# 4. The Y-12 National Security Complex

The Y-12 National Security Complex, a premier manufacturing facility operated by Babcock & Wilcox Technical Services Y-12 L.L.C. (B&W Y-12) for the National Nuclear Security Administration, plays a vital role in DOE's Nuclear Security Enterprise. While drawing on more than 60 years of manufacturing excellence, Y-12 helps ensure a safe and reliable U.S. nuclear weapons deterrent.

The Complex also retrieves and stores nuclear materials, fuels the nation's naval reactors, and performs complementary work for other government and private-sector entities.

Today's environment requires a Y-12 that has a new level of flexibility and versatility. So while continuing its key role, Y-12 has evolved to become the complex that the nation looks to for support in protecting America's future by developing innovative solutions in manufacturing technologies, prototyping, safeguards and security, technical computing, and environmental stewardship.

Due to differing permit reporting requirements and instrument capabilities, various units of measurement are used in this report. The list of units of measure and conversion factors provided on pages xxvii and xxviii is intended to help readers convert numeric values presented herein as needed for specific calculations and comparisons.

## 4.1 Description of Site and Operations

### 4.1.1 Mission

The Y-12 Complex is a one-of-a-kind manufacturing facility that plays an important role in U.S. national security. The roles of the Y-12 Complex include the following:

- receipt, storage, and protection of special nuclear materials;
- quality evaluation/enhanced surveillance of the nation's nuclear weapon stockpile;
- safe and secure storage of nuclear materials;
- dismantlement of weapon secondaries and disposition of weapon components;
- provision of technical support to the National Nuclear Security Administration (NNSA) Defense Nuclear Nonproliferation Program;
- provision of fuel for the nation's naval reactors program;
- transfer of technology to private industry;
- maintenance of DOE capabilities; and
- provision of support to DOE, other federal agencies, and other national priorities.

Babcock & Wilcox Technical Services Y-12, LLC (B&W Y-12) is the NNSA's management and operating contractor responsible for operation of the Y-12 National Security Complex. Located within the city limits of Oak Ridge, Y-12 covers more than 328 ha (810 acres) in the Bear Creek Valley, stretching 4.0 km (2.5 miles) down the valley and nearly 2.4 km (1.5 miles) wide across it. Approximately 6,000 people work on site, including employees of B&W Y-12, NNSA, Wackenhut Services (NNSA's security services contractor), other DOE contractors, and subcontractors.

NNSA-related facilities located off the Y-12 Complex site but in Oak Ridge include the Office of Secure Transportation (OST) Agent Operations Eastern Command (AOEC) Secure Transportation Center and Training Facility and an analytical laboratory. The laboratory is a leased facility providing a wide range of routine and nonroutine analytical services for environmental and hazardous waste programs of NNSA, DOE, and other customers.

### 4.1.2 Transformation

Complex Transformation is NNSA's vision for a smaller, safer, more secure, and less expensive nuclear weapons complex that leverages the scientific and technical capabilities of its workforce and meets national security requirements.

The complex is old; many of the facilities were required for the Cold War security environment but are no longer necessary to use or affordable to maintain. The Y-12 Complex's infrastructure reduction effort focuses on removing excess buildings and infrastructure to support reduction in maintenance and operating cost and to provide real estate for future modernization needs. The country's need to construct smarter, more environmentally friendly buildings is a focus of the new construction projects.

#### 4.1.2.1 Infrastructure Reduction

At Y-12, the Facilities and Infrastructure Recapitalization Program (FIRP) has executed more than 125 major repair, utility upgrade, and demolition projects with a combined value of almost $450 million since 2002. Under this program site personnel have removed 284 excess buildings totaling 1.2 million gross square feet. Through FIRP, Y-12 has also executed more than $30 million of roofing projects, resulting in the replacement of more than 20 acres of deteriorated roofs with modern, energy-efficient roof systems. There were no funded activities under the FIRP during FY 2010, and this program has been completed.

The Infrastructure Reduction project team had completed planning in the previous fiscal year for demolition projects for Buildings 9709 and 9766. Both buildings were key demolitions needed to support the overall transformation efforts. Building 9766, a 36,800 square feet facility, was demolished in 2010. The 9766 building slab will be developed into a parking area. Building 9709 demolition was funded and authorized in late 2010. The project includes the Buildings 9709, 9409-30, and 9416-21. In December, the project completed the utility isolation planning and held the pre-bid meeting for the demolition of the associated structures.

Building 9720-38 was demolished during October and November of 2010. Its 7,700 square footage had been used to store material since its construction in 1981. Additional demolitions were funded via the American Recovery and Reinvestment Act.

#### 4.1.2.2 American Recovery and Reinvestment Act

Funding from the American Recovery and Reinvestment Act of 2009 (ARRA) has allowed more cleanup work to be performed at the Y-12 Complex. Y-12 received ARRA funding in May 2009 for these seven "shovel-ready" projects, which as a group will be completed by the end of FY 2011:

- Alpha 5 Legacy Material Disposition,
- Beta 4 Legacy Material Disposition,
- Building 9206 Filter House deactivation & demolition (D&D),
- Old Salvage Yard Scrap Removal,
- West End Mercury Area Storm Sewer Remediation,
- Biology Complex D&D (Buildings 9769, 9211, 9220, and 9224), Phase I , and
- Building 9735 D&D.

ARRA projects are also regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and are authorized by a time-critical removal action memorandum. The Y-12 Recovery Act projects are scheduled to meet or exceed existing regulatory milestones. Progress on each of these projects is detailed in Section 4.8, Environmental Management and Waste Management Activities.

#### 4.1.2.3 New Construction

The transformation of Y-12 from a Cold War nuclear weapons complex into a 21st century Nuclear Security Enterprise took major steps forward in 2010 with completion of critical infrastructure projects and planning continued for others.

**Potable Water Project Completed.** A critical improvement to the operations of the Y-12 National Security Complex came online with the 2010 summer start-up of a new potable water system that includes two prominent, 220-foot-tall water towers and more than 1.5 miles of newly installed water lines. The site uses potable water for operations, as well as drinking water.

The $62.5 million Potable Water System Upgrades Project provides a more reliable long-term water supply. In addition to 8,360 linear feet of newly installed piping, 3,800 linear feet were replaced, and another 2,115 feet were cleaned and lined.

Original cast-iron water mains and laterals that had deteriorated were either repaired or replaced. Sprinkler systems that contain antifreeze were modified to include a backflow preventer, to ensure no cross-connections with potable water. Fourteen antifreeze loops were severed from the water supply, and the antifreeze was drained to eliminate the possibility of cross-contamination; 52 backflow preventers were installed.

The most visible features of the project are the two water towers, each holding two million gallons (Fig. 4.1). They are similar to those many cities across the country use to supply drinking water.

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**Fig. 4.1. New tanks for the potable water system can be seen in the background, while in the foreground is Y-12's new, natural-gas-fired steam plant.**

**Steam Plan Life Extension Project.** A new, more efficient steam plant (Fig 4.1) at the Y-12 National Security Complex that will significantly reduce emissions opened in April 2010. The new plant replaced a coal-burning facility built in 1954 and was built as part of the NNSA's Facilities and Infrastructure Recapitalization Program. The $59 million facility generates steam in four boilers that burn natural gas, and the steam is used for heating and other processes, including fire protection systems.

The new plant, which can run on fuel oil if needed, is expected to significantly reduce emissions of greenhouse gases, such as carbon dioxide and nitrous oxide, as well as toxic substances, like particulate matter and sulfur dioxide, by up to 99%.

**Complex Command Center (CCC) —**The proposed Complex Command Center will house the fire department, the plant shift superintendent's office, the technical support/emergency operations center, and emergency management support. These functions are now scattered throughout the site in aging, outmoded facilities. Third-party financing was determined not to be a viable acquisition strategy at this time for the CCC project and various acquisition strategies, including the use of more traditional line-item funding, are being evaluated.

**Uranium Process Facility (UPF)—**The UPF (Fig. 4.2), cornerstone of Y-12's modernization strategy, is proposed to replace current enriched uranium and other processing operations. This involves a new, fully modernized manufacturing facility optimized for safety, security, and efficiency. It would be the only facility of its type in the United States.

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**Fig. 4.2. Uranium Process Facility conceptual image.**

## 4.2 Environmental Management System

As part of B&W Y-12's commitment to environmentally responsible operations, Y-12 has implemented an environmental management system (EMS) based on the rigorous requirements of the globally recognized International Organization for Standardization (ISO) 14001-2004 (ISO 2004).

### 4.2.1 Integration with Integrated Safety Management System

The Integrated Safety Management System (ISMS) is the DOE's umbrella of environment, safety, and health (ES&H) programs and systems that provides the necessary structure for any work activity that could potentially affect the public, a worker, or the environment. B&W Y-12's ISMS has incorporated the elements of the ISO 14001 EMS in the overall umbrella of ISMS for environmental compliance, pollution prevention, waste minimization, and resource conservation. The DOE Office of Health, Safety and Security (HSS) annual environmental progress reports on implementation of EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (Executive Order 2007) and Office of Management and Budget's Environmental Stewardship Scorecard gave Y-12 an EMS scorecard rating for FY 2010 of green, indicating full implementation of EO 13423 requirements.

### 4.2.2 Policy

The environmental policy of B&W Y-12 and its commitment to providing sound environmental stewardship practices through the implementation of an EMS have been defined, are endorsed by top management, and have been made available to the public via company-sponsored forums and public documents such as this one. The B&W Y-12 ES&H policy is presented in Fig. 4.3.

This policy has been communicated to all employees; has been incorporated into General Employee Training (GET) for every employee, guest, and contractor; and made available for viewing on the internal Y-12 Web Site. Y-12 personnel are made aware of the commitments stated in the policies and how the commitments relate to Y-12 work activities.

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**Y-12 Environment, Safety, and Health Policy**

*Policy:* As we work to achieve the Y-12 mission and our vision of a modernized Y-12 Complex, we will do so by ensuring the safety and health of every worker, the public, and the environment. Every employee, contractor, and visitor is expected to take personal responsibility for their actions.

- Environmental Policy: We protect the environment, prevent pollution, comply with applicable requirements, and continually improve our environment.
- Safety and Health Policy: The safety and health of our workers and the protection of public health and safety are paramount in all that we do. We maintain a safe work place and plan and conduct our work to ensure hazard prevention and control methods are in place and effective.

*In support of this policy, we are committed to:*

- Integration of Environment, Safety and Health (ES&H) into our business processes for w ork planning, budgeting, authorization, execution, and change control in accordance with our Integrated Safety Management System.
- Continuously improving our processes and systems by establishing, tracking, and achieving goals that drive performance excellence.
- Direct, open, and truthful communication of this policy and our ES&H performance to our employees, contractors, customers, and stakeholders.
- Strive to minimize the impact of our operations on the environment in a safe, compliant, and cost-effective manner using sustainable practices for energy efficiency, fleet management, water consumption, pollution prevention, recycling/reuse, source reduction, resource conservation, and environmentally preferable purchasing.
- Incorporate sustainable design principles into the design and construction of facility upgrades, new facilities, and infrastructure considering life-cycle costs and savings.
- Incorporate the use of engineering controls to reduce or eliminate hazards whenever possible into the design and construction of facility upgrades, new facilities, and infrastructure.
- Strive to provide a clean and efficient workplace free of occupational injuries and illnesses (Target Zero).
- Foster and maintain a work environment of mutual respect and teamwork that encourages free and open expression of ES&H concerns.

**Fig. 4.3. B&W Y-12 environment, safety, and health policy.**

## 4.2.3 Planning

### 4.2.3.1 Environmental Aspects

Environmental aspects may be thought of as potential environmental hazards associated with a facility operation, maintenance job, or work activity. Aspects and impacts are evaluated to ensure that the significant aspects and potential impacts continue to reflect stakeholder concerns and changes in regulatory requirements. The following aspects have been identified as potentially having significant environmental impact:

- waste generation,
- air emissions,
- liquid discharges,
- storage/use of chemicals and radioactive materials,
- legacy contamination,
- excess/surplus materials,
- historical and cultural resources,
- natural resource consumption (energy and water), and
- natural resource conservation (positive impacts).

The EMS provides the system to ensure that environmental aspects are systematically identified, monitored, and controlled in order to mitigate or eliminate potential impacts to the environment.

#### 4.2.3.2 Legal and Other Requirements

To implement the compliance commitments of the ES&H policy and to meet legal requirements, systems are in place to review changes in federal, state, or local environmental regulations and to communicate those changes to affected staff. The environmental compliance status is documented each year in this report (see Sect. 4.3).

#### 4.2.3.3 Objectives, Targets, and Environmental Action Plans

B&W Y-12 continues to respond to change and pursue sustainability initiatives by establishing and maintaining environmental objectives, targets (goals), and action plans. Goals and commitments are established annually, are agreed to by the Y-12 NNSA Site Office (YSO) and B&W Y-12, and are consistent with Y-12's mission, budget guidance, ES&H work scope, site incentive plans, and continuous improvement. Targets and action plans are established for broad objectives to pursue improvement in environmental performance in five areas: clean air, energy efficiency, hazardous materials, stewardship of land and water resources, and waste reduction/recycling/buy green. Highlights of the 2010 B&W Y-12 environmental targets achieved are presented in Sect. 4.2.6.1.

#### 4.2.3.4 Programs

NNSA has developed and funded several important programs to integrate environmental stewardship into all facets of Y-12's missions. The programs also address the DOE order requirements for protecting various environmental media, reducing pollution, conserving resources, and helping to promote compliance with all applicable environmental regulatory requirements and permits.

##### 4.2.3.4.1 Environmental Compliance

The B&W Y-12 Environmental Compliance Department (ECD) provides environmental technical support services and oversight for Y-12 Complex line organizations to ensure that site operations are conducted in a manner that is protective of workers, the public, and the environment; in compliance with applicable standards, DOE orders, environmental laws, and regulations; and consistent with B&W Y-12's environmental policy and site procedures. The ECD serves as the B&W Y-12 interpretive authority for environmental compliance requirements and as the primary point of contact between B&W Y-12 and external environmental compliance regulatory agencies such as the city of Oak Ridge, the Tennessee Department of Environment and Conservation (TDEC), and the U.S. Environmental Protection Agency (EPA). The ECD administers compliance programs aligned with the major environmental legislation that affects Y-12 Complex activities. Compliance status and results of monitoring and measurements conducted by these compliance programs are presented in this document.

The ECD also maintains and ensures implementation of the Y-12 EMS and spearheads initiatives to proactively address environmental concerns in order to continually improve environmental performance and go "beyond compliance."

##### 4.2.3.4.2 Waste Management

The B&W Y-12 Waste Management Department manages and supports the full life cycle of all waste streams within the Y-12 Complex. While ensuring compliance with federal and state regulations, DOE orders, waste acceptance criteria, and Y-12 procedures and policies, the Waste Management Department provides

- technical support to generators on waste management, pollution prevention, and recycling issues and
- waste certification in accordance with DOE orders and the Nevada National Security Site Waste Acceptance Criteria for waste to be shipped to that site for disposition.

#### 4.2.3.4.3 Sustainability and Stewardship

The Sustainability and Stewardship Program has two major missions. The first is to establish and maintain company-wide programs and services to support sustainable waste management operations. These sustainable operations include Pollution Prevention and Recycling Programs, Excess Materials, Waste Sampling, Waste Generator Services, and Y-12 PrYde. The Y-12 PrYde program incorporates an inspection and rating system related to the cleanliness of facilities, materials, and hazardous/unsafe conditions to help personnel maintain work areas in a clean, safe, environmentally sound, and professional manner.

The second mission is the stewardship practices, the programs that manage the legacy issues and assist in the prevention of additional problematic areas being formed. Stewardship Programs include Clean Sweep, and Unneeded Materials and Chemicals (UMC).

The synergistic effects of combining these programs under a single umbrella improves overall compliance with Executive Orders, DOE Orders, state and federal regulations, and NNSA expectations and also eliminates duplication of efforts while providing an overall improved appearance of the Y-12 Complex to enhance modernization efforts.

Additionally, the implementation of these programs directly supports EMS objectives and targets to disposition unneeded materials and chemicals, continually improve recycle programs by adding new recycle streams as applicable, improve environmentally preferable purchasing (i.e., promoting the purchase of products made with recycled content and bio-based products, including alternative fuels such as E85 and biodiesel), meet sustainable design requirements, complete the pollution prevention reporting requirements, and implement various other related activities.

#### 4.2.3.4.4 Energy Management

Energy management is an ongoing and comprehensive effort containing key strategies to reduce consumption of energy, water, and fuel (electricity, coal, natural gas, and gasoline/diesel). As part of Facility Management and Programs in Facilities, Infrastructure, and Services, Energy Management tracks federally mandated conservation initiatives at Y-12 and informs personnel about sustainability issues, particularly in relation to energy, water, and fuel conservation and efficiency.

Among other duties, the Energy Manager directs the site toward meeting energy management sustainability goals as defined in the Site Sustainability Plan (SSP) (B&W 2010) issued in December 2010.

## 4.2.4 Implementation and Operation

### 4.2.4.1 Roles, Responsibility, and Authority

The safe, secure, efficient, and environmentally responsible operation of Y-12 requires the commitment of all personnel. All personnel share the responsibility for successful day-to-day accomplishment of work and the environmentally responsible operation of Y-12. Environmental and Waste Management technical support personnel assist the line organizations with identifying and carrying out their environmental responsibilities. Additionally, an Environmental Officer Program is in place to facilitate communication of environmental regulatory requirements and to promote the EMS as a tool to drive continual environmental improvement at Y-12. Environmental Officers coordinate their organization’s efforts to maintain environmental regulatory compliance and promote other proactive improvement activities.

### 4.2.4.2 Communication and Community Involvement

Y-12 is committed to keeping the community informed in areas of operations, environmental concerns, safety, and emergency preparedness. The Community Relations Council, composed of 20 members from a cross section of the community, including environmental advocates, neighborhood residents, Y-12 retirees, and business and government leaders, serves to facilitate communication between

B&W Y-12 and the community. The council provides feedback to B&W Y-12 regarding its operations and ways to enhance community and public communications. A few examples of Y-12's community outreach activities are described in the following paragraphs.

B&W Y-12 sponsored and participated in community events in 2010 including WaterFest at the Ijams Nature Center in Knoxville and Oak Ridge Earth Day (Fig 4.4) to provide highlights of Y-12's environmental management, sustainability and stewardship, pollution prevention activities, and information about the Tennessee Pollution Prevention Partnership (TP3) to more than 2,000 members of the public. B&W Y-12 also sponsored the Oak Ridge Associated Universities Science Bowl, East Tennessee Fuels Coalition Run for Clean Air, and the Foothills Land Conservancy in 2010. In addition B&W Y-12 has promoted the history of Oak Ridge by partnering with The Oak Ridge Secret City Festival (Fig. 4.5) and the American Museum of Science and Energy to provide guided tours of the Y-12 Complex.

As part of Y-12 America Recycles Day (Fig 4.6) activities, staff from the Y-12 Pollution Prevention Program visited four local charities to distribute $200 checks raised by Y-12 employee aluminum beverage can (ABC) recycling efforts. Since the ABC recycling program began in 1994, more than $78,000 has been donated to various charities.

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**Fig. 4.4. Y-12 celebrates the 40th anniversary of Earth Day in 2010.**

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**Fig. 4.5. Visitors board a bus for a tour of Y-12, held in conjunction with the Secret City Festival.**

ORNL 2011-G00644/chj


**Fig. 4.6. An aluminum beverage can (ABC) recycling reminder as part of America Recycles Day.**

B&W Y-12 actively promoted the TP3 program by mentoring and sharing information with interested organizations to encourage pollution prevention and involvement in TP3. In 2010, B&W Y-12 shared information concerning the TP3 program with the city of Farragut, Tennessee America Recycles, Y-12 employees, and members of the local community.

#### 4.2.4.3 Emergency Preparedness and Response

Local, state, and federal emergency response organizations (EROs) are fully involved in the Y-12 emergency drill and exercise program. The annual drill and exercise schedule is coordinated with all organizations to ensure maximum possible participation. At a minimum, the Tennessee Emergency Management Agency (TEMA) Duty Office and the DOE Headquarters (HQ) Watch Office participate in all Y-12 emergency response exercises.

Y-12 conducted two full-participation exercises (FPEs) with the state of Tennessee in FY 2010. The focus of these FPEs were (1) conduct an integrated response to a chemical release at Y-12; (2) conduct integrated field monitoring operations for a chemical release; (3) conduct integrated emergency public information operations; (4) triage, treat, decontaminate and transport injured, chemically injured, and contaminated persons; and (5) allow local hospitals to manage an influx of “worried well” patients claiming contamination from the event. Three additional full-scale exercises were conducted involving a criticality event and security events.

Y-12’s expertise in emergency management continues to be recognized within the Department of Energy. Y-12 Emergency Management Program Office (EMPO) staff performed an evaluation of the Nevada National Security Site in January 2010, Los Alamos National Laboratory in August 2010, and Lawrence Livermore National Laboratory in September 2010. EMPO staff also participated in the DOE Emergency Management Issues Special Interest Group Conference held in Las Vegas, Nevada. Y-12 made presentations, participated in steering committee meetings, and distributed Y-12 Emergency Management Program information to other DOE facility emergency management professionals.

### 4.2.5 Checking

#### 4.2.5.1 Monitoring and Measurement

Y-12 maintains procedures to monitor and measure key characteristics of its operations and activities that can have a significant environmental impact and to monitor overall environmental performance. Environmental effluent and surveillance monitoring programs are well established, and the results of the

2010 program activities are reported elsewhere in this document. Progress achieving environmental goals is reported as a monthly metric on the senior management web portal, Performance Track, that consolidates and maintains Y-12 site-level performance measures. Progress is reviewed in periodic meetings with senior management and NNSA-YSO.

#### 4.2.5.2 EMS Assessments

To periodically verify that the EMS is operating as intended, assessments are conducted as part of Y-12's assessment program. The assessments are designed to ensure that nonconformities with the ISO 14001 standard are identified and addressed. Y-12's EMS assessment program consists of a three-pronged approach that includes focused EMS assessments; routine surveillances, inspections and data reviews; and environmental multi-media assessments integrated with regularly scheduled facility evaluations lead by the Independent Assessment Organization.

Four EMS assessments and four facility evaluations employing an environmental multi-media approach were conducted in 2010. As a result of the EMS assessments a new internal web tool, EC ConDocs, is being developed which provides improved access to and management of controlled documents maintained by the Environmental Compliance Department, including procedures and technical reports. The facility evaluations confirmed the EMS is being adequately implemented across the site.

### 4.2.6 EMS Performance

The EMS objectives and targets and other plans, initiatives, and successes that work together to accomplish DOE goals and reduce environmental impacts are discussed in this section. Y-12's initial SSP was developed in 2010 based on guidance from DOE-HQ. That guidance included incorporating the past year's performance and plans for out years. Accordingly, Y-12 reported performance via DOE's Pollution Prevention Tracking and Reporting System (PPTRS) and to Energy Management. An SSP is required by Executive Order 13514, Federal Leadership in Environmental, Energy and Economic Performance.

#### 4.2.6.1 EMS Objectives and Targets

B&W Y-12 achieved nine of nine targets scheduled for completion by end of FY 2010. Overall 51 actions were completed versus 50 planned for completion through September. Five additional targets scheduled for completion by end of FY 2011 are on schedule. Highlights included the following with additional detail and success presented in other sections of this report.

