all storm water outfall groups also receive general site runoff, which may include storm water runoff from grassy areas, roads, and paved areas within ETTP.

There are 121 permitted storm water outfalls at ETTP regulated under NPDES Permit No. TN0002950. Of the 121 total outfalls, 38 representative outfalls are required to be sampled. The outfalls are grouped into four categories based on the types of flows being discharged through the outfalls.

- **Group IV storm water outfalls** (Table 3.6) generally flow continuously. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls receive storm water runoff from site industrial operations that have the greatest potential for contamination. The representative outfalls in this group must be monitored weekly for flow and pH and quarterly for oil and grease and total suspended solids (TSS).
- **Group III storm water outfalls** (Table 3.7) flow continuously or intermittently. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls receive storm water runoff from site industrial operations with potential for contamination. The representative outfalls in this group must be monitored monthly for flow and pH and quarterly for oil and grease and TSS.
- **Group II storm water outfalls** (Table 3.8) flow intermittently. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls do not have a significant potential to discharge contaminants. The representative outfalls in this group must be monitored quarterly for flow and pH and annually for TSS.
- **Group I storm water outfalls** (Table 3.9) flow intermittently. They receive flow from remote areas of the site, from administrative and other nonindustrial operation areas, and from site roads and railways. They may discharge storm water runoff, groundwater infiltration, and groundwater from sumps. These outfalls pose little or no threat of discharging significant amounts of contaminants. The representative outfalls in this group must be monitored semiannually for flow and pH.

Table 3.6. Group IV storm water outfalls[a,b]

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening level
Flow (mgd)	Estimated[c]	Weekly	NA	NA	NA	NA
pH (standard units)[d]	EPA-150.1	Weekly	Grab	6.0	9.0	<6.4 or >8.4
Total suspended solids (TSS) (mg/L)	SM-2540 D	Quarterly	Grab	NA	NA	70
Oil and grease (mg/L)	EPA-1664A	Quarterly	Grab	NA	NA	8.0

[a] Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2009 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, (DOE 2010).

[b] Storm water outfall 100 shall be sampled as being representative of Group IV. Group IV storm water outfalls 128 and 130 will not be sampled.

[c] Technical Release 55 (TR-55) with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in millions of gallons per day (mgd) as estimated daily maximum values. No flow field measurements are required.

[d] The pH analyses shall be performed within 15 min of sample collection.

Table 3.7. Group III storm water outfalls[a,b]

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening level
Flow (mgd)	Estimated[c]	Monthly	NA	NA	NA	NA
pH (standard units)[d]	EPA-150.1	Monthly	Grab	4.0	9.0	<6.4 or >8.4
Total suspended solids (TSS) (mg/L)	SM-2540 D	Quarterly	Grab	NA	NA	70
Oil and grease (mg/L)	EPA-1664A	Quarterly	Grab	NA	NA	8.0

[a] Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2009 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE 2010).

[b] These storm water outfalls shall be sampled as being representative of Group III: 05A, 154, 158, 170, 180, 190, 195, 210, 230, 280, 294, 340, 350, 360, 382, 390, 430, 490, 710, 724/760, and 992. These Group III storm water outfalls will not be sampled: 156, 160, 162, 168, 200, 240, 270, 292, 330, 362, 387, 440, 700, 720, 730, 740, 750, 770 and 970. Outfall 724 will be sampled as being representative of this group, if possible. However, if seasonal fluctuations in the depth of the Clinch River cause this storm water outfall to become flooded, which will preclude sample collection efforts, storm water outfall 760 will be sampled instead.

[c] Technical Release 55 (TR-55) method with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in millions of gallons per day (mgd) as estimated daily maximum values. No flow field measurements are required.

[d] The pH analyses shall be performed within 15 min of sample collection.

The development of the ETTP SWP3 is required by Part IV of the ETTP NPDES Permit No. TN0002950. The program is in place to minimize the discharge of pollutants in storm water runoff from ETTP, assess the quality of storm water discharges from ETTP, determine potential sources of pollutants affecting storm water, and provide effective controls to reduce or eliminate the pollutant sources. The SWP3 provides a means whereby sources of pollutants that are likely to affect the quality of storm water discharges are identified, best management practices that can be used to control the entry of pollutants into storm water discharges are developed, and methods for implementing pollution prevention practices are devised. Analytical parameters to be monitored at each storm drain as part of the ETTP SWP3 are chosen based upon a review of available analytical data from previous storm water sampling efforts and knowledge of past processes and practices at ETTP. Storm water discharges from ETTP are fully characterized during each NPDES permitting period and in accordance with storm water pollution prevention plans.

Table 3.8. Group II storm water outfalls[a,b]

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening level
Flow (mgd)	Estimated[c]	Quarterly	NA	NA	NA	NA
pH (standard units)[d]	EPA-150.1	Quarterly	Grab	4.0	9.0	<6.4 or >8.4
Total suspended solids (TSS) (mg/L)	SM-2540 D	Annually	Grab	NA	NA	70

[a] Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2009 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE 2010).

[b] These storm water outfalls shall be sampled as being representative of Group II: 124, 142, 150, 250, 380, 510, 570, 690, and 890. These Group II storm water outfalls will not be sampled: 120, 129, 140, 144, 146, 148, 262, 296, 297, 300, 310, 320, 530, 540, 550, 560, 580, 600, 610, 620, 640, 680, 692, 694, 696, 780, 800, 820, 830, 860, 870,880 and 892.

[c] Technical Release 55 (TR-55) method with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in millions of gallons per day (mgd) as estimated daily maximum values. No flow field measurements are required.

[d] The pH analyses shall be performed within 15 min of sample collection.

Table 3.9. Group I storm water outfalls[a,b]

Parameter	Method	Frequency	Sample type	Minimum	Maximum	Screening level
Flow (mgd)	Estimated[c]	Semiannually	NA	NA	NA	NA
pH (standard units)[d]	EPA-150.1	Semiannually	Grab	6.0	9.0	<6.4 or >8.4

[a] Detailed results can be found in Table 1.1 of *Environmental Monitoring on the Oak Ridge Reservation: 2009 Results*, Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE 2010).

[b] These storm water outfalls shall be sampled as being representative of Group I: 198, 334, 410, 532, 660, 900 and 996. These Group I storm water outfalls will not be sampled: 196, 197, 220, 322, 326, 332, 400, 420, 450, 460, 470, 500, 520, 522, 590, 650, 670, 897, 910, 920, 929, 930, 934, 940, 950, 960, 980 and 990.

[c] Technical Release 55 (TR-55) method with rainfall data will be used by the Environmental Compliance and Protection Organization to estimate flows. Flow will be reported in millions of gallons per day (mgd) as estimated daily maximum values. No flow field measurements are required.

[d] The pH analyses shall be performed within 15 min of sample collection.

The Biological Monitoring and Abatement Program (BMAP) is also a requirement of NPDES Permit No. TN0002950. Its purpose is to assess the ecological health of the ETTP's receiving streams and ponds. The BMAP consists of three tasks: toxicity monitoring, bioaccumulation monitoring, and ecological surveys of in-stream communities (both fish and benthic macroinvertebrates). The BMAP monitoring program is conducted by the ORNL Biological and Environmental Sciences (BES) under the direction of the ETTP EC&P Organization. Details of the monitoring are provided in the applicable revisions of the *East Tennessee Technology Park Biological Monitoring and Abatement Program Sampling and Analysis Plan,* (BJC 2008a, 2009c). In addition, each task is governed by task-specific procedures generated and maintained by ESD.

The toxicity monitoring task for BMAP includes tests of effluent from selected storm water outfalls concurrently with surface water from ambient sites in Mitchell Branch. Water fleas (*Ceriodaphnia dubia*) are used for toxicity testing. Caged clams *(Corbicula fluminea)* are placed in several water bodies at ETTP. After 4 weeks, they are removed and analyzed for PCBs and mercury. Fish are collected from selected water bodies at ETTP. Largemouth bass are collected from the pond sites, and redbreast sunfish are collected from creek sites. Game fish of a size large enough to be taken by sports fishermen are selected both to provide more accurate data of potential human health concerns and to reduce the amount of variation in contamination levels in the individual fish due to age and size differences. Fillets are taken from each game fish and analyzed for PCBs. Beginning in CY 2009, fish were analyzed for mercury.

Both fish communities and benthic macroinvertebrate communities at selected locations were sampled. Species diversity and density of each were examined. Detailed information on the results of the BMAP is contained in Section 3.6.

3.5.1.2 Comparison of the Storm Water Pollution Prevention Program (SWP3) Sampling Results to Screening Levels

The purpose of the SWP3 sampling is to evaluate and characterize storm water runoff from ETTP. Analytical parameters to be monitored at each storm water outfall were chosen based on the following criteria:

- a review of available analytical data from previous storm water sampling efforts;
- knowledge of various processes and functions that have been conducted at ETTP;
- current and past material storage and handling practices; and
- current and past waste disposal practices employed at ETTP.

The SWP3 sampling provides information required as part of the ETTP NPDES permit renewal process. The sampling effort also incorporates an increased emphasis on the identification of specific sources of pollutants that may be transported by storm water. This information is used to support the site cleanup program that is being conducted in accordance with CERCLA requirements.

Analytical results from the SWP3 sampling effort conducted in 2009 were compared with applicable screening levels to identify locations where storm water runoff could be contributing pollutants to receiving waters. These screening levels were applied to all data collected as part of the 2009 SWP3 storm water sampling effort. In general, the most stringent criterion that could be identified in the references given for a particular parameter was chosen as the screening level for that parameter. Applicable screening levels for data collected as part of the SWP3 sampling program are listed in Table 3.10.

Screening levels for which immediate notifications are required are provided to the analytical laboratories, in order to receive early notification that a result is approaching or has exceeded an effluent limitation. Early notification can lead to actions that prevent a noncompliance or multiple noncompliances with the permit. Notification of storm water screening level exceedances are sent automatically from designated subcontract laboratories to the BJC Sample Management Office (SMO) upon completion of sample analysis and verification of analytical results. The SMO is responsible for immediately notifying ETTP Environmental Compliance and Protection (EC&P) personnel that the screening level exceedance has occurred so that investigation can be initiated to determine if best management practices or other corrective measures may be required. When necessary, corrective actions will be implemented to ensure that an NPDES permit limit or other reference standard is not exceeded during subsequent sampling events.

The screening level for a specific radionuclide is equal to 4% of the DCG for that radionuclide in water, as listed in DOE Order 5400.5, Chap. 3; the reference standard is the DCG for each radionuclide. Four percent of the DCG represents the DOE criterion of 4 millirem EDE from ingestion of drinking water. Screening levels and reference standards are 15 pCi/L for gross alpha and 50 pCi/L for gross beta per the National Primary Drinking Water regulations, Subparts B and G (40 CFR 141).

Screening levels and reference standards for other parameters are generally based on Tennessee water quality criteria (WQC), Rules of Tennessee Division of Water Pollution Control, Chap. 1200-4-3 (TDEC 2009) and the criteria listed in the ETTP NPDES Permit TN0002950, Part III, A, Toxic Pollutants.

Table 3.10. Project quantitation[a] levels, screening levels, and reference standards for storm water monitoring at ETTP

Parameter	Project quantitation level	Screening level	Reference standard	Units
Radionuclides				
Gross alpha	5	15	15	pCi/L
Gross beta	5	50	50	pCi/L
^{60}Co	10	200	5,000	pCi/L
^{90}Sr	4	40	1,000	pCi/L
^{99}Tc	12	4,000	100,000	pCi/L
^{228}Th	1	16	400	pCi/L
^{230}Th	1	12	300	pCi/L
^{232}Th	1	2	50	pCi/L
^{226}Ra	0.3	4	100	pCi/L
^{3}H	300	80,000	2,000,000	pCi/L
^{234}U	1	20	500	pCi/L
^{235}U	1	24	600	pCi/L
^{236}U	1	20	500	pCi/L
^{238}U	1	24	600	pCi/L
Total U	1	31	770	µg/L
^{137}Cs	10	120	3,000	pCi/L
^{237}Np	0.4	1.2	30	pCi/L
^{238}Pu	1	1.6	40	pCi/L
$^{239/240}$Pu	1	1.2	30	pCi/L
Volatile organic compounds (VOCs)				
1,1,1-Trichloroethane	2	75	100	µg/L
1,1,2,2-Tetrachloroethane	2	30	40	µg/L
1,1,2-Trichloroethane	2	75	100	µg/L
1,1-Dichloroethane	2	75	100	µg/L
1,1-Dichloroethene	2	24	32	µg/L
1,2-Dichloroethane	2	75	100	µg/L
1,2-Dichloropropane	2	75	100	µg/L
2-Butanone	10	75	100	µg/L
2-Hexanone	10	75	100	µg/L
4-Methyl-2-pentanone	10	75	100	µg/L
Acetone (2-Propanone)	10	75	100	µg/L
Benzene	2	75	100	µg/L
Bromodichloromethane	2	75	100	µg/L
Bromoform	2	75	100	µg/L
Bromomethane (methyl bromide)	2	75	100	µg/L
Carbon disulfide	10	75	100	µg/L
Carbon tetrachloride	2	12	16	µg/L
Chlorobenzene	2	75	100	µg/L
Chloroethane	2	75	100	µg/L
Chloroform	2	75	100	µg/L
Chloromethane (methyl chloride)	2	75	100	µg/L
Cis-1,2-Dichloroethene	2	75	100	µg/L
Cis-1,3-Dichloropropene	2	75	100	µg/L
Dibromochloromethane	2	75	100	µg/L
Ethylbenzene	2	75	100	µg/L
Methylene chloride	2	75	100	µg/L

Table 3.10 (continued)

Parameter	Project quantitation level	Screening level	Reference standard	Units
Styrene	2	75	100	µg/L
Tetrachloroethene	2	25	33	µg/L
Toluene	2	75	100	µg/L
Trans-1,2-Dichloroethene	2	75	100	µg/L
Trans-1,3-Dichloropropene	2	75	100	µg/L
Trichloroethene	2	75	100	µg/L
Vinyl chloride	2	18	24	µg/L
Xylenes (dimethyl benzene)	2	75	100	µg/L
Polychlorinated biphenyls (PCBs)				
PCBs	0.5	detectable	0.00064	µg/L
Metals				
Aluminum	100	NA	NA	µg/L
Antimony	100	480	640	µg/L
Arsenic	6	7	10	µg/L
Barium	100	NA	NA	µg/L
Beryllium	5	75	100	µg/L
Boron	100	NA	NA	µg/L
Cadmium	1	Detectable	0.25	µg/L
Calcium	100	NA	NA	µg/L
Chromium, total	25	75	100	µg/L
Chromium, VI	5	8	11	µg/L
Cobalt	100	NA	NA	µg/L
Copper	3	6.8	9.0	µg/L
Iron	100	NA	NA	µg/L
Lead	2	2	2.5	µg/L
Lithium	5	75	100	µg/L
Magnesium	100	NA	NA	µg/L
Manganese	100	NA	NA	µg/L
Mercury	0.1	Detectable	0.051	µg/L
Nickel	5	39	52	µg/L
Potassium	100	NA	NA	µg/L
Selenium	2	3.8	5	µg/L
Silver	1	2.4	3.2	µg/L
Sodium	100	NA	NA	µg/L
Thallium	5	Detectable	0.47	µg/L
Vanadium	100	NA	NA	µg/L
Zinc	2	90	120	µg/L
Field readings				
Dissolved oxygen (minimum)	4.0–8.0	<6.0	5.0	mg/L
pH (maximum)	14.0	>8.4	9.0	Standard units
pH (minimum)	1.0	<6.4	6.0	Standard units
Temperature	0–100	>27	NA	^{o}C

[a] Quantitation is defined as the lowest amount of analyte in a sample that can be quantitatively determined with suitable precision and accuracy.

3.5.1.3 Storm Water Monitoring Conducted for the Phased Construction Completion Report

On January 5, 2007, a meeting was held with TDEC personnel to discuss monitoring expectations for contaminated slabs that remain following building demolition and that await remediation. A review of the *Balance of Site—Laboratory Phased Construction Completion Reports* (PCCRs) (DOE 2007, 2007a, 2007b) by TDEC personnel raised issues about monitoring of the building slabs. TDEC personnel expressed concern about the potential release of contaminants from the slabs and did not believe that the PCCRs currently describe the monitoring effort in sufficient detail. TDEC agreed that DOE meets the requirements of 10 CFR 835 and DOE Order 5400.5 through the Radiation Protection Program, storm water compliance monitoring, and ambient watershed exit pathway sampling. However, TDEC personnel stated that the PCCRs needed to be more specific in describing the location and frequency of monitoring for the slab in question.

To obtain additional analytical information to address some of TDEC's stated concerns with the PCCRs, sampling of storm water runoff was conducted at various locations where radiological contamination may be present on the concrete pads or footprints of buildings that have recently been demolished. Samples of storm water runoff from the concrete pads/building footprints in each of the areas were collected at nearby storm water catch basins or directly from the building pads. The samples were collected to obtain data that would be considered as the worst-case radiological discharge from these areas. Runoff samples collected directly from the building pads were collected from areas where the flow is most prevalent or most concentrated into a distinct discharge.

Samples were collected when runoff from the pads 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. Storm water outfalls were sampled as close as possible to the time that the building pads, or catch basins that drain to them, were sampled. This was done to allow some correlation of the contaminant levels in the runoff samples from the building pads with the levels of contaminants in the storm water outfall samples. Samples collected from each of the locations listed in Table 3.11 were analyzed for gross alpha/gross beta radiation, isotopic uranium, total uranium, and technetium-99.

Table 3.11. Storm water sampling for the Phased Construction Completion Reports

Sampling location	Gross alpha/ gross beta	Total uranium	Isotopic uranium	^{99}Tc
K-1420 Pad runoff	X	X	X	X
Outfall 158	X	X	X	X
Outfall 160	X	X	X	X
Outfall 170	X	X	X	X

All runoff and outfall 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 Documen*t (EPA 1992) and applicable procedures that have been developed by the sampling subcontractor. All guidelines stated in the ETTP *SWPP Program (SWP3) Sampling and Analysis Plan* (SAP) (BJC 2008b, 2009d) concerning sample documentation, analytical procedures, quality assurance (QA), and quality control (QC) were followed as part of this sampling effort.

Sampling locations were chosen based on the observed runoff characteristics for the building pad. The exact number of sampling locations was also changed in some instances based on runoff flow patterns. Samples were collected when runoff from the pads 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.

As part of the 2009 SWP3 sampling, samples were collected at the north side of the K-1420 building footprint (Fig. 3.18) in an area near the former calciner room. Samples were also collected from storm water outfalls 158, 160, and 170 in concurrence with the K-1420 pad samples. Samples of building pad runoff from the area were scheduled to be collected monthly during wet weather conditions. However,

due to the lack of qualifying storm events, these samples were collected only during March, September, and October 2009. Table 3.12 presents 2009 analytical results exceeding screening levels for outfalls 158, 160, and 170 as well as for the K-1420 pad runoff.

Fig. 3.18. The K-1420 pad after demolition.

Table 3.12. Results exceeding screening levels for 2009 radiological monitoring performed in conjunction with D&D activities[a,b]

Sampling location	Date sampled	Gross alpha radiation (pCi/L)	Gross beta radiation (pCi/L)	^{99}Tc (pCi/L)	^{233}U/^{234}U (pCi/L)	^{238}U (pCi/L)	Total uranium (µg/L)
Outfall 158	3/26/09	153	58.4	–	75.6	47.3	145
Outfall 160	3/26/09	568	131	–	491	73	230
K-1420 Pad runoff	3/26/09	43.6	–	–	63	–	–
Outfall 158	9/16/09	79.2		–	47	32.1	97.2
Outfall 160	9/16/09	347	68.4	–	275	48	149
Outfall 170	9/16/09	–	–	–	–	–	–
K-1420 Pad runoff	9/16/09	49.1	–	–	35.9	–	–
Outfall 158	10/14/09	79	–	–	38.1	–	71.8
Outfall 160	10/14/09	312	–	–	205	60.2	186
Outfall 170	10/14/09	–	–	–	–	–	–
K-1420 Pad runoff	10/14/09	91.4	–	–	69.1	–	41.5

[a] Screening levels are 15 pCi/L gross alpha radiation, 50 pCi/L gross beta radiation, 4,000 pCi/L ^{99}Tc, 20 pCi/L ^{233}U/^{234}U, 24 pCi/L ^{235}U and ^{238}U, and 31 µ/L total uranium.

[b] Dash indicates results below screening level thresholds.

In 2009, gross alpha radiation was detected in the discharges from storm water outfalls 158 and 160 and the K-1420 pad at levels greater than 15 pCi/L, which is the screening level developed from the maximum contaminant level (MCL) established by the Safe Drinking Water Act. Gross alpha radiation for outfall 170 was below screening level. Compared to historical data (Fig. 3.19 and Tables 3.13, 3.14, 3.15, and 3.16), the results for the 2009 SWP3 sampling are representative of the levels of gross alpha radiation normally found at these locations.

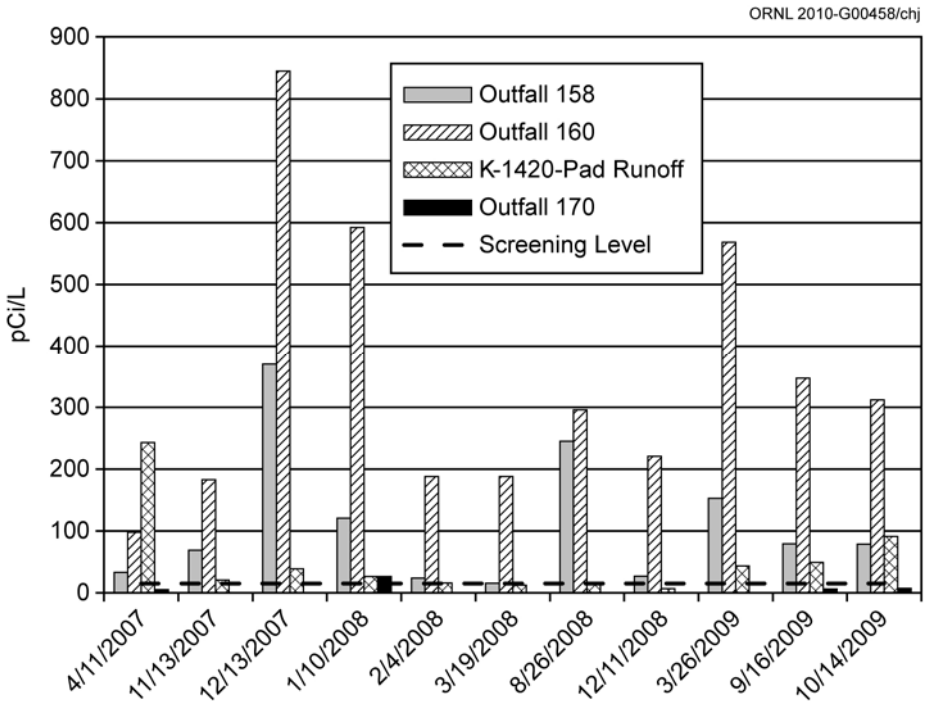


Fig. 3.19. Relative levels of gross alpha radioactivity in discharges from outfalls 158, 160, 170 and the K-1420 pad.