- Clean Air—A project to replace the coal-fired boiler steam plant with an new plant fired by natural gas was completed. (see Sect. 4.1.2.3). In addition, completed and revised the Greenhouse Gas (GHG) FY 2008 Base Year presentation and GHG inventory calculation (see Sect. 4.2.6.7).
- Energy Efficiency—Phase 1 of Energy Savings Performance Contract (ESPC) projects was implemented. Planned for FY 2013 completion, these projects will reduce energy intensity by 4% and potable water use by 5%. To promote energy awareness, a new web-based energy awareness training video was completed for delivery in FY 2011 to Y-12 site employees. Additional accomplishments are presented in Sect. 4.2.6.3. Energy and water baselines are shown in Figs. 4.11 and 4.12, respectively.
- Hazardous Materials—ARRA funding is being used to expedite removal of legacy wastes and building demolition at the Y-12 National Security Complex (see Sect. 4.8).
- Land/Water Conservation—A Y-12 water assessment was completed to develop a comprehensive understanding of the current water-consuming applications and equipment at Y-12 and to identify key areas for water efficiency improvements. Additional water conservation successes are presented in Sect. 4.2.6.4.
- Reduce/Reuse/Recycle/Buy Green—The Y-12 Pollution Prevention Program spearheads the evaluation of bio-based products for usage at Y-12 and efficiency and data quality improvements for reporting sustainable acquisition goals. Section 4.2.6.2 presents additional successes that support this EMS target area.

#### 4.2.6.2 Sustainability and Stewardship

Numerous efforts at Y-12 have reduced its impact on the environment. Efforts include increased use of environmentally friendly products and processes and reductions in waste and emissions. During the past few years, these efforts have been recognized by our customers, our community, and other stakeholders (see Sect. 4.2.7). Not only have the pollution prevention efforts at Y-12 benefited the environment, they have also resulted in avoided costs (Fig. 4.7).

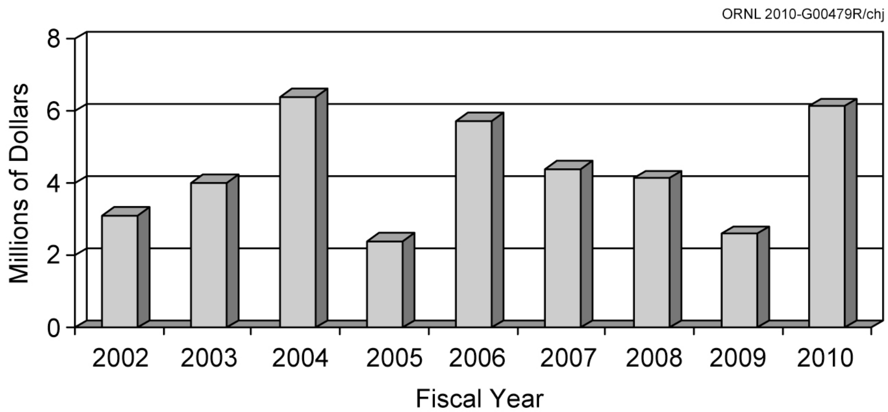


**Fig. 4.7. Cost avoidance from Y-12 pollution prevention activities.**

In FY 2010, Y-12 implemented 110 pollution prevention initiatives (Fig. 4.8), with a reduction of more than 50.68 million kilograms (111 million pounds) of waste and a cost savings/avoidance of more than $6.1 million. The completed projects include the activities presented below.

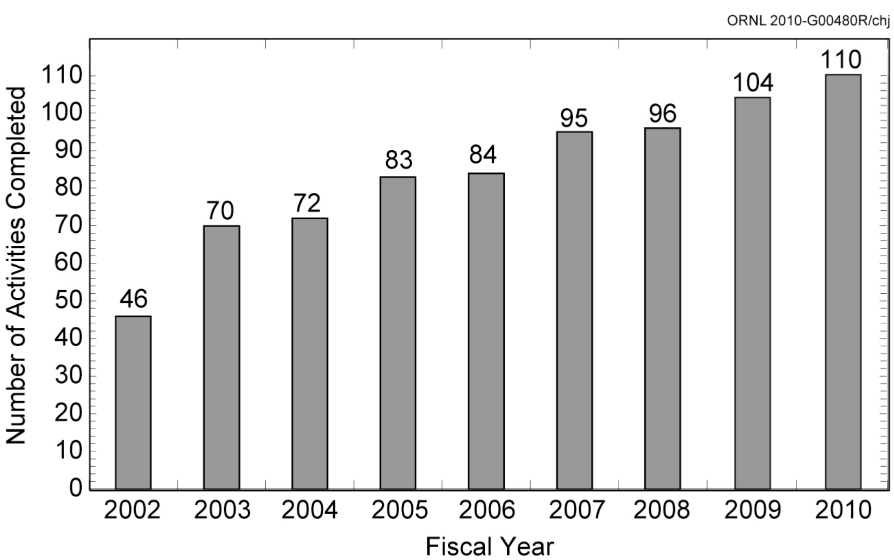


**Fig. 4.8. Y-12 pollution prevention initiatives.**

**Initiatives with Pollution Prevention Benefits and Source Reduction.** Sustainable initiatives have been embraced across the Y-12 Complex to reduce the impact of pollution on the environment and to increase operational efficiency. Many of Y-12's sustainable initiatives have pollution prevention benefits or targets eliminating the source of pollution, including the 2010 activities highlighted in this section.

**Product Exchange.** Product Exchange provides a mechanism for employees to post unneeded surplus consumable items available for reuse by other groups. Y-12 enhanced the Product Exchange system in 2010 to include additional consumable items such as office products. Product Exchange now includes the following categories of consumable materials and chemicals: Office, Lab, and Maintenance. Product Exchange exemplifies Y-12's sustainability practices and provides an efficient and environmentally friendly way to make recycling and reusing unneeded or surplus materials and chemicals easy and accessible.

**Sustainable Acquisition/Environmentally Preferable Purchasing.** Sustainable products, including recycled-content materials, are procured for use across the Y-12 Complex. In 2010, B&W Y-12 procured recycled-content materials valued at more than $3.53 million for use at the site.

**Unneeded Materials and Chemicals.** The UMC initiative was implemented to assist in the potential utilization and ultimate disposition of resources that were not being used. The overall goal of the UMC initiative is reuse of existing resources while providing a cleaner/safer facility and improved compliance. The UMC disposition process (Fig. 4.9) does not simply manage all UMC as waste but first tries to find another outlet using a systematic process. The steps of this process are to first try to identify another use (1) within Y-12, (2) within DOE, (3) within the government, (4) through sale to the public, (5) through recycle, and finally (6) through disposal as waste. Since 2006, the UMC program at Y-12 has dispositioned more than 8,100 items.

**Y-12 Analytical Chemistry.** For over 30 years, the Analytical Chemistry Organization (ACO) has used the inductively coupled plasma (ICP) method for beryllium analysis. While the ICP method produced sound results, other issues began to emerge such as the generation of Resource Conservation Recovery Act (RCRA) regulated hazardous waste acidic rinsates, high equipment costs, and repetitive motion problems. A new method was needed in order to address the above issues and to process the increased number of beryllium samples that would be generated by Y-12's American Recovery and Reinvestment Act (ARRA) project activities. Through collaboration with other DOE facilities and technology transfer companies, Y-12 has implemented a new method, automated fluorescence, to analyze beryllium that prevents the generation of hazardous waste and improves workplace safety both in the laboratory and in the field.

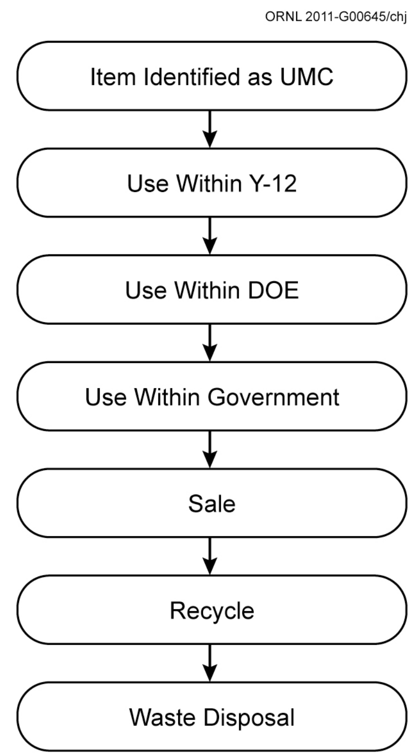


**Fig. 4.9. Unneeded Materials and Chemicals Disposition Process at Y-12.**

**Recycling Initiatives.** B&W Y-12 has a well-established recycling program and continues to identify new material streams and to expand the types of materials that can be recycled by finding new markets and outlets for the materials. As shown in Fig. 4.10, over 1.36 million kilograms (2.99 million pounds) of materials was diverted from landfills and into viable recycle processes. Currently, recycled materials range from office-related materials to operations-related materials such as scrap metal, tires, and batteries. The recycling program was expanded in 2010 to include light-emitting diode (LED) lamps and empty sodium hydroxide bottles. Many recycling activities have been implemented, including the 2010 activities highlighted in this section.

**ARRA Activities.** ARRA funds are being used to prepare large contaminated excess facilities for demolition, demolish five excess buildings, and clean up sources of environmental contamination. Y-12's ARRA projects have focused on completing activities in a sustainable, timely, and safe manner. Y-12's ARRA projects have recycled or reused over 1 million pounds of materials. Y-12 has completed all ARRA project milestones on or ahead of schedule while achieving a milestone of 1 million safe work hours without a lost time injury. Project teams have focused on exploring and implementing waste minimization practices for legacy materials. This focus has resulted in the transfer of excess materials from Y-12 to other organizations for reuse. Personnel have taken steps to preserve historical items discovered as a part of the cleanup efforts.

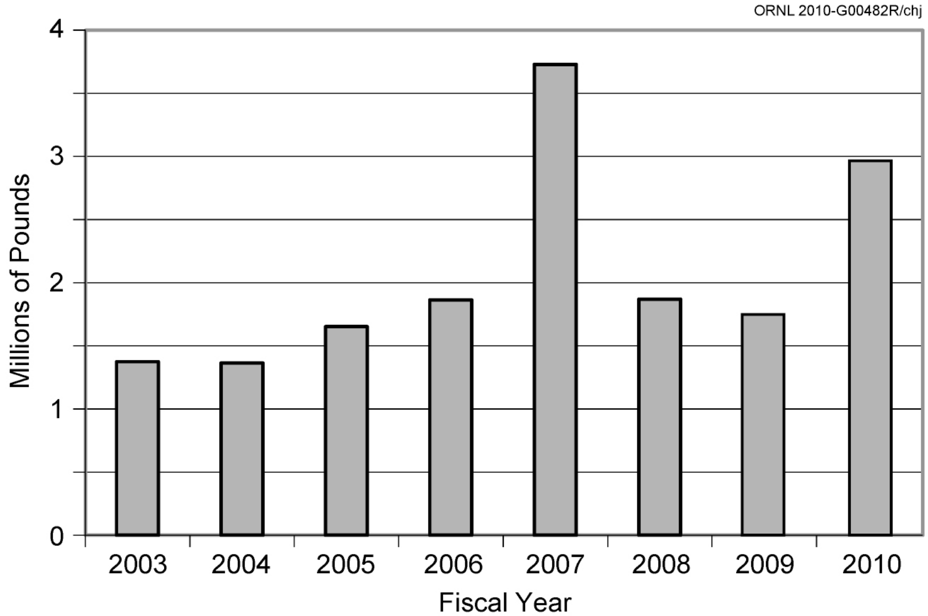


**Fig. 4.10. Y-12 recycling results.**

**Waste Management Plan Reviews.** The underlying principle behind this initiative is to review all of the Waste Management Plans prior to implementation, which supports the goals to increase the longevity of landfill space, save energy and natural resources, reduce costs to Y-12, and to comply with Federal regulations. The team ensures that all wastes that are planned to be generated have been reviewed to ensure that source reduction techniques have been incorporated and that all recyclable materials have been identified. Finally, review of the plans provides an opportunity to suggest pollution prevention considerations including any optimizations/source reduction techniques, and recycling/reuse opportunities.

**Greenhouse Gas Reductions.** An initiative was started to develop a more effective logistics process for managing shipments to the Nevada Nuclear Security Site (NNSS). The goals were to better utilize trailer capacity and reduce the corresponding transportation cost per project without jeopardizing project or shipping timelines. The newly developed combination loading process has led to a 50% reduction in the number of shipments to NNSS. In addition, personnel coordinated the removal of the Poe-style sanitary dumpsters and replaced them with standard compactor-style dumpsters. Each Poe-style dumpster had to be transported to the landfill to be emptied and then returned to its normal location, while compactor dumpsters can be emptied into the compactor truck prior to transporting the combined loads to the landfill in a single trip.

The completion of these activities has reduced manpower requirements and resulted in a reduction of greenhouse gas emissions related to transportation of materials. These activities resulted in a combined cost avoidance of more than $281,000 in transportation costs related to eliminating more than 113,000 vehicle miles traveled.

### 4.2.6.3 Energy Management

In 2010 the Department of Energy sites' "executable plans," previously developed annually to update and report energy use, were renamed "SSPs" and expanded to cover the requirements of Executive Orders 13423 and 13514 and DOE's Strategic Sustainability Performance Plan (SSPP), Discovering Sustainable Solutions to Power and Secure America's Future (DOE 2010).

Y/IA-437, Y-12 SSP (B&W Y-12 2010), published in December 2010, serves as a deliverable to fulfill the planning and reporting requirements of these requirements. The DOE sustainability goals and Y-12 status and plans for these goals are summarized in Table 4.1.

**Table 4.1. Y-12 Site Sustainability Plan Goal Performance and Review for 2010**

| DOE Goal | Y-12 Performance Status | Planned Actions and Key Issues |
|---|---|---|
| 28% Scope 1 & 2 GHG reduction by FY 2020 from a FY 2008 baseline | Currently on track to meet this goal with 9.4% estimated reduction in Scope 1 & 2 GHG | Y-12 and Federal Energy Management Program (FEMP) Scope 1 & 2 GHG baseline calculations are not consistent and will be further evaluated for future reporting. |
| 30% energy intensity reduction by FY 2015 from a FY 2003 baseline | Y-12 has achieved a 16.8% reduction in energy intensity from the 2003 baseline. ESPC implementation is projected to provide an additional 11.6% reduction. | Energy- and water-efficiency projects will continue to be implemented as funding allows. |
| 7.5% of a site's annual electricity consumption from renewable sources by FY 2010 (2× credit if the energy is produced on-site) | Y-12 purchased Green-e–certified Renewable Energy Certificates (RECs) in the amount of 21,000 MWh per year. This meets the goal for FY 2010–FY 2012. | The purchase and installation of renewable energy sources were evaluated in a FEMP study and deemed economically infeasible for Y-12. On the basis of the study, a waiver will probably be submitted to NNSA. |
| Every site to have at least one on-site renewable energy generating system by FY 2010 | The Y-12 site has implemented various small-scale photovoltaic systems to power lights, battery-charging stations, and remote analytical equipment. | Renewable electricity systems will be continually reevaluated according to application and cost benefit. |
| 10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline | Y-12 has exceeded the alternative fuel goal with a 837% increase in alternative fuel vehicle (AFV) consumption versus the FY 2005 baseline. | Additional measures will be evaluated for continued improvement beyond the initial goals |
| 2% annual reduction in fleet petroleum consumption by FY 2015 relative to a FY 2005 baseline | Y-12 has achieved the petroleum reduction goal with a 42% reduction versus the FY 2005 baseline | Additional measures will be evaluated for continued improvement beyond the initial goals. |
| 75% of light-duty vehicle purchases must consist of AFVs by FY 2015 | Y-12 has met this goal in 2010, attaining 100% of AFV vehicles of the 17 purchased. | Plans are for 100% of future light-duty vehicle purchases to be AFVs. |
| To the maximum extent practicable: advanced metering for electricity by October 2012; steam and natural gas by October 2016; standard meters for water | Based on current funding levels, it will be difficult for Y-12 to meet the 2012 goal. | Metering has been prioritized and is being upgraded as funding allows. |
| Cool roofs for roof replacements unless project already has Critical Decision 2 (CD-2) approval. New roofs must have thermal resistance of at least R-30. | Y-12 is meeting this goal. Investments in roofing have resulted in more than 20 acres of new roofing since FY 2002. Full implementation of cool roof technology in new roofing applications was achieved in 2008. | Future roofing projects will continue to use cool roofs where practical, with 10,055 $ft^2$ planned installation in FY 2011. |

**Table 4.1 (continued)**

| DOE Goal | Y-12 Performance Status | Planned Actions and Key Issues |
|---|---|---|
| Training and outreach: DOE facility energy managers to be Certified Energy Managers by September 2012 | Y-12 is meeting this requirement. | The Y-12 energy manager will attain Certified Energy Manager status in FY 2011. Energy Awareness training has been added as a baseline training requirement for all employees. |
| Sulfur hexafluoride ($SF_6$) capture program by September 2012 | The $SF_6$ gas is contained and is only used in specific applications. The neutron generator will be evaluated to see if additional capture and recovery devices could be installed. | Future applications will not use $SF_6$ coolant. |
| 13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline | Y-12 is not currently meeting this goal. Y-12's Scope 3 GHG emissions have increased by 6.0% from the FY 2008 baseline, primarily due to increased workforce resulting from ARRA initiatives | The increase in Scope 3 emissions is proportional to the increase in plant population due to additional mission activities including ARRA projects. The site will investigate additional opportunities for reducing commuter emissions and business travel. |
| All new construction and major renovations greater than $5 million to be LEED® Gold certified (Leadership in Energy and Environmental Design). Meet HPSB guiding principles if less than or equal to $5 million. | Existing plans for any new construction or leased facilities are being developed with the LEED certification criteria. | The Uranium Processing Facility (UPF) project has a LEED professional on the design team and is evaluating the impact of LEED certification. |
| 15% of existing buildings larger than 5,000 gross square feet to be compliant with the five guiding principles of HPSB by FY 2015. | Y-12 is at risk for meeting this goal. One building is LEED certified, and HPSB assessments have determined the appropriate cadre of buildings to prioritize. The site will make incremental progress within existing funding until additional funding is identified. Two buildings will bring Y-12 into compliance if tracking based on square footage; 13 buildings are required if tracking is based on building count. | The EPA Portfolio Manager will be used to track progress toward the guiding principles. Future funding availability will have a significant influence on progress made in this area. |
| 16% water intensity reduction by FY 2015 from a FY 2007 baseline, 26% by FY 2020 | Y-12 has met this goal with a 29.3% potable water intensity reduction from the confirmed FY 2007 baseline. ESPC implementation will further assist with water conservation at Y-12. | Water conservation measures (WCMs) will continue to be incorporated on a building-by-building basis. |

**Table 4.1 (continued)**

| DOE Goal | Y-12 Performance Status | Planned Actions and Key Issues |
|---|---|---|
| 20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline | Y-12 does not consume ILA water; water is purchased to supplement creek flow as required by the State of Tennessee National Pollutant Discharge Elimination System (NPDES) permit. A recent negotiation with Tennessee Department of Environmental Conservation (TDEC) reduced the supplement from 7 million gal/d to 5 million gal/d, a reduction of 29%, once implemented. | The City of Oak Ridge has been requested to install a constant pressure-regulated source to control the augmentation flow to maintain the 2M gal/d reduction |
| Divert at least 50% of nonhazardous solid waste from landfill by FY 2015, excluding construction and demolition materials and debris | Y-12 has had an industrial recycling/diversion rate of more than 70% since 2006. | At least one new recycle material stream is added to the recycling program each fiscal year to further increase the diversion rate. |
| Divert at least 50% of construction and demolition materials and debris from landfill by FY 2015 | Y-12 has had an industrial recycling/diversion rate of more than 70% since 2006. | At least one new recycle material stream is added to the recycling program each fiscal year to further increase the diversion rate. |

**Energy Performance**. Comprising 57% of the Y-12 greenhouse gas (GHG) emissions, purchased electricity is by far the major contributor to energy intensity. During FY 2010, reductions in energy intensity (Fig. 4.11) were a result of the conversion from coal to natural gas steam generation, an increase of energy efficient square footage at the Y-12 site, and implementation of energy-efficient measures in select facilities. A new gas-fired (fuel oil backup) steam plant was constructed and placed into service. This change in operation completely eliminated the consumption of coal and the associated environmental aspects of the process. Heating, ventilation, and air-conditioning (HVAC) setbacks were put in place in two leased facilities. Additionally, HVAC equipment and monitoring controls in several buildings were repaired and reconnected, providing more efficient functionality. Several production facilities are undergoing lighting upgrades to replace outdated incandescent and fluorescent fixtures with new energy efficient lighting.

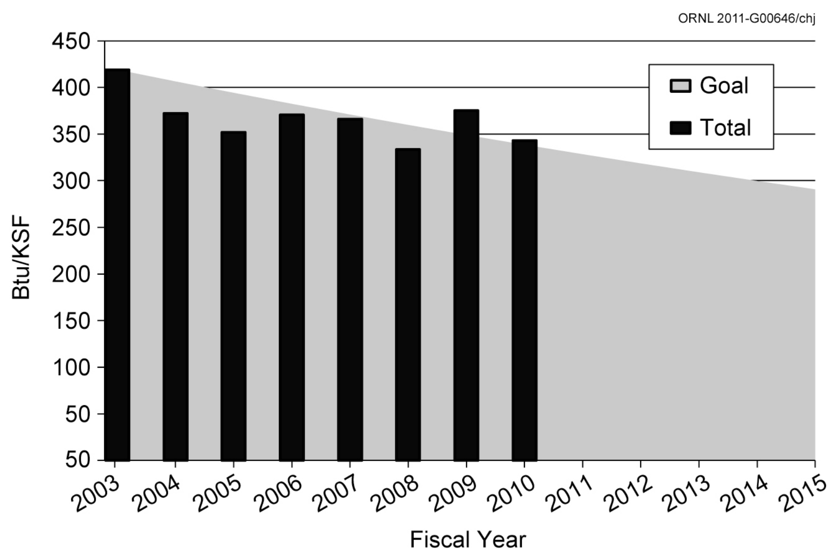


**Fig. 4.11. Y-12 Energy Intensity vs Goal: FY2007 vs FY 2010.** KSF = thousand square feet, GSF = gross square footage.

#### 4.2.6.4 Water Conservation

Based upon the FY 2007 baseline, in FY 2010 Y-12 reduced annual potable water consumption by 298,944,000 gal, or 21.8%. This equates to a potable water intensity reduction of 29.3%, almost double the water intensity reduction goal of 16% (Fig. 4.12). This also exceeds the FY 2026 goal of 26% reduction. Continued reductions in water usage are attributable to the upgrades in water-consuming systems, such as the steam plant, demineralization plant, cooling tower, and process water.

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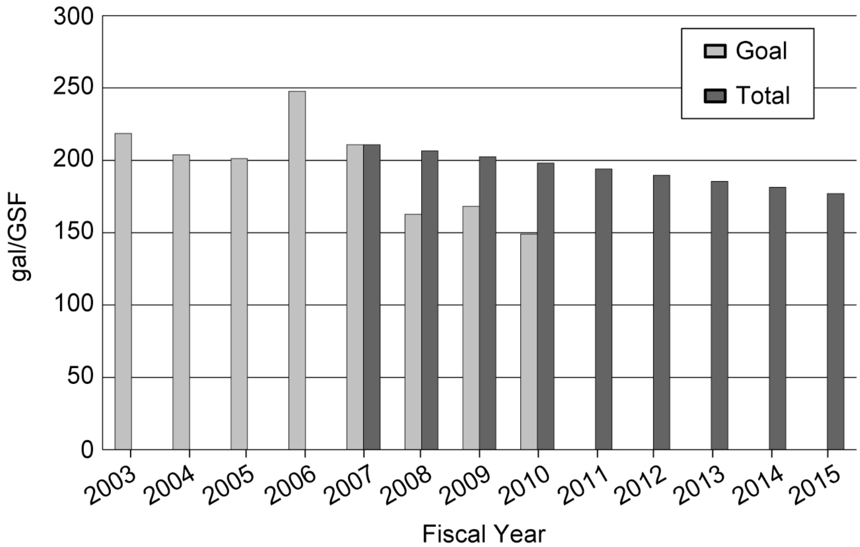


**Fig. 4.12. Y-12 Site Water Intensity vs Goal: FY2007 vs FY 2010.**

The DOE Federal Energy Management Program (FEMP) Water Program, led by Pacific Northwest National Laboratory and Water Savers, Inc., a water efficiency company, conducted a site-wide water assessment at Y-12 during April through August 2010. The water assessment resulted in recommended water conservation measures (WCMs) that could save 228,154 kgal annually (16.5%) and reduce energy by 40,307 million BTUs. If all WCMs are implemented, the annual cost savings is $714,201. The water-assessment team identified 18 unique water and energy conservation measures designed to improve the water efficiency of Y-12. Many of the domestic upgrades are identified for future implementation on a building-by-building basis as funding allows. Similarly, many of the cooling tower upgrades are prioritized and will be evaluated accordingly for implementation as funding permits.

#### 4.2.6.5 Fleet Management

The Y-12 site has already surpassed the petroleum reduction goal with respect to the 2005 baseline. The site achieved a 53 % reduction within 5 years, which surpasses the requirement for the reduction of 2% per year. These four initiatives have helped spur that significant reduction.

- Vehicle pools were established at facilities with large concentrations of workers.
- Car pooling is encouraged in areas where it is feasible.
- Shuttle buses are provided throughout areas of the plant site.
- Vehicles not meeting site-use goals have been removed or reassigned on the basis of site needs.

Furthermore, the site has been very successful in achieving the goals for alternative fuel usage, as summarized in Table 4.2. A 837% increase in alternative fuels has been achieved from the 2005 baseline (surpassing the goal of 100%), with 20% of the current Y-12 fleet being alternative fuel vehicles. Of Y-12's 538 vehicles (includes government owned, GSA leased, and commercially leased), 108 are now flexible fuel vehicles and 77 were converted to ultra-low sulfur diesel fuel. All flexible fuel–capable vehicles have been operated on E85 ethanol alternative fuel since 2008.

**Table 4.2. Summary of petroleum and alternative fuel usage over a 5-year period**

| | 2005 Baseline | 2010 Data | % Increase/ decrease | EO 13423 goal | Actual |
|---|---|---|---|---|---|
| Petroleum (Non-fleet) | 54,426 L (14,378 gal) | 24,181 L (6,388 gal) | 55.6% decrease | 2% per year decrease | 14% per year decrease |
| Petroleum (Fleet) | 606,141 L (160,126 gal) | 348,802 L (75,262 gal) | 53% decrease | 2% per year decrease | 10% per year decrease |
| E85 fuel + biodiesel | 18,174 L (4,801 gal) | 53,132 L (62,483 gal) | 837% increase | 10% per year increase | 167.4% per year increase |

In order to track the continued success of the fuel-saving measures, the fleet manager monitors gasoline, E85 ethanol, and B20 biodiesel fuel consumption by both Y-12 and General Services Administration vehicles and maintains monthly reporting metrics. Future fleet management energy savings will be achieved by continued strict monitoring of vehicle use. Increasing the use of alternative fuels and replacing gasoline-fueled vehicles with E85-fueled vehicles will occur as funding permits. Goals in support of alternative fuel use have been achieved such as procuring a hybrid bus and pickup truck for the Y-12 fleet in addition to the E85 replacements (Fig 4.13).

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**Fig. 4.13. Y-12 fleet receives newer, greener vehicles.**

## 4.2.6.6 Electronic Stewardship

The Y-12 Complex committed to the Federal Electronics Challenge (FEC) pledge in 2008 to improve the management of electronic assets during all life-cycle phases: acquisition and procurement, operation and maintenance, and end-of-life management. In 2010, as an FEC Partner, B&W Y-12 completed all FEC annual reporting to account for efficient operation and maintenance of electronics and implementation of other practices to maximize Y-12 energy efficiency, reduce electronic-related wastes, and improve end-of-life management. B&W Y-12 received a 2010 FEC Silver Level Award in April 2010 (see Sect. 4.2.7).

## 4.2.6.7 Greenhouse Gas (GHG)

Y-12 developed a preliminary GHG inventory in August 2009. The inventory was developed for FY 2008, with an initial FY 2003 baseline year. Based on the requirements of Executive Order 13514, Y-12's baseline year was changed to FY 2008.

Table 4.3 provides Scope 1 and 2 GHG emissions for FY 2008 and FY 2010. Y-12 is currently not meeting the Scope 3 GHG emissions goal against the 2008 baseline. Y-12's Scope 3 GHG emissions have increased by 6.1% since FY 2008. This increase is proportional to the increase in site population due to additional mission activities including ARRA projects. Scope 3 emissions are reduced through employee workweek schedules, carpool programs, enhanced off-site computing, and waste management improvements. Implementation of those existing initiatives occurred before the 2008 baseline.

**Table 4.3. Y-12 comprehensive GHG emissions comparison**

| Comparison of Y-12 greenhouse gas emissions (mt $CO_2$) | Data source[a] | FY 2008 baseline | FY2010 PPTRS and EMS-4/FAST estimates |
|---|---|---|---|
| **Scope 1** | | | |
| Fuel Consumption – Coal[b] | EMS-4 | 115,090 | 53,388 |
| Fuel Consumption – Natural Gas[b] | EMS-4 | 7,952 | 51,697 |
| Non-Fleet Fuel Consumption – Gasoline | EMS-4 | 265 | no data |
| Non-Fleet Fuel Consumption – DSL | EMS-4 | 103 | no data |
| Fleet Vehicle Consumption – B20 | B&W FAST | 181 | 0 |
| Fleet Vehicle Consumption – DSL | B&W FAST | 73 | 296 |
| Fleet Vehicle Consumption – E85 | B&W FAST | 40 | 60 |
| Fleet Vehicle Consumption – Gas | B&W FAST | 1,384 | 667 |
| Industrial Fugitive Emissions | PPTRS | 16,233 | 3,096.2 |
| On-Site Landfill | PPTRS | ETTP[c] | ETTP |
| On-Site Wastewater | PPTRS | 6.9 | 7.3 |
| **Scope 2** | | | |
| Electricity | EMS-4 | 185,089 | 186,492 |
| **Total Scope 1 & 2** | | **326,417** | **295,704** |
| **Scope 3** | | | |
| T&D Losses | FEMP | 12,194 | 12,286 |
| Off-site Municipal Wastewater Treatment | FEMP | 266 | 280 |
| Employee Commute | PPTRS | 17,447 | 18,747 |
| Air Travel | PPTRS | 1,920 | 2,377 |
| Rental Car (Ground Travel) | PPTRS | 331 | 411 |
| **Total Scope 3** | | **32,158** | **34,101** |
| **TOTAL GHG Emissions** | | **358,575** | **329,805** |

[a]EMS-4 – Energy Management System 4
B&W FAST – Y-12 fleet reported data via Federal Automotive Statistical Tool
PPTRS – Pollution Prevention Tracking and Reporting System
FEMP – Federal Energy Management Program
[b]Emissions were estimated using AP42 engineering emission factors for the specific steam boiler equipment in use at the Y-12 Complex. FEMP estimates are based on emission factors designated for bituminous coal and natural gas as defined in the EPA Mandatory GHG reporting rules, which are based on national average combustion efficiency rather than the specific combustion equipment in use at the Y-12 site.
[c]ETTP – Reported as part of ETTP site report.

Y-12 is on track to meet the reduction goal for Scope 1 and 2 GHG emissions through the successful implementation of numerous energy initiatives outlined in this document and in Y-12's Environmental Management System. Fleet baselines reported via Federal Automotive Statistical Tool (FAST) include existing data for all on-site subcontractors. Portions of the FY 2010 data are not available for all contractors; therefore, the value generated by FEMP will be greater than reflected below.

Results indicate that the majority (57%) of Y-12's FY 2010 GHG emissions were from indirect (Scope 2) emission from purchased electricity. The largest direct (Scope 1) emission during the baseline year was from combustion of coal to produce steam (32.1%). This contribution was reduced by 50% due to the start-up of the natural gas–fired steam plant during FY 2010. As previously mentioned, this project also diminishes the estimated GHG emissions from industrial fugitive emissions by a factor of 10 to account for approximately 0.5% of the site-wide Scope 1 and 2 GHG emissions in FY 2010. Based on current estimates, overall Y-12 has achieved a 9% reduction in Scope 1 and 2 emissions compared with the FY 2008 baseline. Data for all GHG emissions will be refined during the FY 2011 time frame.

### 4.2.7 Awards and Recognition

The Y-12 commitment to environmentally responsible operations has been recognized by more than 65 external environmental awards since November 2000 from local, state, and national agencies. The awards received in 2010 are summarized below.

**DOE E-Star Award.** "Y-12's Sustainability and Stewardship Program Transforms Y-12 into a Greener and Leaner Complex" was selected to receive an E-Star Award from DOE Headquarters (Fig. 4.14). The E-Star Award recognizes innovation and/or excellence in pollution prevention and environmental sustainability stewardship efforts within DOE and is selected by an independent panel. This award was selected from approximately 127 nominations by pollution prevention representatives from the U.S. Department of Health and Human Services, U.S. Department of Homeland Security, and U.S. Army Corps of Engineers.

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**Fig. 4.14. "Y-12's Sustainability and Stewardship Program Transforms Y-12 into a Greener and Leaner Complex" was selected to receive an E-Star Award from DOE Headquarters.**

**Tennessee Chamber of Commerce and Industry (TCC&I).** B&W Y-12 was recognized in three areas at the 28th Annual Tennessee Chamber of Commerce and Industry Environmental Conference in awards ceremonies on October 2010. Award winners were selected by a panel of state officials who reviewed the nomination, accomplishments, and compliance records of the respective environmental programs. B&W Y-12 received the following two awards:

- Environmental Excellence Award for "Y-12's Sustainability and Stewardship Program Transforms Y-12 into a Greener and Leaner Complex"
- Air Quality Award for "Y-12's New Steam Plant"

Additionally, B&W Y-12 received achievement certificates for the following activities:

- Solid Waste Management Certificate for "Y-12 Unneeded Materials and Chemicals Initiative"
- Solid Waste Management Certificate for "Y-12 Initiatives Make DOE-wide Electronics Recycling Securely Sustainable"

**NNSA Awards.** In 2010 the Y-12 Complex received one NNSA Pollution Prevention Best in Class Award and two NNSA Environmental Stewardship Awards. This is the seventh consecutive year that the Y-12 Complex has been recognized by NNSA for award-winning activities. These awards recognize innovation and/or excellence in pollution prevention and environmental sustainability stewardship efforts within the NNSA and DOE and are selected by an independent panel.

**Tennessee Pollution Prevention Partnership.** In 2010**,** Y-12 was awarded Performer Level status in the TP3 Program for another year. In order to maintain Performer Level status in the TP3 Program, Y-12 must illustrate ongoing commitment to pollution prevention through the completion of a success story and mentoring and outreach activities. Y-12's activities are reviewed annually by the members of the TDEC TP3 Program Review Panel.

**Federal Electronics Challenge.** B&W Y-12 received a 2010 FEC Silver Level Award in April 2010 which recognizes the achievements of FEC partners and their leadership in federal electronics stewardship. Y-12 was one of 14 Silver Level Award winners (Fig. 4.15). This FEC Silver Award was specifically received for Y-12's accomplishments in operations and maintenance and end-of-life management activities of electronics.

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**Fig. 4.15. Y-12 was presented a 2010 Federal Electronics Challenge Silver Award.**

# 4.3 Compliance Status

## 4.3.1 Environmental Permits

Table 4.4 notes environmental permits in force at Y-12 during 2010. More detailed information can be found within the following sections.

## 4.3.2 NEPA/NHPA Assessments

NNSA adheres to the National Environmental Policy Act (NEPA) regulations, which require federal agencies to evaluate the effects of proposed major federal activities on the environment. The prescribed evaluation process ensures that the proper level of environmental review is performed before an irreversible commitment of resources is made.

During 2010, environmental evaluations were completed for 34 proposed actions, all of which were determined to be covered by a categorical exclusion (CX).

### 4.3.2.1 Site-Wide Environmental Impact Statement (SWEIS) for Y-12 Complex

The NEPA implementing procedures, 10 CFR 1021 (DOE 1996), require a 5-year evaluation of the current Y-12 Complex site-wide environmental impact statement (SWEIS). A new SWEIS is being prepared to evaluate the new modernization proposals and to update the analyses presented in the original Y-12 SWEIS (issued in November 2001). The notice of intent was published in the *Federal Register* on November 28, 2006, and a public scoping meeting was held December 15, 2006, in Oak Ridge.

The draft SWEIS was issued in October 2009 (NNSA 2009), and a notice of availability was published in the *Federal Register* on October 30, 2009. Two public hearings for the draft SWEIS were held on November 17 and 18, 2009. These hearings allowed members of the public to provide comments on the draft SWEIS. The meetings were attended by approximately 350 members of the public. The public comment period for the draft SWEIS ended on January 29, 2010. The final SWEIS was issued February 2011, and the Notice of Availability was published March 4, 2011.

### 4.3.2.2 Preserving Y-12's History for Future Generations

In accordance with the National Historic Preservation Act (NHPA), NNSA is committed to identifying, preserving, enhancing, and protecting its cultural resources. The compliance activities in 2010 included completing an NHPA Section 106 review on 34 proposed projects, and participating in various outreach projects with local organizations and schools.

Thirty-four proposed projects were evaluated to determine whether any historic properties eligible for inclusion in the *National Register of Historic Places* would be adversely impacted. Of the 34 proposed projects, it was determined that there were no adverse effects on historic properties eligible for listing in the *National Register* and that no further Section 106 documentation was required.

The Y-12 Oral History Program continues with ongoing efforts to conduct oral interviews of current and former employees to document the knowledge and experience of those who worked at the Y-12 Complex during World War II and the Cold War era. The interviews provided information on day-to-day operations of the Y-12 Complex, the use and operation of significant components and machinery, and how technological innovations occurred over time. Some of the information collected from the interviews may be used in various media to include DVDs shown in the Y-12 History Center.

**Table 4.4. Y-12 Complex environmental permits**

| Regulatory driver | Permit title/description | Permit number | Issue date | Expiration date | Owner | Operator | Responsible contractor |
|---|---|---|---|---|---|---|---|
| CAA | New Steam Plant Package Boilers (Construction) | 960947 | 9/06/2007 | 2/01/2009[a] | DOE | DOE | B&W Y-12 |
| CAA | Chip Oxidizer Operating Permit | 554594 | 10/21/2004 | 10/21/2009[b] | DOE | DOE | B&W Y-12 |
| CAA | Operating Permit (Title V) | 554701 | 10/21/2004 | 10/21/2009[b] | DOE | DOE | B&W Y-12 |
| CAA | Steam Plant (existing) Clean Air Interstate Rule $NO_x$ Permit | 861316 | 6/9/2008 | Upon renewal of Title V permit (554701) | DOE | DOE | B&W Y-12 |
| CAA | Disassembly and Storage Operation (Construction) | 963891P | 9/29/2010 | 10/01/2011 | DOE | DOE | B&W Y-12 |
| CWA | Industrial & Commercial User Wastewater Discharge (Sanitary Sewer Permit) | No. 1-91 | 4/1/2010 | 3/31/2015 | DOE | DOE | B&W Y-12 |
| CWA | National Pollutant Discharge Elimination System Permit | TN0002968 | 3/13/2006 | 12/31/2008 Application for reissuance submitted 7/1/2008 | DOE | DOE | B&W Y-12 |
| CWA | Construction General Permit for Bear Creek Road Bypass | TNR 133700 | 5/26/2010 | On Notice of Termination of May 30, 2010 (covered until new general permit issued) | Stein Construction | Stein Construction | B&W Y-12 |
| CWA | 401 Water Quality Certification / ARAP Access / Haul Road | NRS10.083 | 6/10/2010 | 6/09/2015 | B&W Y-12 | B&W Y-12 | B&W Y-12 |
| CWA | Department of Army Permit | 2010-00366 | 9/02/2010 | 9/02/2015 | DOE, B&W Y-12 | B&W Y-12 | B&W Y-12 |
| CWA | General Stormwater Permit Potable Water System Upgrade (area F&P) | TNR 132628 | 6/29/2007 | 5/30/2010 (project completed 2010) | B&W Y-12 | B&W Y-12 | B&W Y-12 |

**Table 4.4 (continued)**

| Regulatory driver | Permit title/description | Permit number | Issue date | Expiration date | Owner | Operator | Responsible contractor |
|---|---|---|---|---|---|---|---|
| CWA | General Stormwater Permit Potable Water System Upgrade (area O) | TNR 132975 | 6/29/2007 | 5/30/2010 (project completed 2010) | DOE | Washington Group | Washington Group |
| CWA | General Stormwater Permit Steam Plant Replacement Project | TNR 133198 | 7/2/2008 | 5/30/2010 (project completed 2010) | DOE | G&S Construction | G&S Construction |
| RCRA | Hazardous Waste Transporter Permit | TN3890090001 | 1/19/2011 | 1/31/2012 | DOE | DOE | B&W Y-12 |
| RCRA | Hazardous Waste Corrective Action Permit | TNHW-121 | 9/28/2004 | 9/28/2014 | DOE | DOE, NNSA, and all ORR co-operators of hazardous waste permits | BJC |
| RCRA | Container Storage Units | TNHW-122 | 8/31/2005 | 8/31/2015 | DOE | DOE/B&W Y-12 | B&W Y-12/ Navarro-GEM JV, co-operator |
| RCRA | Hazardous Waste Container Storage and Treatment Units | TNHW-127 | 10/06/2005 | 10/06/2015 | DOE | DOE/B&W Y-12 | B&W Y-12 co-operator |
| RCRA | RCRA Post-Closure Permit for the Chestnut Ridge Hydrogeologic Regime | TNHW-128 | 9/29/2006 | 9/29/2016 | DOE | DOE/BJC | BJC |
| RCRA | RCRA Post-Closure Permit for the Bear Creek Hydrogeologic Regime | TNHW-116 | 12/10/2003 | 12/10/2013 | DOE | DOE/BJC | BJC |
| RCRA | RCRA Post-Closure Permit for The Upper East Fork Poplar Creek Hydrogeologic Regime | TNHW-113 | 9/23/2003 | 9/23/2013 | DOE | DOE/BJC | BJC |
| Solid Waste | Industrial Landfill IV (Operating, Class II) | IDL-01-103-0075 | Permitted in 1988—most recent modification approved 1/13/1994 | N/A | DOE | DOE/BJC | BJC |

**Table 4.4 (continued)**

| Regulatory driver | Permit title/description | Permit number | Issue date | Expiration date | Owner | Operator | Responsible contractor |
|---|---|---|---|---|---|---|---|
| Solid Waste | Industrial Landfill V (Operating, Class II) | IDL-01-103-0083 | Initial permit 4/26/1993 | N/A | DOE | DOE/BJC | BJC |
| Solid Waste | Construction and Demolition Landfill [Overfilled, Class IV Subject to CERCLA Record of Decision (ROD)] | DML-01-103-0012 | Initial permit 1/15/1986 | N/A | DOE | DOE/BJC | BJC |
| Solid Waste | Construction and Demolition Landfill VI (Postclosure care and maintenance) | DML-01-103-0036 | Permit terminated by TDEC 3/15/2007 | N/A | DOE | DOE/BJC | BJC |
| Solid Waste | Construction and Demolition Landfill VII (Operating, Class IV) | DML-01-103-0045 | Initial permit 12/13/1993 | N/A | DOE | DOE/BJC | BJC |
| Solid Waste | Centralized Industrial Landfill II (Postclosure care and maintenance) | IDL-01-103-0189 | Most recent modification approved 5/8/1992 | N/A | DOE | DOE/BJC | BJC |

[a] A request for extension was submitted to TDEC on January 7, 2009. This permit is addressed in the Title V renewal application.

[b] The Y-12 Title V Operating Air Permit Renewal Application was submitted to TDEC on April, 23, 2009. As part of the permit application renewal, it was requested that TDEC combine Air Permit 554594 into Air Permit 554701 followed by cancellation of Air Permit 554594.

Abbreviations

| | |
|---|---|
| BJC | Bechtel Jacobs Company |
| CAA | Clean Air Act |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CWA | Clean Water Act |
| DOE | U.S. Department of Energy |
| GEM-JV | GEM Technologies, Inc. Joint venture |
| NNSA | National Nuclear Security Administration |
| NOT | Notice of termination |
| ORR | Oak Ridge Reservation |
| RCRA | Resource Conservation and Recovery Act |
| ROD | record of decision |
| TDEC | Tennessee Department of Environment and Conservation |

The Y-12 History Center, located in The New Hope Center, continues to be a work in progress featuring new artifacts, photographs, and pop-up signs. The Y-12 History Center displays exhibits, photographs, artifacts, brochures, DVDs, and other information associated with the history of Y-12 and the New Hope Community. The Center is open to the public Monday through Thursday from 8:00 a.m. to 5:00 p.m. and on Fridays by special request. A selection of materials, including DVDs, books, pamphlets, postcards and fact sheets, is available free to the public. Tours of the center were conducted for various organizations, local schools, and VIP visitors.

Outreach activities in 2010 consisted of B&W Y-12 partnering with the city of Oak Ridge, the Convention and Visitor's Bureau, and the Arts Council of Oak Ridge who sponsors the annual Secret City Festival. The Secret City Festival promoted the history of the Manhattan Project by providing guided tours of the Y-12 Complex in June. The American Museum of Science and Energy ran shuttles continuously to Y-12's New Hope Visitor Center. The Y-12 Complex conducted a total of 46 tours. About 1,377 people from 29 states visited the Y-12 History Center and toured the Y-12's historic facility, Building 9731, known as the "Pilot Plant" (Fig 4.16). Tour participants had an opportunity to tour the east end of Y-12 with an off-stop at Building 9731, an off-stop at the overlook on Chestnut Ridge to get a view of the Y-12 Plant, and a windshield tour of the Highly Enriched Uranium Materials Facility (HEUMF) as they returned to the New Hope Center. The tour participants were greeted at Building 9731 by two "Pilot Plant" retirees, Mrs. Jane Greer Puckett and Mr. Martin Skinner (Fig 4.17). Mrs. Puckett was the first female graduate from the statistics program at the University of Tennessee. From 1943 – 1947, she worked as a statistician in Building 9731. She was responsible for verifying the production data for the uranium-235. Martin Skinner was an electrical engineer when he worked at Y-12. From 1946–1950, he worked in Building 9731 with a crew of people that conducted testing of the calutrons. He also helped design a display on how to operate the calutrons.