Gross beta radiation was detected in the discharges from outfalls 158 and 160 at levels that exceed the screening level of 50 pCi/L developed from the MCL compared to historical data (Fig. 3.20 and Tables 3.13, 3.14, 3.15, and 3.16). The results for the 2009 sampling effort are representative of the level of gross beta radiation normally found at these locations. Gross beta radiation for outfall 170 was below screening level.

No ^{99}Tc was detected at levels above the screening level of 4000 pCi/L in samples collected at outfalls 158, 160, and 170 and the K-1420 pad as part of the 2009 SWP3 (Tables 3.13–3.16).

Uranium-233/234 was detected in the discharge from outfalls 158, 160, and the K-1420 Pad in 2009 at levels that exceed the 4% of DCG level of 20 pCi/L for this radionuclide, as seen in Fig. 3.21. Exceedances were not detected for outfall 170. Historical data for ^{233}U/^{234}U collected at this location (Tables 3.13–3.16) indicate that the ^{233}U/^{234}U data for 2009 were near the middle of the range of the historical results.

Uranium-235/236 was not detected at levels above the 4% of DCG level of 24 pCi/g for the 2009 SWP3 sampling (Tables 3.13–3.16).

Uranium-238 was detected in discharges from outfalls 158 and 160 at levels that exceeded 4% of the DCG level of 24 pCi/L. Exceedances were not detected for outfall 170 or the K-1420 pad. Comparing the 2009 results to historical data for ^{238}U collected from these locations (Tables 3.13–3.16) indicate that ^{238}U results collected as part of the 2009 SWP3 sampling are near the middle of the range of the historical results.

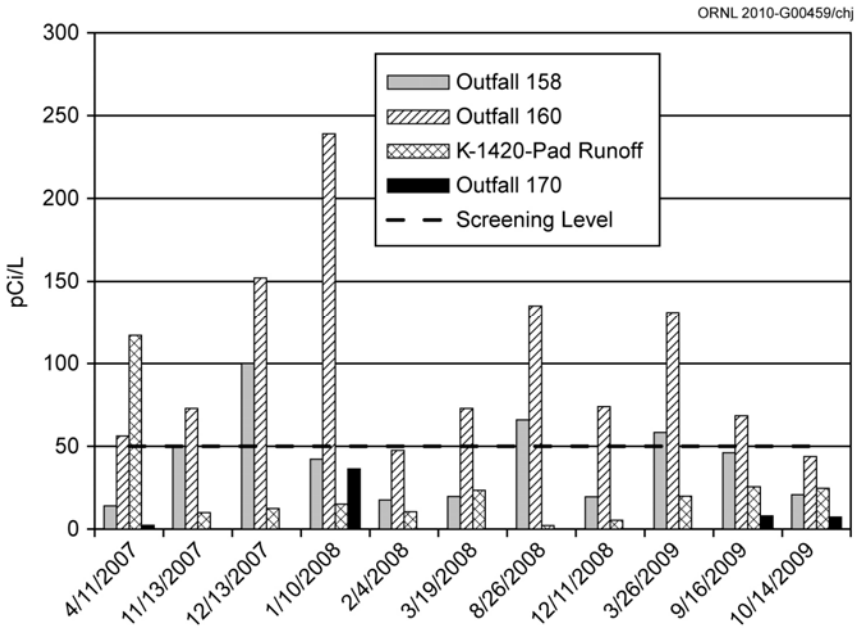


Fig. 3.20. Relative levels of gross beta radioactivity in discharges from outfalls 158, 160, 170 and the K-1420 pad.

Table 3.13. Analytical results from sampling performed at storm water outfall 158

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening level	15	50	20	24	24	4000	31
July 2003	98.8	97.5	0.068 U[a]	–0.021	–0.034	No data	No data
May 2004	64.9	44.7	31.87	1.86	18.59	No data	No data
April 2007	33.2	14	19.9	1.94	12.3	No data	37.5
November 2007	69.2	50.1	37.1	1.91	23.1	47.4	69.6
December 2007	370	100	153	12	96.9	69.5	294
January 2008	121	42.3	48.3	3.55	32.4	26.2	98
February 2008	23.8	17.6	11.3	0.994	7.7	14.5	23.4
March 2008	15.8	19.7	8.71	0.041 U	5.44	13.7	16.2
July 2008	89.6	60.7	40.9	3.94	30.9	46.3	93.7
August 2008	245	66	121	7.36	68.2	55.7	206
December 2008	27.3	19.5	63 U	0.72	8.2	14.4	25.2
March 2009	153	58.4	75.6	5.18	47.3	32	145
September 2009	79.2	46.1	47	3.53	32.1	45.1	97.2
October 2009	79	20.8	38.1	2.29	23.8	23	71.8

[a] U—analyte not detected in sample.

Note: Radiological results are reported after background activity has been subtracted. In cases where background activity exceeds the sample activity, this will result in negative values.

Table 3.14. Analytical results from sampling performed at storm water outfall 160

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening level	15	50	20	24	24	4000	31
March 2001	114	49	66	4.32	38	84	No data
August 2001	48	49	37.38	1.78	7.42	54	No data
January 2002	1020	421	591.9	32.01	108.9	445	No data
February 2004	203	78.2	151.7	10.89	89.68	23.7	65.4
April 2007	98.2	56.3	85.9	5.04	21.2	78	37.5
November 2007	183	72.9	117	8.88	62.7	61.9	191
December 2007	845	152	547	30.3	202	96.2	615
January 2008	592	239	405	18.6	73.8	280	228
February 2008	188	47.5	130	6.31	21.1	54.1	65.7
March 2008	185/191	54.8/90.8	137/150	8.7/10.3	20.7/22.2	58.4/61.4	65.6/70.8
August 2008	296	135	216	10.3	59.7	213	182
December 2008	221	73.9	170	8.1	23.2	74.8	73.4
March 2009	568	131	491	22.7	73	174	230
September 2009	347	68.4	275	13.5	48	73.8	149
October 2009	312	43.9	205	14.9	60.2	41.5	186

Table 3.15. Analytical results from sampling performed at storm water outfall 170

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening level	15	50	20	24	24	4000	31
January 2002	2.77 U	9.09	1.10	0.03 U	0.44	2.96 U	No data
July 2002	2.46 U	15.2	1.32	0.05 U	0.57	<8.24	No data
September 2005	1.28 U	4.68 J	0.60 J	0.01 U	0.37 J	2.98U	No data
April 2007	5.07	2.46 U	7.17	0.44	2.93	27.2 U	8.92
January 2008	26.3	36.3	98.1	6.14	7.89	13.8	26.3
September 2009	6.11	8.11	2.96	0.19	0.67	10.3	2.09
October 2009	7.16	7.37	3.09	0.29 U	1.01	13.6	3.13

Table 3.16. Analytical results from sampling performed at the K-1420 building pad

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening level	15	50	20	24	24	4000	31
April 2007	243	117	194	12	24.8	222	79.4
November 2007	20.8	9.94	15	0.923	2.95	5.04 U	9.2
December 2007	39.1	12.5	28.6	1.66	5.11	4.97 U	16
January 2008	26.7	15.1	17.3	1.03	3.3	11.7	10.3
February 2008	16.1	10.6	11.6	0.426	1.69	12	5.23
March 2008	12.6	23.4	11.2	0.73	1.69	24.7	5.37
August 2008	13.6	2.11 U	11.2	0.766	2.07	4.09 U	6.51
December 2008	6.9	5.34	63 U	0.23	1.2	2.9 U	3.9
March 2009	43.6	19.9	63 U	1.8	6	13.9	19
September 2009	49.1	25.5	35.9	2.13	7.22	48.2	22.5
October 2009	91.4	24.7	69.1	5.02	13.2	17.3	41.5

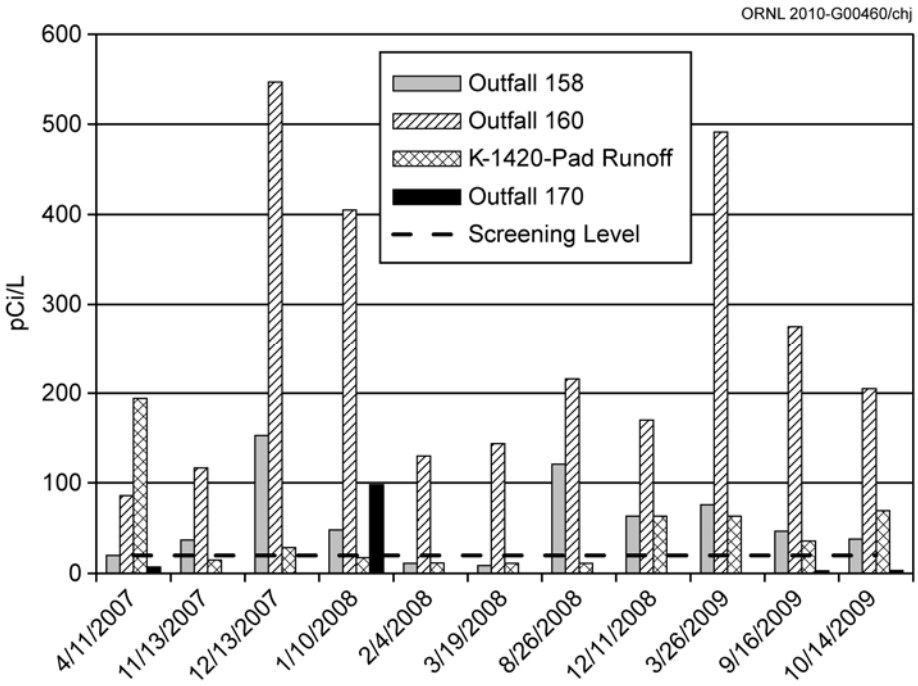


Fig. 3.21. Relative levels of $^{233}U/^{234}U$ in discharges from outfalls 158, 160, and 170 and the K-1420 pad.

Total uranium was detected in the discharge from storm water outfalls 158 and 160 and K-1420 pad at levels that exceed the screening level of 31 μg/L. Exceedances were not detected for outfall 170. Total uranium results collected as part of the 2009 SWP3 sampling are several times higher than the screening level at outfalls 158 and 160. However, a comparison to historical results available for total uranium (Tables 3.13–3.16) indicates that total uranium results collected as part of the FY 2009 SWP3 sampling are within the range of historical results.

Gross alpha radiation was detected in the runoff from the K-1420 pad at levels greater than the MCL of 15 pCi/L (Fig. 3.19). However, the levels of gross alpha radiation were, in almost all cases, much lower than levels observed in the storm water outfalls associated with the pad. The acceptable dose rate in surface water for piscivorous wildlife is 100 mrad per day. The total uranium activity on the slab that will result in a 100 mrad per day dose in Mitchell Branch is 2600 pCi/L. Analytical results collected since April 2007 (Table 3.16) indicate that total uranium concentrations are two orders of magnitude below the 2600 pCi/L level. Therefore, it can be concluded that the K-1420 pad is no longer a significant contributor of radioactive contaminants to the storm drain system.

Table 3.17. Storm water sampling for radiological discharges,[a] 2009

Storm water outfall	Date sampled
100	06/29/09
292	06/10/09
350	07/13/09
430	06/10//09

[a] Including gross alpha, gross beta, transuranics (^{237}Np, ^{238}Pu, and $^{239/240}Pu$), isotopic uranium, and ^{99}Tc.

3.5.1.4 Radiological Monitoring of Storm Water Discharges

The ETTP conducts radiological monitoring of storm water discharges to determine compliance with applicable dose standards. It 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 periodically as part of the SWP3. In 2009, new radiological sampling results were obtained for four storm water outfalls (Table 3.17). These results were used with radiological results for other storm water outfalls from other years, along with calculated flows based on rain events in 2009, to estimate the total discharge of each radionuclide from ETTP via the storm water discharge system (Table 3.18).

Storm water samples were collected from discharges resulting from a storm event greater than 0.1 in. that occurred within a period of 24 h or less and at least 72 h after any previous rainfall greater than 0.1 in. in 24 h. Composite samples were collected at each outfall using Isco automated sampling equipment. The composite samples consisted of at least three aliquots taken during the first 60 min of a storm event discharge. Samples composited by time (equal volume aliquots collected at a constant interval) were used. In situations where the use of an Isco sampler was infeasible or impractical, 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 3.18. Radionuclides released to off-site surface waters from the East Tennessee Technology Park storm water system, 2009 (Ci)[a]

Radionuclide	Amount
^{99}Tc	2.1E–2
^{234}U	7.0E–3
^{235}U	5.8E–4
^{238}U	4.4E–3

[a] 1 Ci = 3.7×10^{10} Bq.

Radiological monitoring was conducted in 2009 as part of the SWP3 for different purposes. Results of all SWP3 radiological monitoring that exceeded screening levels in 2009 are shown in Table 3.19. Comparisons of historical analytical results to those from the 2009 sampling effort are given in Tables 3.14, 3.20, 3.21 and 3.22.

Table 3.19. Storm water radiological results exceeding screening levels for radiological discharges, 2009 (pCi/L)[a,b]

Storm water outfall	Gross alpha radiation (pCi/L)	Gross beta radiation (pCi/L)	^{233}U/^{234}U (pCi/L)	^{238}U (pCi/L)	Total uranium (µg/L)
160	138	106	97	62.5	189
292	43	–	22.6	–	32.8
350	187	62.4	79.1	63.9	192
490	–	57.1	–	–	–

[a] 1 pCi = 0.037 Bq.
[b] Screening levels are 15 pCi/L gross alpha radiation, 50 pCi/L gross beta radiation, 20 pCi/L ^{233}U/^{234}U, 24 pCi/L ^{234}U and ^{238}U, and 31 µ/L total uranium.
[c] Dashed line indicates no exceedances.

Table 3.20. Analytical results from sampling performed at storm water outfall 292

	Gross alpha (pCi/L)	Gross beta (pCi/L)	^{233}U/^{234}U (pCi/L)	^{235}U/^{236}U (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (µg/L)
Screening level	15	50	20	24	24	4000	31
May 2001	63.3	87.6	30.83	1.70	19.11	67.5	32.96
March 2002	227	116	121.2	8.89	72.86	104	No data
December 2003	38.3	16.7	17.89	1.11	11.01	12.2	No data
February 2007	136	88	84.1	5.63	51.4	79.5	156
June 2009	43	29.1	22.6	1.64	10.8	39.5	32.8

Table 3.21. Analytical results from sampling performed at storm water outfall 350

	Gross alpha (pCi/L)	Gross beta (pCi/L)	^{233}U/^{234}U (pCi/L)	^{235}U/^{236}U (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (µg/L)
Screening level	15	50	20	24	24	4000	31
May 2001	162	76.5	70.31	4.36	54.65	26.5	No data
May 2002	25.2	14.8	16.83	1.25	13.3	0.69 U[a]	No data
February 2005	242	76.5	139	7.39	106	4.87 U	No data
December 2006	171	30.4	91.4	6.87	71.8	20.2	217
July 2009	187	62.4	79.1	4.77	63.9	13.7	192

[a] U—analyte not detected in sample.

Table 3.22. Analytical results from sampling performed at storm water outfall 490

	Gross alpha (pCi/L)	Gross beta (pCi/L)	$^{233}U/^{234}U$ (pCi/L)	$^{235}U/^{236}U$ (pCi/L)	^{238}U (pCi/L)	^{99}Tc (pCi/L)	Total U (μg/L)
Screening level	15	50	20	24	24	4000	31
July 2001	5	52	1.22 U	0.24 U[a]	0 U	17	1 U
January 2002	17.3	81.5	2.01	0.05 U	0.38	60.9	2.75 U
August 2005	2.45 J	7	1.57	No data	0.44	108	No data
February 2007	9.71	22.8	3.32	No data	0.9	28.6 U	No data
October 2008	7.57	29.6	0.82	No data	-0.08 U	38.5	–0.18 U
February 2009	10.6	57.1	No data	0.079	0.41	95.4	1.3

[a] U—analyte not detected in sample.

Gross alpha radiation was detected in the discharges from storm water outfalls 160, 292, and 350 at levels that exceeded the screening level for gross alpha activity of 15 pCi/L (Tables 3.14, 3.20, and 3.21). Results for gross alpha radiation collected at these locations since 2001 indicate that the gross alpha radiation results collected during this portion of the 2009 SWP3 sampling effort are within the historical range.

Gross beta radiation was detected in the discharges from storm water outfalls 160, 350, and 490 at levels that exceed the MCL of 50 pCi/L for this analyte (Tables 3.14, 3.21, and 3.22). Results for gross beta radiation collected at these locations since 2001 indicate that the gross beta radiation results collected during this portion of the 2009 SWP3 sampling are within the historical range.

Uranium-233/-234 was detected in the discharges from storm water outfalls 160, 292, and 350 at levels that exceed the 4% of DCG level of 20 pCi/L for this radionuclide (Tables 3.14, 3.20, and 3.21). Results for $^{233}U/^{234}$ collected at these locations since 2001 indicate that the $^{233}U/^{234}$ results collected during this portion of the 2009 SWP3 sampling are within the historical range.

Uranium-238 was detected in the discharges from storm water outfalls 160 and 350 at levels that exceed the 4% of DCG level of 24 pCi/L for this radionuclide (Tables 3.14 and 3.21). Results for ^{238}U collected at these locations since 2001 indicate that the ^{238}U levels in data collected during this portion of the 2009 SWP3 sampling are within the historical range.

Total uranium was detected in the discharges from outfalls 160, 292, and 350 at levels that exceed the screening level of 31 μg/L for this analyte (Tables 3.14, 3.20, and 3.21). Limited historical data for total uranium indicate that the total uranium level in data collected during this portion of the 2009 SWP3 sampling is within the historical range.

3.5.1.5 Monitoring Conducted as Part of the Demolition of Building K-1035

Building K-1035 was built in 1945 as a maintenance general stores warehouse. In the early 1960s it was converted to an instrument maintenance facility. Shop activities have included an instrument shop, metal cabinet fabrication, a photoelectroplating process, printed circuit board fabrication shop, acid cleaning area, line recorder cleaning, and pneumatic repair shop. To the south of the building are the K-1035 Acid Pits. These two pits, an acid pit and neutralization pit, received acid and solvent wastes from two dedicated instrument shops within the building, the Printed Circuit Board Fabrication Facility and the Acid Cleaning Area. The process drains from the acid pit and the neutralization pit flowed to a single catch basin that discharged to the storm drain 190 network. The Acid Cleaning Area operated from the early 1960s to 1985, and the Printed Circuit Board Fabrication Facility operated from the early 1960s to 1977.

In April 2009, work began on the demolition of Building K-1035 (Fig. 3.22). All materials that potentially contained asbestos, including siding, pipe insulation, roofing material, etc., were removed

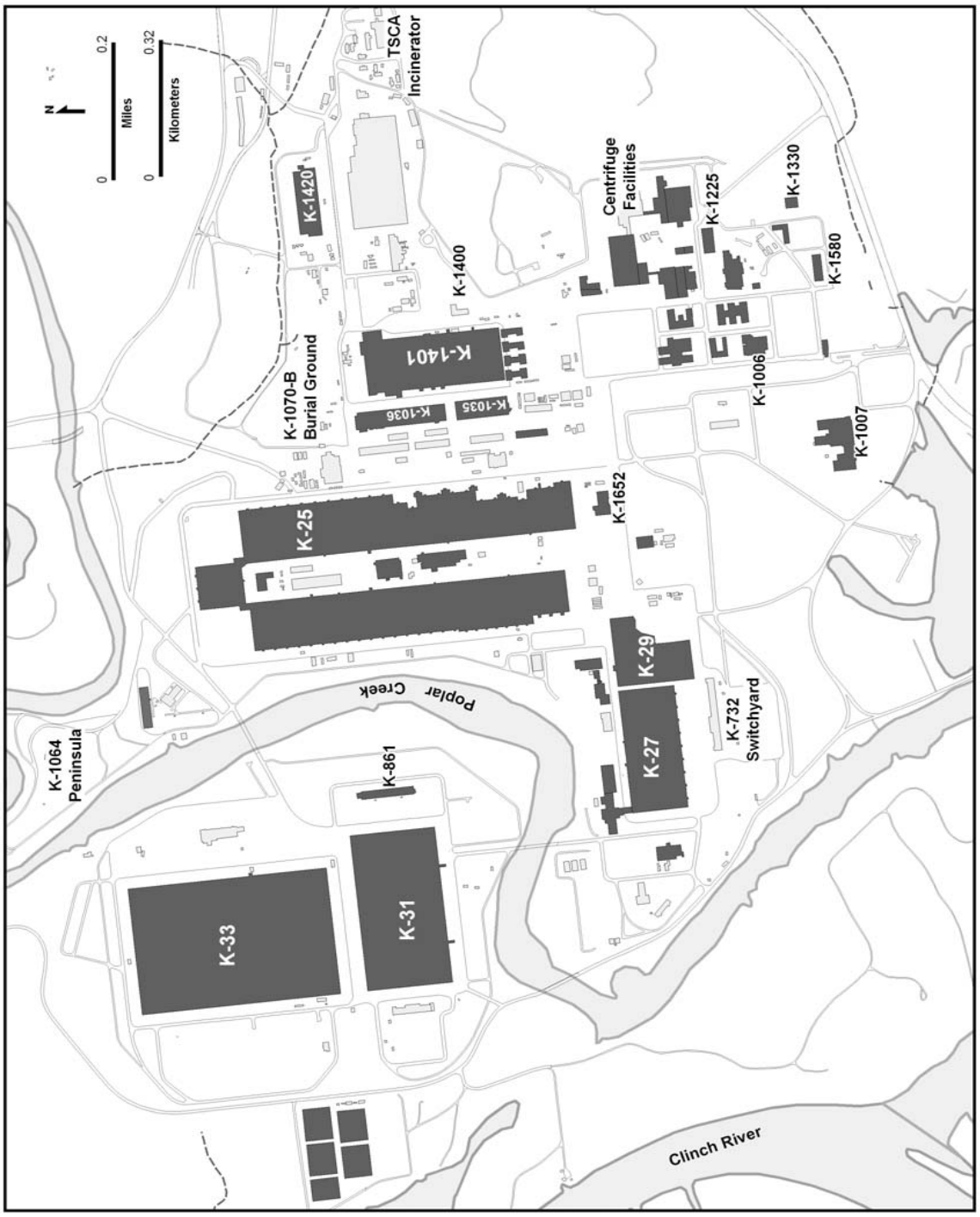


Fig. 3.22. Map of ETTP locations including areas involved in 2009 sampling activities.

prior to general demolition using heavy equipment. The remainder of the building was demolished using heavy equipment. In June 2009, the building was reduced to rubble (Fig. 3.23). Final removal of building rubble was completed in July 2009. Waste material generated from the building's demolition was sent to the EMWMF or other off-site disposal facilities (Fig. 3.24).