B&W Y-12 also partnered with the American Museum of Science and Energy by providing guided public tours from June through September. Other outreach activities include visiting local schools and conducting presentations on the history of Y-12 and Oak Ridge.

ORNL 2011-G00651/chj

**Fig. 4.16. Y-12's Building 9731 between two images of calutrons.**

ORNL 2011-G00652/chj


**Fig. 4.17. "Calutron Girls" Betty Whitehead, left, and Dorothy Spoon, right, join Jane Greer Puckett, in center, as they share memories of earlier times working at Y-12.**

### 4.3.3 Clean Air Act

This section contains a review of the major elements of the Clean Air Program at the Y-12 Complex Including program highlights for 2010.

The DOE was issued the Title V Major Source Operating Permits 554701 and 554594 in 2004 for the Y-12 Complex and required compliance implementation began April 1, 2005. More than 3,000 data points are obtained and reported under the Title V operating permit every 6 months, and there are five continuous monitors for criteria pollutants as well as numerous continuous samplers for radiological emissions. There was no noncompliance as a result of monitoring activities during 2010.

In 2010, two construction air permits were in effect at the Y-12 Complex. Under a permit issued in 2007, construction began in 2008 on the replacement steam plant. The new steam plant was transitioned to Y-12 operations on April 30, 2010. Since the new steam plant is in operation, the old steam plant is shut down, and there is no plan to operate it again in the future.

A construction air permit was issued on September 29, 2010, for an operation for the machining of beryllium and/or beryllium compounds. The current operation is permitted under Y-12 Major Source (Title V) Operating Permit.

Historically, more than 90% of the Y-12 Complex pollutant emissions to the atmosphere were attributed to the operation of the old coal-fired and natural gas–fired steam plant. Emissions from the new steam plant will be significantly lower than those from the old steam plant, resulting in an overall air quality improvement. The new steam plant burns primarily natural gas and will have a Number 2 fuel oil backup. The Clean Air construction permit for this project included a Best Available Control Technology analysis for certain criteria pollutants and a case-by-case Maximum Achievable Control Technology (MACT) analysis for hazardous air pollutants.

Prior 2-year efforts to increase usage of E85 (i.e., a mixture of 85% ethanol and 15% gasoline) in flexible fuel vehicles continued to reap motor vehicle emission reductions in 2010.

In 2010, TDEC personnel performed an inspection of the Y-12 Complex on July 28 and 29 to verify compliance with applicable regulations and permit conditions. No compliance issues were identified.

### 4.3.4 Clean Water Act and Aquatic Resources Protection

The Y-12 NPDES permit (TN0002968) was issued on March 13, 2006, and became effective on May 1, 2006. An application for reissuance of the NPDES permit was submitted to TDEC, Division of Water Pollution Control, on July 1, 2008.

The permit expired December 31, 2008, and Y-12 Complex discharges are continuing under the requirements of this permit pending TDEC action on the renewal application. The effluent limitations contained in the permit are based on the protection of water quality in the receiving streams. The permit emphasizes storm water runoff and biological, toxicological, and radiological monitoring.

During 2010 the Y-12 Complex continued its excellent record for compliance with the National Pollutant Discharge Elimination System (NPDES) water discharge permit. More than 5,000 data points were obtained from sampling required by the NPDES permit; only one noncompliance was reported. Some of the key requirements in the permit are summarized below (additional details are provided in Sect. 4.5, Surface Water Program):

- chlorine limitations based on water quality criteria at three outfalls located near the headwaters of East Fork Poplar Creek which are controlled by dechlorination systems;
- reduction of the measurement frequency for pH and chlorine at East Fork Poplar Creek outfalls with the additional requirement for measurements in stream at two locations (Station 17 and monitoring location C11);
- a radiological monitoring plan requiring monitoring and reporting of uranium and other isotopes at pertinent locations (see Sect. 4.5.2);
- implementation of a storm water pollution prevention plan requiring sampling and characterization of storm water (see Sect. 4.5.3);
- storm water sampling of stream baseload sediment at four instream East Fork Poplar Creek locations (see Sect. 4.5.3);
- a requirement for an annual storm water monitoring report, an annual report of the Biological Monitoring and Abatement Plan (BMAP) data;
- a requirement to manage the flow of East Fork Poplar Creek such that a minimum flow of 19 million L/day (5 million gal/day) is guaranteed by adding raw water from the Clinch River to the headwaters of East Fork Poplar Creek; and
- whole effluent toxicity testing limitation for the three outfalls of East Fork Poplar Creek (see Sect. 4.5.8).

A notice of appeal of certain permit terms and limits for legacy constituents of mercury and PCBs was filed by NNSA in April 2006. The permit limits for toxicity at three outfalls were appealed because legacy contamination may adversely affect toxicity and their cleanup is addressed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Chlorine limits at the headwaters of the creek were also appealed, and a compliance schedule was requested so that a dechlorination unit could be put in place to handle a more stringent chlorine limit at outfall 109. The dechlorination unit has since been installed in accordance with the compliance schedule. Issues associated with the appeal were not resolved prior to expiration of the permit.

An application for renewal of the NPDES permit was completed in June 2008 and was submitted to TDEC on July 1, 2008. This work effort included special sampling needed to fully characterize effluents and to properly complete permit application forms. During 2010 permits for storm water associated with construction activity were in effect for three projects located in the Y-12 Complex. The projects are the Potable Water System (storage tanks and waterlines), the Steam Plant Life Extension, and The Bear Creek Road Bypass. Y-12 Environmental Compliance staff continue to keep TDEC apprised of site developments, and as of January 2011 TDEC had not yet issued a draft of the new permit.

The Industrial and Commercial User Wastewater Discharge Permit (1-91) was issued by the city of Oak Ridge to Y-12 on April 1, 2010. The permit, which expires on March 31, 2015, provides requirements for the discharge of wastewaters to the sanitary sewer system as well as prohibitions for certain types of wastewaters. There were 11 permit exceedances of the permit in 2010. Three were for exceeding the discharge limit (monthly average) for total recoverable phenols, two were for exceeding the discharge limit (daily maximum) for total recoverable phenols, one was for exceeding the discharge limit (monthly average) for total oil and grease, one was for exceeding the discharge limit (daily maximum) for oil and grease, and four were for exceeding the maximum daily allowable flow limit. During the year, the city of Oak Ridge conducted two inspections under the Industrial Pretreatment Program (February 8, 2010, and August 25, 2010). The city of Oak Ridge requested, and Y-12 has delivered, an action plan to address inflow/infiltration into the sanitary sewer system. Members of the Clean Water Program continued to work on surface water programs such as Storm Water Pollution Prevention, including storm water sampling and site inspections, BMAP, and development of best management practices plans for projects and site activities. Work continued on streamlining data management for compliance reporting, review, approval, and tracking of water discharges and connections to the storm and sanitary sewer systems.

### 4.3.5 Safe Drinking Water Act

The City of Oak Ridge supplies potable water to the Y-12 Complex that meets all federal, state, and local standards for drinking water. The water treatment plant, located north of the Y-12 Complex, is owned and operated by the city of Oak Ridge.

The Tennessee Regulations for Public Water Systems and Drinking Water Quality, Chap.1200-5-1, sets limits for biological contaminants and for chemical activities and chemical contaminants. Sampling for the following is conducted by the Y-12 Utilities Management Organization:

- Total coliform
- Chlorine residuals
- Lead
- Copper
- Disinfectant by-product
- Propylene glycol

In 2010, the Y-12 potable water system retained its approved status for potable water with the TDEC. A 3-year sanitary survey was conducted by the state of Tennessee during 2010. The score for the survey was 98 out of a possible 100. Y-12 continued sampling the potable water system for propylene glycol. TDEC instituted a requirement for sampling the site potable water system for propylene glycol in 2007 after learning that an unapproved cross connection exists between the Y-12 potable water system and the antifreeze fire sprinkler systems containing propylene glycol. All of the samples collected during 2010 resulted in laboratory results below the detection limits. There are future plans to eliminate these cross connections.

All total coliform samples collected during 2010 were analyzed by the state of Tennessee laboratory, and the results were negative. Analytical results for disinfectant by-products (total trihalomethanes and haloacetic acids) for the Y-12 water systems were below the TDEC and Safe Drinking Water Act (SDWA) limits. The Y-12 potable water system is currently sampled triennially for lead and copper, and the system sampling was last completed in August 2008. These results were below the TDEC and SDWA limits and met the established requirements.

Major improvements to the potable water system were performed during 2009–2010 including the following:

- Constructed two 7.5 million liters (2 million gal) elevated water tanks
- Replaced 702 m (2,300 ft) of potable water lines
- Cleaned and lined 645 m (2,115 ft) of potable water lines
- Excavated and inspected 317 m (1,040 ft) of existing potable water lines
- Installed 52 new backflow assemblies
- Isolated and converted 152 antifreeze loop fire sprinkler systems

### 4.3.6 The Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) regulates hazardous wastes that, if mismanaged, could present risks to human health or the environment. The regulations are designed to ensure that hazardous wastes are managed from the point of generation to final disposal. In Tennessee, EPA delegates the RCRA program to TDEC; EPA retains an oversight role. Y-12 is considered a "large-quantity generator" because it may generate more than 1,000 kg (2,205 lb) of hazardous waste in a month and because it has RCRA permits to store hazardous wastes for up to 1 year before shipping off site to licensed treatment and disposal facilities. Y-12 also has a number of satellite accumulation areas and 90-day waste storage areas.

Mixed wastes are materials that are both hazardous (under RCRA guidelines) and radioactive. The Federal Facilities Compliance Act (1992) requires that DOE work with local regulators to develop a site treatment plan to manage mixed waste. Development of the plan has two purposes: to identify available treatment technologies and disposal facilities (federal or commercial) that are able to manage mixed waste produced at federal facilities and to develop a schedule for treating and disposing of the waste streams.

The ORR Site Treatment Plan (TDEC 2010) is updated annually and submitted to TDEC for review. The last update was October 2010 and documents the current mixed-waste inventory and describes efforts undertaken to seek new commercial treatment and disposal outlets for various waste streams. NNSA has developed a disposition schedule for the mixed waste in storage and will continue to maintain and update the plan as a reporting mechanism, as progress is made. Y-12 is reducing inventory of legacy mixed waste as part of the plan (Fig. 4.18).

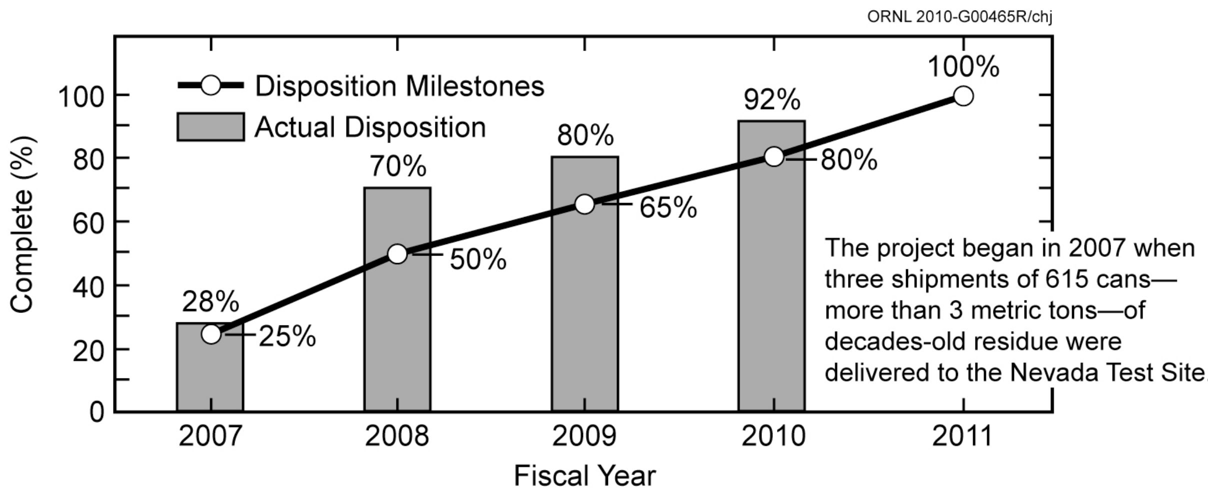


**Fig. 4.18. Reducing inventory of legacy mixed waste as part of the ORR Site Treatment Plan.**

The quantity of hazardous and mixed wastes generated by Y-12 decreased in 2010 (Fig. 4.19). The decrease was attributed to a reduction of contaminated groundwater treated this year, which directly correlates to 25 cm (10 in.) less rainfall in 2010 than in 2009. Waste resulting from repackaging and disposal of legacy mixed waste also increased. Legacy mixed wastes are being repackaged and disposed of in accordance with milestones in the ORR Site Treatment Plan. Progress on disposition of legacy mixed wastes exceeded established milestones for FY 2010. Ninety-five percent of the total hazardous and mixed waste generated in 2010 was generated as contaminated leachate from legacy operations. The Y-12 Complex currently reports waste on 105 active waste streams. Y-12 is a state-permitted treatment, storage, and disposal facility. Under its permits, Y-12 received 2,028 kg (4,472 lb) of hazardous and mixed waste from the off-site Union Valley analytical chemistry laboratory in 2010. In addition, 492,074 kg (1,085,023 lb) of hazardous and mixed waste was shipped to DOE-owned and commercial treatment, storage, and disposal facilities. More than 8 million kg (18 million lb) of hazardous and mixed wastewater was treated at on-site wastewater treatment facilities.

TDEC conducted a comprehensive inspection of Y-12’s hazardous waste program in November 2010, including permitted storage facilities, satellite accumulation areas, and 90-day accumulation areas. No violations were noted during the inspection.

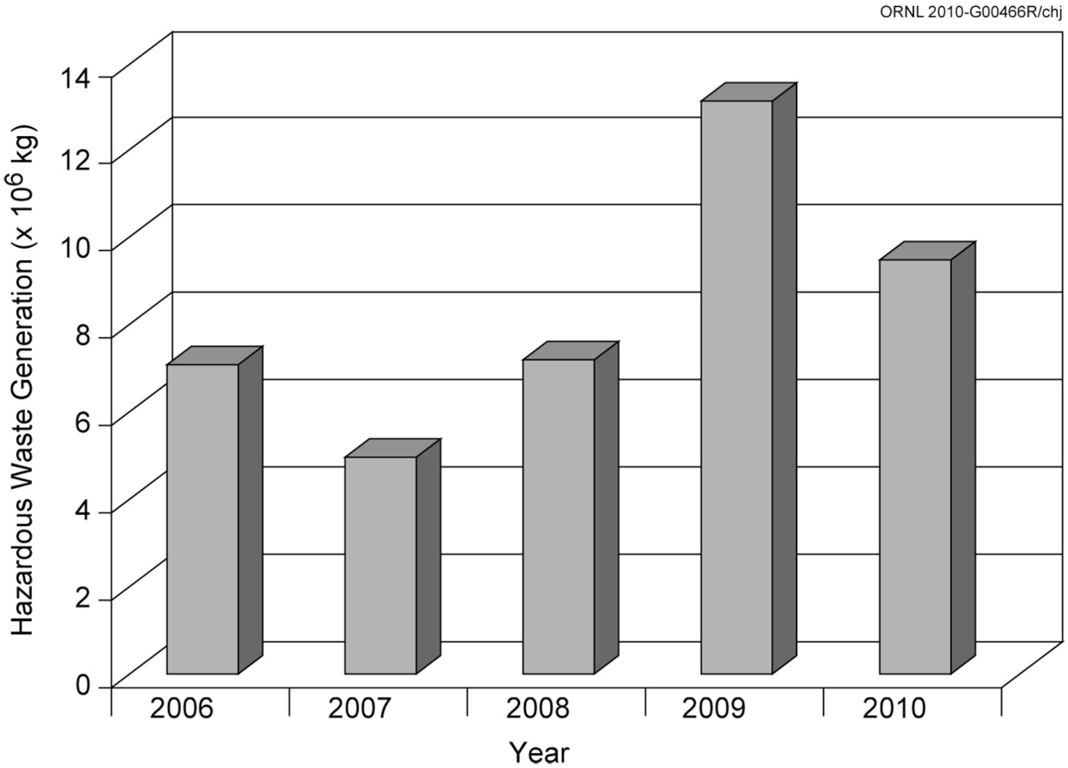


**Fig. 4.19. Hazardous waste generation, 2006–2010.**

### 4.3.6.1 RCRA Underground Storage Tanks

TDEC regulates the active petroleum underground storage tanks (USTs) at Y-12. Existing UST systems that are to remain in service at the Y-12 Complex must comply with performance requirements described in TDEC underground storage tank regulations (TN 1200-1-15). Three specific requirements are considered:

- release detection for both the tank and piping,
- corrosion protection for both the tank and piping, and
- spill/overfill prevention equipment.

The Y-12 UST Program includes two active petroleum USTs that meet all current regulatory compliance requirements. The UST registration fees for the tanks are current, enabling fuel delivery until March 31, 2012. All legacy petroleum UST sites at Y-12 have either been granted final closure by TDEC or have been deferred to the CERCLA process for further investigation and remediation. TDEC conducted a comprehensive inspection of Y-12's petroleum USTs in August 2009. No violations were found during that inspection.

### 4.3.6.2 RCRA Subtitle D Solid Waste

Located within the boundary of the Y-12 Complex are the Oak Ridge Reservation landfills operated by the DOE-EM (Office of Environmental Management) program. The facilities include two Class II operating industrial solid waste disposal landfills and one operating Class IV construction demolition landfill. The facilities are permitted by TDEC and accept solid waste from DOE operations on the ORR. In addition, one Class IV facility (Spoil Area 1) is overfilled by 8,945 $m^3$ (11,700 $yd^3$) and has been the subject of a CERCLA remedial investigation/feasibility study. A CERCLA Record of Decision (ROD) for Spoil Area 1 was signed in 1997. One Class II facility (Landfill II) has been closed and is subject to postclosure care and maintenance. Associated TDEC permit numbers are noted in Table 4.4.

Landfill V, a Class II landfill, is used for disposal of sanitary, industrial, construction, and demolition waste. Expansion of this landfill was initiated in April 2010 with ARRA funding. Expansion of the landfill will increase capacity by 294,354 $m^3$ (385,000 $yd^3$) to provide more capacity for the increased cleanup work on the Reservation. The expansion also includes upgrading and refurbishing support facilities.

### 4.3.7 RCRA/CERCLA Coordination

The ORR Federal Facility Agreement is intended to coordinate the corrective action processes of RCRA required under the Hazardous Waste Corrective Action permit (formerly known as the Hazardous and Solid Waste Amendments permit), with CERCLA response actions.

Three RCRA postclosure permits, one for each of the three hydrogeologic regimes at Y-12, have been issued to address the eight major closed waste disposal areas at Y-12. Because it falls under the jurisdiction of two postclosure permits, the S-3 Pond Site is described as having two parts, eastern and former S-3 (Table 4.5). Postclosure care and monitoring of the East Chestnut Ridge Waste Pile was incorporated into permit TNHW-128. Groundwater corrective actions required under the postclosure permits have been deferred to CERCLA. RCRA groundwater monitoring data were reported to TDEC and EPA in the Groundwater Monitoring Report for Y-12 (BJC 2011).

Periodic updates of proposed construction and demolition activities at the Y-12 Complex (including alternative financing projects) 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 that warrant CERCLA oversight. The goal is to ensure that modernization efforts do not impact the effectiveness of previously completed CERCLA environmental remedial actions and that they do not adversely impact future CERCLA environmental remedial actions.

### 4.3.8 Toxic Substances Control Act

The storage, handling, and use of PCBs are regulated under the Toxic Substances Control Act (TSCA). Capacitors manufactured before 1970 that are believed to be oil filled are handled as if they contain PCBs, even when that cannot be verified from the manufacturer's records. Certain equipment containing PCBs and PCB waste containers must be inventoried and labeled. The inventory is updated by July 1of each year. The 2010 (PCB) annual inventory was submitted June 16, 2010.

Given the widespread historical uses of PCBs at Y-12, along with fissionable material requirements that must be maintained, an agreement between EPA and DOE was negotiated to assist the ORR facilities in becoming compliant with TSCA regulations. This agreement, known as the Oak Ridge Reservation Polychlorinated Biphenyl Federal Facilities Compliance Agreement (ORR PCB FFCA), which became effective in 1996, provides a forum with which to address PCB compliance issues that are truly unique to these facilities. Y-12 operations involving TSCA-regulated materials were conducted in accordance with TSCA regulations and the ORR-PCB-FFCA.

**Table 4.5. RCRA postclosure status for former treatment, storage, and disposal units on the ORR**

| Unit | Major components of closure | Major postclosure requirements |
|---|---|---|
| **Upper East Fork Poplar Creek Hydrogeologic Regime (RCRA Postclosure Permit No. TNHW-113)** | | |
| New Hope Pond | Engineered cap, Upper East Fork Poplar Creek distribution channel | Cap inspection and maintenance. No current groundwater monitoring requirements in lieu of ongoing CERCLA actions in the eastern portion of Y-12 |
| Eastern S-3 Ponds Groundwater Plume | None for groundwater plume, see former S-3 Ponds (S-3 Site) for source area closure | Postclosure corrective action monitoring. Inspection and maintenance of monitoring network |
| **Chestnut Ridge Hydrogeologic Regime (RCRA Postclosure Permit No. TNHW-128)** | | |
| Chestnut Ridge Security Pits | Engineered cap | Cap inspection and maintenance. Postclosure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks |
| Kerr Hollow Quarry | Waste removal, access controls | Access controls inspection and maintenance. Postclosure detection monitoring. Inspection and maintenance of monitoring network and survey benchmarks |
| Chestnut Ridge Sediment Disposal Basin | Engineered cap | Cap inspection and maintenance. Postclosure detection monitoring. Inspection and maintenance of monitoring network and survey benchmarks |
| East Chestnut Ridge Waste Pile | Engineered cap | Cap inspection and maintenance. Postclosure detection monitoring. Inspection and maintenance of monitoring network, leachate collection sump and survey benchmarks. Management of leachate |
| **Bear Creek Hydrogeologic Regime (RCRA Postclosure Permit No. TNHW-116)** | | |
| Former S-3 Ponds (S-3 Site) | Neutralization and stabilization of wastes, engineered cap, asphalt cover | Cap inspection and maintenance. Postclosure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks |
| Oil Landfarm | Engineered cap | Cap inspection and maintenance. Postclosure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks |
| Bear Creek Burial Grounds A-North, A-South and C-West, and the Walk-In Pits | Engineered cap, leachate collection system specific to the burial grounds | Cap inspection and maintenance. Post-closure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks |

Abbreviations

RCRA Resource Conservation and Recovery Act

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

## 4.3.9 Preventing Spills and Reporting Spills/Releases

### 4.3.9.1 Preventing Oil Pollution and Spills

Y-12 maintains its *Spill Prevention, Control, and Countermeasures Plan* (SPCC Plan) to prevent spills of oil and hazardous constituents as well as the countermeasures to be invoked should a spill occur. A revision to the SPCC Plan was issued in 2010. This revision updated general Y-12 Complex spill prevention techniques and, in particular, reflected the addition of a fuel oil storage tank and dike system built and operated as part of the new Y-12 Complex Steam Plant.

In general, the first response of an individual discovering a spill is to call the plant shift superintendent. Spill response materials and equipment are stored near tanks and drum storage areas and other strategic areas of the Y-12 Complex to facilitate spill response. All Y-12 personnel and subcontractors are required to have initial spill and emergency response training before they can work on site. This training is received as part of the GET Program.

### 4.3.9.2 Emergency Reporting Requirements

The Emergency Planning and Community Right-to-Know Act (EPCRA) and Title III of the Superfund Amendments and Reauthorization Act (SARA) require that facilities report inventories (i.e., Tier II Report sent to the local emergency planning committees and the state emergency response commission) and releases (i.e., Toxic Release Inventory Report submitted to state and federal environmental agencies) of certain chemicals that exceed specific release thresholds. Y-12 complied with those requirements in 2010 through the submittal of reports under EPCRA Sections 302, 303, 311, 312, and 313. Y-12 had no releases of extremely hazardous substances as defined by EPCRA in 2010.

One Section 311 notification was made in 2010 because of the significant increase in the amount of one material in inventory. This material was not new to the reporting process, but the increased amount warranted notification to emergency responders. There were no newly identified hazardous or extremely hazardous chemicals over threshold during 2010. 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 Section 312 requirements. Y-12 reported 64 chemicals that were in inventory over threshold during the 2010 reporting year.

Each ORR facility evaluates its respective operations to determine applicability for submittal of annual toxic release inventory reports (Section 313) 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 these chemicals are evaluated to determine which chemicals exceeded the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations are made, releases and off-site transfers are calculated for each chemical that exceeded one or more of the thresholds.

Total 2010 reportable toxic releases to air, water, and land, and waste transferred off site for treatment, disposal, and recycling were 59,148 kg (130,399 lb). Table 4.6 lists the reported chemicals for the Y-12 Complex and summarizes releases and off-site transfers for those chemicals exceeding reporting thresholds.

**Table 4.6. Emergency Planning and Community Right-to-Know Act Section 313 toxic chemical release and off-site transfer summary for the Y-12 Complex, 2009 and 2010**

| Chemical | Year | Quantity[a] (lb)[b] |
|---|---|---|
| Chromium | 2009 | 6,106 |
| | 2010 | *c* |
| Cobalt | 2009 | *d* |
| | 2010 | *c* |
| Copper | 2009 | *c* |
| | 2010 | 4,265 |
| Lead Compounds | 2009 | 12,859 |
| | 2010 | 73,412 |
| Manganese | 2009 | *d* |
| | 2010 | *c* |
| Mercury Compounds | 2009 | 125 |
| | 2010 | 13 |
| Methanol | 2009 | 92,020 |
| | 2010 | 52709 |
| Nickel | 2009 | *c* |
| | 2010 | *c* |
| Nitric Acid | 2009 | 3,320 |
| | 2010 | *d* |
| Ozone | 2009 | *c* |
| | 2010 | *d* |
| Silver | 2009 | *d* |
| | 2010 | *c* |
| Sulfuric Acid | 2009 | 46,000 |
| | 2010 | *d* |
| Total | 2009 | 161,180 |
| | 2010 | 130,399 |

[a] Represents total releases to air, land, and water and includes off-site waste transfers. Also includes quantities released to the environment as a result of remedial actions, catastrophic events, or one-time events not associated with production processes.

[b] 1 lb = 0.45359237 kg.

[c] Not applicable because releases were less than 500 lb; hence, a Form A was submitted.

[d] Not reported for the year (i.e., below threshold).

### 4.3.9.3 Spills and Releases

Y-12 has procedures for notifying off-site authorities for categorized events at the Y-12 National Security Complex. Off-site notifications are required for specified events according to federal statutes, DOE orders, and the Tennessee Oversight Agreement. As an example, any observable oil sheen on East Fork Poplar Creek and any release impacting surface water must be reported to the EPA National Response Center in addition to other reporting requirements. Spills of CERCLA reportable quantity (RQ) limits must be reported to the EPA National Response Center, DOE, the Tennessee Emergency Management Agency, and the Anderson County Local Emergency Planning Committee.

There were no releases of hazardous substances exceeding an RQ. There was one release of waste water into upper East Fork Poplar Creek (see Sect. 4.3.9.4) that resulted in a fish kill.

#### 4.3.9.4 Environmental Occurrences

The Y-12 Occurrence Reporting program provides timely notification to the DOE Complex of Y-12 events and site conditions that could adversely affect the public or worker health and safety, the environment, national security, DOE's safeguards and security interests, functioning of DOE facilities, or the department's reputation.

Y-12 occurrences are categorized and reported through the Occurrence Reporting and Processing System (ORPS). ORPS provides NNSA and the DOE community with a readily accessible database of information about occurrences at DOE facilities, causes of those occurrences, and corrective actions to prevent recurrence of the events. DOE analyzes aggregate occurrence information for generic implications and operational improvements.

On August 29, 2010, approximately 300 gallons of lime slurry overflowed a neutralization process tank located at the Y-12 Steam Plant Wastewater Treatment Facility [Occurrence Report Number**:** NA--YSO-BWXT-Y12SITE-2010-0030]. A portion of the overflow entered the storm drain system and reached East Fork Poplar Creek (EFPC) at NPDES Outfall 200. Surveys of the stream inside Y-12 revealed 33 dead minnows in the area of Outfall 200. Many other live, active fish were also observed in the area. The condition was determined to be an isolated acute event, and no additional impact to fish in EFPC was observed. Water samples were taken and the relative pH (acid/base scale) measurements were 7.85, which are within the normal range of 6.0–9.0 (a pH of 7.0 is neutral).

#### 4.3.9.5 Mercury Removal from Storm Drain Catch Basins

In May 2003, metallic mercury was observed in two storm drain catch basins located in the west end of the Y-12 Complex. The storm drain line on which the catch basins are located flows into East Fork Poplar Creek at Outfall 200. Mercury tends to collect at those low spots in the drain system following heavy rains. During 2010, spill response and waste services personnel conducted two removals and recovered an estimated 2.6 kg (7.0 lb) of mercury. Approximately 32.6 kg (73 lb) have been recovered since 2003.

### 4.3.10 Audits and Oversight

A number of federal, state, and local agencies oversee Y-12 activities. In 2010, Y-12 was inspected by federal, state, or local regulators on five occasions. The TDEC Department of Energy Oversight Division maintained a part-time regulator on site who provided periodic oversight of Y-12 activities. Except for work completed under the Federal Facilities Agreement (FFA), TDEC DOE Oversight work is nonregulatory. This clarification is made to avoid any misunderstanding of TDEC DOE Oversight's role at Y-12. Most other matters such as CAA, CWA, and RCRA are regulated by TDEC's Knoxville Basin Office, not TDEC DOE Oversight. The Environmental Restoration Section at TDEC DOE-O handles CERCLA matters at Y-12. In addition to external audits and oversight, Y-12 has a comprehensive self-assessment program.

TDEC inspectors completed their annual compliance inspection of Y-12's hazardous waste management practices November 18. The five-member audit team inspected more than 40 RCRA-permitted storage and accumulation areas, examined RCRA annual reports, training records, spill control equipment, waste characterization records, hazardous waste manifests, and waste reduction reports. This is the third consecutive year that no noncompliance findings were identified. A summary of external regulatory audits and reviews for 2010 is provided in Table 4.7.

**Table 4.7. Summary of external regulatory audits and reviews, 2010**

| Date | Reviewer | Subject | Issues |
|---|---|---|---|
| February 8 | City of Oak Ridge | Semi-Annual Industrial Pretreatment Compliance Inspection | 0 |
| July 28–29 | TDEC | Annual Clean Air Compliance Inspection | 0 |
| August 25 | City of Oak Ridge | Semi-Annual Industrial Pretreatment Compliance Inspection | 0 |
| November 16–17 | TDEC | Clean Water Act Compliance Evaluation Inspection | 0 |
| November 16–18 | TDEC | Annual Resource Conservation and Recovery Act (RCRA) Inspections | 0 |

### 4.3.10.1 Enforcement Actions and Memos

There was no consent orders issued to Y-12 in 2010.

## 4.4 Air Quality Program

Permits issued by the state of Tennessee are the primary vehicle used to convey the clean air requirements that are applicable to the Y-12 Complex. New projects are governed by construction permits, and eventually, the requirements are incorporated into the site-wide Title V operating permit. Sections of the Title V permit contain requirements that are generally applicable to most industrial sites. Examples include requirements associated with asbestos controls, control of stratospheric ozone-depleting chemicals, and control of fugitive emissions as well as the general administration of the permit. The Title V permit also contains a section of specific requirements directly applicable to individual sources of air emissions at Y-12. Major requirements included in that section include the National Emission Standards for Hazardous Air Pollutants for Radionuclides (Rad NESHAP, 40 CFR 61) requirements and the numerous requirements associated with emissions of criteria pollutants and other hazardous air pollutants (nonradiological). In addition, a number of sources that are exempt from permitting requirements under state rules but subject to listing on Title V permit application are documented, and information about them is available upon request from the state.

Ambient air monitoring, while not specifically required by any permit condition, is conducted at Y-12 to satisfy DOE order requirements, as a best management practice and/or to provide evidence of sufficient programmatic control of certain emissions. Ambient air monitoring conducted specifically for Y-12 (i.e., mercury monitoring) is supplemented by additional monitoring conducted for the ORR and by both on-site and off-site monitoring conducted by TDEC. In addition, the overall effectiveness of the Clean Air Act compliance program is ensured by internal audits and external audits, such as the annual inspection conducted by state of Tennessee personnel.

### 4.4.1 Construction and Operating Permits

In 2010, Y-12 Complex had two construction air permits. One construction permit was for the replacement steam plant continued in 2010. The other construction permit was for operation of the machining beryllium and/or beryllium compounds.

The DOE/NNSA and Y-12 Title V permits, currently two permits with an outstanding request to combine them into one permit, include 32 air emission sources and more than 100 air emission points. All remaining emission sources are categorized as insignificant and exempt from permitting. The Tennessee Air Pollution Control Board issued a minor modification to the Title V Major Source Operating Permit 554701 on April 5, 2009. The minor modification was to align permit conditions with site transformation activities. Permit change requests still pending at the end of 2010 include

- a request to convert one construction permit to an operating permit;

- a request to combine permit 554594 (which only has one emission source) into the existing Y-12 site-wide permit;
- a request to add the new steam plant to the operating permit;
- a request to add Fuel Station Stage 1 emission control requirements to the permit;
- a request to change a condition in a construction permit to add beryllium to the process;
- a request to convert the machining operation for adding beryllium to an operating permit; and
- a request for an operational flexibility change for the metal working operation.

The Y-12 Complex major source (Title V) operating air permit renewal application was prepared and hand delivered to the TDEC personnel in April 2009. As part of the permit application renewal, it was requested that TDEC combine Air Permit 554594 into Air Permit 554701 followed by cancellation of Air Permit 554594. The complete permit application consists of four volumes. The complete, unedited application consists of Volumes 1, 2, 3.2, and 4.3. Volumes 3.1, 4.1, and 4.2, which are edited for classification reasons, were provided to the TDEC for their review and approval. Any classified information is held on site at the Y-12 National Security Complex for the appropriately Q-cleared TDEC personnel to review as needed. The Title V renewal operating air permit from the TDEC is still pending at end of 2010.

Permit administration fees in excess of $70,000 per year are paid to TDEC in support of the Title V program. Y-12 has chosen to pay the fees based on a combination of actual emissions [steam plant, methanol, solvent 140 volatile organic compound (VOC)] and allowable emissions (balance of plant). In years when a detailed air emission inventory is not required to be compiled for Y-12 operations, the emissions ledger compiled to support the annual fee payment is the most comprehensive presentation of total site emissions. In 2010, emissions categorized as actual emissions totaled 1,533,795 kg (1,690.72 tons), and emissions calculated by the allowable methodology totaled 647,884 kg (714.17 tons). The total emissions fee paid was $79,072.27.

Demonstrating compliance with the conditions of air permits is a significant effort at the Y-12 Complex. Key elements of maintaining compliance are maintenance and operation of control devices, monitoring, record-keeping, and reporting. High-efficiency particulate air (HEPA) filters, baghouses, and scrubbers are control devices used at the Y-12 Complex. HEPA filters are found throughout the complex, and in-place testing of HEPA filters to verify the integrity of the filters is routinely performed. Baghouses and scrubbers are operated and maintained in accordance with source-specific procedures. Monitoring consists of tasks such as continuous stack sampling, one-time stack sampling, and monitoring the operation of control devices. Examples of continuous stack sampling are the radiological stack monitoring systems on numerous sources throughout the complex, continuous $NO_x$ monitors and continuous opacity monitors on the old steam plant. Continuous $NO_x$ and opacity monitoring were ceased on April 30, 2010 when the old steam plant went off-line.

The Y-12 Complex site-wide permit requires quarterly and semiannual reports. In addition, two major annual reports are required. One report is the overall ORR radiological NESHAP report (CFR 2009a), which includes specific information regarding Y-12 Complex emissions; the second is an annual Title V compliance certification report indicating compliance status with all conditions of the permit. Reports were submitted quarterly and results are summarized in Table 4.8 and 4.9 (see Sect. 4.4.1.4).

### 4.4.1.1 Generally Applicable Permit Requirements

The Y-12 Complex, like many industrial sites, has a number of generally applicable requirements that require management and control. Asbestos, ozone-depleting substances, and fugitive particulate emissions are notable examples.

#### 4.4.1.1.1 Control of Asbestos

The Y-12 Complex has numerous buildings and equipment that contain asbestos-containing materials. The compliance program for management of removal and disposal of asbestos-containing materials includes demolition and renovation notifications to TDEC and inspections, monitoring, and prescribed work practices for abatement and disposal of asbestos materials. There was no reportable release of asbestos in 2010. There were seven notifications of asbestos demolition or renovation (NoDRs) submitted to TDEC in 2010: five for demolitions, two for renovations, and one record of oral regulatory communication. All have been completed.

#### 4.4.1.1.2 Stratospheric Ozone Protection

Y/TS-1880, *Y-12 Complex Ozone Depleting Substances (ODS) Phase-Out and Management Plan* (B&W Y-12 2009a), provides a complete discussion of requirements and compliance activities at the Y-12 Complex. ODS reductions are based on the DOE Order 450.1A (DOE 2008) objective to phase out as equipment reaches life expectance, equipment repairs are no longer cost-effective, or viable solvent replacements are identified. Past ODS reduction initiatives began in the early 1980s and focused on Class I ODS usage in refrigerants and solvent cleaning operations. Only one small chiller remains at the Y-12 Complex which contains Class I ODS. This system has a 181-kg (400-lb) charge of refrigerant and was manufactured in 1992. If it is determined to be economically practicable, this system will be retrofitted in accordance with the DOE 2010 implementation goal.

Y-12 Complex initiatives in support of the DOE objectives have also involved elimination of solvents in cleaning processes. Operations personnel developed and implemented changes in one process which reduced the amount of ODS solvent emissions by up to 8,891 kg (19,600 lb) each year. Evaluation of ODS reduction opportunities continue for another solvent cleaning operation. Future actions related to this process will be dependent on ongoing efforts to identify a safe and viable replacement chemical or to identify practical and cost-effective modifications to process equipment.

Any Class I and Class II substitutions are made in accordance with EPA's Significant New Alternatives Program (SNAP). Y-12 Complex personnel are notified as EPA issues regulations detailing SNAP replacement chemicals which may be applicable to plant operations. In order to prevent ODS from coming on-site, procurement documents are written to ensure that no additional equipment or processes using Class I ODS are brought onsite, and Class II ODS usage is limited wherever possible.

Infrastructure reduction activities also led to the reduction of ODS materials on site. All refrigerants and solvents must be removed from equipment prior to disposal. Recovered ODS are typically recycled/reused in other equipment in the Y-12 Complex. However, Class I ODS deemed excess must be transferred to Defense Logistics Agency as needed. Remaining ODS are offered to other DOE sites or government agencies, sold, or properly disposed if not useable.

#### 4.4.1.1.3 Fugitive Particulate Emissions

As Modernization and Infrastructure Reduction efforts increase at the Y-12 Complex, the need also increases for good work practices and controls to minimize fugitive dust emissions from construction and demolition activities. Y-12 Complex personnel continue to use a mature project planning process to review, recommend, and implement appropriate work practices and controls to minimize fugitive dust emissions.

### 4.4.1.2 Radiological National Emission Standard for Hazardous Air Pollutants

The release of radiological contaminants, primarily uranium, into the atmosphere at the Y-12 Complex occurs almost exclusively as a result of plant production, maintenance, and waste management activities. The major radionuclide emissions contributing to the dose from the Y-12 Complex are the nuclides $^{234}U$, $^{235}U$, $^{236}U$, and $^{238}U$, which are emitted as particulates. The particle size and solubility class of the emissions are determined based on review of the operations and processes served by the exhaust systems to determine the quantity of uranium handled in the operation or process, the physical form of the uranium, and the nature of the operation or process. The four categories of processes or operations that are considered in the total of uranium emissions are

- those that exhaust through monitored stacks,
- unmonitored processes for which calculations are performed per Appendix D of 40 CFR 61 (CFR 2009b),

- processes or operations exhausting through laboratory hoods also involving Appendix D calculations, and
- emissions from room ventilation exhausts using radiological control monitoring data from the work area.

Continuous sampling systems are used to monitor emissions from a number of process exhaust stacks at the Y-12 Complex. In addition, a probe-cleaning program is in place, and the results from the probe cleaning at each source are incorporated into the respective emission point source term. In 2010, 40 process exhaust stacks were continuously monitored, 34 of which were major sources; the remaining 6 were minor sources. The sampling systems on these stacks have been approved by EPA Region 4.

During 2010, unmonitored uranium emissions at the Y-12 Complex occurred from 37 emission points associated with on-site, unmonitored processes and laboratories operated by B&W Y-12. Emission estimates for the unmonitored process and laboratory stacks were made using inventory data with emission factors provided in 40 CFR Part 61, Appendix D (CFR 2009b). The Y-12 Complex source term includes an estimate of those unmonitored emissions.

The Analytical Chemistry Organization laboratory, operated by B&W Y-12, is located in a leased facility on Union Valley Road, approximately 0.3 miles east of the Y-12 Complex, and is not within the ORR boundary. In 2010 there were no emission points (or sources) in the laboratory facility.

Additionally, estimates from room ventilation systems are considered using radiological control data on airborne radioactivity concentrations in the work areas. Where applicable, exhausts from any area where the monthly concentration average exceeds 10% of the derived air concentration (DAC), as defined in the Compliance Plan (DOE 2005), are included in the annual source term. Annual average concentrations and design ventilation rates are used to arrive at the annual emission estimate for those areas. Five emission points from room ventilation exhausts were identified in 2010 where emissions exceeded 10% of the DAC. These emission points feed to monitored stacks, and any radionuclide emissions are accounted for as noted for monitored emission points.

The Y-12 Complex Title V Major Source Operating Permits contain a site-wide, streamlined alternate emission limit for enriched and depleted uranium process emission units. A limit of 907 kg (2,000 lb) per year of particulate was set for the sources for the purposes of paying fees. The compliance method defined for Permit 554701, Condition E3, and Permit 554594, Condition E4, requires the annual actual mass emission particulate emissions to be generated using the same monitoring methodologies required for Rad NESHAP compliance. An estimated 0.014 Ci (0.7 kg) of uranium was released into the atmosphere in 2010 as a result of Y-12 activities (Figs. 4.20 and 4.21).

The calculated radiation dose to the maximally exposed off-site individual from airborne radiological release points at Y-12 during 2010 was 0.2 mrem. This dose is well below the NESHAP standard of 10 mrem and is less than 0.07% of the 300 mrem that the average individual receives from natural sources of radiation. (See Sect. 7.1.2. for an explanation of how the airborne radionuclide dose was determined.)

#### 4.4.1.3 Quality Assurance

Quality assurance activities for the Rad NESHAP program are documented in *Y-12 National Security Complex Quality Assurance Project Plan for National Emission Standards for Hazardous Air Pollutants (NESHAP) for Radionuclide Emission Measurements* (Y-12 2010a). The plan satisfies the quality assurance (QA) requirements in 40 CFR Part 61, Method 114 (CFR 2007), for ensuring that the radionuclide air emission measurements from the Y-12 Complex are representative to known levels of precision and accuracy and that administrative controls are in place to ensure prompt response when emission measurements indicate an increase over normal radionuclide emissions. The requirements are also referenced in TDEC regulation 1200-3-11-.08. The plan ensures the quality of the Y-12 radionuclide emission measurements data from the continuous samplers, breakthrough monitors, and minor radionuclide release points. It specifies the procedures for the management of the activities affecting the quality of the data. The QA objectives for completeness, sensitivity, accuracy, and precision are discussed. Major programmatic elements addressed in the QA plan are the sampling and monitoring program, emission characterization, the analytical program, and minor source emission estimates.

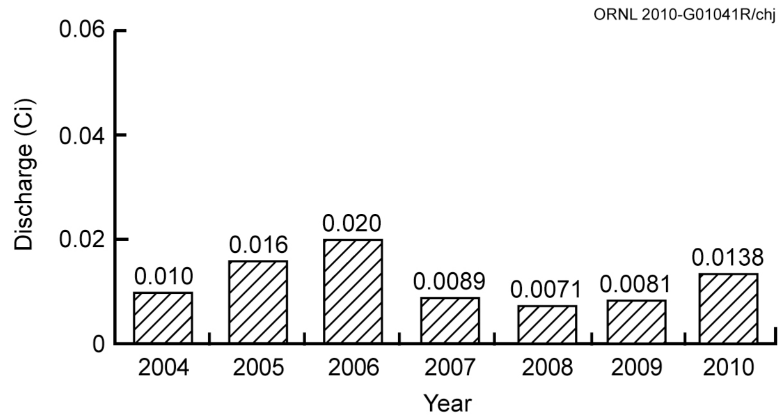


**Fig. 4.20. Total curies of uranium discharged from the Y-12 Complex to the atmosphere, 2004–2010.**

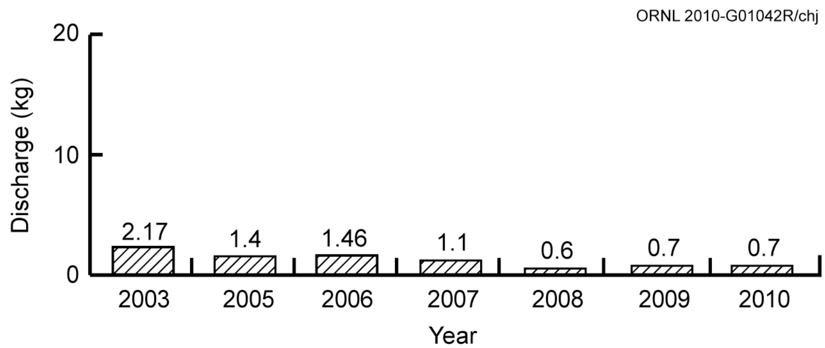


**Fig. 4.21. Total kilograms of uranium discharged from the Y-12 Complex to the atmosphere, 2004–2010.**

### 4.4.1.4 Source-Specific Criteria Pollutants

Proper maintenance and operation of a number of control devices (e.g., HEPA filters, baghouses, and scrubbers) are key to controlling emissions of criteria pollutants. The primary source of criteria pollutants at the Y-12 Complex is the steam plant, where coal and natural gas were burned in 2010. Information regarding actual vs. allowable emissions from the steam plant is provided in Tables 4.8 and 4.9. The Y-12 Title V operating air permit for the old Steam Plant required the opacity monitoring systems to be fully operational 95% of the operational time of the monitored units during each month of the calendar quarter. During 2010, the opacity monitoring systems were operational for more than 95% of the operational time of the monitored units during each month. During 2010, five 6-minute periods of excess emissions occurred. Quarterly reports of the status of the old Steam Plant opacity monitors were submitted to TDEC personnel.