ORNL 2010-G00463/chj

Fig. 3.23. K-1035 building demolition.

ORNL 2010-G00516/chj

Fig. 3.24. Demolition debris generated from K-1035 building being sent to EMWMF.

Before the demolition of Building K-1035 began, the water in nearby storm drain inlets and at storm water outfall 190 was sampled. This provided a baseline for determining if contaminants might be present in the runoff from the K-1035 area. Sampling was also performed during the demolition of the building. This was done to determine the efficacy of the protective measures that were installed around storm drain inlets to prevent any demolition materials from entering the storm drain system. Sampling will also be performed after demolition to determine the impact of the demolition on the storm water runoff from this area. Samples were collected for analysis for gross alpha/gross beta radiation, isotopic uranium, technetium-99, metals, mercury, VOCs, and PCBs.

In conjunction with the D&D of the Building K-1035, manholes 13037A, 13050, and 13074A were sampled as part of the FY 2009 SWP3. "Before demolition" samples were collected in November 2008, and "during demolition" samples were collected in May, June, and August 2009. The "after demolition" samples have not yet been collected.

Sampling locations were chosen by EC&P and sampling subcontractor personnel based on their close proximity to the area that was being remediated and their accessibility and ease of sampling. Locations with the greatest likelihood of receiving storm water runoff from the area were preferred sampling locations. However, because many of the storm drains in the area are inaccessible, sampling locations were chosen where flow could be observed and Isco sampling equipment could be installed with minimal complications.

All samples collected as part of this portion of the 2009 SWP3 sampling were grab samples collected either manually or with Isco samplers. For the purposes of the ETTP SWP3 sampling, a grab sample is defined as a discrete individual sample that can be collected either manually or with an Isco sampler within a short period, usually 15 min or less. Both manual grab and Isco grab samples were collected within the first 30 min of a discharge. All samples collected in conjunction with the D&D of Building K-1035 were collected in accordance with the guidelines presented in the *East Tennessee Technology Park Storm Water Pollution Prevention Program Sampling and Analysis Plan*. All guidelines stated in the ETTP SWP3 SAP concerning sample documentation, analytical procedures, QA/QC, etc., were followed as part of this sampling effort.

The metals results from the sampling performed in conjunction with the Building K-1035 D&D are presented in Figs. 3.25, 3.26, and 3.27. The figures indicate the following:

- Except for arsenic, all metals were present at higher concentrations in the "during demolition" samples collected in summer 2009 compared to the "before demolition" samples collected in November 2008.
- Except for arsenic, all metals were present at concentrations at or near the WQC for the given metal.
- Metal results were fairly consistent between the three manholes.
- Improvements in the sediment controls in the Building K-1035 demolition area may have been needed to provide more effective removal of contaminants from the storm water runoff there.

The VOC results from the sampling performed in conjunction with the Building K-1035 D&D are presented in Figs. 3.28, 3.29, and 3.30. The figures indicate that

- no clear conclusions can be drawn from the VOC results from samples collected as part of the Building K-1035 sampling effort;
- many of the results showed VOCs at non-detectable levels; and
- the concentration of VOCs in the three manholes sampled does not appear to have been affected by the demolition of Building K-1035.

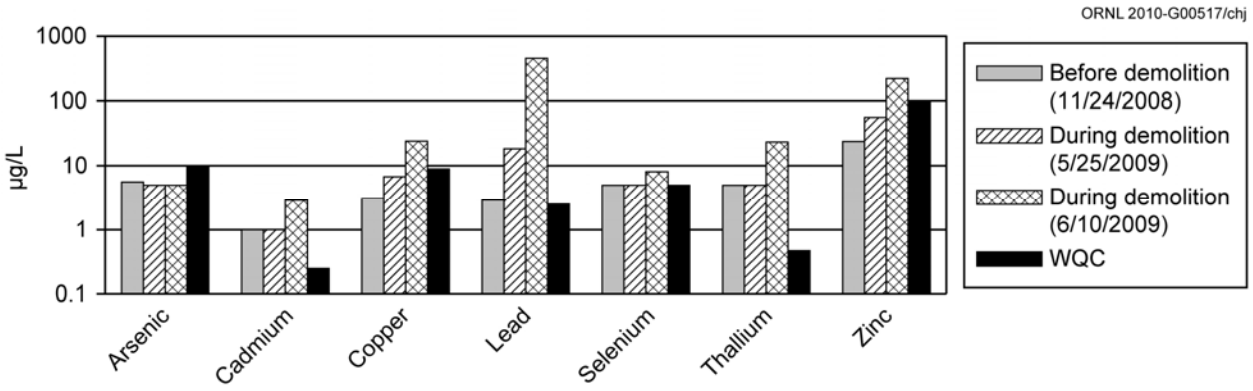


Fig. 3.25. Metals results at manhole 13050. WQC = water quality criteria.

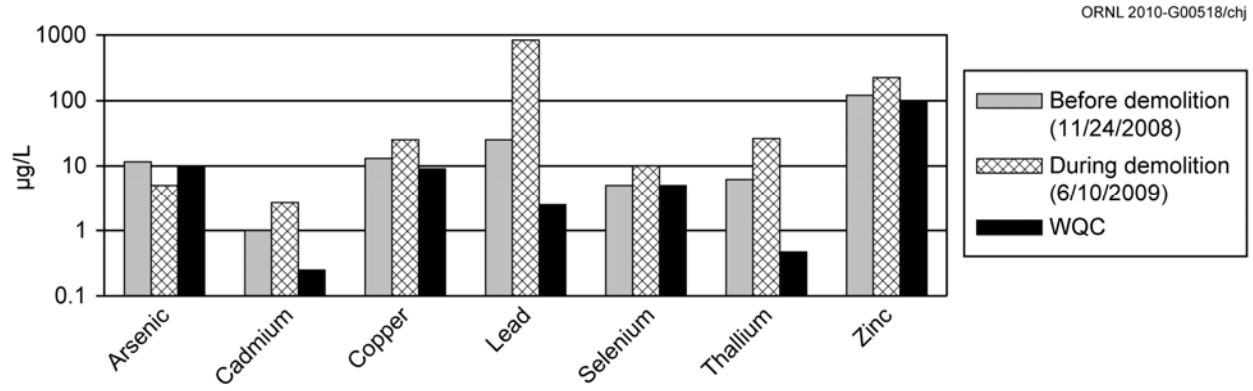


Fig. 3.26. Metals results at manhole 13037A. WQC = water quality criteria.

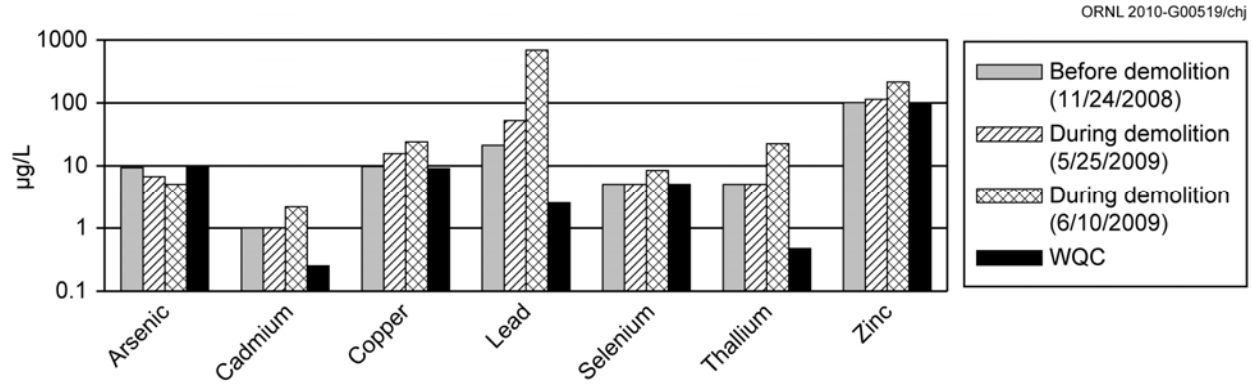


Fig. 3.27. Metals results at manhole 13074A. WQC = water quality criteria.

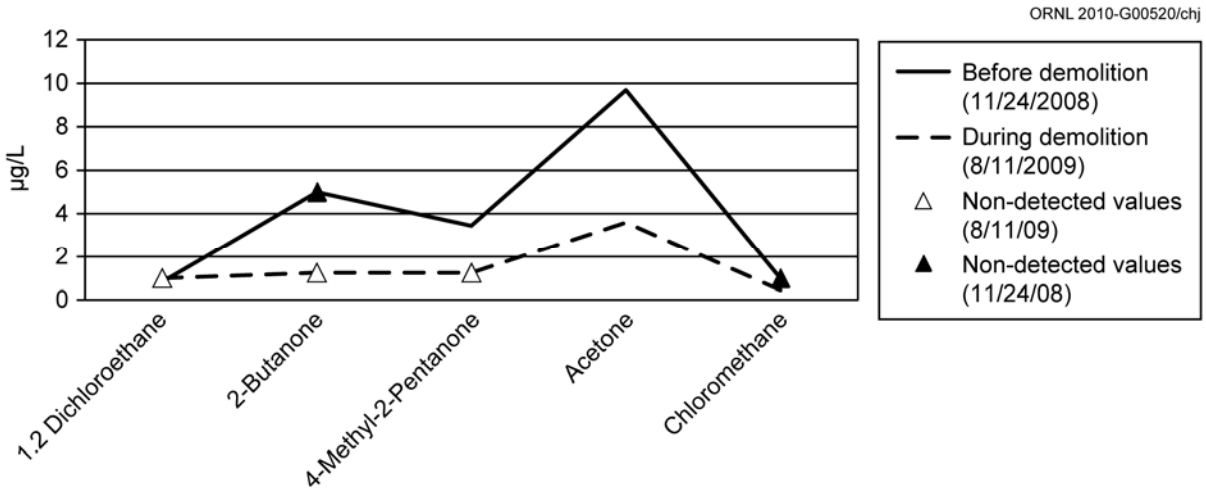


Fig. 3.28. VOC results at manhole 13050.

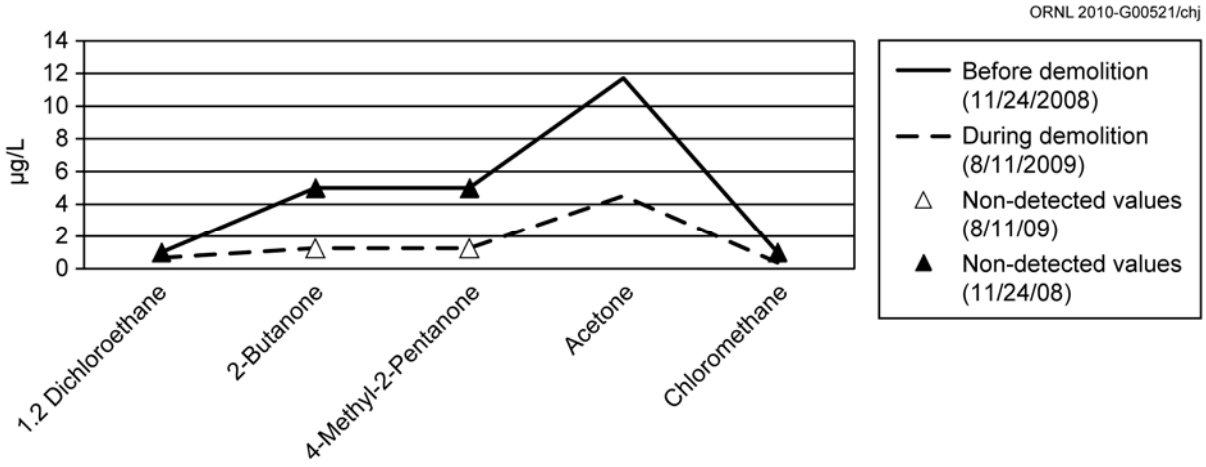


Fig. 3.29. VOC results at manhole 13037A.

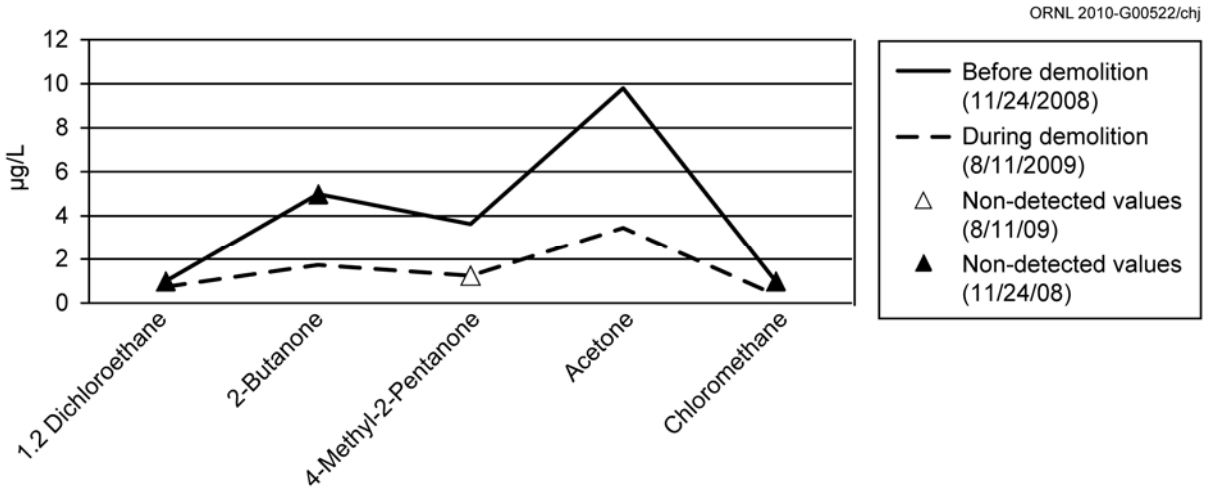


Fig. 3.30. VOC results at manhole 13074A.

The PCB results from the sampling performed in conjunction with the Building K-1035 D&D are presented below in Figs. 3.31, 3.32, and 3.33. The figures indicate that:

- concentrations of PCB-1254 and PCB-1260 both increased in the summer 2009 "during demolition" sampling event, and
- all other concentrations of PCBs appear to have been unaffected by the demolition.

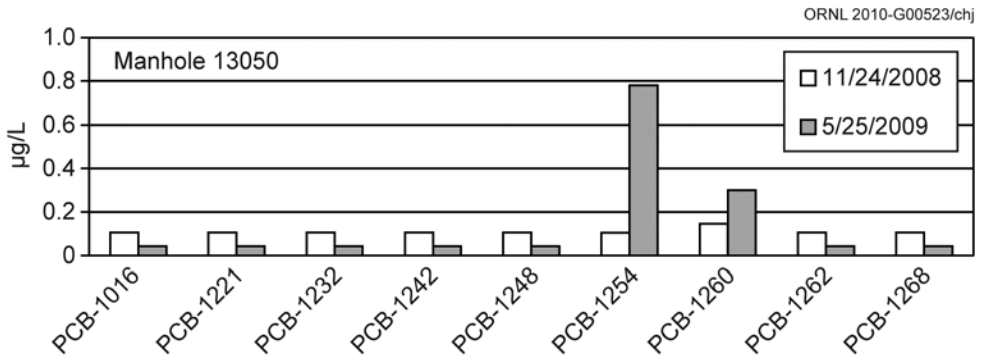


Fig. 3.31. PCB results at manhole 13050.

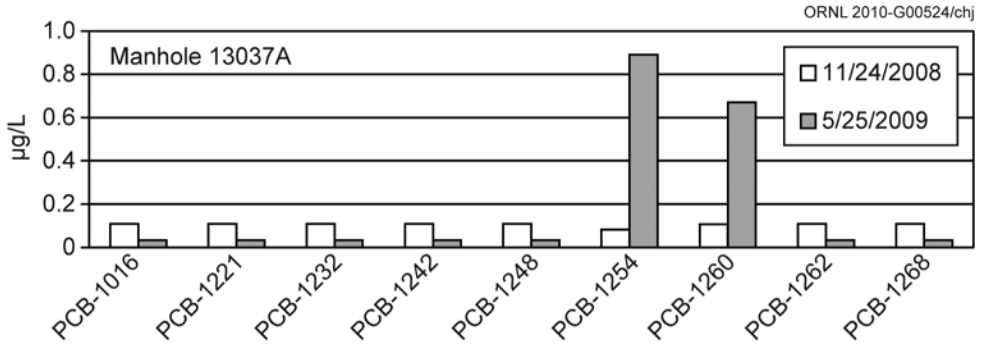


Fig. 3.32. PCB results at manhole 13037A.

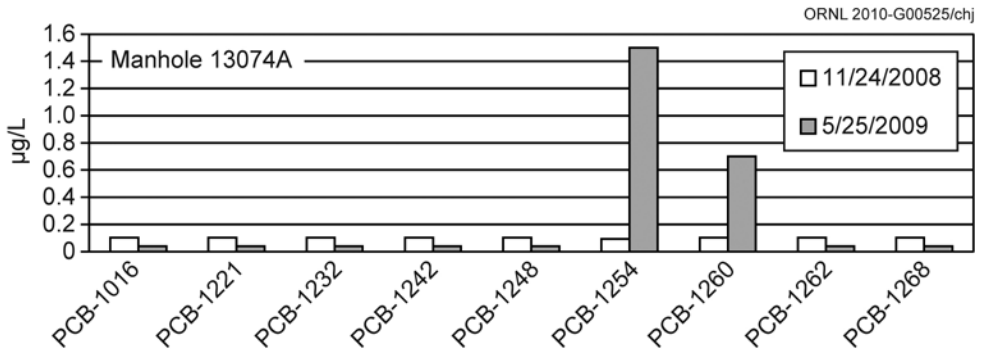


Fig. 3.33. PCB results at manhole 13074A.

None of the radiological samples collected as part of the Building K-1035 D&D sampling had results that were above the screening levels.

The demolition of the building structure at K-1035 was completed in 2009. As part of the D&D activities there, the acid pits that were located on the south end of the building were removed. Visible mercury and other contaminants were found where the acid pits had been. Therefore, remediation of the

soil at the south end of Building K-1035 will be conducted in 2010. Specified manholes will be sampled during the soil removal activities on the south end of the building as part of the 2010 SWP3 sampling. EC&P personnel will assist in planning the times these samples should be collected. In addition, final closure activities are scheduled to be performed at K-1035 in 2010. Specified manholes and outfalls will be sampled upon completion of all closure activities at Building K-1035.

3.5.1.6 Monitoring of K-1006 Sump

The Building K-1006 basement sump is a 30-in. diameter by 36-in. deep concrete structure. It is located in the northeast corner basement of the K-1006 laboratory building (Fig. 3.22) beneath the interior stairwell. The sump receives groundwater flow that is periodically pumped to the sanitary sewer system by a float-controlled pump. The *Comprehensive Environmental Response, Compensation, and Liability Act Section 120(h) Assessment for the K-1006 Material and Chemistry Laboratory*, K/EM-543/R1, states that the sump in the northeast corner of the basement accumulates rainwater from a drain in the concrete floor area adjacent to the basement's outside door. Discharge from this sump was believed to be routed to storm drain 100. In the past, it received water from steam condensate and a sink drain in the room C107. The sink drain has been removed from service. The sump was neither recorded as part of the sump registration program conducted in the mid 1990s nor assigned an identification number; however, it was registered in 2008 and designated sump S-073A.

In May 2007, sediment in the bottom of the sump was sampled. This sampling was performed under CERCLA to determine if the sump met the requirements of the Zone 2 Record of Decision. Samples of the solids were found to exceed applicable remediation levels for the radium/thorium decay series (41.64 pCi/g); PCB-1254 (23,000 mg/kg); and ^{238}U (116 pCi/g). Due to these exceedances of remediation levels, the sump did not meet the applicable CERCLA requirements and therefore required remediation.

In January 2009, water samples from the sump were obtained while the sediment was still in the sump to determine if any contaminants of concern were being discharged. The samples were analyzed for gross alpha, gross beta, VOCs, metals, isotopic uranium, and thorium. The analytical results from this water sampling effort that exceeded screening levels are presented in Table 3.23.

Table 3.23. Analytical results exceeding screening levels from water samples collected at sump S-073A before sediment removal

Location	Cadmium (μg/L)	Copper (μg/L)	Lead (μg/L)	Nickel (μg/L)	Silver (μg/L)	Zinc (μg/L)	Mercury (μg/L)	Gross alpha (pCi/L)	PCB-1254 (μg/L)	PCB-1260 (μg/L)
Before sediment removal	9.5	114	105	54.6	2.5	263	2	19.8	1.2	NA
After sediment removal	1.18	15	8.76	NA	NA	NA	0.189	NA	0.46	0.31

In February 2009, a dye test was performed to verify whether the sump discharges to the environment, and if it does, whether it discharges to the storm drain system, the sanitary sewer system, or into the soil. Several floor drains in the basement of K-1006 appeared to drain into the sump. To verify whether they were connected to the sump, these floor drains were dye tested, along with another possibly connected drain at the foot of an external stairwell. The dye test indicated that the sump was connected to the sanitary sewer system, that the floor drain at the basement's north end was discharged to the sump, that a floor drain near the exit door of the basement was plugged, and that the drain at the foot of the external stairs was also connected to the sump. This last drain appears to be the major contributor of water to the sump.

City of Oak Ridge personnel involved with the management of the sanitary sewer system were notified about the results of the dye testing effort. Because of the levels of some contaminants in the tested water, city personnel requested an estimate of the quantity of the discharge from the sump into the sanitary sewer system. In February 2009, flow monitoring equipment was placed in the sump to determine how much water the sump was discharging. Data were collected from February 2009 through

the first week of May 2009. It was found that the sump did not discharge during periods of dry weather. The discharge rate of the sump was found to be directly related to the amount of rainfall that occurred. The sump was found to discharge approximately 6–8 gal of water per 0.1 in. of rainfall. The flow monitoring equipment was removed from the sump in August 2009.

Removal of the solids in the bottom of the sump was initiated in March 2009. The water present in the sump at the time the solids were to be removed was pumped into 5-gal containers using a peristaltic pump. After all free water was removed from the sump, the solids were removed using a small handheld shovel and placed into 5-gal waste containers. Grout was added to the solids, hydrated with water from the sump, and allowed to set. Excess water was returned to the sump. The solidified material was turned over to waste management personnel for disposal.

After the sediments were removed, the sump was allowed to discharge for a period of approximately 2 months before additional water samples were collected. This was done to allow the sump adequate time to discharge and refill several times. The water in the sump was sampled in June 2009. The levels of some of the contaminants that had exceeded screening levels before the solids were removed were found to have dropped below screening levels after the solids were removed. However, several of the contaminants remained above screening levels. The analytical results that exceeded screening levels are presented in Table 3.23.

Sump S-073A will remain in place until the demolition of the K-1006 building occurs.