Table 4.10 is a record of excess emissions and inoperative conditions for the east and west stack opacity monitors for 2010. Visible emission evaluations were also conducted at the steam plant semiannually to demonstrate compliance. The Y-12 Title V operating air permit also required continuous monitoring of $NO_x$ mass emissions during the ozone season (May 1 through September 30). Since the old steam plant did not operate during the ozone season in 2010, the cumulative $NO_x$ mass emissions measured from the steam plant was 0 kg (0 tons) of $NO_x$, the limit being 157,850 kg (174 tons), as shown in Fig. 4.22. Boiler 3 was shutdown, and its tonnage was removed from the total $NO_x$ limit for the steam plant.

Particulate emissions from point sources result from many operations throughout Y-12. Compliance demonstration is achieved via several activities, including monitoring the operations of control devices, limiting process input materials, and using certified readers to conduct stack-visible emission evaluations.

**Table 4.8. Actual vs. allowable air emissions from the Old Oak Ridge Y-12 Steam Plant, 2010**

| Pollutant | Emissions (tons/year)[a] | | Percentage of allowable |
|---|---|---|---|
| | Actual | Allowable | |
| Particulate | 6 | 945 | 0.6 |
| Sulfur dioxide | 337 | 20,803 | 1.6 |
| Nitrogen oxides[b] | 167 | 5,905 | 2.8 |
| Nitrogen oxides (ozone season only) | 0[c] | 174 | 0 |
| Volatile organic compounds[b] | 1.3 | 41 | 3.2 |
| Carbon monoxide[b] | 17 | 543 | 3.1 |

**NOTE:** The old steam plant boilers were permanently turned off on April 30, 2010. The emissions are based on fuel usage data for January through April 2010.

[a] 1 ton = 907.2 kg.

[b] When there is no applicable standard or enforceable permit condition for some pollutants, the allowable emissions are based on the maximum actual emissions calculation as defined in Tennessee Department of Environment and Conservation Rule 1200-3-26-.02(2)(d)3 (maximum design capacity for 8760 h/year). The emissions for both the actual and allowable emissions were calculated based on the latest EPA compilation of air pollutant emission factors. (EPA 1995 and 1998. *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume 1: Stationary Point and Area Sources*. Environmental Protection Agency, Research Triangle Park, N.C. January 1995 and September 1998.)

[c] The $NO_x$ monitors did not operate in 2010.

**Table 4.9. Actual vs. allowable air emissions from the New Oak Ridge Y-12 Steam Plant, 2010**

| Pollutant | Emissions (tons/year)[a] | | Percentage of allowable |
|---|---|---|---|
| | Actual | Allowable | |
| Particulate | 4 | 41 | 9.8 |
| Sulfur dioxide | 0.3 | 39 | 0.8 |
| Nitrogen oxides[b] | 14 | 81 | 17.3 |
| Nitrogen oxides (ozone season only) | 0[c] | 0 | 0 |
| Volatile organic compounds[b] | 2 | 9.4 | 21.3 |
| Carbon monoxide[b] | 28.5 | 139 | 20.5 |

**NOTE:** The emissions are based on fuel usage data for May through December 2010. The emissions also included the fuel used during testing.

[a] 1 ton = 907.2 kg.

[b] When there is no applicable standard or enforceable permit condition for some pollutants, the allowable emissions are based on the maximum actual emissions calculation as defined in Tennessee Department of Environment and Conservation Rule 1200-3-26-.02(2)(d)3 (maximum design capacity for 8760 h/year). The emissions for both the actual and allowable emissions were calculated based on the latest EPA compilation of air pollutant emission factors. (EPA 1995 and 1998. *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume 1: Stationary Point and Area Sources*. Environmental Protection Agency, Research Triangle Park, N.C. January 1995 and September 1998.)

[c] The new steam plant does not contain $NO_x$ monitors.

**Table 4.10. Periods of excess emissions and out-of-service conditions for old Y-12 Steam Plant east and west opacity monitors, 2010**

| Date | Stack | Condition | Comments |
|---|---|---|---|
| January 13 | East | Two 6-min periods of excess emissions | Due to torn filter bags in Compartment 7 of Baghouse 4. |
| January 18 | East | One 6-min period of excess emissions | Due to torn filter bags in Compartment 8 of Baghouse 4. |
| January 28 | West | One 6-min period of excess emissions | Due to start-up of the fans on Boiler 2. |
| February 27 | East | One 6-min period of excess emissions | Due to start-up of the fans on Boiler 4. |

**NOTE:** The old steam plant boilers were permanently turned off on April 30, 2010.

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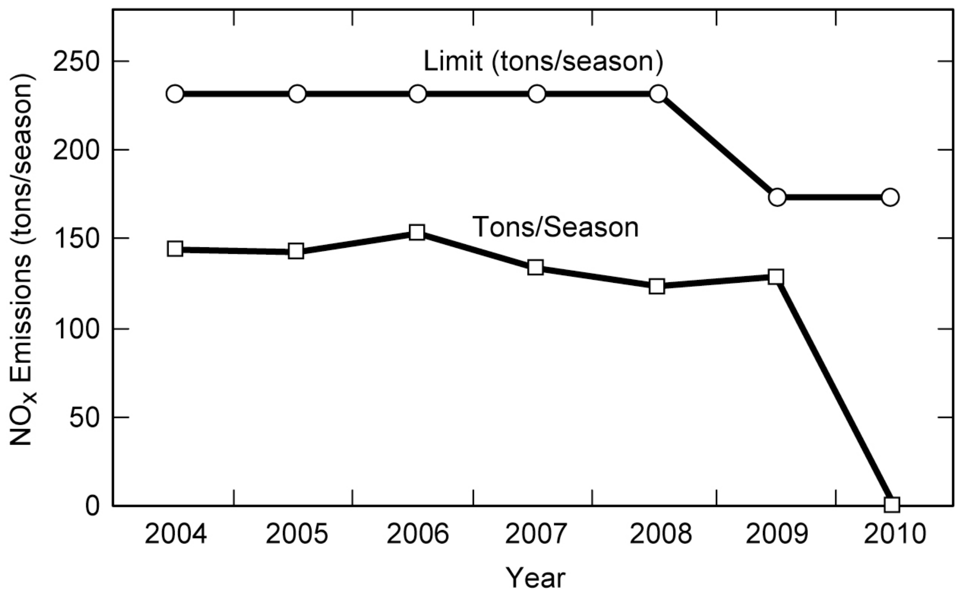


**Fig. 4.22. Y-12 Steam Plant $NO_x$ emissions per ozone season.**

Emissions of $SO_2$ were primarily from the combustion of coal at the old steam plant. Sulfur in coal is analyzed, and calculations are performed to ensure that emissions remain below permit limits.

Use of Solvent 140 and methanol throughout the complex along with use of acetonitrile at a single source are primary sources of VOC emissions. Material mass balances and engineering calculations are used to determine annual emissions.

The results of monitoring a number of process parameters along with stack-monitoring results are provided in reports to TDEC quarterly, semiannually, and annually. All monitored results, including stack-monitoring results, were provided in reports in 2010 and were in compliance with the Title V permit.

### 4.4.1.5 Quality Control

Calibration error tests of the opacity monitoring systems at the old steam plant were historically performed on a semiannual basis as required by the permit. Since the old steam plant was permanently shut down on April 30, 2010, no calibration error tests were required for the opacity monitors in 2010.

The $NO_x$ continuous emissions monitoring systems were operated in conformance with the requirements of 40 CFR 75 (CFR 2010). Requirements included a periodic relative accuracy test audit (RATA) for continuous nitrogen oxides emissions monitoring systems as part of the $NO_x$ Budget Trading Program. Since the $NO_x$ monitors did not operate during 2010 ozone season, a periodic RATA was not required.

#### 4.4.1.6 Hazardous Air Pollutants (Nonradiological)

Beryllium emissions from machine shops are regulated under a state-issued permit and are subject to a limit of 10 g per 24 h. Compliance is demonstrated through a one-time stack test and through monitoring of control device operations. Hydrogen fluoride is used at one emission source, and emissions are controlled through the use of scrubber systems. The beryllium control devices and the scrubber systems were monitored during 2010 and found to be operating properly.

Methanol is released as fugitive emissions (e.g., pump and valve leaks) as part of the brine/methanol system. Methanol is subject to state air permit requirements; however, due to the nature of its release (fugitive emissions only), there are no specific emission limits or mandated controls. Mercury is a significant legacy contaminant at the Y-12 Complex, and cleanup is being addressed under the environmental remediation program. Like methanol emissions, mercury air emissions from legacy sources are fugitive in nature and therefore are not subject to specific air emission limits or controls. On-site monitoring of mercury is conducted and is discussed under Sect. 4.4.2, Ambient Air.

The old Y-12 Steam Plant emissions, due to the combustion of coal, contained hazardous air pollutants such as mercury, hydrogen chloride, and other metals and gaseous hazardous air pollutants. In 2007 the EPA vacated a proposed MACT, which was intended to minimize hazardous air pollution emissions. The old Y-12 Steam Plant would have become subject to certain elements of the new rule effective in 2007 had the rule not been vacated. The new natural-gas-fired steam plant came on-line on April 20, 2010, and coal is no longer combusted, prior to the rule becoming effective in 2011. In 2007, a case-by-case MACT review was conducted as part of the construction permitting process for the Y-12 replacement steam plant. Specific conditions aimed at minimizing hazardous air pollutant emission from the new steam plant will be incorporated into the operating permit for the new source.

Unplanned releases of hazardous air pollutants are regulated through the Risk Management Planning regulations. Y-12 Complex personnel have determined that there are no processes or facilities containing inventories of chemicals in quantities exceeding thresholds specified in rules pursuant to Clean Air Act, Title III, Sect.112(r), “Prevention of Accidental Releases.” Therefore, the Y-12 Complex is not subject to that rule. Procedures are in place to continually review new processes and/or process changes against the rule thresholds.

### 4.4.2 Ambient Air

To understand the complete picture of ambient air monitoring in and around the Y-12 Complex, data from monitoring conducted on and off site specifically for Y-12, DOE reservation-wide monitoring, and on-site and off-site monitoring conducted by TDEC personnel must be considered. There are no federal regulations, state regulations, or DOE orders that require ambient air monitoring within the Y-12 Complex boundary; however, on-site ambient air monitoring for mercury and radionuclides is conducted as a best management practice. With the reduction of plant operations and improved emission and administrative controls, levels of measured pollutants have decreased significantly during the past several years. In addition, major processes that result in emission of enriched and depleted uranium are equipped with stack samplers that have been reviewed and approved by EPA to meet requirements of the NESHAP regulations.

#### 4.4.2.1 Mercury

The Y-12 Complex ambient air monitoring program for mercury was established in 1986 as a best management practice. The objectives of the program have been to maintain a database of mercury concentrations in ambient air, to track long-term spatial and temporal trends in ambient mercury vapor, and to demonstrate protection of the environment and human health from releases of mercury to the atmosphere at Y-12. Originally, four monitoring stations were operated at Y-12, including two within the former mercury-use area near the west end of Y-12. The two atmospheric mercury monitoring stations currently operating at Y-12, Ambient Air Station No. 2 (AAS2) and Ambient Air Station No. 8 (AAS8), are located near the east and west boundaries of Y-12, respectively (Fig. 4.23). Since their establishment in 1986, AAS2 and AAS8 have monitored mercury in ambient air continuously with the exception of short intervals of downtime because of electrical or equipment outages. In addition to the monitoring stations located at Y-12, a control or reference site (Rain Gauge No. 2) was operated on Chestnut Ridge in the Walker Branch Watershed for a 20-month period in 1988 and 1989 to establish a reference concentration.

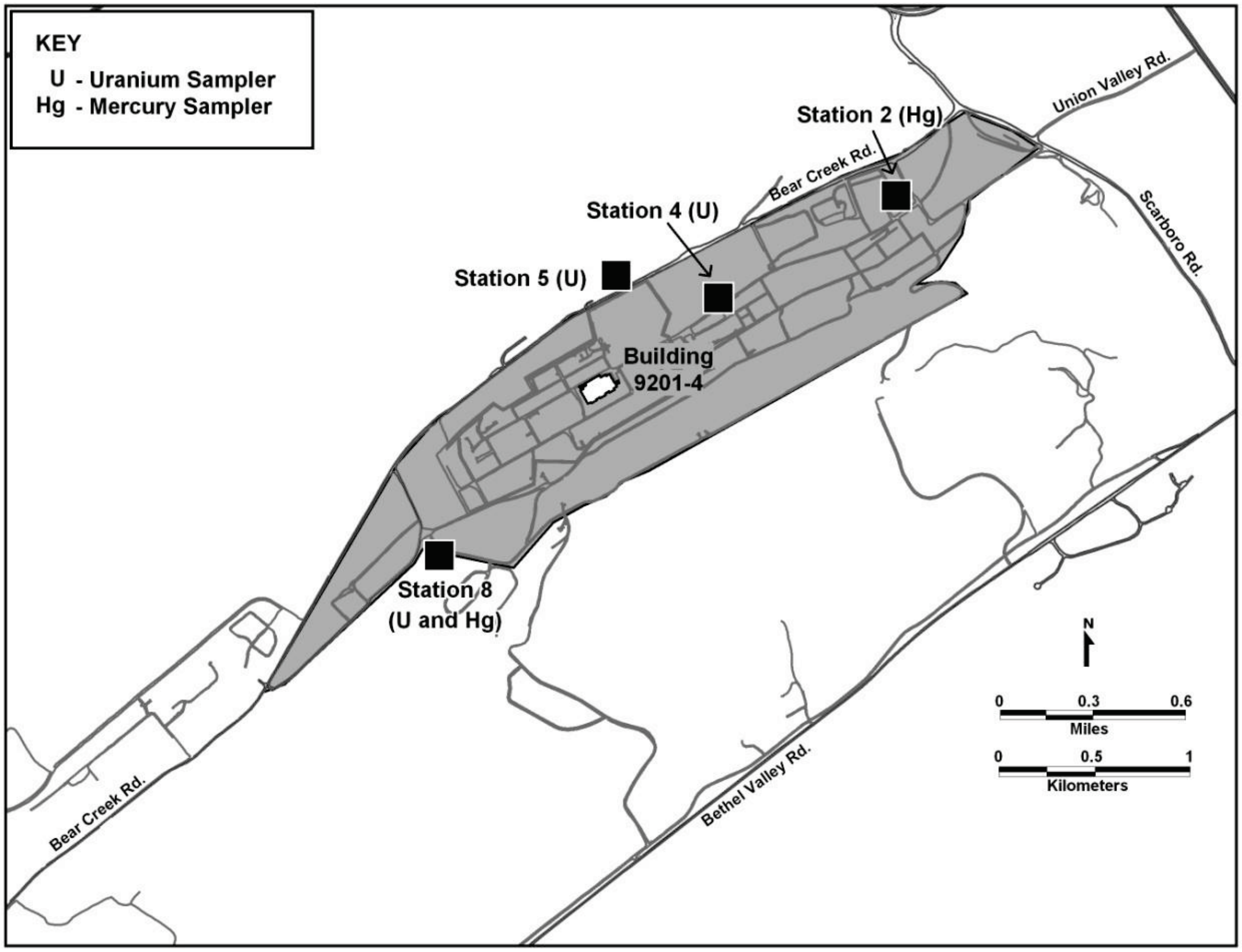


**Fig. 4.23. Locations of ambient air monitoring stations at the Y-12 Complex.**

In order to determine mercury concentrations in ambient air, airborne mercury vapor is collected by pulling ambient air through a sampling train consisting of a Teflon filter and an iodated-charcoal sampling trap. A flow-limiting orifice upstream of the sampling trap restricts airflow through the sampling train to ~1 L/min. Actual flows are measured weekly with a calibrated Gilmont flowmeter in conjunction with the weekly change-out of the sampling trap. The charcoal in each trap is analyzed for total mercury using cold vapor atomic fluorescence spectrometry after acid digestion. The average concentration of mercury vapor in ambient air for each 7-day sampling period is calculated by dividing the total mercury per trap by the volume of air pulled through the charcoal trap during the corresponding sampling period.

As reported previously, the average mercury concentration at the ambient air monitoring sites has declined significantly since the late 1980s. Recent average annual concentrations at the two boundary stations are comparable to concentrations measured in 1988 and 1989 at the Chestnut Ridge reference site (Table 4.11). The average mercury concentration at the AAS2 site for 2010 was 0.0035 $\mu g/m^3$ (N = 49),

**Table 4.11. Summary of data for the Oak Ridge Y-12 National Security Complex ambient air monitoring program for mercury for CY2010.** The averages for 1986 through 1988, a period of elevated mercury concentration, are also shown for comparison

| Ambient air monitoring stations | Mercury vapor concentration (µg/m$^3$) | | | |
|---|---|---|---|---|
| | 2010 Minimum | 2010 Maximum | 2010 Average | 1986–1988[a] Average |
| AAS2 (east end of the Y-12 Complex) | 0.0007 | 0.012 | 0.0035 | 0.010 |
| AAS8 (west end of the Y-12 Complex) | 0.0011 | 0.013 | 0.0050 | 0.033 |
| Reference Site, Rain Gauge No.2 (1988[b]) | N/A | N/A | N/A | 0.006 |
| Reference Site, Rain Gauge No.2 (1989[c]) | N/A | N/A | N/A | 0.005 |

[a]Period in late-80s with elevated ambient air mercury levels.
[b]Data for period from February 9 through December 31, 1988.
[c]Data for period from January 1 through October 31, 1989.

comparable to averages measured since 2003 though higher than reported for 2009 (i.e., 0.0030 µg/m$^3$). After noting a gradual increase in average annual concentration at AAS8 for the period 2005 through 2007 (thought to be perhaps due to increased excavation and decontamination and decommissioning work on the west end during this period), the average concentration at AAS8 for 2010 was 0.0050 µg/m$^3$ (N = 49) or similar to levels recorded in 2008 and the early 2000s.

Table 4.11 summarizes the 2010 mercury results and results from the 1986 through 1988 period for comparison. Figure 4.24 illustrates temporal trends in mercury concentration for the two active mercury monitoring sites since the inception of the program in 1986 through 2010 (plots 1, 2) and seasonal trends at AAS8 from 1993 through 2010 (plot 3). The dashed line superimposed on plots 1 and 2 is the EPA reference concentration (RfC) of 0.3 µg/m$^3$ for chronic inhalation exposure. The large increase in Hg concentration at AAS8 observed in the late 1980s (plot 2) was thought to be related to disturbances of Hg-contaminated soils and sediments during the Perimeter Intrusion Detection Assessment System and utility restoration projects under way then in West End Mercury Area. In plot 3, a monthly moving average has been superimposed over the AAS8 data to highlight seasonal trends in mercury at AAS8 from January 1993 through 2010.

In conclusion, 2010 average mercury concentrations at the two mercury monitoring sites are comparable to reference levels measured for the Chestnut Ridge reference site in 1988 and 1989. Measured concentrations continue to be well below current environmental and occupational health standards for inhalation exposure to mercury vapor, that is, the National Institute for Occupational Safety and Health recommended exposure limit of 50 µg/m$^3$ (time-weighted average or TWA for up to a 10-h workday, 40-h workweek), the American Conference of Governmental Industrial Hygienists workplace threshold limit value of 25 µg/m$^3$ as a TWA for a normal 8-h workday and 40-h workweek, and the current EPA reference concentration (RfC = 0.3 µg/m$^3$) for elemental mercury for daily inhalation exposure without appreciable risk of harmful effects during a lifetime.

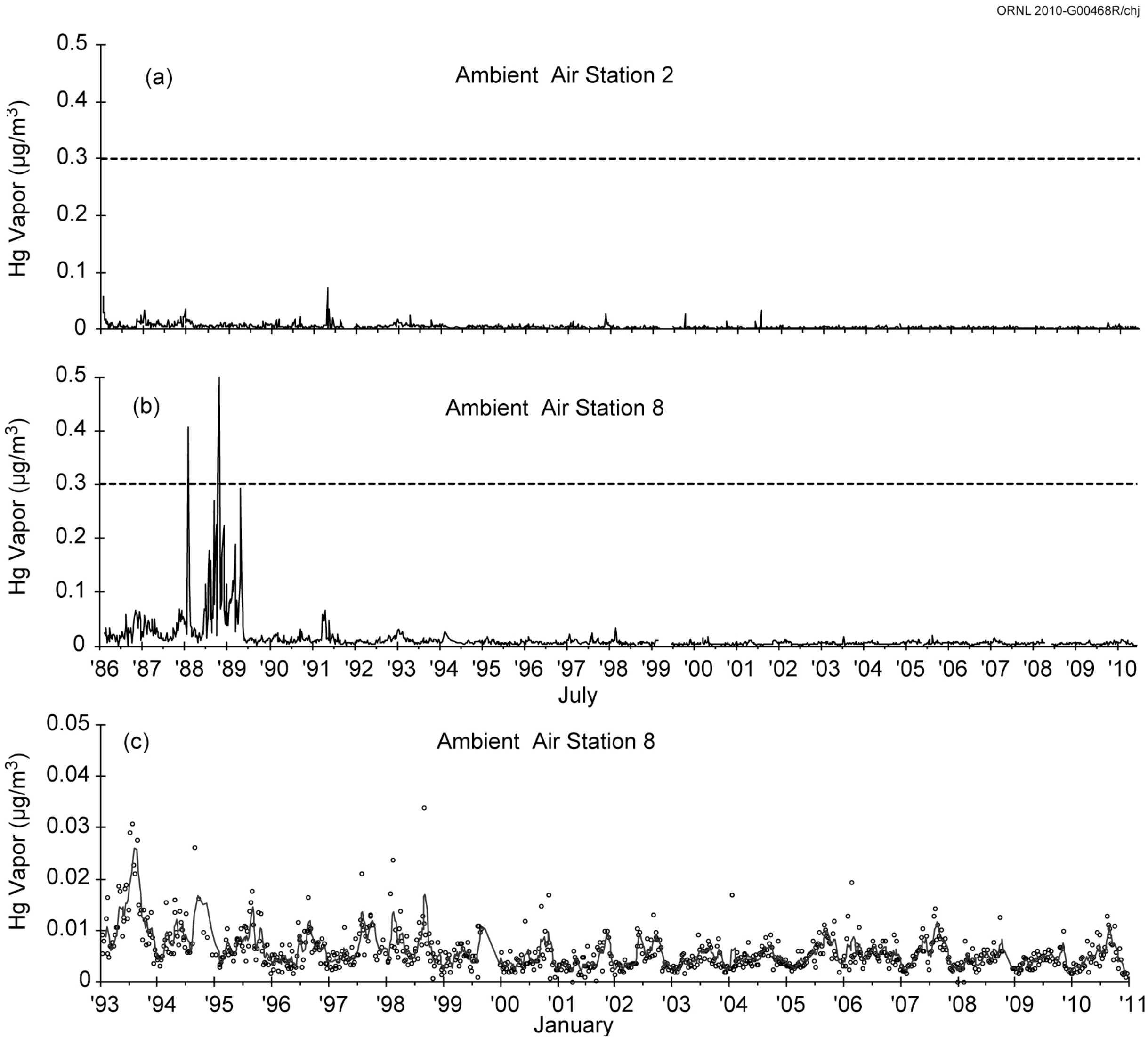


**Fig. 4.24. Temporal trends in mercury vapor concentration for the boundary monitoring stations at the Y-12 National Security Complex, July 1986 to January 2011 (plots 1 and 2) and January 1993 to January 2011 for AAS8 (plot 3).**

## 4.4.2.2 Quality Control

A number of QA/QC steps are taken to ensure the quality of the data for the Y-12 mercury in ambient air monitoring program.