3.5.1.7 Monitoring of Runoff from K-1070-B Burial Ground

The K-1070-B Burial Ground (Fig. 3.22) covers approximately 3.7 acres. This burial ground was opened in the early 1950s when the amount of equipment, materials, and parts reached a level that made warehouse storage impractical. The burial ground grew outward from the side of the hill south of Mitchell Branch. As waste was added and covered, the elevation became level with the K-1300 complex to the south. The unit is estimated to have been in operation from 1950 through the mid-1970s. Technological advances resulted in plant improvement programs that generated large quantities of obsolete machinery, equipment, materials, and parts for disposal. Also, a former disposal site located near the junction of Highways 95 and 58 that was jointly used by the ORR sites was cleaned up in the 1960s. At least 10 tractor-trailer loads of materials were brought to K-1070-B for disposal. These materials included contaminated parts and equipment. Operation of K-1070-B continued until the opening of the K-1070-C/D Burial Ground in the mid-1970s. The K-1070-B Old Burial Ground was closed by being covered with soil, seeded with fescue, and planted with black locust trees.

The overall site surface slopes toward the north downward to the Northeast Patrol Road. Surface runoff from the site is collected in a shallow ditch along the Patrol Road that discharges to Mitchell Branch.

To meet the closure requirements for this facility, the materials buried in the K-1070-B Burial Ground must be excavated and moved to EMWMF, where they will be properly disposed of. Excavation activities at the K-1070-B Burial Ground were initiated in 2008 and are ongoing.

Manholes 8002 and 8017 are located upgradient of the K-1070-B Burial Ground. Outfall 190 is located downgradient of the burial ground. Manholes 8002 and 8017 and outfall 190 were sampled together after activities at the K-1070-B Burial Ground had been initiated in an effort to determine if the ongoing remedial activities were changing the water quality of the storm water runoff in the area as it passed through the burial ground area (Table 3.24).

The results from the K-1070-B closure sampling event conducted in February 2009 were reviewed, and results above screening level were plotted as seen in Figs. 3.34 and 3.35. Several of the parameters of interest did increase downgradient of the burial ground, including chromium, mercury, and PCB-1260. However, this trend was not consistent for all of the parameters of interest. As apparent from the figures, no definite conclusions can be drawn about the effect of the K-1070-B burial ground closure activities on storm water runoff quality.

Table 3.24. Surface water sampling to support CERCLA remedial action activities at the K-1070-B Burial Ground

RA or D&D activity	Sampling location	Sampling frequency	Sampling events	Gross alpha/beta	Isotopic uranium, ^{99}Tc	PCBs	VOCs	Metals[a]/ mercury
K-1070-B Burial Ground	MH 8002	During closure activities	1	X	X	X	X	X
	MH 8017	During closure activities	1	X	X	X	X	X
	SD-190	During closure activities	1	X	X	X	X	X

[a] Metals analysis includes Al, Ag, As, Ba, Be, B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Sb, Se, V, Zn, and Tl.

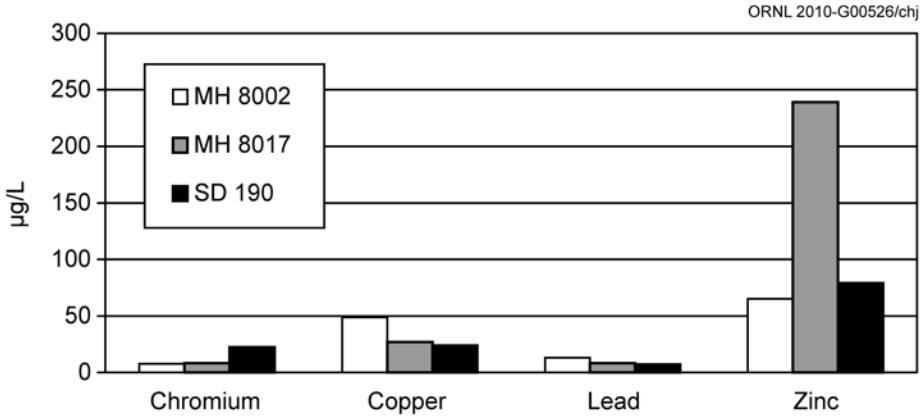


Fig. 3.34. Sample results for chromium, copper, lead, and zinc obtained during K-1070-B CERCLA remedial action activities. MH = manhole, SD = storm drain.

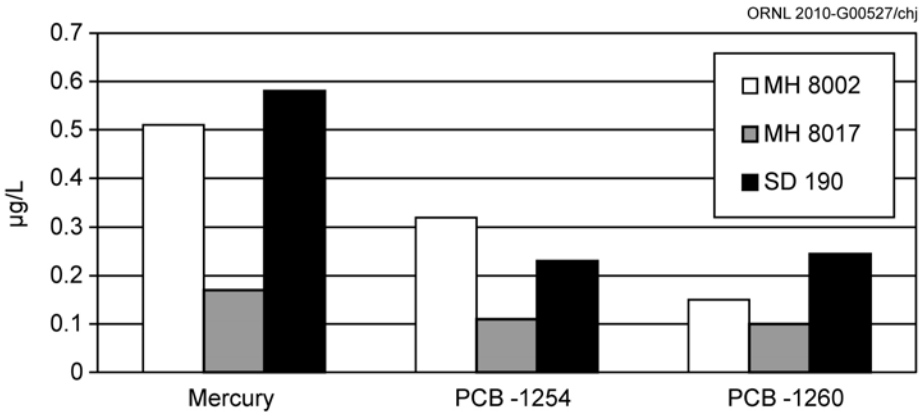


Fig. 3.35. Sample results for mercury and PCBs obtained during K-1070-B CERCLA remedial action activities. MH = manhole, SD = storm drain.

3.5.1.8 K-31 and K-33 Area Storm Water Sampling

As stated in 2009 Remediation Effectiveness Report for DOE (RER) (DOE 2009), prepared as part of the BJC Water Resources Restoration Program, chromium concentrations in groundwater measured between the K-31/K-33 buildings (Fig. 3.22) and Poplar Creek are somewhat elevated. Significant chromium concentrations (highest of any wells in the area) are shown for groundwater well UNW-043. The highest chromium concentration shown for this well is about 9 mg/L measured in 2003; most of the other chromium results for this well are between 1 and 4 mg/L. The residual chromium contamination is attributed to leaks of recirculated cooling water. The chromium at this location is almost entirely trivalent, with little or no hexavalent chromium being observed. These chromium concentrations greatly exceed the Tennessee Fish and Aquatic Life criterion continuous concentration for trivalent chromium, which is based on the applicable water hardness, and any groundwater with these concentrations entering surface water would be a concern.

As part of the FY 2009 SWP3 sampling effort, samples were collected from the ETTP storm drain system in the K-31/K-33 area to monitor for metals and radiological contaminants in storm water discharges (Table 3.25). Several of these samples could not be collected because there was no dry weather or wet weather flow present at any of the times they were visited. No dry or wet weather sampling was performed at outfalls 510, 560, 600, 660, or 690 due to lack of flow. Efforts to collect samples from these outfalls will continue through 2010.

Table 3.25. Storm water sampling in the K-31/K-33 area

Storm water outfall	Sampling event(s)	Area of investigation	Metals by EPA-200.7	Gross alpha/ gross beta
590	1, wet weather	K-861	X	X
700	1, wet weather	K-33	X	X
710	1, dry weather	K-33	X	X

Analytical results for the K-31/K-33 area that exceeded screening levels in samples collected in 2009 are given in Table 3.26. Analytical results from these samples were used to provide information for determining if chromium or other metals are present in storm water discharges in quantities that exceed the Tennessee WQC. In addition, the total amount of chromium and other metals in combined storm water and groundwater discharges to receiving waters could be determined.

Table 3.26. Storm water results from K-31/K-33 sampling exceeding screening levels

Storm water outfall	Chromium (μg/L)	Copper (μg/L)
590	8.1	
710		10.2

Chromium was detected in the discharge from storm water outfall 590 at a level of 8.1μg/L (Table 3.26). This exceeds the screening level for chromium, which is 8 μg/L. No previous analytical data are available for this outfall. Outfall 590 receives discharges from the former location of the K-861 cooling tower and associated facilities. Including the K-861 cooling tower, there were a total of five cooling towers that were constructed of either treated redwood or Douglas fir to dissipate the heat from the recirculating cooling water system to the environment. A chromate/zinc/phosphate treatment was used for corrosion control. In the 1960s, a Martreat treatment was used to control biological fouling in the cooling towers. That process reportedly produced copper fluorides, copper chromate, zinc arsenate, and zinc chromate. The cooling towers were demolished as part of the Cooling Tower Demolition Project conducted in 1996–1998.

Copper was detected in the discharge from storm water outfall 710 at a level of 10.2 μg/L (Table 3.26). This exceeds the screening level for copper, which is 7 μg/L. Copper had not been detected at levels above screening criteria in earlier sampling performed in 2006 and 2007. Outfall 710 receives storm water discharges from Building K-33, a portion of Building K-31, the former location of the K-792 Switchyard, and the K-1065 waste storage facilities. All storm water runoff from Buildings K-31 and K-33 that enters this drainage system passes through oil skimmer K-897-N before discharging through

outfall 710. Buildings K-31 and K-33 are currently inactive. A decision on the final disposition of the buildings will be made in the future. The K-1065 facility remains active, but no discharges from the facility to the environment have been reported. The K-792 Electrical Switchyard transferred electrical power to the K-33 cascade operations. A series of French drains were installed underneath the gravel bed of the switchyard when it was constructed in 1954. An oil skimmer for storm water runoff was installed in 1981. All of the equipment has been removed from this switchyard, and it is no longer active.

3.5.1.9 Sampling of the K-702-A Slough

A portion of the Powerhouse area drains to Poplar Creek through the K-702-A slough. This flume is connected to Poplar Creek by underground piping. Discharges from the Powerhouse area into the K-702-A slough currently consist almost entirely of storm water runoff.

The K-702-A slough receives storm water runoff from the K-700 Powerhouse and associated area. The Powerhouse generated and distributed electrical power for ORGDP operations using fossil-fuel-fired steam-generating facilities. Several storm water outfalls carry storm water runoff from the general Powerhouse area to the slough. The slough also receives discharges from the K-720 Fly Ash Pile, which was historically used for disposal of fly ash generated by the coal-fired boilers in the K-700 Powerhouse. Discharges from the K-720 Coal Ash Pile enter the slough via outfall 992.

Arsenic and selenium have been detected in historical sampling events conducted at outfall 992. Also, the discharge from outfall 992 has been observed to have a very low pH on several occasions. Runoff from the K-720 Fly Ash Pile is believed to be the primary contributor of arsenic and selenium to the discharge from outfall 992. It is also believed to be the source of the low pH discharges from this outfall. In 1994, the K-720 Fly Ash Pile area was covered with soil and seeded. In 2008, the drainage channel for runoff from the K-720 area was lined with rip-rap in an effort to prevent the discharge of low-pH runoff from the ash pile. Elevated levels of arsenic or selenium have not been noted in the K-702-A slough. Radiological contamination is not expected to be present in the K-702-A slough. In addition, the K-702-A slough is not a contributor of mercury or PCBs to Poplar Creek.

As part of the discussions involved with the new NPDES permit application, it was discovered that there was very little recent information on the water quality in the K-702-A slough. Also, there was little available data on the effect of the Outfall 992 discharge on the water quality of the K-702-A slough. Therefore, sampling of the slough was requested as part of the 2009 SWP3 sampling effort.

Samples were collected at the easternmost and westernmost ends of the slough. In addition, samples were collected from the portion of the slough immediately downstream of the inflow of outfall 992. The samples were collected during dry and wet weather conditions. Dry weather conditions were defined as flows following a period of at least 72 h after a storm event of 0.1 in. or greater in 24 h. Wet weather samples were collected from discharges resulting from a storm event greater than 0.1 in. that occurred within a period of 24 h or less and at least 72 h after any previous rainfall greater than 0.1 in. in 24 h. All of the recommended locations were sampled as part of a single sampling event. All samples were collected by the manual grab sampling technique. Table 3.27 contains information on how the samples for this effort were collected.

For the purpose of this sampling effort, it was assumed that the water in the slough was fairly homogeneous. Therefore, the grab samples were collected from the bank instead of from a boat. Also, the entire water column from the surface of the slough to the bottom of the slough was not requested to be represented as part of each sample. Samples at each location were analyzed for metals (using EPA 200.7), mercury, gross alpha/beta, PCBs, and VOCs.

The analytical results from this water sampling effort that exceeded screening levels are presented in Table 3.28. Mercury and thallium were detected above screening levels in each of the wet and dry weather samples that were collected as part of this sampling effort. However, the screening level for both of these materials is any amount of the substance that is detectable by approved laboratory methods.

This sampling effort will be repeated after the water level in the Clinch River has been lowered to winter pool levels. This will also lower the water level in Poplar Creek, lessening the possibility that any contaminants would be diluted by the backflow of water from Poplar Creek into the slough. Thus, these samples would provide a “worst case” result.

Table 3.27. K-702-A slough sampling

Storm water outfall	Sampling event(s)	PCBs	Metals by EPA-200.7	Gross alpha/ gross beta	Mercury
K-702-A West End	1, dry weather	X	X	X	X
K-702-A West End	1, wet weather	X	X	X	X
K-702-A East End	1, dry weather	X	X	X	X
K-702-A East End	1, wet weather	X	X	X	X
K-702-A Middle	1, dry weather	X	X	X	X
K-702-A Middle	1, wet weather	X	X	X	X
Outfall 992 Pooled Area	1, dry weather	X	X	X	X
Outfall 992 Pooled Area	1, wet weather	X	X	X	X

NOTE: All wet weather samples were collected during the first 30 min of a qualifying storm event discharge.

Table 3.28. Storm water sampling results from K-702-A slough exceeding screening levels

Location sampled	Sampling event	Mercury (ng/L)	Thallium (μg/L)
Outfall 992 Pool	Dry weather	10.1	18
Outfall 992 Pool	Wet weather	10.8	19.4
K-702-A West End	Dry weather	5.18	23.9
K-702-A West End	Wet weather	4.82	17.5
K-702-A East End	Dry weather	10.5	18.2
K-702-A East End	Wet weather	16.2	13.3
K-702-A Middle	Dry weather	13.5	18.4
K-702-A Middle	Wet weather	14.2	13.1

3.5.1.10 Investigation of PCBs, Mercury, and Metals in Mitchell Branch and Associated Storm Water Outfalls

PCBs, mercury, and other metals have been detected in the water sampling performed at outfalls that contribute flow to Mitchell Branch. In an effort to obtain more current analytical data from the discharges from these outfalls and identify how the discharges from these outfalls might be affecting the water quality of Mitchell Branch, sampling for PCBs, mercury, and metals was requested at several storm water outfall locations and at several locations within Mitchell Branch.

Sampling was conducted at the following nine locations: Outfalls 170, 180, 190, and 198; Mitchell Branch kilometers (MIKs) 1.4, 0.71, 0.59, and 0.45; and K-1700.

Samples at all locations were analyzed for PCBs, total mercury, and metals. In addition, samples were collected at outfall 180, MIK-0.59, and K-1700 for analysis for methyl mercury. Comparison of analytical results to the Tennessee WQC (TN 1200-4-3 General WQC) was performed.

The applicable water quality criterion for mercury is 0.051 μg/L; therefore, total mercury samples were analyzed by a laboratory with a method detection limit (MDL) for mercury below this criterion. The laboratory method used for total mercury analysis is the EPA 1631 method because it can detect mercury below the water quality criterion. Depending on the laboratory that runs the analysis, the EPA 1631 method has a detection limit as low as 0.5 ng/L. Methyl mercury samples were to be analyzed using the EPA 1630 method. Based on the laboratory that performs the analysis, this method has a detection limit as low as 0.02 ng/L. Analysis for metals at all storm drain and in-stream locations was performed using the EPA 200.7 method. In addition, replicate metals samples that were analyzed using the EPA 200.8 method were collected at all in-stream locations. The additional metals sampling was collected to provide

analytical data on all metals detected by these two analytical methods for the in-stream locations. The sampling effort also provided a QA/QC check for the laboratories. Analysis for PCBs was done using the EPA 608 method.

Samples were collected during both wet and dry weather conditions. Wet weather samples were collected from flows resulting from a storm event greater than 0.1 in. in magnitude in 24 h and that occurred at least 72 h after any previous storm event of 0.1 in. or greater in 24 h. If an intermittent rainfall occurred over a period of 24 h and did not equal or exceed 0.1 in., it was not considered to be a storm event, and the 72-h delay until the next rainfall that can potentially be sampled was not in effect. Wet weather sampling of all locations was conducted during the same storm event, when possible. Mitchell Branch samples were collected progressing from the farthest downstream sampling location to the farthest upstream sampling location. All of the wet weather samples were collected by the manual grab sampling technique. This sampling effort is outlined in Table 3.29.

Table 3.29. Wet weather sampling for PCBs, mercury, and metals

Sampling location	PCBs	ICP[a] metals (by EPA 200.7)	ICP metals (by EPA 200.8)	Total mercury	Methyl mercury
Outfall 170	X	X		X	
Outfall 180	X	X		X	X
Outfall 190	X	X		X	
MIK-1.4	X	X	X	X	
MIK-0.71	X	X	X	X	
MIK-0.59	X	X	X	X	X
MIK-0.45	X	X	X	X	
K-1700	X	X	X	X	X

[a]ICP = inductively coupled plasma

Table 3.30 indicates the parameters that exceeded screening levels in samples collected in September 2009 under wet weather conditions. Analytes that exceeded an applicable water quality criterion included thallium at K-1700 (result of 1.13 µg/L exceeded criterion of 0.051 µg/L), mercury at outfall 180 (0.0884 µg/L), and total chromium at outfall 170 (16.1 µg/L). No other exceedances of screening levels were noted in the analytical data from this sampling effort.

Table 3.30. Results of wet weather sampling for PCBs, mercury, and metals that exceeded screening levels, September 2009

Sampling location	Total mercury (ng/L)	Thallium (µg/L)	Chromium (µg/L)
MIK-1.4	5.4		
Outfall 170	5.3		16.1
MIK-0.71	4.2		
Outfall 180	88.4		
MIK-0.59	10.4		
Outfall 190	36		
MIK-0.45	18.4	<0.402	
K-1700	22.1	1.13	

Dry weather samples collected in Mitchell Branch were collected in July 2009 progressing from the farthest downstream sampling location to the farthest upstream sampling location. Dry weather samples were collected from flows following a period of at least 72 h after a storm event of 0.1 in. or greater in

24 h. All of the dry weather samples were collected by the manual grab sampling technique. This sampling effort is outlined in Table 3.31.

Table 3.31. Dry weather sampling for PCBs, mercury, and metals, July 2009

Sampling location	PCBs	ICP metals (by EPA 200.7)	ICP metals (by EPA 200.8)	Total mercury	Methyl mercury
Outfall 170	X	X		X	
Outfall 180	X	X		X	X
Outfall 190	X	X		X	
MIK-1.4	X	X	X	X	
MIK-0.71	X	X	X	X	
MIK-0.59	X	X	X	X	X
MIK-0.45	X	X	X	X	
K-1700	X	X	X	X	X

Table 3.32 indicates parameters that exceeded screening levels in dry weather sampling conducted in July 2009. The only exceedance of an applicable water quality criterion was mercury at outfall 180 (result of 0.1145 μg/L exceeded criterion of 0.051 μg/L). The only other result that approached an applicable water quality criterion was thallium at K-1700; however, the field replicate was a non-detect. No other exceedances of screening levels were noted in the analytical data from this sampling effort.

Table 3.32. Results of dry weather sampling for PCBs, mercury, and metals that exceeded screening levels, July 2009

Sampling location	Total mercury (ng/L)	Thallium (μg/L)
MIK-1.4	0.8	
Outfall 170	5.5	
MIK-0.71	3.1	
Outfall 180	114.5	
MIK-0.59	10.8	
Outfall 190	13.9	
MIK-0.45	11.4	
K-1700	12.1	<0.407

Figure 3.36 shows the thallium concentrations noted in the analytical data. Figure 3.37 indicates the progression of mercury concentrations in Mitchell Branch from the upper reaches of the branch (MIK 1.4) to a location near the point where Mitchell Branch discharges into Poplar Creek (K-1700). Figure 3.38 indicates the progression of chromium concentrations in Mitchell Branch from MIK 1.4 to K-1700.

Mercury is almost nonexistent in the upper reaches of Mitchell Branch. Outfall 170 discharges a small amount of mercury into Mitchell Branch, but it is attenuated by the flow of the branch by the time it reaches MIK 0.71. At outfall 180, an elevated amount of mercury is discharged into Mitchell Branch. Even though mercury levels are still elevated, this mercury discharge from outfall 180 is somewhat attenuated by the time the flow of Mitchell Branch reaches MIK 0.59. At outfall 190, a small amount of mercury is once again discharged into Mitchell Branch, but is attenuated by the other flow in the branch by MIK-0.45. Between MIK 0.45 and K-1700, mercury levels rise somewhat, possibly due to the presence of contaminated sediments in the K-1700 area. Figure 3.39 is an aerial photo showing the sampling locations along Mitchell Branch and the mercury levels at each of the sampling locations.

Outfall 180 appears to be a primary source of mercury discharges into Mitchell Branch. Past operations that involved the use of mercury have occurred in the outfall 180 drainage area. The K-1303 Mercury Distillation and Recovery Unit operated from 1948–1954. This facility included a rinsing operation that generated a waste stream containing small levels of mercury that were discharged to

K-1407-B Pond and Poplar Creek via Mitchell Branch. In 1948 the K-1303 Building ventilation was modified to discharge mercury fumes above the roof of the building. Mercury contamination was subsequently identified on the roof and in the soils surrounding the building. The facility was demolished in 2004. In addition, the Building K-1401 housed an instrument development lab in the north end of the building. Mercury diffusion pumps were used in this area in conjunction with mass spectrometers. Other activities conducted in K-1401 that involved mercury included the acid cleaning of mercury flasks from Y-12. The practice of bypassing the holding pond and dumping tanks of used cleaning fluids into Mitchell Branch was performed weekly. Mercury was also stored and handled in the instrument development laboratory in the north end of K-1401. Building K-1401 was demolished in 2008.

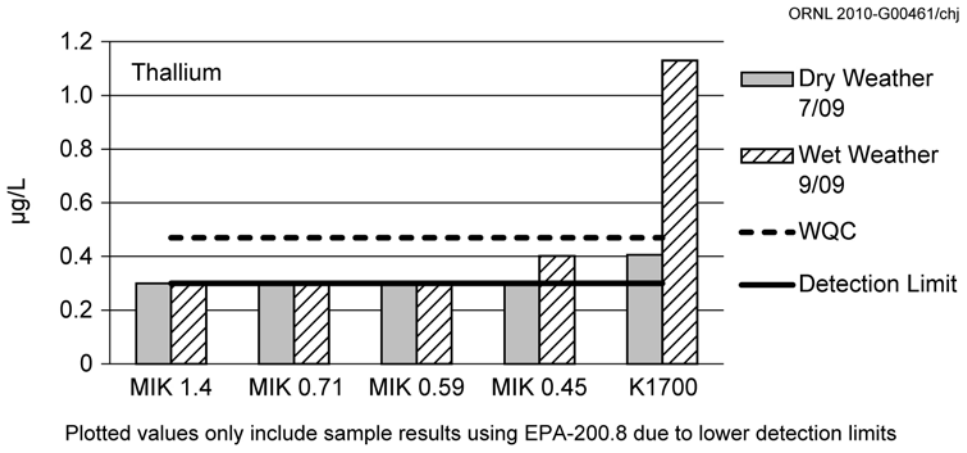


Fig. 3.36. Thallium results from Mitchell Branch investigation sampling event.

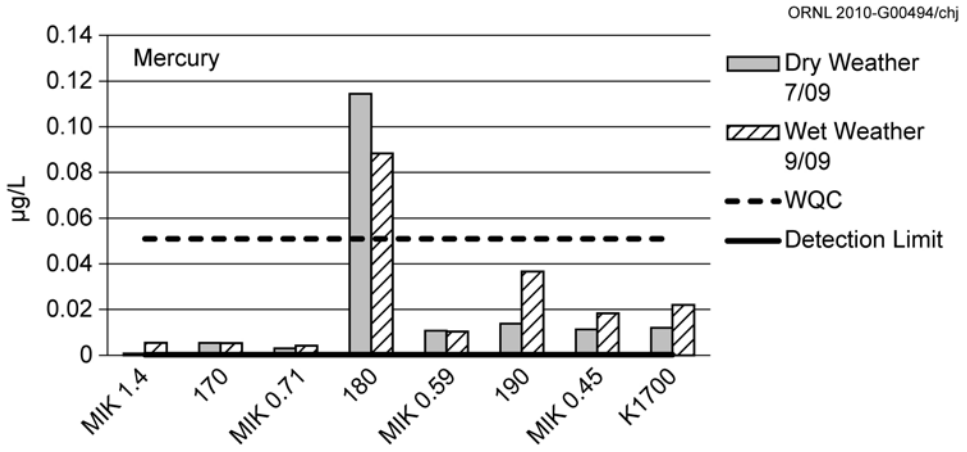


Fig. 3.37. Mercury results from Mitchell Branch investigation sampling event.

Outfall 170 discharges small amounts of mercury into Mitchell Branch. The most likely source of mercury in this drainage system is from the K-1420 area. Recovery operations in K-1303 were transferred to K-1420 in 1956. From then until 1980, operations in the K-1420 ground floor recovery room included the recovery and purification of mercury from wastes using a washing and distillation process. The recovery room was located in the northwest corner of K-1420. The total amount of mercury processed over the years is uncertain, but records refer to the recovery of tons of mercury. Mercury contamination has been identified in K-1420 floor drains, holding ponds that received building drainage, and beneath the concrete floor of the building. Building K-1420 was demolished in 2007.

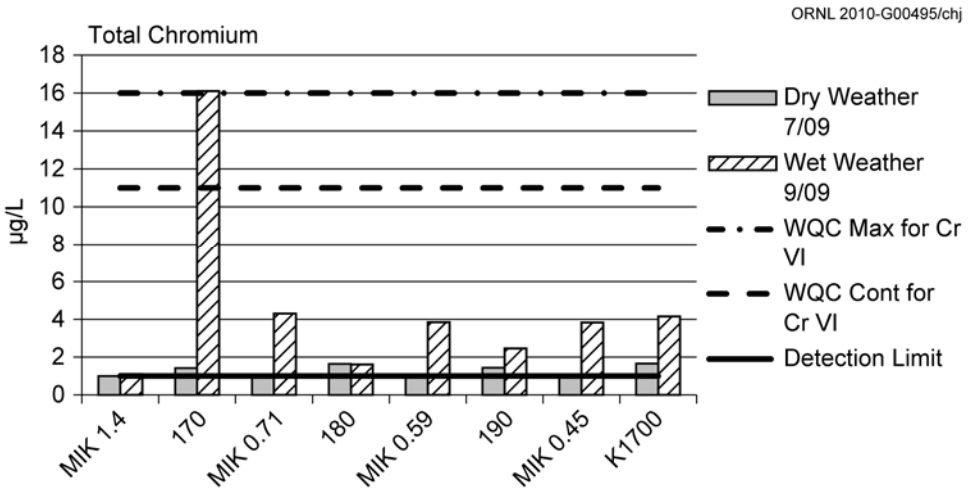


Fig. 3.38. Chromium results from Mitchell Branch investigation sampling event.

Fig. 3.39. Aerial photo of Mitchell Branch mercury sampling locations and results.

Mercury is also present in the discharge from outfall 190 to Mitchell Branch. The most likely source of mercury in the outfall 190 drainage system is from operations conducted in Building K-1401, as described previously. In addition, mercury may have come from the treatment of mercury-contaminated wastewaters at the K-1413 facility. Wastewater from Y-12 was transported by tanker truck to K-1413 for treatment. At least one shipment of Y-12 wastewater to K-1413 was known to have been contaminated with mercury.

3.5.1.11 Sampling of Active Sumps at ETTP

Approximately 104 sumps were once located in various building basements, switchyards, and other facilities around ETTP. Many of the sumps no longer discharge because the sump pump has been removed or de-energized, or the building served by the sump has been demolished or abandoned and the sumps have been filled. Water from the sumps that are still active may be discharged to the ETTP storm water drainage system or sanitary sewer system or routed to the CNF.

Sumps were sampled as part of the ETTP accumulated water discharge program from 1994 until 1998. During 1998, ETTP CWA Program personnel analyzed the historical data from the previous year's sampling events and determined that the sump program would be suspended. Except for the sampling of a few selected sumps as part of the 2002 SWP3 sampling, no analytical data have been collected from the sumps since the program was suspended.

As part of the 2009 SWP3, all of the sumps that actively collect and discharge groundwater and storm water were identified; approximately 15 were thought to be currently active at ETTP. To obtain current analytical data for these active sumps, each was to be sampled for parameters that were selected based on past analytical results from the sump. Table 3.33 provides information on the locations of the active sumps that were sampled in 2009, where they discharge, and the parameters they were sampled for.

Table 3.33. Sampling of sumps believed to be active at ETTP

Sump number	Building/area	Location/sump description	Discharge point	Parameters to be sampled
S054	K-732 Switchyard	Basement, center, near columns 15 and 16	Outfall 440	PCBs, VOCs, pH, visual check for oily sheen
S055	K-732 Switchyard	Valve vault 2	Outfall 440	PCBs, VOCs, pH, visual check for oily sheen
S056	K-732 Switchyard	Valve vault 3	Outfall 440	PCBs, VOCs, pH, visual check for oily sheen
S057	K-732 Switchyard	Synchronous condenser 101	Outfall 440	PCBs, VOCs, pH, visual check for oily sheen
S058	K-732 Switchyard	Synchronous condenser 102	Outfall 440	PCBs, VOCs, pH, visual check for oily sheen
S059	K-732 Switchyard	Synchronous condenser 103	Outfall 440	PCBs, VOCs, pH, visual check for oily sheen

The sumps located in the K-732 switchyard (Fig. 3.22) were sampled in August 2009. The analytical results from this water sampling effort that exceeded screening levels are presented in Table 3.34. PCBs were detected at levels above screening criteria in four of the six sumps that were sampled. All of the sumps that were found to contain elevated levels of PCBs discharge through oil/water separators. These devices have proven to be effective in removing any traces of oil that may contain PCBs. PCBs have only rarely been noted in analytical data from storm water outfalls served by oil/water separators.

Table 3.34. K-732 Switchyard sump sampling results exceeding screening levels

Location sampled	PCB-1254 (μg/L)	PCB-1260 (μg/L)
S054		0.086
S057	6	
S058	0.36	
S059	36.6	

Sampling of the sumps located in the K-762 Switchyard, Building K-1037, and Building K-1210 will be performed in 2010.

3.5.1.12 NPDES Monitoring at the CNF Waste Water Treatment System

Nonradiological monitoring of CNF effluent is conducted according to the requirements of NPDES Permit No. TN0074225. Monitoring requirements, frequencies, and sample types required under the permit are listed in Table 3.35. Wastewater from CNF is discharged through outfall 001 into the Clinch River.

Table 3.35. NPDES permit no. TN0074225 outfall 001 monitoring requirements

Parameter	Collection frequency	Sample type
Flow	Continuous	Recorder
pH	Continuous	Recorder
Total suspended solids (TSS)	Weekly	24-h composite
Chemical oxygen demand (COD)	Weekly	24-h composite
Benzene	Bimonthly	Grab
Ethylbenzene	Bimonthly	Grab
Toluene	Bimonthly	Grab
Methylene chloride	Bimonthly	Grab
Bromoform	Monthly	Grab
Carbon tetrachloride	Monthly	Grab
Chlorodibromomethane	Monthly	Grab
Chloroform	Monthly	Grab
Dichlorobromomethane	Monthly	Grab
Tetrachloroethylene	Monthly	Grab
1,1,1-Trichloroethane	Monthly	Grab
Trichloroethylene	Monthly	Grab
Vinyl chloride	Monthly	Grab
Naphthalene	Monthly	Grab
Oil and grease	Monthly	Grab
Total petroleum hydrocarbons (TPH)	Monthly	Grab
Chloride, total	Monthly	24-h composite
Polychlorinated biphenyls (PCBs)	Monthly	24-h composite
Uranium, total	Monthly	Monthly composite
Gross alpha radioactivity	Monthly	Monthly composite
Gross beta radioactivity	Monthly	Monthly composite
^{234}U	Monthly	Monthly composite
^{235}U	Monthly	Monthly composite
^{236}U	Monthly	Monthly composite
^{238}U	Monthly	Monthly composite
^{99}Tc	Monthly	Monthly composite
^{137}Cs	Monthly	Monthly composite
^{238}Pu	Monthly	Monthly composite
^{239}Pu	Monthly	Monthly composite
^{237}Np	Monthly	Monthly composite
Other radionuclides—determined monthly	Monthly	Monthly composite
Cadmium, total	Quarterly	24-h composite
Chromium, total	Quarterly	24-h composite
Copper, total	Quarterly	24-h composite
Lead, total	Quarterly	24-h composite
Nickel, total	Quarterly	24-h composite
Silver, total	Quarterly	24-h composite
Zinc, total	Quarterly	24-h composite
Mercury, total	Quarterly	24-h composite
Acetone	Quarterly	Grab
Acetonitrile	Quarterly	Grab
Methyl ethyl ketone	Quarterly	Grab
Chlordane	Quarterly	Grab

Table 3.35 (continued)

Parameter	Collection frequency	Sample type
Total toxic organics (TTO)[a]	Quarterly	Grab
Settleable solids[b]	Biannually	Grab
Cyanide, total	Annually	Grab

[a] TTOs include, at a minimum, chloroform, bromoform, dichlorobromomethane, chlorodibromomethane, carbon tetrachloride, tetrachloroethylene, methylene chloride, naphthalene, benzene, ethylbenzene, toluene, and PCB. Other parameters listed in 40 CFR Part 433 are analyzed if their presence is suspected based on process knowledge.

[b] To comply with DOE Order 5400.5, Chap. II, 3.a.(4), the presence of settleable solids greater than 0.1 mg/L must be determined. If settleable solids are present, the sample will be filtered and the solids will be analyzed for total uranium, gross alpha radioactivity, and gross beta radioactivity. Sufficient volume shall be collected and held for radiological analyses. "Settleable solids" is not a NPDES permit parameter, and the result is not reported with the discharge monitoring report.

Radiological sampling of effluent from the CNF and/or the K-1435 Waste Water Treatment System is conducted weekly. The weekly samples are then composited into a single monthly sample. Table 3.36 lists the total discharges in 2009 by isotope. The radiological results are compared with the DCGs. The sum of the fractions must be kept below 100% of the DCGs; in practice the effluent results from the CNF and/or the K-1435 Waste Water Treatment System were well below 100% of the DCGs until 2007. Figure 3.40 shows a rolling 12-month average for 2009. Beginning in September 2006 and continuing at irregular intervals until February 2009, there were some anomalously high results for uranium isotopes, which caused spikes in comparisons of the sums of the fractions of the DCGs. In October 2007, the sum of the fractions of the DCGs exceeded 1.0 for the first time. Work continues on evaluating the most effective way to treat the waste. Operational changes that have taken place include more frequent changeout of the carbon filters, more frequent removal of built-up clarifier sludge, double treatment of the water when necessary, and the substitution of ferrous sulfate for ferric sulfate to cause the uranium to precipitate more readily. The substitution was made as a result of bench-scale jar tests to determine the most effective materials to use. Monitoring results for 2009 showed a marked decrease in the rolling 12-month average of the sum of the fractions of the DCGs from a high of 1.1 in January 2008 to 0.8 in December 2009.

Table 3.36. Isotopic discharges from the Central Neutralization Facility/Waste Water Treatment System, 2009

Isotope	Curies	Isotope	Curies
^{241}Am	1.2E–5	^{239}Pu	1.2E–5
		^{99}Tc	1.6E–1
^{137}Cs	2.4E–3	^{230}Th	2.4E–5
^{60}Co	2.8E–7	^{234}Th	2.4E–3
3H	1.6E–1	^{234}U	6.9E–3
		^{235}U	7.5E–4
^{237}Np	5.0E–5	^{236}U	4.2E–4
^{238}Pu	1.9E–5	^{238}U	2.7E–2

Although uranium isotopes constitute the greatest mass (approximately 82 kg) of radionuclides discharged from CNF, ^{99}Tc and tritium account for the greatest activity, due to their much higher specific activities. Transuranic isotopes constitute a small fraction of the total.

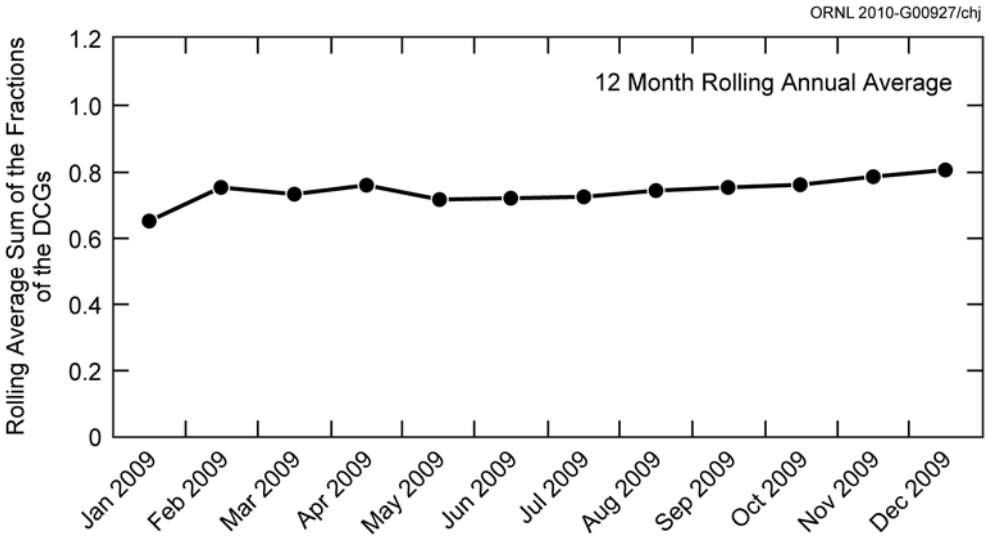


Fig. 3.40. CNF/K-1435 Waste Water Treatment System radionuclide liquid discharges.

3.5.1.13 NPDES Permit Noncompliances

There was one CWA or NPDES permit noncompliance at ETTP in 2009.

Storm water outfall 340 is monitored monthly as part of the ETTP NPDES permit compliance program. This outfall is located near the southwest corner of the K-25 Building. It receives surface runoff and roof drainage from the west wing of the K-25 Building.

On January 6, 2009, sampling subcontractor personnel were collecting routine NPDES permit compliance data at storm water outfall 340. They obtained a pH reading of 9.1 standard units at the designated NPDES monitoring location for that outfall. Sampling subcontract personnel then verified the calibration of the pH meter according to procedure. The pH meter calibration proved to be accurate. The pH reading of 9.1 SU is outside the NPDES-permitted range of 4.0–9.0 SU for this outfall. This constitutes a noncompliance with the ETTP NPDES storm water permit.

In preparation for the demolition of the K-25 Building, a storm water pollution prevention plan was prepared. The plan described the various methods that would be employed to prevent demolition debris and contaminated runoff from entering the storm drain system. One of the main protective measures that was implemented as part of the stormwater pollution prevention plan was the temporary sealing of storm drain inlets near the demolition area. The inlets were covered with rubberized mats, and the mats were sealed with flowable fill. It is believed that the elevated pH at outfall 340 may have been related to either or both of the following conditions concerning the sealing of the storm drain inlets.

1. The sealing of the storm drain inlets caused the backup of storm water into debris piles that had accumulated in the vicinity of the inlets. The pH of the storm water may have been raised by the contact of the storm water with concrete powder and other residue generated during the demolition of the K-25 Building. Due to infiltration of the accumulated storm water into cracks in the storm drain piping, and because incomplete sealing of some of the storm drain inlets occurred, storm water with an elevated pH entered the storm drain system.
2. The gap between the rubberized mats that were placed over the storm drain inlets and the ground surface at the inlet was sealed with a cementitious material. The cementitious material is strong enough to withstand regular truck traffic that might pass over the sealed storm water inlets. However, heavy construction equipment involved in building demolition had been driven over the sealed storm drains, which caused the cementitious material to break apart and fall into the storm drain inlet. This created the potential for storm water to enter the storm drain inlet by bypassing the damaged seal. It

also created the opportunity for the storm water to contact the broken cementitious material as it entered into the storm drain, which could raise the pH of the water.

A corrective action plan was developed shortly after the elevated pH measurement was taken. The corrective actions included the following:

1. identification of all storm water inlets that might have defective seals;
2. removal of as much of the building debris and sealing material from the storm water inlets where the seals had failed as possible;
3. plugging the risers and damaged storm water inlets with 4000 PSI concrete instead of flowable fill to provide additional strength and to prevent future damage;
4. placement of jersey bouncers over the storm drain inlets to prevent future damage due to truck and heavy construction equipment traffic;
5. continued routine inspections of the storm drain inlets for damage or undesired ingress of storm water; and
6. modification of the stormwater pollution prevention plan and changing of storm water control measures as dictated by changing conditions as demolition of the K-25 Building progresses.

All of the above corrective actions were implemented as soon as possible after this incident occurred.

No threat to human health or the environment occurred as a result of this event. No fish kills or other adverse impacts to the biota were observed.

3.5.2 Surface Water Monitoring

The ETTP environmental monitoring program personnel conduct environmental surveillance activities at 11 surface water locations (Fig. 3.41) to monitor groundwater and storm water runoff (K-1700, K-1007-B, and K-901-A) or ambient stream conditions [Clinch River kilometer (CRK) 16; CRK 23; K-1710; K-716; and MIK 0.5, 0.6, 0.7, and 1.4]. Depending on the location, samples may be collected and analyzed for radionuclides quarterly (K-1700 and MIK 0.5, 0.6, 0.7, and 1.4) or semiannually (remainder of locations). Results of radiological monitoring are compared with the DCGs. Radiological data are reported as fractions of DCGs for reported radionuclides. If the sum of DCG fractions for a location exceeds 100% for the year, a source investigation is required. Sources exceeding DCG requirements would need an analysis of the best available technology to reduce the sum of the fractions of the radionuclide concentrations to their respective DCGs to less than 100%. Comparisons with DCGs are updated regularly to maintain an annual average. The monitoring results at all of the surveillance locations generally have remained less than 1% of the allowable DCG (Fig. 3.42). The exceptions are K-1700 and three of the downstream locations on Mitchell Branch as indicated by the sums of the fractions of the DCGs for these locations as follows:

- K-1700: 2.7%,
- MIK 0.5: 2.3%,
- MIK 0.6: 1.9% , and
- MIK 0.7: 1.6%.

The percentage of the DCGs at K-1700 (2.7%) was slightly below the percentage of the 2008 monitoring results (3.4%).

Depending on the monitoring location, water samples may be analyzed for pH, selected metals, and VOCs. In 2009, results for these parameters were well within the appropriate Tennessee State water quality standards.

Figures 3.43 and 3.44 illustrate the concentrations of TCE (trichloroethene, trichloroethylene) and total 1,2-DCE (dichloroethene, cis-1,2-dichloroethylene, trans 1,2-dichloroethylene) from K-1700 (which monitors Mitchell Branch), the only surface water monitoring location where VOCs are regularly

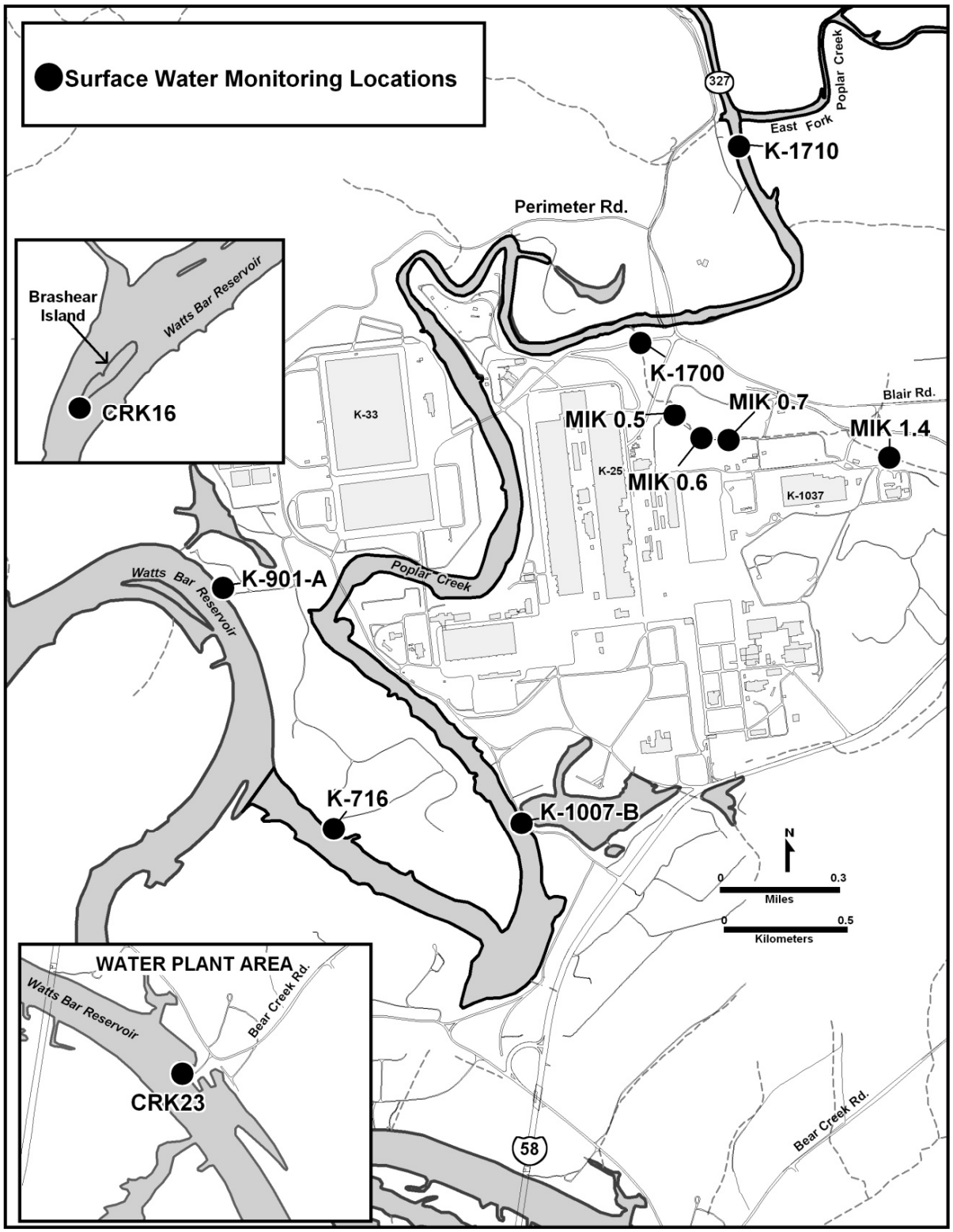


Fig. 3.41. Environmental monitoring program surface water monitoring locations.