An hour meter records the actual operating hours between sample changes. This allows for correction of total flow in the event of power outages during the weekly sampling interval.

The Gilmont correlated flowmeter used for measuring flows through the sampling train is purchased new each year or, if not new, is shipped back to the manufacturer annually for calibration traceable to the National Institute of Standards and Technology.

A minimum of 5% of the samples in each batch submitted to the analytical laboratory are blank samples. The blank sample traps are submitted “blind” to verify trap blank values and to serve as a field blank for diffusion of mercury vapor into used sample traps during storage prior to analysis.

In order to verify the absence of mercury breakthrough, 5 to 10% of the field samples have the front (upstream) and back segments of the charcoal sample trap analyzed separately. The absence of mercury above blank values on the back segment confirms the absence of breakthrough.

Chain-of-custody forms track the transfer of sample traps from the field technicians all the way to the analytical laboratory.

A field performance evaluation is conducted annually by the project manager to ensure that proper procedures are followed by the sampling technicians. No issues were identified in the last evaluation conducted March 25, 2009.

Analytical QA/QC requirements include

- use of prescreened and/or laboratory purified reagents,
- analysis of at least two method blanks per batch,
- analysis of standard reference materials,
- analysis of laboratory duplicates (one per 10 samples; any laboratory duplicates differing by more than 10% at five or more times the detection limit are to be rerun [third duplicate] to resolve the discrepancy), and
- archival of all primary laboratory records for at least 1 year.

#### 4.4.2.3 Ambient Air Monitoring Complementary to the Y-12 Ambient Air Monitoring

Ambient air monitoring is conducted at multiple locations near the ORR to measure radiological and other selected parameters directly in the ambient air. These monitors are operated in accordance with DOE orders. Their locations were selected so that areas of potentially high exposure to the public are monitored continuously for parameters of concern. This monitoring provides direct measurement of airborne concentrations of radionuclides and other hazardous air pollutants, allows facility personnel to determine the relative level of contaminants at the monitoring locations during an emergency, verifies that the contributions of fugitive and diffuse sources are insignificant, and serves as a check on dose-modeling calculations. As part of the ORR network, an ambient air monitoring station located in the Scarboro Community of Oak Ridge (Station 46) measures off-site impacts of the Y-12 operations. This station is located near the theoretical area of maximum public pollutant concentrations as calculated by air-quality modeling. ORR network stations are also located at the east end of the Y-12 Complex (Station 40) and just south of the Country Club Estates neighborhood (Station 37).

The state of Tennessee is primarily responsible for ambient air monitoring to characterize the region in general and to characterize and monitor DOE operations specifically. This is accomplished in numerous ways. Specific to Y-12 operations, there are three uranium ambient air monitors within the Y-12 Complex boundary that, since 1999, have been utilized by TDEC personnel in their environmental monitoring program. Each of the monitors uses 47-mm borosilicate glass-fiber filters to collect particulates as air is pulled through the units. The monitors control airflow with a pump and rotometer set to average approximately 2 standard cubic feet per minute.

In addition, TDEC DOE Oversight Division air quality monitoring includes several other types of monitoring on the ORR, for example,

- RADNet air monitoring,
- fugitive radioactive air emission monitoring,
- ambient VOC air monitoring,
- perimeter air monitoring,
- real-time monitoring of gamma radiation,
- ambient gamma radiation monitoring using external dosimetry, and
- program-specific monitoring associated with infrastructure-reduction activities.

Results of these activities are summarized in annual status reports, which are issued by the TDEC DOE Oversight Division.

The state of Tennessee also operates a number of regional monitors to assess ambient concentrations of criteria pollutants such as sulfur dioxide, particulate (various forms), and ozone, for comparison against ambient standards. The results are summarized and available through EPA and state reporting mechanisms.

## 4.5 Water Quality Program

### 4.5.1 NPDES Permit and Compliance Monitoring

The current Y-12 NPDES permit (TN0002968) requires sampling, analysis, and reporting for approximately 65 outfalls. Major outfalls are noted in Fig. 4.25. The number is subject to change as outfalls are eliminated or consolidated or if permitted discharges are added. Currently, the Y-12 Complex has outfalls and monitoring points in the following water drainage areas: East Fork Poplar Creek, Bear Creek, and several tributaries on the south side of Chestnut Ridge, all of which eventually drain to the Clinch River.

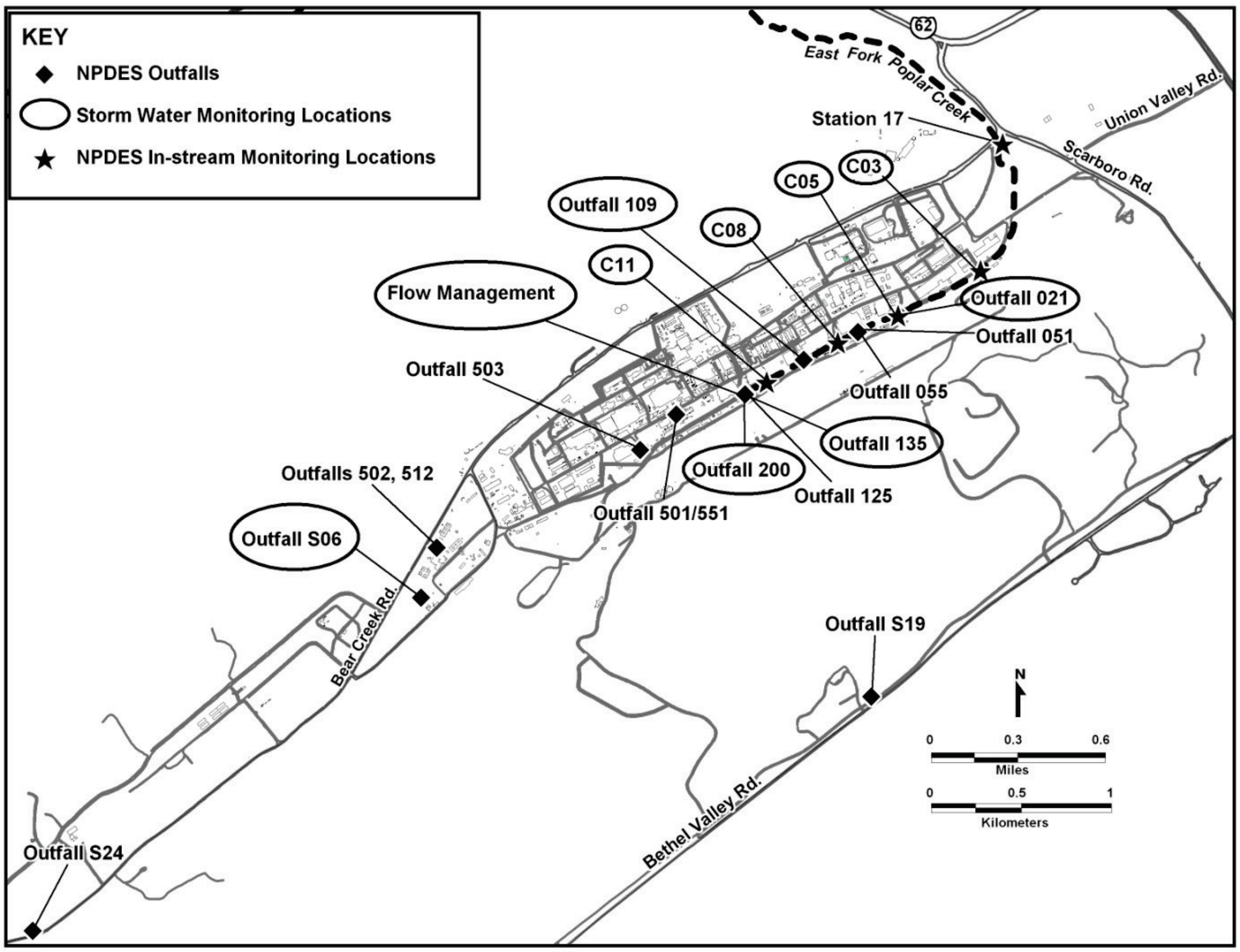


**Fig. 4.25. Major Y-12 Complex National Pollutant Discharge Elimination System (NPDES) outfalls and storm water monitoring locations.**

Discharges to surface water allowed under the permit include storm drainage, cooling water, cooling tower blowdown, steam condensate, and treated process wastewaters, including effluents from wastewater treatment facilities. Groundwater inflow into sumps in building basements and infiltration to the storm drain system are also permitted for discharge to the creek. The monitoring data collected by the sampling and analysis of permitted discharges are compared with NPDES limits where applicable for each parameter. Some parameters, defined as "monitor only," have no specified limits.

The water quality of surface streams in the vicinity of the Y-12 Complex is affected by current and legacy operations. Discharges from the Y-12 Complex processes flow into East Fork Poplar Creek before the water exits the Y-12 Complex. East Fork Poplar Creek eventually flows through the city of Oak Ridge to Poplar Creek and into the Clinch River. Bear Creek water quality is affected by area source runoff and groundwater discharges. The NPDES permit requires regular monitoring and storm water characterization in Bear Creek and several of its tributaries.

Requirements of the NPDES permit for 2010 were satisfied, and monitoring of outfalls and instream locations indicated excellent compliance. Data obtained as part of the NPDES program are provided in a monthly report to the TDEC. The percentage of compliance with permit requirements for 2010 was >99.9%. The only 2010 NPDES permit limit excursion occurred when the measured cadmium value at Outfall 200, 0.00118 mg/L, exceeded the permit limit of 0.001 mg/L on December 8, 2010. At the time of the reading, there were no observed adverse effects on the receiving stream. An accidental discharge of 300 gallons of lime slurry which overflowed a process tank at the Steam Plant Wastewater Treatment Facility on August 29, 2010, resulted in a second NPDES noncompliance. A portion of the discharge reached East Fork Polar Creek through Outfall 200. Thirty-three dead minnows were found in the upper portion of the creek following this incident.

Dechlorination treatment in the upper reach of EFPC provided excellent control of chlorinated discharges, and toxicity testing results of three outfalls in the upper reach have shown no toxicity. Table 4.12 lists the NPDES compliance monitoring requirements and the 2010 compliance record.

### 4.5.2 Radiological Monitoring Plan and Results

A radiological monitoring plan is in place at the Y-12 Complex to address compliance with DOE orders and NPDES Permit TN002968. The permit requires the Y-12 Complex to submit results from the radiological monitoring plan quarterly as an addendum to the NPDES discharge monitoring report. There were no discharge limits set by the NPDES permit for radionuclides; the requirement is to monitor and report. The radiological monitoring plan was developed based on an analysis of operational history, expected chemical and physical relationships, and historical monitoring results. Under the existing plan, effluent monitoring is conducted at three types of locations: (1) treatment facilities, (2) other point-source and area-source discharges, and (3) instream locations. Operational history and past monitoring results provide a basis for parameters routinely monitored under the plan (Table 4.13). The current *Radiological Monitoring Plan for Y-12 Complex* (B&W Y-12 2010b) was last revised and reissued in June 2010.

Radiological monitoring during storm water events is accomplished as part of the storm water monitoring program. Uranium is monitored at three major East Fork Poplar Creek storm water outfalls, four instream monitoring locations as well as raw water flow, and at an instream outfall on Bear Creek. Results of storm event monitoring during 2010 were reported in *Annual Storm Water Report for the Y-12 National Security Complex, Oak Ridge, Tennessee* (B&W Y-12 2011), which was issued in January 2011. In addition, the monthly 7-day composite sample for radiological parameters taken at Station 17 on East Fork Poplar Creek likely includes rain events.

Radiological monitoring plan locations sampled in 2010 are noted in Fig. 4.26. Table 4.14 identifies the monitored locations, the frequency of monitoring, and the sum of the percentages of the derived concentration guidelines (DCGs) for radionuclides measured in 2010. Radiological data were well below the allowable DCGs.

**Table 4.12. NPDES compliance monitoring requirements and record for the Y-12 Complex, January through December 2010**

| Discharge point | Effluent parameter | Daily avg (lb/d) | Daily max (lb/d) | Daily avg (mg/L) | Daily max (mg/L) | Percentage of compliance | Number of samples |
|---|---|---|---|---|---|---|---|
| Outfall 501 (Central Pollution Control) | pH, standard units | | | *a* | 9.0 | *b* | 0 |
| | Total suspended solids | | | 31.0 | 40.0 | *b* | 0 |
| | Total toxic organic | | | | 2.13 | *b* | 0 |
| | Hexane extractables | | | 10 | 15 | *b* | 0 |
| | Cadmium | 0.16 | 0.4 | 0.075 | 0.15 | *b* | 0 |
| | Chromium | 1.0 | 1.7 | 0.5 | 1.0 | *b* | 0 |
| | Copper | 1.2 | 2.0 | 0.5 | 1.0 | *b* | 0 |
| | Lead | 0.26 | 0.4 | 0.1 | 0.2 | *b* | 0 |
| | Nickel | 1.4 | 2.4 | 2.38 | 3.98 | *b* | 0 |
| | Nitrate/Nitrite | | | | 100 | *b* | 0 |
| | Silver | 0.14 | 0.26 | 0.05 | 0.05 | *b* | 0 |
| | Zinc | 0.9 | 1.6 | 1.48 | 2.0 | *b* | 0 |
| | Cyanide | 0.4 | 0.72 | 0.65 | 1.20 | *b* | 0 |
| | PCB | | | | 0.001 | *b* | 0 |
| Outfall 502 (West End Treatment Facility) | pH, standard units | | | *a* | 9.0 | 100 | 6 |
| | Total suspended solids | 19 | 36.0 | 31.0 | 40.0 | 100 | 6 |
| | Total toxic organic | | | | 2.13 | 100 | 1 |
| | Hexane extractables | | | 10 | 15 | 100 | 6 |
| | Cadmium | 0.16 | 0.4 | 0.075 | 0.15 | 100 | 6 |
| | Chromium | 1.0 | 1.7 | 0.5 | 1.0 | 100 | 6 |
| | Copper | 1.2 | 2.0 | 0.5 | 1.0 | 100 | 6 |
| | Lead | 0.26 | 0.4 | 0.10 | 0.20 | 100 | 6 |
| | Nickel | 1.4 | 2.4 | 2.38 | 3.98 | 100 | 6 |
| | Nitrate/Nitrite | | | | 100 | 100 | 6 |
| | Silver | 0.14 | 0.26 | 0.05 | 0.05 | 100 | 6 |
| | Zinc | 0.9 | 1.6 | 1.48 | 2.0 | 100 | 6 |
| | Cyanide | 0.4 | 0.72 | 0.65 | 1.20 | 100 | 6 |
| | PCB | | | | 0.001 | 100 | 3 |
| Outfall 503 (West End Treatment Facility) | pH, standard units | | | *a* | 9.0 | *b* | 0 |
| | Total suspended solids | 125 | 417 | 30.0 | 40.0 | *b* | 0 |
| | Hexane extractables | 63 | 83.4 | 10 | 15 | *b* | 0 |
| | Iron | 20.8 | 20.8 | 5.0 | 5.0 | *b* | 0 |
| | Cadmium | 0.16 | | 0.075 | 0.15 | *b* | 0 |
| | Chromium | 0.8 | 0.8 | 0.20 | 0.20 | *b* | 0 |
| | Copper | 4.17 | 4.17 | 0.20 | 0.40 | *b* | 0 |
| | Lead | | | 0.10 | 0.20 | *b* | 0 |
| | Zinc | 4.17 | 4.17 | 1.0 | 1.0 | *b* | 0 |

**Table 4.12 (continued)**

| Discharge point | Effluent parameter | Daily avg (lb/d) | Daily max (lb/d) | Daily avg (mg/L) | Daily max (mg/L) | Percentage of compliance | Number of samples |
|---|---|---|---|---|---|---|---|
| Outfall 512 (Groundwater Treatment Facility) | pH, standard units | | | *a* | 9.0 | 100 | 12 |
| | PCB | | | | 0.001 | 100 | 4 |
| Outfall 520 | pH, standard units | | | *a* | 9.0 | 100 | 19 |
| Outfall 200 (North/South pipes) | pH, standard units | | | *a* | 9.0 | 100 | 54 |
| | Hexane extractables | | | 10 | 15 | 100 | 53 |
| | Cadmium | | | 0.001 | 0.025 | 92 | 12 |
| | Lead | | | 0.041 | 1.190 | 100 | 12 |
| | PCB | | | 0.002 | 0.002 | 100 | 4 |
| Outfall 550 | pH, standard units | | | *a* | 9.0 | *b* | 0 |
| | Mercury | | | 0.002 | 0.004 | *b* | 0 |
| Outfall 551 | pH, standard units | | | *a* | 9.0 | 100 | 52 |
| | Mercury | | | 0.002 | 0.004 | 100 | 52 |
| Outfall 051 | pH, standard units | | | *a* | 9.0 | 100 | 13 |
| Outfall 135 | pH, standard units | | | *a* | 9.0 | 100 | 12 |
| | Lead | | | 0.04 | 1.190 | 100 | 12 |
| | PCB | | | 0.002 | 0.002 | 100 | 4 |
| Outfall 125 | pH, standard units | | | *a* | 9.0 | 100 | 12 |
| | Cadmium | | | 0.001 | 0.025 | 100 | 12 |
| | Lead | | | 0.04 | 1.190 | 100 | 12 |
| | PCB | | | 0.002 | 0.002 | 100 | 4 |
| Outfall 055 | pH, standard units | | | *a* | 9.0 | 100 | 13 |
| | Mercury | | | | 0.004 | 100 | 46 |
| | Total Residual Chlorine | | | | 0.5 | 100 | 3 |
| Outfall 109 | pH, standard units | | | *a* | 9.0 | 100 | 5 |
| | Total Residual Chlorine | | | | 0.5 | 100 | 4 |
| Outfall 021 | pH, standard units | | | *a* | 9.0 | 100 | 5 |
| | Total Residual Chlorine | | | | 0.188 | 100 | 4 |
| Outfall 077 | pH, standard units | | | *a* | 9.0 | b | 0 |
| Outfall EFP | pH, standard units | | | *a* | 9.0 | 100 | 209 |

**Table 4.12 (continued)**

| Discharge point | Effluent parameter | Daily avg (lb/d) | Daily max (lb/d) | Daily avg (mg/L) | Daily max (mg/L) | Percentage of compliance | Number of samples |
|---|---|---|---|---|---|---|---|
| Outfall C11 | pH, standard units | | | *a* | 9.0 | 100 | 26 |
| | Total residual chlorine | | | | 0.019 | 100 | 24 |
| | Temperature ($^{o}$C) | | | | 30.5 | 100 | 25 |
| Outfall S06 | pH, standard units | | | *a* | 9.0 | 100 | 2 |
| Outfall S19 | pH, standard units | | | *a* | 9.0 | 100 | 1 |
| Outfall S24 | pH, standard units | | | *a* | 9.0 | 100 | 4 |
| Category I outfalls | pH, standard units | | | *a* | 9.0 | 100 | 20 |
| Category II outfalls | pH, standard units | | | *a* | 9.0 | 100 | 30 |
| | Total Residual Chlorine | | | | 0.5 | 100 | 31 |
| Category III outfalls | pH, standard units | | | *a* | 9.0 | 100 | 11 |
| | Total residual chlorine | | | | 0.5 | 100 | 10 |

[a] Not applicable.
[b] No discharge.