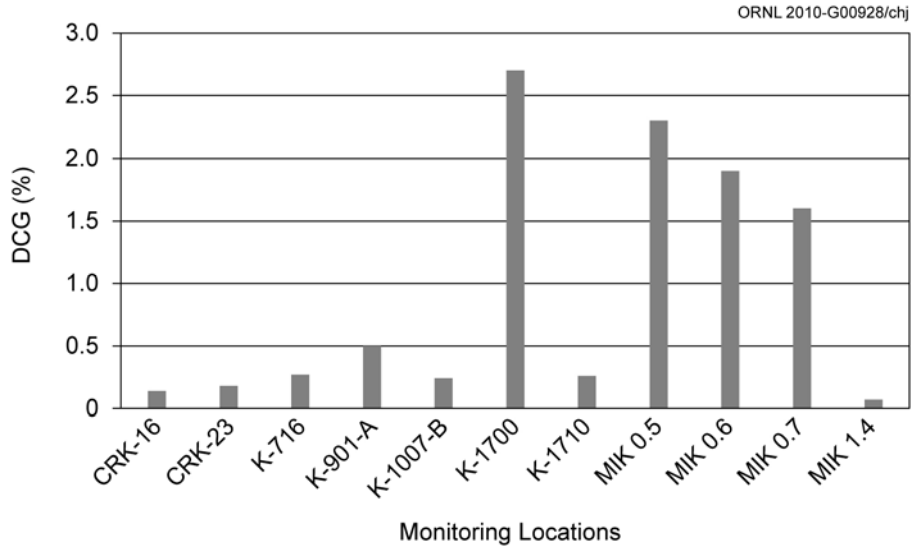


Fig. 3.42. Percentage of derived concentration guides (DCGs) at surface water monitoring locations, 2009.

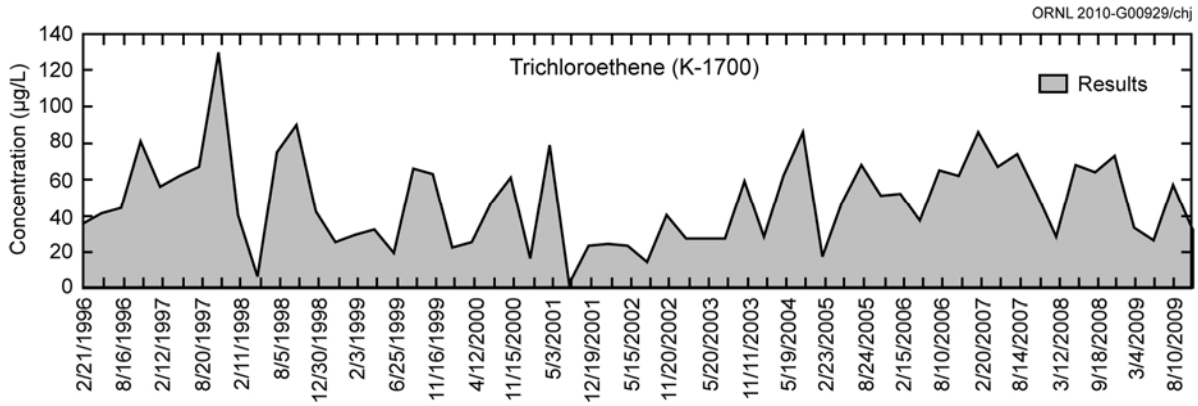


Fig. 3.43. TCE concentrations at K-1700.

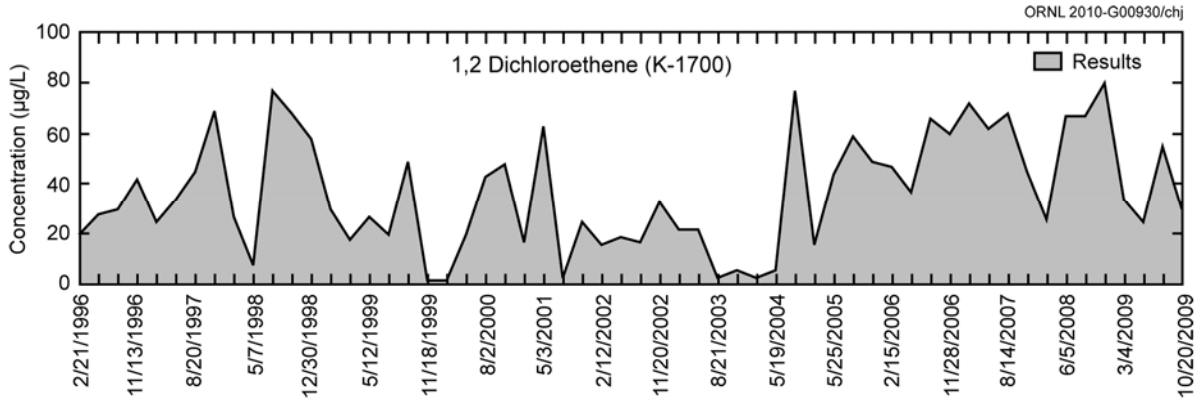


Fig. 3.44. 1,2-DCE concentrations at K-1700.

detected. Concentrations of TCE and total 1,2-DCE are below the Tennessee WQC for recreation, organisms only (300 μg/L for TCE and 10,000 μg/L for trans 1,2-DCE), (Appendix D, Table D.2), 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 (Fig. 3.45). 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. When detected, the concentrations are lower than in the stream. Therefore, it appears that the primary source of these compounds is contaminated groundwater.

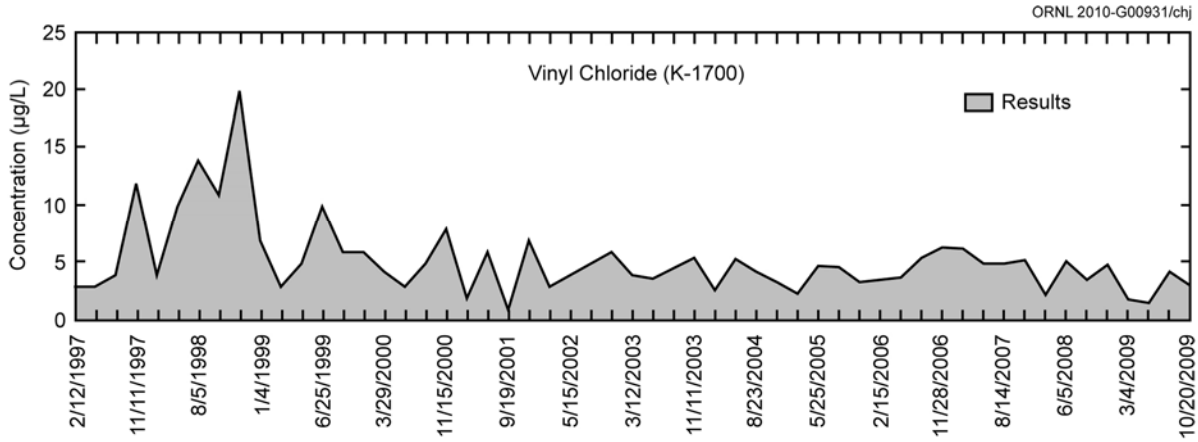


Fig. 3.45. Vinyl chloride concentrations at K-1700.

Surface water has been routinely sampled by DOE contractors and TDEC for several years as part of environmental monitoring programs. The DOE contractor surface water sampling program is conducted in accordance with DOE order surveillance program guidance. In data collected as part of the DOE contractor's sampling effort, dry weather levels of total chromium over the past 10 years (Fig. 3.46) have been shown to be generally less than 0.01 mg/L, or in some instances, at nondetectable levels. Results from routine surface water monitoring conducted in fall 2006 showed a significant increase in the total chromium level in Mitchell Branch but still below the WQC for total chromium. Sampling performed in the spring of 2007 by DOE contractors and TDEC indicated that chromium levels had increased above the levels found in the fall 2006 sampling. The highest total chromium result was a value of 140 μg/L, which exceeded the then-applicable WQC of 100 μg/L. Based on these sampling results, a joint effort was initiated by personnel from the DOE contractor, the TDEC surface water program, and the CERCLA program in June 2007. Historical maps and photographs, utility and waste process pipeline drawings, monitoring records for building sumps, and other sources of information were reviewed to search for possible uses and sources of chromium in the Mitchell Branch watershed. A chromium collection system employing two extraction wells and pumps was installed to pump water from the vicinity of storm water outfall 170 for treatment at the CNF. Since this system was installed, chromium levels in Mitchell Branch have dropped dramatically, with levels being routinely measured at less than 3 μg/L.

3.6 Biological Monitoring

The ETTP BMAP SAP consists of three tasks designed to evaluate the effects of ETTP operations on the local environment, identify areas where abatement measures would be most effective, and test the efficacy of the measures. These tasks are (1) toxicity monitoring of effluent and ambient waters from several locations within Mitchell Branch, (2) bioaccumulation studies, and (3) instream monitoring of biological communities. Figure 3.47 shows the major water bodies at ETTP, and Figure 3.48 shows the monitoring locations along Mitchell Branch.

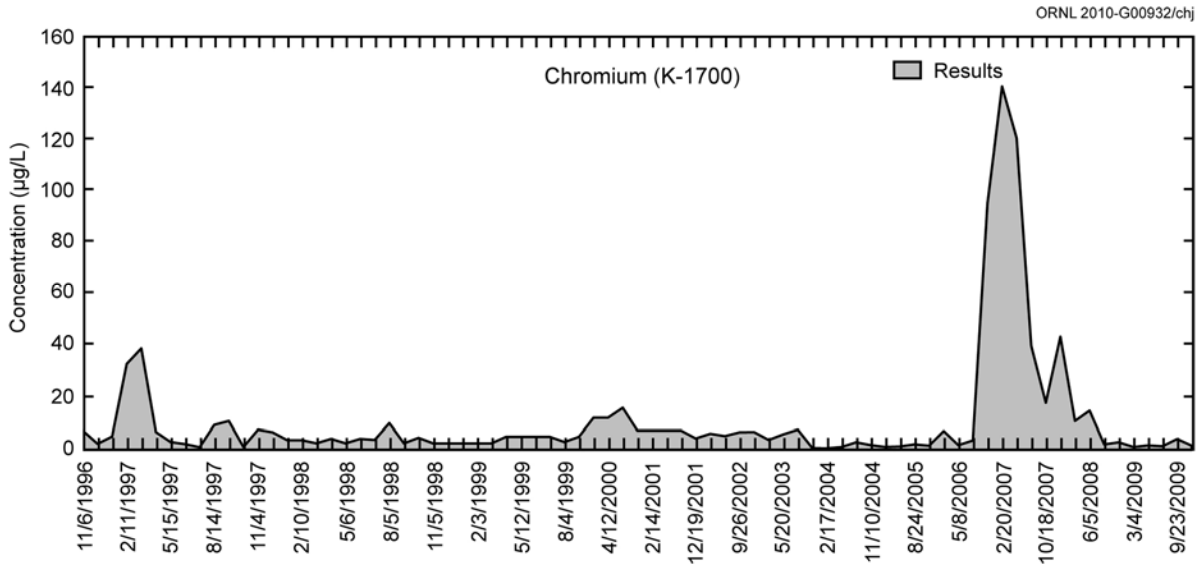


Fig. 3.46. Total chromium concentrations at K-1700.

In April and October of 2009, survival and reproduction toxicity tests using the water flea *Ceriodaphnia dubia* (Fig. 3.49) were conducted at four ambient locations in Mitchell Branch. At the same time, survival and reproduction toxicity tests using *C. dubia* were conducted on effluent from storm water outfalls (SDs)-170 and -190. In the April tests (Table 3.37), none of the water from the ambient station or from SD-170 exhibited toxicity. Water from storm water outfall 190 did not affect *Ceriodaphnia* survival but did reduce reproduction at concentrations as low at 12%. Previously, the overall trend was one of consistent toxicity to *Ceriodaphnia* from SD-190, with infrequent toxicity from the ambient locations and occasional toxicity at SD-170. The sources of these problems have not been definitively identified. The data gathered in previous studies indicate at least two possible sources, one being groundwater percolating through waste in the K-1070-B Burial Ground and leaching out small quantities of metals. Some of this groundwater flows into the storm drain system and likely contributes to the toxicity at SD-190. Nickel and zinc are present in water collected from the storm drain system near K-1070-B at levels that have been shown to be toxic to *Ceriodaphnia.* However, other factors have not been ruled out.

In the October tests (Table 3.38), none of the water from SD-170 or SD-190 exhibited toxicity. In contrast, water from ambient stations MIK 0.8, 0.7, and 0.4 did not affect *Ceriodaphnia* survival, but did reduce reproduction. Water from MIK 0.2 also reduced reproduction, but not by a statistically significant amount. Serial dilutions are not used in the tests of water from the ambient locations, so no no-observed effects concentrations are available. While not unprecedented, the occurrence of toxicity in the water from the ambient stations is unusual. Chemical analyses of water collected from the ambient stations failed to show any obvious explanation for the toxicity.

In June and July, 2009, caged clams *(Corbicula fluminea)* were placed at several locations around ETTP (Table 3.39). The clams (Fig. 3.50) were allowed to remain in place for 4 weeks and were then analyzed for uptake of PCBs and mercury. Results of the PCB analyses were generally consistent with those of previous years, although the concentration of PCBs in clams from storm water outfall 100 were substantially lower than in the 2008 test. The highest concentrations were found in the clams from the K-1007-P1 Pond, with lower concentrations found in the clams from Mitchell Branch. In the clams from storm water outfall 100, PCB concentrations decreased from 2008 to 2009. However, the concentrations were still elevated above levels seen at most of the other locations on ETTP. Clams from the K-901-A Pond contained detectable concentrations of PCBs, but the levels were considerably lower. In the clams from Mitchell Branch, the PCBs detected were primarily Arochlor-1254. On the other hand, elevated levels of Arochlors-1248, -1254, and -1260 were detected in the clams from the K-1007-P1 Pond. In the K-901-A Pond, low levels of Arochlors-1248, -1254, and -1260 were detected. In general,

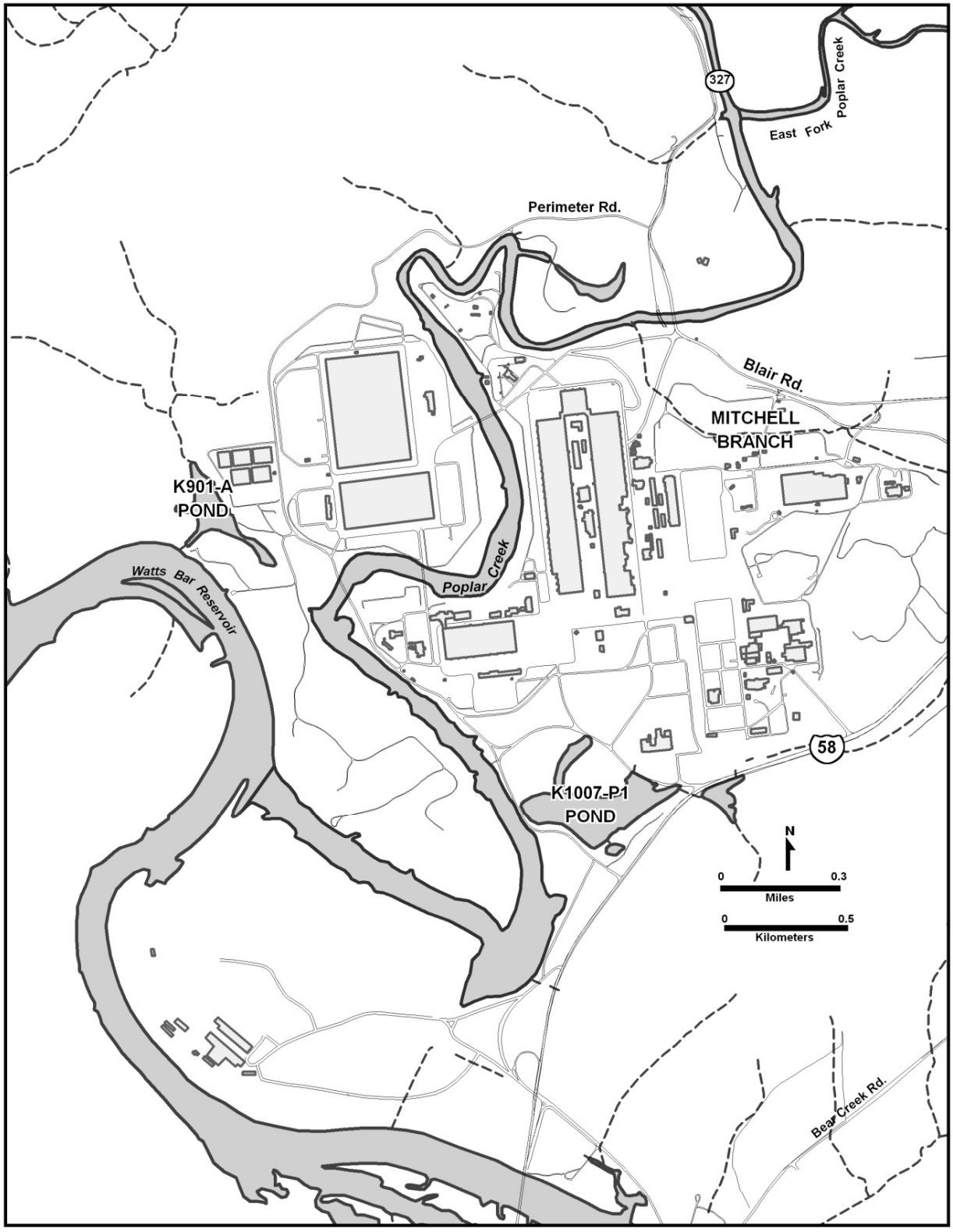


Fig. 3.47. Waterways at ETTP.

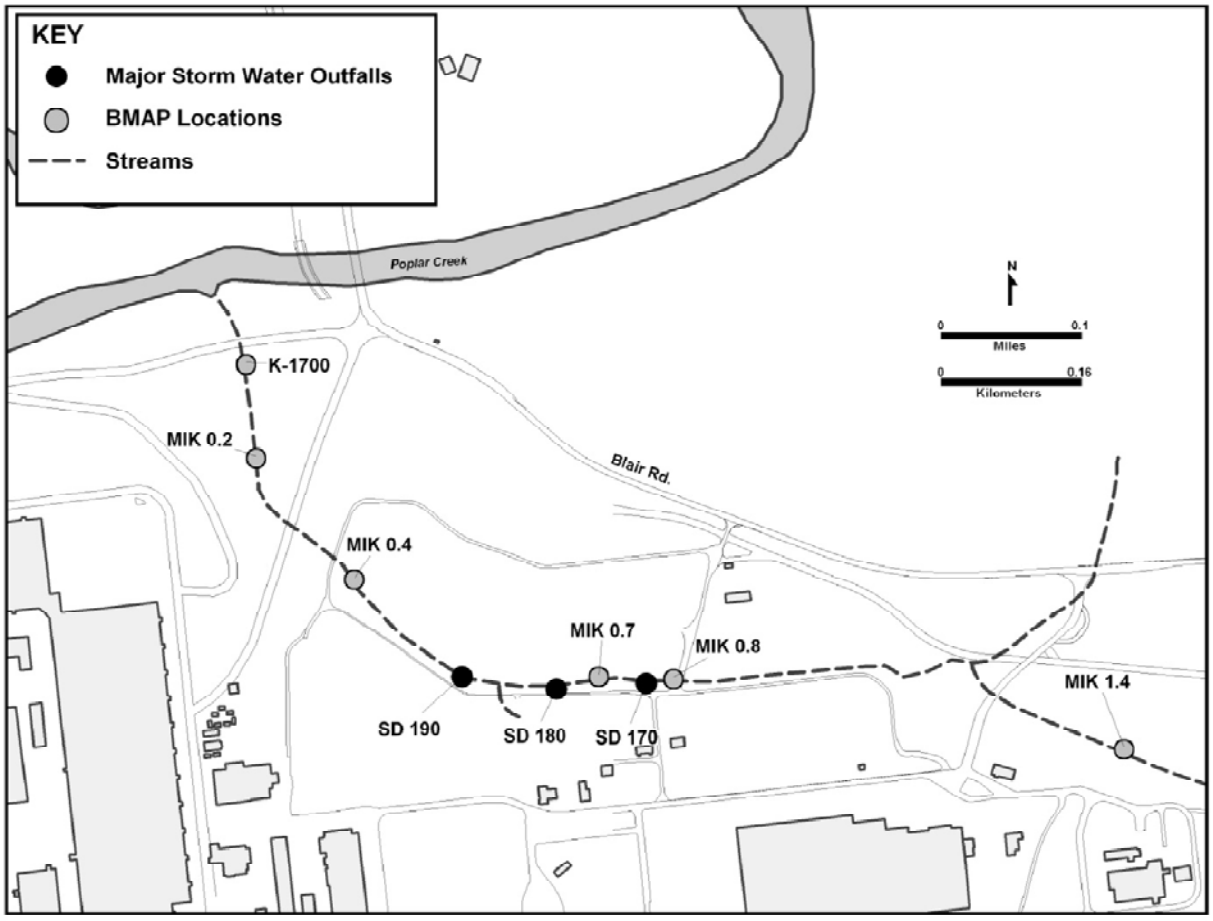


Fig. 3.48. Major storm water outfalls and biological monitoring locations on Mitchell Branch.

Fig. 3.49. Water flea *(Ceriodaphnia dubia)*.

Table 3.37. Mitchell Branch and associated storm water outfall toxicity test results, April 2009

(No-observed-effects concentrations)

Test	MIK 0.8	SD 170	MIK 0.7	SD 190	MIK 0.4	MIK 0.2
Ceriodaphnia survival (%)	100	100	100	100	100	100
Ceriodaphnia reproduction (%)	100	100	100	6	100	100

Table 3.38. Mitchell Branch and associated storm water outfall toxicity test results, October 2009

(No-observed-effects concentrations)

Test	MIK 0.8	SD 170	MIK 0.7	SD 190	MIK 0.4	MIK 0.2
Ceriodaphnia survival (%)	100	100	100	100	100	100
Ceriodaphnia reproduction (%)	NA	100	NA	100	NA	NA

Table 3.39. Average PCB concentrations in biota, 2009

Location	Species	Average PCB concentration (µg/g)	Range (µg/g)	Number of fish above 1 µg/g	Total Hg (ng/g)	Methyl Hg (ng/g)	Total aqueous Hg (ng/g)
K-1007-P1 Pond	Largemouth bass	14.9	5.8-41	6/6			
K-901-A Pond	Largemouth bass	0.48	0.26–1.1	1/6			
Mitchell Branch	Redbreast sunfish	0.99	0.11–2.1	2/6	0.49		
Hinds Creek (ref)	Redbreast sunfish	0.01	<0.01–0.002	0/6			
MIK 0.8	*Corbicula fluminea*	0.10	NA	NA	41.3	11.5	12.96
SD170	*Corbicula fluminea*	0.26	NA	NA	30.9	9.1	19.23
MIK 0.7	*Corbicula fluminea*	0.17	NA	NA	36.15	14.2	14.59
MIK 0.5	*Corbicula fluminea*	0.23	NA	NA	56.9	15.0	77.99
SD190	*Corbicula fluminea*	2.03	NA	NA	62.55	10.8	57.4
MIK 0.4	*Corbicula fluminea*	0.84	NA	NA	44.55	14.4	25.09
MIK 0.2	*Corbicula fluminea*	2.43	NA	NA	41.3	11.5	24.27
SD100 (upper)	*Corbicula fluminea*	0.83	NA	NA			
SD100 (lower)	*Corbicula fluminea*	1.52	NA	NA			
SD 120	*Corbicula fluminea*	0.46	NA	NA			
SD 490	*Corbicula fluminea*	0.43	NA	NA			
K-1007-P1 outfall	*Corbicula fluminea*	0.88	NA	NA			
K-1007-P1 mid-pond	*Corbicula fluminea*	1.02	NA	NA			
K-901-A outfall	*Corbicula fluminea*	0.15	NA	NA			
Sewee Cr (ref)	*Corbicula fluminea*	0.02	NA	NA	25.6	5.9	

ppm = parts per million

Fig. 3.50. Asian clam (*Corbicula fluminea*).

the concentrations of PCBs at most locations from the 2009 monitoring exhibited similar distributions to those from the 2008 effort. However, the measured concentrations at almost every location had decreased from 2008. For example, levels at MIK 0.7 averaged 0.41 μg/g in the 2008 samples but dropped to 0.17 μg/g in 2009, while at MIK 0.4, the average dropped from 1.6 μ/g in 2007 to 0.84 μg/g in 2009. Levels at MIK 0.2 were very similar in both years (2.76 μg/g in 2008 and 2.43 in 2009). Concentrations in clams from the lower storm water outfall 100 dropped from 4.1 μg/g in 2008 to 1.52 in 2009. It is too early to tell if these measurements reflect actual decreases in environmental PCB concentrations, or if they are just within the normal range of variations.

Clams from the Mitchell Branch watershed were analyzed for mercury (both total mercury and methyl mercury) in 2009 for the first time in many years (Table 3.39). Although mercury was detected in all clams, the highest mercury levels were found in the clams from SD-190 (62.6 ng/g total mercury) and below SD-170 at MIK 0.5 (56.9 ng/g total mercury). Mercury levels decreased downstream from SD-190. Methyl mercury concentrations in clams from Mitchell Branch ranged from 20%–40% of the total mercury concentration with the highest levels of methyl mercury being found in the clams from MIK 0.5 (15.0 ng/g) and MIK 0.4 (14.4 ng/g).

Fish were collected from K-1007-P1 Pond (Fig. 3.51) in February 2009. The fish were collected earlier than usual because of the remediation activities planned for the pond. Fish were also collected from Mitchell Branch and K-901-A Pond in May 2009 (Table 3.39). Largemouth bass were collected from the pond sites, and redbreast sunfish (Fig. 3.52) were collected from Mitchell Branch. Game fish of a size typically caught by sports fishermen were selected both to provide more accurate data of potential human health concerns and to reduce the amount of variation in contamination levels in the individual fish due to age and size differences. Fillets were taken from each game fish and analyzed for PCBs. Results from all three monitoring locations were lower than last year's results, but the relative spatial results were similar to those of historical results. The fish with the highest concentrations (14.8 μg/g) were from P1 pond, while fish from the K-901-A pond had the lowest concentrations (0.48 μg/g). Fish from Mitchell Branch averaged 0.99 μg/g. Concentrations in one fish from the K-901-A pond and two fish from Mitchell Branch exceeded the state of Tennessee posting limit of 1 μg/g. Concentrations in all six of the fish from the K-1007-P1 pond exceeded the limit. As a result of these studies, a remedial action to remove the contaminated fish from the K-1007-P1 pond and re-contour the pond to reduce the availability of PCB-contaminated sediments was implemented in 2009. Details of the remedial action are given in Sect. 3.8.2.

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Fig. 3.51. Fish bioaccumulation sampling at K-1007-P1 pond.

ORNL 2010-G00936/chj

Fig. 3.52. Redbreast sunfish *(Lepomis auritus)*.

Fish from Mitchell Branch were also analyzed for total mercury (Table 3.39). The fish averaged 0.49 μg/g of total mercury. Previous studies have shown that methyl mercury accounts for greater than 95% of the total mercury in fish, so a separate analysis for methyl mercury was not conducted. For comparison, the state posting criteria for mercury in fish tissue is 0.3 mg/L. Mercury analyses have not

been performed as part of the fish bioaccumulation subtask of the ETTP BMAP program in many years; therefore, no meaningful historical comparisons could be made.

In April 2009, the benthic macroinvertebrate community at four Mitchell Branch locations (MIKs 0.4, 0.7, 0.8, and 1.4) was sampled using the traditional techniques developed by the ORNL ESD. MIK 1.4 was the reference location. In the last 10 years, the condition of the benthic macroinvertebrate community at all locations in Mitchell Branch has generally improved. In 2009, total taxa richness and richness of the *Ephemeroptera, Plecoptera*, and *Trichoptera* (EPT) species was greatest at MIK 1.4 and decreased at the downstream locations (Fig. 3.53). EPT species are generally pollution intolerant, and lower values generally correlate to some degree of impact to the stream. Total density at MIKs 0.8 and 0.7 was greater than at MIK 1.4, but the density of pollution-intolerant species was generally lower at all of the locations downstream of MIK 1.4 with the exception of MIK 0.8. One possible explanation for the lower number of individuals at MIK 1.4 when compared to MIKs 0.7 and 0.8 may be that Mitchell Branch is shallower at MIK 1.4, and the lower flows may inhibit the population size. Higher densities downstream of MIK 1.4 may also indicate nutrient enrichment, which commonly leads to increases in density.

Consequently, in August 2008, TDEC protocols were used at monitoring location MIKs 0.4, 0.7, and 0.8. Also, in August 2009, TDEC protocols were used at the same three locations on Mitchell Branch and MIK 1.4 (Fig. 3.54). TDEC protocols differ from the ORNL protocols in several key respects. The habitat assessment (which primarily considers the physical aspects of the stream to determine its suitability to support invertebrate communities) indicated that not all of the locations along Mitchell Branch meet the habitat goals for this region. In the 2008 study, all three locations (i.e., MIKs 0.4, 0.7, and 0.8) failed to meet the habitat goals. In the 2009 study, MIKs 0.7, 0.8, and 1.4 met the goals, with the exception being MIK 0.4. However, even at MIK 0.8, the parameter score for the 2009 study (108) compares favorably with the score at the same location in 2008 (90). The results of the semi-quantitative assessment indicated that Mitchell Branch is slightly impaired, which is consistent with the results from the studies using the ORNL protocols. Although improvements in the water quality and health of the community may be due to improvement in the stream's quality, it may also be possible that the actual biotic indices (only slightly different) indicate that the changes were within range of natural annual fluctuations.

Fish communities in Mitchell Branch (MIKs 0.4 and 0.7) and at three reference sites were sampled in March and June of 2009 (Table 3.40). Species richness, density, and biomass were examined. Results for MIK 0.4 were very similar to those in 2008, although one new species, the banded sculpin (*Cottus carolinae*) was collected. Total density and biomass increased slightly for the second year in a row. At MIK 0.7 biomass and density showed slight decreases from last year, while species richness remained unchanged. Wide swings in these three parameters are typical of streams that have been severely impacted and are still recovering. While the condition of the fish community has not yet reached a stable condition typical of less impacted streams in the area, the stream is still dominated by more tolerant fish species.

3.7 Quality Assurance Program

BJC is committed to developing, implementing, and maintaining a formal QA program that ensures the highest standards of performance by empowering employees in their respective areas of responsibility through fostering a "no fault" attitude toward the identification and reporting of quality deficiencies. The quality program provides the framework for a results-oriented management system that focuses on performing work safely and meeting mission and customer expectations while allowing BJC and its subcontractors to become more efficient through process improvement.

The BJC QA Program is a management system that addresses three major elements: managing work, performing work (whether self-performed or subcontracted), and assessing the adequacy of work. The management element encompasses management programs, including organizational structure and responsibilities, and management processes, including planning, scheduling, and resource considerations. The management element also includes personnel training and qualifications, continuous improvement, and documents and records. The performance element includes work processes, design, procurement, and inspection and acceptance testing. The assessment element includes external assessments, independent assessments, and management assessments.

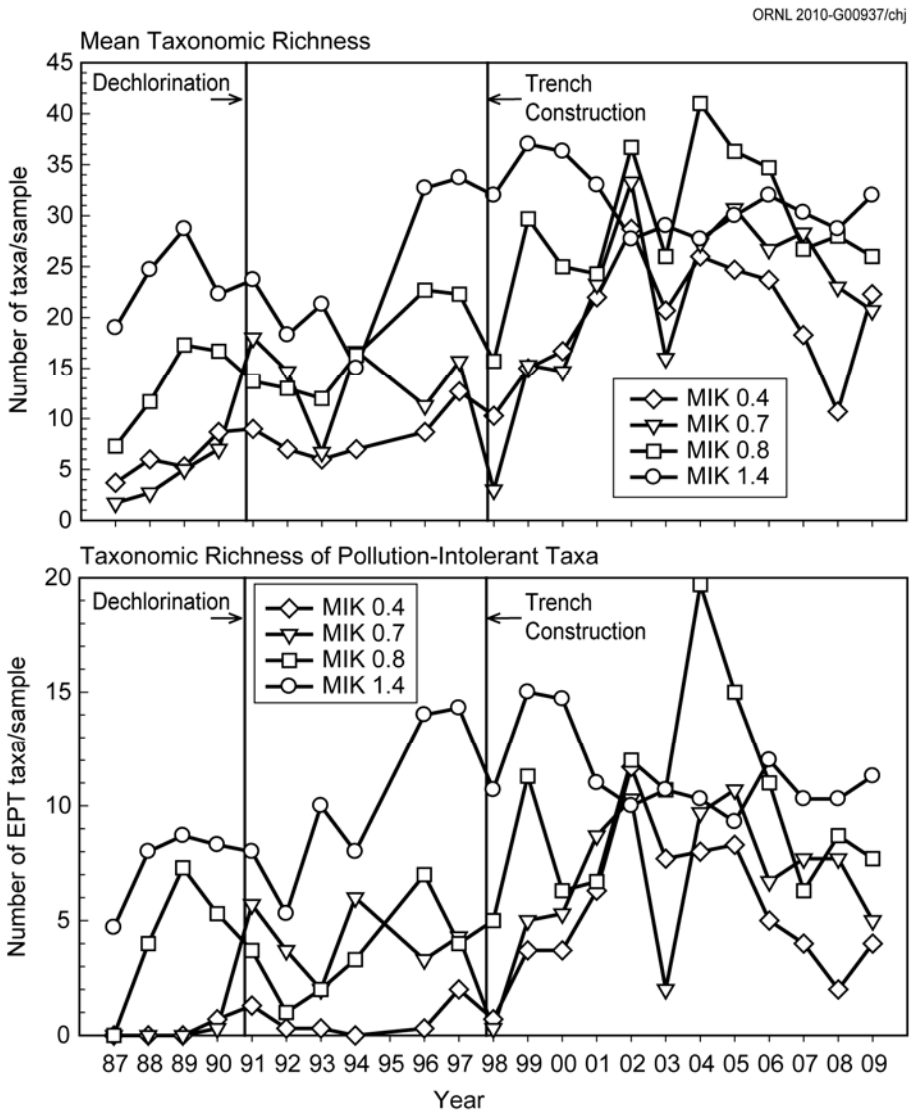

Fig. 3.53. Temporal trends in mean total taxonomic richness (top) and mean taxonomic richness of pollution-intolerant taxa (*Ephemeroptera*, *Plecoptera*, and *Trichoptera*, or EPT) in Mitchell Branch based on samples collected with ORNL protocols in April of each year, 1987–2009.

The BJC QA Program is based on the Title 10 *Code of Federal Regulations* (CFR) Part 830.120, "Quality Assurance Requirements" and is incorporated within the ISMS. The program identifies the consensus standards used in its development and implementation and describes how the contractor responsible for the facility will implement the requirements contained in those documents. Where equivalent elements do not already exist, additional requirements for radioactive waste packaging are included from 10 CFR 71 Subpart H. DOE reviews changes made to the program annually.

The QA Program requirements are reflected in implementing procedures. Subcontractors must meet the same elements when developing and following their own QA plan for each scope of work, or when following the BJC QA Program in executing work scope. Through its BJC Park Worker Annual Training Program, BJC introduces and emphasizes the importance of the QA Program so that it is understood by BJC and subcontract personnel.

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Fig. 3.54. Benthic macroinvertebrate sampling using Tennessee Department of Environment and Conservation protocols.

New and revised DOE standards (e.g., orders, manuals, technical standards, guides) are screened by BJC QA Organization staff for applicability to BJC work scope and to recommend an approach for developing BJC's position on incorporation into the contract. Applicable standards are routed to functional managers and subject matter experts (SMEs). Necessary actions to address new and/or revised federal, state, and local laws and regulations are considered by the BJC Standards Review Board, whose responsibilities include evaluating issues to determine the need for considering changes to BJC contractual standards due to the following:

- challenges that relate to the appropriateness of safety standards;
- changes to federal, state, and local laws and regulations;
- changes to voluntary consensus standards included as contractual standards;
- changes to approved DOE directives that address safety requirements; and
- new work scope or hazards.

Links to the current set of contractual standards and requirements are maintained on the BJC website. Additional links are provided for reference to DOE's directives. The BJC organizational structure, functional responsibilities, levels of authority, and interfaces for those planning, managing, performing, and assessing the work are defined in company policies, program plans, program procedures, directives, and subcontracts, as appropriate.

The BJC QA Organization has a key role in implementing continuous improvement and provides direct support to program and project teams throughout the company to facilitate integration of QA requirements into project activities. The BJC QA functional manager is responsible for providing central leadership, direction, and assessment of the BJC QA Program and for assisting BJC project managers and subcontract coordinators in verifying that, when required, subcontractors have an adequate QA plan in place before work is initiated.

BJC senior management is responsible for the leadership and commitment to quality achievement and improvement within a framework of public, worker, and environmental safety. BJC management also has the primary responsibility and accountability for the scope and implementation of the BJC QA Program. BJC personnel are held directly responsible for the quality of their work; line management has final responsibility for the achievement of quality. BJC personnel have the responsibility to immediately stop work if an operation or process seriously jeopardizes safety, health, or the environment or if it possesses

imminent life-threatening implications as defined in BJC procedures. These responsibilities are passed down to subcontractors through language contained in each subcontract and through the *Worker Safety and Health Program Description* (BJC 2009e) and *Environmental Compliance and Protection Plan* (BJC 2009f).

Table 3.40. Fish species richness, density (individuals/m^2), and biomass (g fish/m^2) at Mitchell Branch sites and reference sites, Mill Branch, Scarboro Creek, and Ish Creek for March and June 2009

Species	MIK 0.7	MIK 0.4	MBK 1.6	SCK 2.2	ISK 1.0
Unidentified larval minnow	0.02 (0.01)	–	–	–	–
Largescale stoneroller *Campostoma oligolepis*	3.20 (13.19)	1.79 (5.12)	–	0.01 (0.01)	0.21 (0.69)
Striped shiner *Luxilus chrysocephalus*	1.51 (4.84)	0.63 (1.87)	–	–	0.20 (0.90)
Tennessee dace *Phoxinus tennesseensis*	–	–	0.01 (0.01)	–	0.05 (0.02)
Bluntnose minnow *Pimephales notatus*	–	–	–	–	0.01 (0.01)
Western blacknose dace *Rhinichthys obtusus*	2.08 (4.07)	0.66 (1.07)	0.30 (0.55)	0.36 (1.39)	0.61 (1.26)
Creek chub *Semotilus atromaculatus*	0.42 (1.74)	0.32 (2.60)	0.27 (1.45)	–	0.33 (1.47)
White sucker *Catostomus commersoni*	–	–	0.03 (0.26)	–	0.01 (0.04)
Western mosquitofish *Gambusia affinis*	0.02 (<0.01)	0.21 (0.09)	–	–	–-
Banded sculpin *Cottus carolinae*	0.05 (0.27)	0.02 (0.08)	–	0.51 (2.35)	0.13 (1.10)
Redbreast sunfish *Lepomis auritus*	0.02 (0.12)	0.06 (1.15)	–	–	–
Hybrid sunfish *Lepomis sp. x*	–	–	–	0.01 (0.02)	–
Green sunfish *Lepomis cyanellus*	–	0.02 (0.17)	–	0.01 (0.15)	0.49 (1.75)
Bluegill *Lepomis macrochirus*	–	–	0.09 (1.30)	–	–
Stripetail darter *Etheostoma kennicotti*	–	–	0.03 (0.04)	–	0.06 (0.08)
Species richness	7	8	6	4	10
Total density	7.32	3.71	0.73	0.90	2.10
Total biomass	24.24	12.15	3.61	1.92	7.32

Mitchell Branch kilometer	MIK
Mill Branch kilometer	MBK
Scarboro Creek kilometer	SCK
Ish Creek kilometer	ISK

The BJC QA Program is implemented through management processes, which include training personnel and verifying their qualifications; identifying opportunities for improvement; controlling documents and records; and planning, scheduling, and identifying resources.

The quality of items, services, and processes is ensured for subcontracts through the procurement process by requiring subcontractors to work under the BJC QA Program or to provide a QA plan that identifies the specific quality requirements applicable to the subcontractor's scope of work.

Environmental management operations include environmental cleanup, waste management, and reindustrialization activities. The ultimate success of BJC's environmental program and projects depends on the quality of the environmental data collected and used in the decision-making process. Environmental data operations include the collection, management, use, assessment, retention, and reporting of such data.

All activities involving the generation, acquisition, and use of environmental data are planned and documented. The type and quality of the data are determined with respect to their intended use. The data quality objective process establishes the objectives for data collection and quality. Determining the type and quality of environmental data needed involves data users as well as personnel responsible for activities affecting data quality.

Environmental monitoring programs at ETTP incorporate data quality objectives and other quality assurance protocols through the sampling and analysis plans and the associated laboratory statements of work. The monitoring program SME and the BJC Sample Management Office (SMO) collaborate in choosing the most appropriate analytic methodology for both radiological and non-radiological monitoring. Sample quantitation levels (the point at which it is possible to quantify the concentration within the appropriate level of confidence), screening levels for notification, analytical methods, and other information necessary to ensure that the data collected is of the appropriate quality are included in the plans. The SMO and the SME review these criteria with the contracting laboratories to ensure that they are capable of meeting the criteria. If for any reason the laboratory is unable to meet any of the requested criteria, the SME must determine if the laboratory's capabilities are adequate. The appropriate action is then taken to either amend the statement of work or to send the analytical work to a laboratory capable of meeting the monitoring program needs.

Laboratories conducting radiological and non-radiological analyses for ETTP environmental monitoring programs are reviewed periodically by the SMO to ensure that the quality of the analytical work continues to meet the appropriate standards. In 2009, all laboratories used by ETTP environmental monitoring programs performed satisfactorily. Laboratories used by ETTP must be approved by DOE's Analytical Services Program (DOECAP Audit Team), which conducts routine audits (at least once a year, and more frequently if a problem is noted) to ensure that the analyses are of the highest quality.

When data are received from the laboratory, the SMO reviews the data package from the laboratory. Data completeness, quantitation levels, screening levels, holding times, and methodology are examined to ensure that all quality aspects of the analyses meet the criteria set forth in the S&A plan and the SOW. Any deficiencies are noted and the laboratory is contacted for clarification. When the SMO is satisfied that the data are complete and meet all criteria, the data are forwarded to the SME. The SME conducts further reviews, and uses the data in the appropriate calculations and reports.

Selected programs or projects impose unique QA requirements on their activities. Such special QA Program requirements are added to, and where possible, integrated with the basic BJC QA Program requirements for the affected facilities and activities. For subcontracted work, the necessary QA requirements are included in subcontract language, or the subcontractor is required to develop a QA plan to be submitted to BJC for review and approval. These special QA requirements are applicable to a specific work scope and are monitored by BJC and/or subcontractor personnel, as appropriate.

3.7.1 Integrated Assessment and Oversight Program

QA Program implementation and procedural and subcontract compliance are verified through the BJC Integrated Assessment and Oversight Program. The program identifies the processes for planning, conducting, and coordinating assessment and oversight of BJC 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 BJC, (2) independent assessments conducted by teams independently of the project/function being assessed, and (3) management assessments conducted as self-assessments 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 subcontractor oversight. Informal self-assessments include weekly inspections and routine walkthroughs conducted by subcontractor coordinators, ES&H representatives, quality engineers, and line managers.

QA issues 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 evaluate data from those processes to identify opportunities for improvement.

3.8 Environmental Management Activities

3.8.1 Waste Management Activities

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

The TSCA Incinerator, a thermal treatment facility, treated approximately 2.2 million lb of waste in 2009 (2,066,050 lb of liquid waste and 119,203 lb of solid waste). On December 2, 2009, waste treatment operations ceased at the incinerator, and the facility entered the D&D phase. When the decontamination is completed, the facility will be demolished.

The CNF, ETTP's primary wastewater treatment facility, which processes both hazardous and nonhazardous waste streams, treated more than 18,351,000 million gal of wastewater in 2009. Although the largest single contributor by far was the TSCA Incinerator, wastes also arise from other facilities and remediation projects, including the chromium-contaminated groundwater collection system. With the shutdown of the TSCA Incinerator, CNF reduced operational hours to a single day shift. The facility removes heavy metals and suspended solids from the wastewater, adjusts pH, and discharges the treated effluent into the Clinch River. Sludge from the treatment facility is treated, packaged, and disposed of off-site.

The EMWMF, located in Bear Creek Valley, is used for disposal of waste resulting from CERCLA cleanup actions on the ORR. The EMWMF is an engineered landfill that accepts low-level radioactive and hazardous wastes in accordance with specific waste acceptance criteria under an agreement with state and federal regulators. The EMWMF received approximately 14,700 truckloads of waste accounting for 173,600 tons during FY 2009. In addition, approximately 3.4 million gal of leachate was collected and disposed of at the ORNL Liquids and Gases Treatment Facility. An additional 8.9 million gal of contact water was collected, analyzed, and released to the sediment basin after analyses confirmed that the water met the release criteria. ETTP projects that have disposed of waste at the EMWMF include the following:

- the David Witherspoon, Inc., Site Remedial Action Project;
- the K-25/K-27 D&D Project, including hazardous materials abatement, excess materials removal;
- the K-25 Building west wing demolition debris and equipment; and
- other ETTP D&D projects, including K-1401; K-1066-G Scrapyard; K-1070-B Burial Ground; and K-1035 demolition debris.

To ensure the continuity of disposal capacity for the ORR cleanup waste, construction of a new cell at EMWMF began in 2009. The new cell will bring the total capacity of the EMWMF to slightly below 1.7 million cubic yards. Planning is also under way for a sixth cell, if it should prove necessary.

The use of RFIDs was implemented for waste shipments to EMWMF. This innovation allows for faster and more accurate tracking of waste shipments and reduces paperwork, decreases the shipment cycle time, and improves security of the materials being transported along the haul road.

The Oak Ridge Reservation Landfills are located near the Y-12 complex and are designed for the disposal of sanitary, industrial, construction, and demolition wastes that meet the waste acceptance criteria for each landfill. In FY 2009, more than 145,000 cubic yards of waste was disposed of at these facilities, and more than 1.6 million gal of leachate was collected, monitored, and discharged to the Oak Ridge sewer system. In 2009, planning was initiated to expand Landfill V of the Oak Ridge Reservation Landfills.

3.8.2 Environmental Restoration Activities

The ETTP operated as an enrichment facility for four decades, during which time many of the buildings became contaminated to some degree with radionuclides, heavy metals, and toxic organic compounds. In addition, large quantities of wastes were generated, much of which was stored on the site.

ETTP's Environmental Management Program was created with the goal of demolishing all unnecessary facilities and restoring the site to a usable condition. Safety and health of employees and the public is a constant focus. Cost-effectiveness is also a major consideration in the cleanup operations.

DOE has signed two of three key CERCLA records of decision with the state of Tennessee and EPA authorizing environmental restoration of about 890 ha of land at ETTP. The area encompasses approximately about 567 ha outside the main plant security fence (Zone 1), and about 324 ha inside the fence within the former plant production area (Zone 2). The main objectives of the two decisions are to protect future industrial workers and the underlying groundwater from contamination in soil, slabs, and subsurface structures. The final site-wide record of decision for groundwater, surface water, sediment, and ecological soil risk is in development.

In 2009, the Oak Ridge Office of the Department of Energy received approximately $775 million of American Recovery and Reinvestment Act funding that was allocated to speed up environmental restoration and remediation activities. This funding was used at ETTP for one of the major ongoing operations at the ETTP site: the dismantling of the K-25 Building's west wing and preparation of the east wing for demolition. The K-25 Building is one of the largest D&D projects in the entire DOE complex. The three-story, U-shaped K-25 building, built during the Manhattan Project, covers 1.64 million ft^2 (approximately 18 ha) and contains 3,018 stages of gaseous diffusion process equipment and associated auxiliary systems, including approximately 400 miles of piping. Each stage consists of a converter, two compressors, two compressor motors, and associated piping. Removal of the high-risk equipment components was completed in the west wing in 2008 and is expected to be completed in the east wing in 2010. By the end of FY 2009, approximately 5,500 loads of demolition debris, 1,300 compressors, and 700 converters had been removed and shipped to the EMWMF for disposal. Demolition of the west wing was completed in December 2009, although removal of the debris continues and is expected to be completed in 2010.

Activities under way to prepare the east wing for demolition include removing 104 of the 343 high-risk equipment items; conducting vent, purge, drain, and inspection activities; removing asbestos; and draining lubricants and oils from process systems.

There were several buildings within the K-25 Building footprint. Two of the buildings, K-1101 and K-1201, which housed support facilities for the K-25 Building, were prepared for demolition in 2009. Preparations included removal of approximately 8 million lb of scrap metal, which was initially slated to be shipped to landfills but later determined recyclable, providing reusable metal resources and saving valuable landfill space.

The K-1035 maintenance and instrument shop was demolished in 2009. Demolition debris was disposed of at EMWMF.

Preparations for the demolition of the K-27 building included installation of much of the construction power supply and the removal of most of the combustible materials from the vault and cell levels.

In FY 2009, 4 predominantly uncontaminated and 11 low-risk/low-complexity facilities were demolished. In addition, 3 high-risk buildings in the Poplar Creek area (K-1231, K-1233, and K-413) were demolished.

In 2007, surveillance data indicated that the chromium levels in Mitchell Branch had markedly increased. Subsequent analyses showed that the chromium was almost entirely in the hexavalent state. Since hexavalent chromium has not been used at ETTP for many years, it is believed that the source is groundwater contaminated with legacy material, and not a result of current operational issues. A chromium collection system consisting of an aquitard with two extraction wells and pumps was installed to pump water from the vicinity of outfall 170 for treatment at the CNF and discharge through the CNF NPDES outfall. In January 2009, the original pumps were changed to electric pumps to increase pumping capacity and reduce maintenance costs. Since the installation of this system and subsequent modifications to increase pumping rates, chromium levels in Mitchell Branch have been reduced to well below the WQC of 11 μg/L, and near or below the detection levels of 1 to 3 μg/L.

Largemouth bass from the K-1007-P1 Pond were known to accumulate high concentrations of PCBs in their muscle tissue. As a result of multiple studies of the pond, the major source of PCB contamination was thought to be in the sediments, which are easily suspended by bottom-feeding fish like carp and shad, especially in this system where grass carp totally decimated pond plants that historically served to stabilize the sediments. High nutrient loads in the pond from a large goose population were thought to contribute high suspended algal biomass. Lipid-rich gizzard shad, which forage on sediment and suspended algae and therefore accumulate very high PCBs, served as a major vector of PCB transfer to largemouth bass and wildlife. In 2009, a non-time-critical removal action was implemented that used fish, wildlife, and plant management principles to minimize the risks associated with PCBs in the pond. The problem fish were removed from the pond, geese were discouraged from the area, and extensive pond recontouring and planting was conducted. The goal was to create in the pond a population of relatively low bioaccumulator fish (i.e., primarily small sunfish), plus dense areas of rooted aquatic vegetation to stabilize the sediment to prevent resuspension. This innovative approach was deemed more cost-effective than traditional dredging operations and served to preserve the pond as an ecological and aesthetic asset for the area.

A plume of groundwater contaminated with solvents from degreasing and other maintenance operations lies near the old K-1401 footprint area. In 2009, a treatability study to assess treatment options began with the installation of seven boreholes. Water and soil samples were collected to characterize the nature and extent of the plume. In 2010, sampling of selected intervals will be conducted. Once the data have been collected and reviewed, the appropriate treatments will be determined.

The K-770 Scrapyard contained huge quantities of contaminated scrap metal, which were previously removed. In 2009, work continued on defining the limits of the contaminated soil. This soil is being removed for future industrial use of the area and to protect groundwater resources. Work also continued on remediation of the K-1070-B Burial Ground.

3.8.3 Reindustrialization

The Reindustrialization Program was developed to accelerate cleanup of the site and to allow for beneficial reuse of underutilized facilities and land. Facilities determined appropriate for reuse are leased or transferred to non-DOE entities such as the Community Reuse Organization of East Tennessee (CROET) or the city of Oak Ridge. CROET is a not-for-profit corporation established to foster diversification of the regional economy by reutilizing excess DOE property for private-sector investment and job creation.

The transfer of the Phase I Electrical Distribution System and the Phase I Plant Roadway System to the city of Oak Ridge was ongoing in 2009. The Phase I Electrical Distribution System includes all direct off-site main-plant power lines. The Phase I Plant Roadway System includes the main plant entrance and the main arterial roads.

Buildings K-1000, K-1501, and K-1008-F were transferred to CROET. K-1000 was renovated to become the ETTP Welcome Center, while the other two buildings were leased to private companies.

One 14-acre parcel referred to as ED-4 was transferred to CROET for future development.

One land parcel, referred to as ED-5 West, was transferred to CROET on December 22, 2008. ED-5 West consists of approximately 10.5 ha located near the front of ETTP, behind Pond K-1007-P1 and adjacent to Poplar Creek and Parcel ED-5 East. During 2009, construction of two speculative building and associated utilities proceeded. Also, approximately 3,000 ft^2 of security fence was removed and recycled to reduce the footprint of the plant security area.

These activities are all part of DOE's plan to transform ETTP into a private-sector business and industrial park. Other ETTP buildings and several land areas are in various stages of the transfer process.

3.9 ETTP Groundwater

Groundwater at the ETTP site occurs in residual soils, man-made fill, alluvial soils, and bedrock. Because of extensive terrain modification that occurred during site construction, large areas of the main industrial site were subjected to cut and fill activities that modified site hydrology. Most of the ETTP site is underlain by carbonate bedrock of the Chickamauga Group with subordinate areas underlain by the carbonates of the Knox Group and clastic dominated sandstones, shales, and siltstones of the Rockwood formation. The geologic structure of bedrock beneath the ETTP site is the most complex of the ORR facilities because of structural rock deformation associated with the White Oak Mountain thrust fault and footwall deformation associated with motion along that fault. The structural complexity coupled with the presence of soluble carbonate bedrock beneath the site led to very complex groundwater flow conditions.

3.9.1 ETTP Groundwater Monitoring

Groundwater monitoring at the ETTP is focused primarily on investigating and characterizing sites for remediation under CERCLA and groundwater exit pathway monitoring. As a result of the Federal Facility Agreement and certification of closure of the K-1407-B and -C Ponds, the principal driver at the ETTP is CERCLA. ETTP Groundwater Protection Program requirements are incorporated into the Water Resources Restoration Program, established to provide a consistent approach to watershed monitoring across the ORR and responsible for groundwater surveillance monitoring at the ETTP, including groundwater exit pathway monitoring. This groundwater monitoring is conducted to assess the performance of completed CERCLA actions. Groundwater monitoring wells have been placed downgradient of potential contamination sources. Groundwater discharges into Poplar Creek, the Clinch River, and the three main surface water bodies at ETTP (i.e., the K-901 Pond, K-1007 Pond, and Mitchell Branch). Many of the contaminants at ETTP migrate towards these surface water bodies. Groundwater monitoring wells have been placed near these exit points, and groundwater monitoring is supplemented by the ETTP Environmental Monitoring Plan surface water surveillance program.

The cleanup strategy being followed at ETTP is the transition of areas of concern (AOCs) from characterization to remediation by making decisions at the watershed scale based on recommended land use. The watershed is a surface-drainage basin that includes an AOC or multiple AOCs to be investigated and/or remediated. At ETTP, surface water and groundwater hydrologic conditions differ from those typical of the ORNL and Y-12 sites because of geologic and site development characteristics. At ETTP the surface water system involves several small, local streams that drain to Poplar Creek or directly to Clinch River as well as extensive areas with dispersed surface runoff and groundwater seepage to the large water bodies. Figure 3.55 shows the three principal defined watershed areas (K-1007, Mitchell Branch, and K-901 Watersheds) as well as the K-27 groundwater basin. Also shown are areas of known VOC plumes at the site and exit pathway groundwater monitoring locations. Groundwater is monitored primarily from constructed monitoring wells; however, sampling is also conducted at several springs or seeps where groundwater emanates to surface water bodies.

Groundwater data pertaining to contaminant trends in the vicinity of CERCLA source areas and related to specific remedial actions are discussed in the 2010 RER (DOE 2010a). VOCs, chiefly chlorinated solvents [tetrachloroethene (PCE), trichloroethene (TCE), and 1,1,1-tetrachloroethane (TCA)] the most commonly used solvents at ETTP, and their degradation products, are the main contaminants of concern at most of the groundwater monitoring locations. Very few of these compounds are still used at

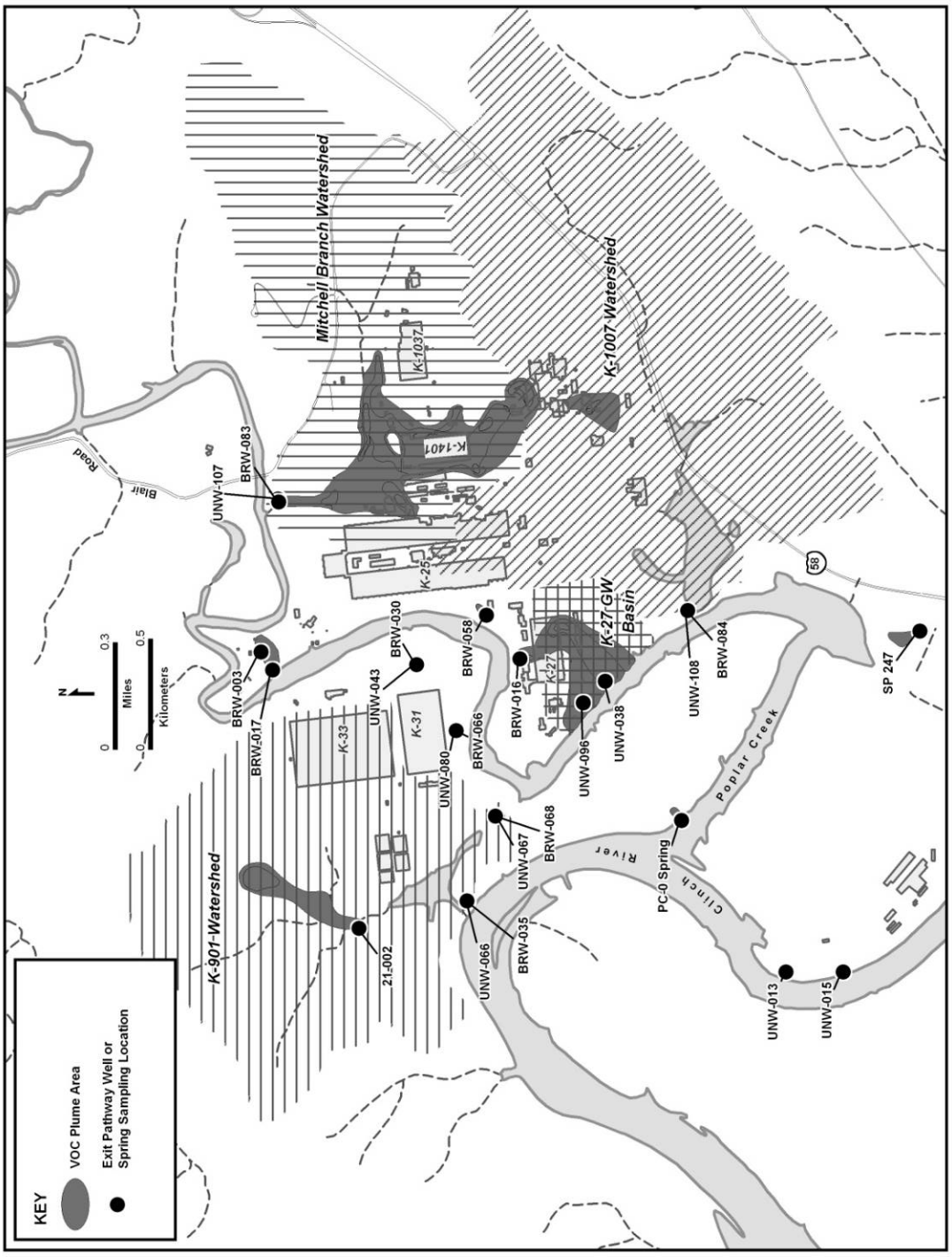

Fig. 3.55. ETTP site exit pathway groundwater monitoring locations.

ETTP, and the contamination in the plumes is due to legacy materials. The degree of degradation that has occurred over time is highly variable depending on local groundwater geochemical conditions and the ability of indigenous microbes to degrade the chlorinated compounds. Radionuclides are a minor concern at locations downgradient of the K-1407-B/C ponds. The 2010 RER (DOE 2010a) includes summaries of groundwater monitoring actions required for individual cleanup actions at ETTP, along with recommendations to modify any requirement that would further ensure protection of human health and the environment.

3.9.2 Exit Pathway Monitoring Results

This section summarizes the results of exit pathway groundwater monitoring at the ETTP site. Similar information is also included in the 2010 RER (DOE 2010a). Groundwater monitoring results for the exit pathways are discussed below starting with the Mitchell Branch exit pathway and then, with respect to Figure 3.55, progressing in a counterclockwise fashion.

The Mitchell Branch exit pathway is monitored using surface water data from the K-1700 Weir on Mitchell Branch and wells BRW-083 and UNW-107. TCE, DCE (essentially all cis-1, 2-DCE), and vinyl chloride are the major contaminants in Mitchell Branch, although low concentrations of carbon tetrachloride, chloroform, and TCA are sometimes detected. VOC concentrations measured during 2009 were below ambient WQC levels for organisms at K-1700.

Wells BRW-083 and UNW-107, located near the mouth of Mitchell Branch, have been monitored since 1994. Table 3.41 shows the history and concentrations of detected VOCs in groundwater. 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 flowpaths that can fluctuate with seasonal hydraulic head conditions, which are strongly affected by rainfall. PCE and TCE were detected at BRW-083 during FY 2009 as a result of the above-average rainfall.

Wells BRW-003 and BRW-017 monitor groundwater at the K-1064 Peninsula burn area. Concentrations of the VOC contaminants TCE, 1,1,1-TCA, and 1,2-DCE have declined to levels less than their respective MCLs.

Groundwater is monitored in four wells (BRW-066, BRW-030, UNW-080, and UNW-043) that lie between buildings K-31/K-33 and Poplar Creek, as shown on Fig. 3.55. VOCs are not contaminants of concern in this area; however, historic leaks of recirculated cooling water have left residual subsurface chromium contamination. Well UNW-043 exhibits the highest residual chromium concentrations of any in the area. Chromium concentrations in well UNW-043 correlate with the turbidity of samples, and acidification of unfiltered samples that contain suspended solids often causes detection of high metals content because the acid preservative dissolves metals that are adsorbed to the solid particles at the normal groundwater pH. During FY 2006, an investigation was conducted to determine if groundwater in the vicinity of the K-31/K-33 buildings contained residual hexavalent chromium from recirculated cooling water leaks. The data indicated the chromium in groundwater near the leak sites was essentially all of the less-toxic trivalent species. During FY 2008 and FY 2009, field-filtered and unfiltered samples were collected from UNW-043. The samples filtered in the field prior to acid preservation contained very little chromium and the dissolved chromium levels did not exceed the MCL. This indicates that most of the chromium in this area is particle bound rather than dissolved in groundwater.

Several exit pathway wells are monitored in the K-27/K-29 area, as shown on Fig. 3.55. TCE is consistently measured at concentrations above its MCL in well UNW-038. The source of persistent 1,2-DCE was measured in well BRW-058 at about half its MCL. VOC contamination is not suspected to be from K-27/K-29 area operations. VOC concentrations in this area show very slowly declining concentrations.

Wells BRW-084 and UNW-108 are exit pathway monitoring locations at the northern edge of the K-1007-P1 Pond (see Fig. 3.55). These wells have been monitored intermittently from 1994 through 1998 and semiannually from FY 2001 through FY 2009. The first detections of VOCs in these wells occurred during FY 2006 with detection of low (~10 µg/L or less) concentrations of TCE and cis-1,2-DCE. The source area for these VOCs has not been confirmed although the VOC plume to the east in the K-1007

watershed is suspected. VOCs were not detected in either of these wells during FY 2009. Metals were detected and associated with the presence of high turbidity in the samples. No primary or secondary MCLs for metals were exceeded in sample aliquots that were field-filtered prior to acid preservation during FY 2009.

Table 3.41. Volatile organic compounds detected in groundwater in the Mitchell Branch exit pathway

Well	Date	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
		(µg/L)			
BRW-083	8/29/2002	ND	**5**	**28**	ND
	3/16/2004	0.69	2.2	**9.9**	ND
	8/26/2004	2	4.7	**20**	ND
	3/14/2007	**5**	**9**	**28**	ND
	3/20/2008	ND	ND	ND	ND
	8/21/2008	ND	ND	ND	ND
	3/12/2009	ND	ND	1.31 J	ND
	8/3/2009	ND	2.66	**14.2**	ND
UNW-107	8/3/1998	ND	ND	3	ND
	8/26/2004	4.7	ND	3.6	ND
	8/21/2006	3.4	**14**	2	1.2
	3/13/2007	25	2 J	**23**	**2**[a]
	8/21/2007	17	ND	**30**	0.3 J
	3/5/2008	ND	ND	ND	ND
	8/18/2008	ND	ND	ND	ND
	3/12/2009	ND	ND	ND	ND
	7/30/2009	ND	ND	ND	ND

[a] Detection occurred in a field replicate. Constituent not detected in regular sample.

Bold table entries exceed primary drinking water/maximum contaminant level screening values (PCE, TCE = 5 µg/L, cis-1,2-DCE = 70 µg/L, vinyl chloride = 2 µg/L)

BRW = bedrock well

J = estimated value

ND = not detected

UNW = unconsolidated well

Exit pathway groundwater in the K-901-A Watershed area (see Fig. 3.55) is monitored by four wells (BRW-035, BRW-068, UNW-066, and UNW-067) and one spring (21-002). Very low concentrations (<5 µg/L) of VOCs are occasionally detected in wells adjacent to the K-901 Pond. However, these contaminants are not persistent in groundwater west and south of the pond. No VOCs were detected in the K-901-A Pond exit pathway wells during FY 2009, and alpha and beta activity levels were less than 15 pCi/L and 25 pCi/L, respectively. TCE is the most significant groundwater contaminant detected in spring 21-002 and its concentration varies from near the 5 µg/L MCL to about 50 µg/L.

Spring PC–0 was added to the sampling program in 2004. During the spring through autumn seasons, spring PC–0 is submerged beneath the Watts Bar lake level, so this location is accessible for sampling only during winter when the lake levels are lower. Measured TCE concentrations in this spring have varied between about 15 to 25 µg/L with an apparent decreasing trend.

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 Fig. 3.55). Alpha and beta activity are measured in this area as indicators of residual radiological constituents. Analytical results indicate that the alpha activity is largely attributable to uranium isotopes. Alpha activity in well UNW-015 varies between about 25–50 pCi/L and is less than 5 pCi/L in UNW-013. Well UNW-013 historically contained ^{99}Tc, a strong beta-emitting radionuclide responsible

for the elevated beta activity in that well. Beta activity in this well has exhibited a gradual decrease from levels greater than 100 pCi/L in 2002 to less than 50 pCi/L in 2009.

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