**Table 4.13. Radiological parameters monitored at the Y-12 Complex, 2010**

| Parameters | Specific isotopes | Rationale for monitoring |
|---|---|---|
| Uranium isotopes | $^{238}$U, $^{235}$U, $^{234}$U, total U, weight % $^{235}$U | These parameters reflect the major activity, uranium processing, throughout the history of Y-12 and are the dominant detectable radiological parameters in surface water |
| Fission and activation products | $^{90}$Sr, $^{3}$H, $^{99}$Tc, $^{137}$Cs | These parameters reflect a minor activity at Y-12, processing recycled uranium from reactor fuel elements, from the early 1960s to the late 1980s, and will continue to be monitored as tracers for beta and gamma radionuclides, although their concentrations in surface water are low |
| Transuranium isotopes | $^{241}$Am, $^{237}$Np, $^{238}$Pu, $^{239/240}$Pu | These parameters are related to recycle uranium processing. Monitoring has continued because of their half-lives and presence in groundwater |
| Other isotopes of interest | $^{232}$Th, $^{230}$Th, $^{228}$Th, $^{226}$Ra, $^{228}$Ra | These parameters reflect historical thorium processing and natural radionuclides necessary to characterize background radioisotopes |

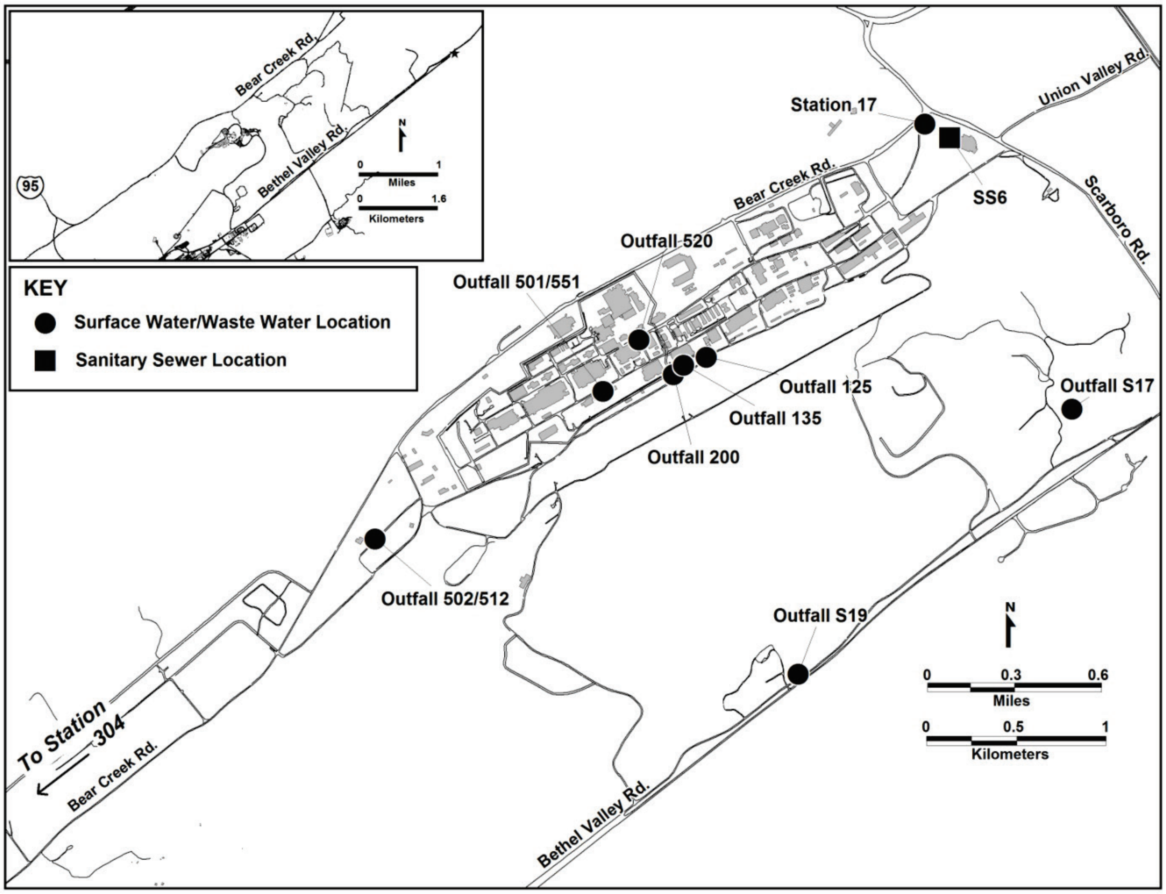


**Fig. 4.26. Surface water and sanitary sewer radiological sampling locations at the Y-12 Complex.**

**Table 4.14. Summary of Y-12 Complex Radiological Monitoring Plan sample requirements and 2010 results**

| Outfall no. | Location | Sample frequency | Sample type | Sum of DCG percentage |
|---|---|---|---|---|
| | **Y-12 Complex wastewater treatment facilities** | | | |
| 501 | Central Pollution Control Facility | 1/month | Composite during batch operation | No flow |
| 502 | West End Treatment Facility | 1/batch | 24-h composite | 3.8 |
| 512 | Groundwater Treatment Facility | 4/year | 24-h composite | 2.5 |
| 520 | Steam condensate | 1/year | Grab | 0.2 |
| 551 | Central Mercury Treatment Facility | 4/year | 24-h composite | 1.1 |
| | **Other Y-12 Complex point and area source discharges** | | | |
| 125 | Outfall 125 | 4/year | 24-h composite | 5.2 |
| 135 | Outfall 135 | 4/year | 24-h composite | 2.5 |
| S17 | Kerr Hollow Quarry | 1/year | 24-h composite | 3.5 |
| S19 | Rogers Quarry | 1/year | 24-h composite | 0 |
| | **Y-12 Complex instream locations** | | | |
| S24 | Outfall S24 | 4/year | 7-day composite | 5.7 |
| Station 17 | East Fork Poplar Creek, complex exit (east) | 1/month | 7-day composite | 1.2 |
| 200 | North/south pipes | 1/month | 24-h composite | 4.3 |
| | **Y-12 Complex Sanitary Sewer** | | | |
| SS6 | East End Sanitary Sewer Monitoring Station | 1/week | 7-day composite | 5.6 |

In 2010, the total mass of uranium and associated curies released from the Y-12 Complex at the easternmost monitoring station, Station 17 on Upper East Fork Poplar Creek, was 326 kg or 0.075 Ci (Table 4.15). Figure 4.27 illustrates a 5-year trend of these releases. The total release is calculated by multiplying the average concentration (grams per liter) by the average flow (million gallons per day). Converting units and multiplying by 365 days per year yields the calculated discharge. The increase in uranium quantity in 2010 may be the result of higher rainfall and subsequent movement of sediment and runoff from surfaces such as rooftops.

**Table 4.15. Release of uranium from the Y-12 Complex to the off-site environment as a liquid effluent, 2006–2010**

| Year | Quantity released | |
|---|---|---|
| | Ci[a] | kg |
| | **Station 17** | |
| 2006 | 0.050 | 131 |
| 2007 | 0.036 | 70 |
| 2008 | 0.046 | 75 |
| 2009 | 0.067 | 187 |
| 2010 | 0.075 | 326 |

[a]1 Ci = 3.7E+10 Bq.

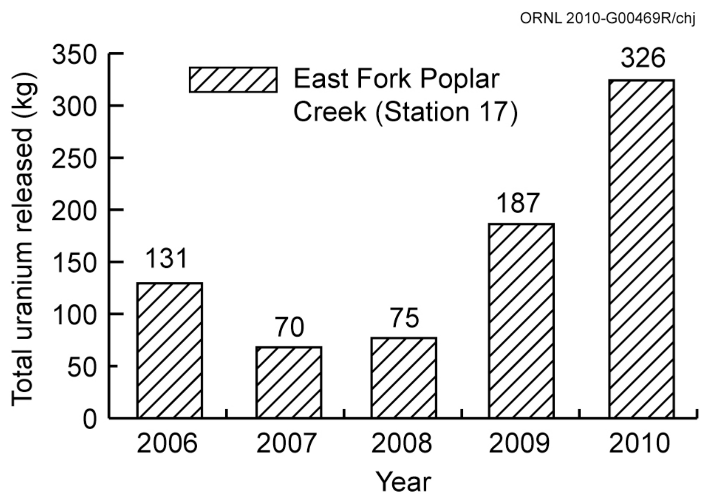


**Fig. 4.27. Five-year trend of Y-12 Complex release of uranium to East Fork Poplar Creek.**

The Y-12 Complex is permitted to discharge domestic wastewater to the city of Oak Ridge's publicly owned treatment works. Radiological monitoring of the sanitary sewer system discharge is conducted and reported to the city of Oak Ridge, although there are no city-established radiological limits. Potential sources of radionuclides discharging to the sanitary sewer have been identified in previous studies at the Y-12 Complex as part of an initiative to meet the "as low as reasonably achievable" goals. Results of radiological monitoring were reported to the city of Oak Ridge in 2010 quarterly monitoring reports.

### 4.5.3 Storm Water Pollution Prevention

The storm water pollution prevention plan at the Y-12 Complex is designed to minimize the discharge of pollutants in storm water runoff. The plan identifies areas that can reasonably be expected to contribute contaminants to surface water bodies via storm water runoff and describes the development and implementation of storm water management controls to reduce or eliminate the discharge of such pollutants. This plan requires (1) characterization of storm water by sampling during storm events,

(2) implementation of measures to reduce storm water pollution, (3) facility inspections, and (4) employee training.

The NPDES permit defines the primary function of the Y-12 Complex to be a fabricated metal products industry. However, it also requires that storm water monitoring be conducted for three additional sectors: scrap/waste recycling activities; landfill and land application activities; and discharges associated with treatment, storage, and disposal facilities as they are defined in the Tennessee Storm Water Multi Sector General Permit for Industrial Activities (TNR050000). Each sector has prescribed cut-off concentration values and some have defined sector mean values. The “rationale” portion of the NPDES permit for the Y-12 Complex states “cut-off concentrations were developed by the EPA and the state of Tennessee and are based on data submitted by similar industries for the development of the multi-sector general storm water permit. The cut-off concentrations are target values and should not be construed to represent permit limits.” Similarly, sector mean values are defined as “a pollutant concentration calculated from all sampling results provided from facilities classified in this sector during the previous term limit.”

Storm water sampling was conducted for 2010 during rain events that occurred in August, September, and October. Results were published in the *Annual Storm Water Report for the Y-12 National Security Complex, Oak Ridge, Tennessee* (B&W Y-12 2011), which was submitted to the Division of Water Pollution Control in January 2011. Consistent with permit requirements, storm water monitoring is performed each year for sector outfalls, three major outfalls that drain large areas of the Y-12 Complex, raw water flow, and four instream monitoring locations on East Fork Poplar Creek (Fig. 4.25). The permit also calls for sampling of stream baseload sediment that is being transported due to the heavy flow. Sediment sampling is performed at the four instream locations.

In general, the quality of storm water exiting the Y-12 Complex via EFPC indicated some decline in 2010. This decline is attributable to construction, demolition, and remediation projects which have been or are scheduled to be completed in 2011. Increased emphasis will be placed on site inspections and the timely implementation of improved storm water control measures. As a proactive measure, additional storm water sampling of the suspect areas will be conducted in early 2011 (instead of waiting until late summer as noted in the NPDES permit).

### 4.5.4 Flow Management (or Raw Water)

Because of concern about maintaining water quality and stable flow in the upper reaches of East Fork Poplar Creek, the NPDES permit requires the addition of Clinch River water to the headwaters of East Fork Poplar Creek (North/South Pipe–Outfall 200 area) so that a minimum flow of 26 million liters (7 million gal) per day is maintained at the point where East Fork Poplar Creek leaves the reservation (Station 17). With the completion of the project, instream water temperatures decreased by approximately 5°C (from approximately 26°C at the headwaters).

A request to modify the NPDES permit to allow the minimum flow, measured at Station 17, to be reduced to 19 million liters (5 million gal) per day was made, and on December 30, 2008, TDEC modified the permit. The modified permit requires 19 million liters (5 million gal) rather than 26 million liters (7 million gal) minimum daily flow as measured at the Station 17 location. In addition to water conservation, this action offers the potential benefit of reducing the transport of mercury from a contaminated section of the streambed.

Discussions with city of Oak Ridge water system management regarding modification of the raw water supply system for EFPC have been conducted. During 2010 the raw water flow input to EFPC was reduced by approximately 1.5 million gal per day.

### 4.5.5 Y-12 Complex Ambient Surface Water Quality

To monitor key indicators of water quality, a network of real-time monitors located at three instream locations along Upper East Fork Poplar Creek is used. The Surface Water Hydrological Information Support System (SWHISS) is available for real-time water quality measurements, such as pH, temperature, dissolved oxygen, conductivity, and chlorine. The locations are shown in Fig. 4.28. The primary function of the SWHISS is to provide an indication of potential adverse conditions that could be causing an impact on the quality of water in Upper East Fork Poplar Creek. It is operated as a best management practice.

Additional sampling of springs and tributaries is conducted in accordance with the Y-12 Groundwater Protection Program to monitor trends throughout the three hydrogeologic regimes (see Sect. 4.6).

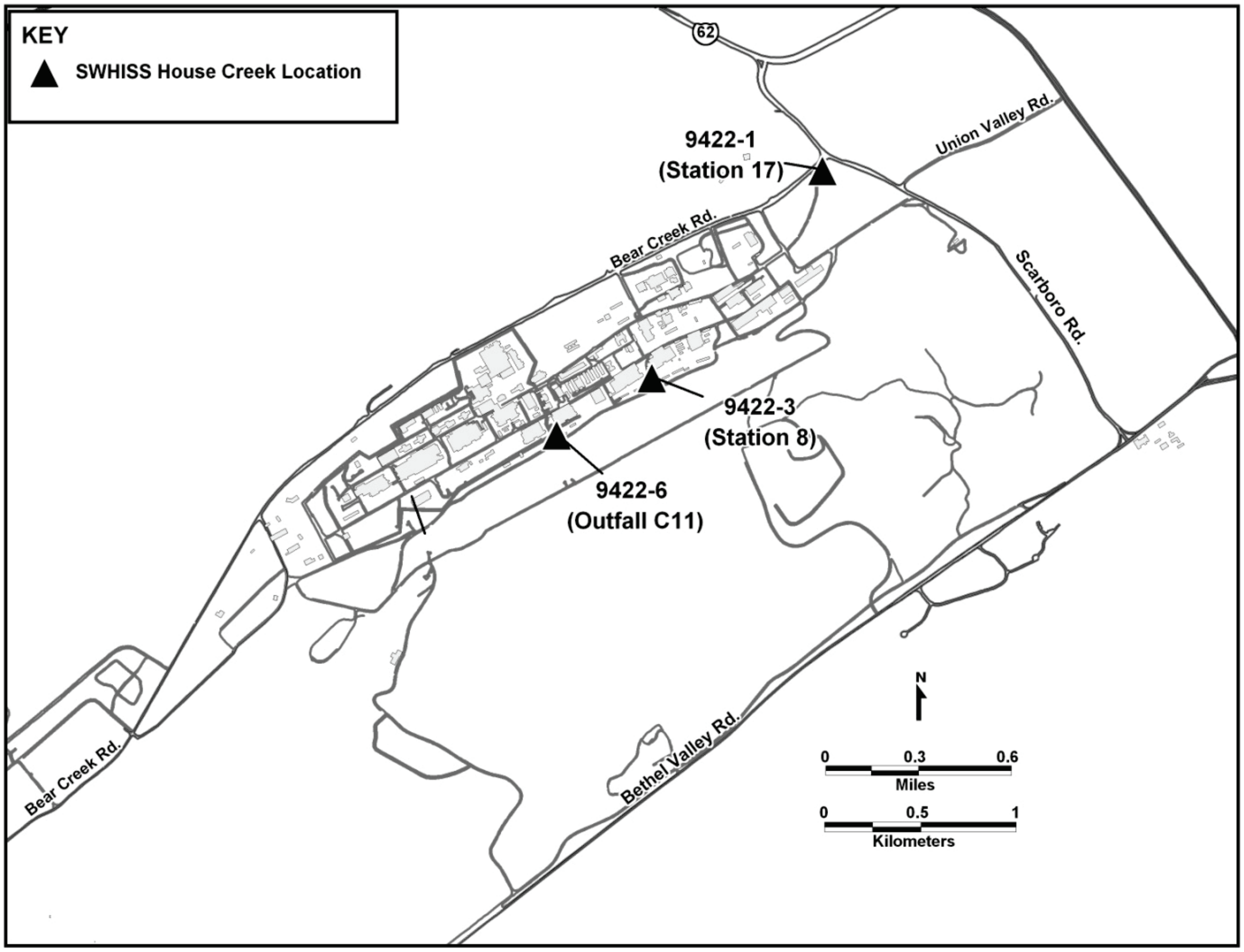


**Fig. 4.28. Surface Water Hydrological Information Support System (SWHISS) monitoring locations.**

## 4.5.6 Industrial Wastewater Discharge Permit

The Industrial and Commercial User Wastewater Discharge Permit No. 1-91 provides requirements for the discharge of wastewaters to the sanitary sewer system as well as prohibitions for certain types of wastewaters. It prescribes requirements for monitoring certain parameters at the East End Sanitary Sewer Monitoring Station. Limitations are set in the permit for most parameters. Samples for gross alpha, gross beta, and uranium are taken by a weekly 24-h composite sample. The sample is analyzed for uranium if the alpha and beta values exceed certain levels. Other parameters (including metals, oil and grease, solids, and biological oxygen demand) are monitored on a monthly basis. Organic parameters are monitored once per quarter. Results of compliance sampling are reported quarterly. Flow is measured 24 h per day at the monitoring station.

As part of the city of Oak Ridge's pretreatment program, city personnel use the monitoring station to conduct compliance monitoring as required by the pretreatment regulations. City personnel also conduct twice yearly compliance inspections. Monitoring results during 2010 (Table 4.16) indicate 11 exceedances of the permit in 2010. Three were for exceeding the discharge limit (monthly average) for total recoverable phenols, two were for exceeding the discharge limit (daily maximum) for total recoverable phenols, one was for exceeding the discharge limit (monthly average) for total oil and grease, one was for exceeding the discharge limit (daily maximum) for oil and grease, and four were for exceeding the maximum daily allowable flow limit.

Over the last several years, Y-12 personnel have conducted flow monitoring at key locations of the sanitary sewer system during wet and dry weather conditions. This effort has enabled a determination to be made of the general areas of the system most likely to contribute the greatest volume of infiltration or inflow of extraneous water into the lines. Examination of the data in 2009 led to the conclusion that inflow of surface water was the major contributor, and in November 2009, a plan was developed to conduct smoke tests of the lines to locate specific inflow problems. The testing effort was initiated in 2010 and is expected to be completed in 2011. During 2010 several minor inflow source corrections were made.

**Table 4.16. Y-12 Complex Discharge Point SS6, Sanitary Sewer Station 6**
(January through December 2010)

| Effluent parameter | Number of samples | Daily average value (effluent limit)[a] | Daily maximum value (effluent limit)[b] | Percentage of compliance |
|---|---|---|---|---|
| Flow, mgd | 365 | *c* | 1.4 | 99 |
| pH, standard units | 15 | *c* | 9/6[d] | 100 |
| Silver | 15 | 0.05 | 0.1 | 100 |
| Arsenic | 15 | 0.01 | 0.015 | 100 |
| Biochemical oxygen demand | 15 | 200 | 300 | 100 |
| Cadmium | 15 | 0.0033 | 0.005 | 100 |
| Chromium | 15 | 0.05 | 0.075 | 100 |
| Copper | 15 | 0.14 | 0.21 | 100 |
| Cyanide | 15 | 0.041 | 0.062 | 100 |
| Iron | 15 | 10 | 15 | 100 |
| Mercury | 15 | 0.023 | 0.035 | 100 |
| Kjeldahl nitrogen | 15 | 45 | 90 | 100 |
| Nickel | 15 | 0.021 | 0.032 | 100 |
| Oil and grease | 16 | 25 | 50 | 94 |
| Lead | 15 | 0.049 | 0.074 | 100 |
| Phenols—total recoverable | 20 | 0.3 | 0.5 | 75 |
| Suspended solids | 15 | 200 | 300 | 100 |
| Zinc | 15 | 0.35 | 0.75 | 100 |

[a]Units in milligrams per liter unless otherwise indicated.
[b]Industrial and Commercial Users Wastewater Permit limits.
[c]Not applicable.
[d]Maximum value/minimum value.

### 4.5.7 Quality Assurance/Quality Control

The Environmental Monitoring Management Information System (EMMIS) is used to manage surface water monitoring data. EMMIS uses standard sample definitions to ensure that samples are taken at the correct location at a specified frequency using the correct sampling protocol.

Field sampling QA encompasses many practices that minimize error and evaluate sampling performance. Some key quality practices include the following:

- use of standard operating procedures for sample collection and analysis;
- use of chain-of-custody and sample identification, customized chain-of-custody documents, and sample labels provided by EMMIS;
- instrument standardization, calibration, and verification;
- sample technician training;
- sample preservation, handling, and decontamination; and
- use of QC samples, such as field and trip blanks, duplicates, and equipment rinses.

Surface water data are entered directly by the analytical laboratory into the Laboratory Information Management System (LIMS) on the day of approval. EMMIS routinely accesses LIMS electronically to capture pertinent data. Generally, the system will store the data in the form of concentrations.

A number of electronic data management tools enable automatic flagging of data points and allow for monitoring and trending data over time. Field information on all routine samples taken for surface water monitoring is entered in EMMIS, which also retrieves data nightly from the analytical laboratory. The system then performs numerous checks on the data, including comparisons of the individual results against any applicable screening criteria, regulatory thresholds, compliance limits, best management standards, or other water quality indicators, and produces required reports.

### 4.5.8 Biomonitoring Program

In accordance with the requirements of the 2006 NPDES permit (Part III-E, p. 9), a biomonitoring program is in place that evaluates three outfalls that discharge to the headwaters of East Fork Poplar Creek (Outfalls 200, 135, and 125). Water from each outfall was tested once in 2010 using fathead minnow larvae and *Ceriodaphnia dubia*. Table 4.17 summarizes the inhibition concentration ($IC_{25}$) results of biomonitoring tests conducted during 2010 at Outfalls 200, 135, and 125. The $IC_{25}$ is the concentration of effluent that causes a 25% reduction in *Ceriodaphnia* survival or reproduction or fathead minnow survival or growth. Thus, the lower the value, the more toxic the effluent. The $IC_{25}$ was greater than the highest tested concentration of each effluent (100% for outfall 200, 20% for outfall 135, and 36% for outfall 125) for each test conducted, indicating that no toxicity was detected during 2010.

**Table 4.17. Y-12 Complex Biomonitoring Program summary information[a] for Outfalls 200, 135, and 125 in 2010**

| Site | Test date | Species | $IC_{25}$[b] (%) |
|---|---|---|---|
| Outfall 200 | 12/7/10 | *Ceriodaphnia* | >100 |
| Outfall 200 | 12/7/10 | Fathead minnow | >100 |
| Outfall 135 | 12/9/10 | *Ceriodaphnia* | >20 |
| Outfall 135 | 12/9/10 | Fathead minnow | >20 |
| Outfall 125 | 12/9/10 | *Ceriodaphnia* | >36 |
| Outfall 125 | 12/9/10 | Fathead minnow | >36 |

[a] The inhibition concentrations ($IC_{25}$) are summarized for the discharge monitoring locations, Outfalls 200, 135, and 125.

[b] $IC_{25}$ as a percentage of full-strength effluent from outfalls 200, 135, and 125 diluted with laboratory control water. The $IC_{25}$ is the concentration that causes a 25% reduction in *Ceriodaphnia* survival or reproduction or fathead minnow survival or growth.

### 4.5.9 Biological Monitoring and Abatement Programs

The NPDES permit issued for the Y-12 Complex in 2006 mandates a Biological Monitoring and Abatement Program (BMAP) with the objective of demonstrating that the effluent limitations established for the facility protect the classified uses of the receiving stream, East Fork Poplar Creek. The BMAP, which has been monitoring the ecological health of East Fork Poplar Creek since 1985, currently consists of three major tasks that reflect complementary approaches to evaluating the effects of the Y-12 Complex discharges on the aquatic integrity of East Fork Poplar Creek. These tasks include (1) bioaccumulation monitoring, (2) benthic macroinvertebrate community monitoring, and (3) fish community monitoring. Data collected on contaminant bioaccumulation and the composition and abundance of communities of aquatic organisms provide a direct evaluation of the effectiveness of abatement and remedial measures in improving ecological conditions in the stream.

Monitoring is presently being conducted at five primary East Fork Poplar Creek sites, although sites may be excluded or added, depending upon the specific objectives of the various tasks. The primary sampling sites include upper East Fork Poplar Creek at East Fork Poplar Creek kilometer (EFK) 24.4 and 23.4 (upstream and downstream of Lake Reality, respectively); EFK 18.7 (also EFK 18.2), located off the ORR and below an area of intensive commercial and light industrial development; EFK 13.8, located upstream from the Oak Ridge Wastewater Treatment Facility; and EFK 6.3, located approximately 1.4 km below the ORR boundary (Fig. 4.29). Brushy Fork at Brushy Fork kilometer (BFK) 7.6 is used as a reference stream in two tasks of the BMAP. Additional sites off the ORR are also occasionally used for reference, including Beaver Creek, Bull Run, Cox Creek, Hinds Creek, Paint Rock Creek, and the Emory River in Watts Bar Reservoir (Fig. 4.30).

Significant increases in species richness and diversity in East Fork Poplar Creek over the last 2 decades demonstrate that the overall ecological health of the stream continues to improve. However, the pace of improvement in the upper reaches of East Fork Poplar Creek near the Y-12 Complex has slowed in recent years, and fish and invertebrate communities continue to be less diverse than the corresponding communities in reference streams.

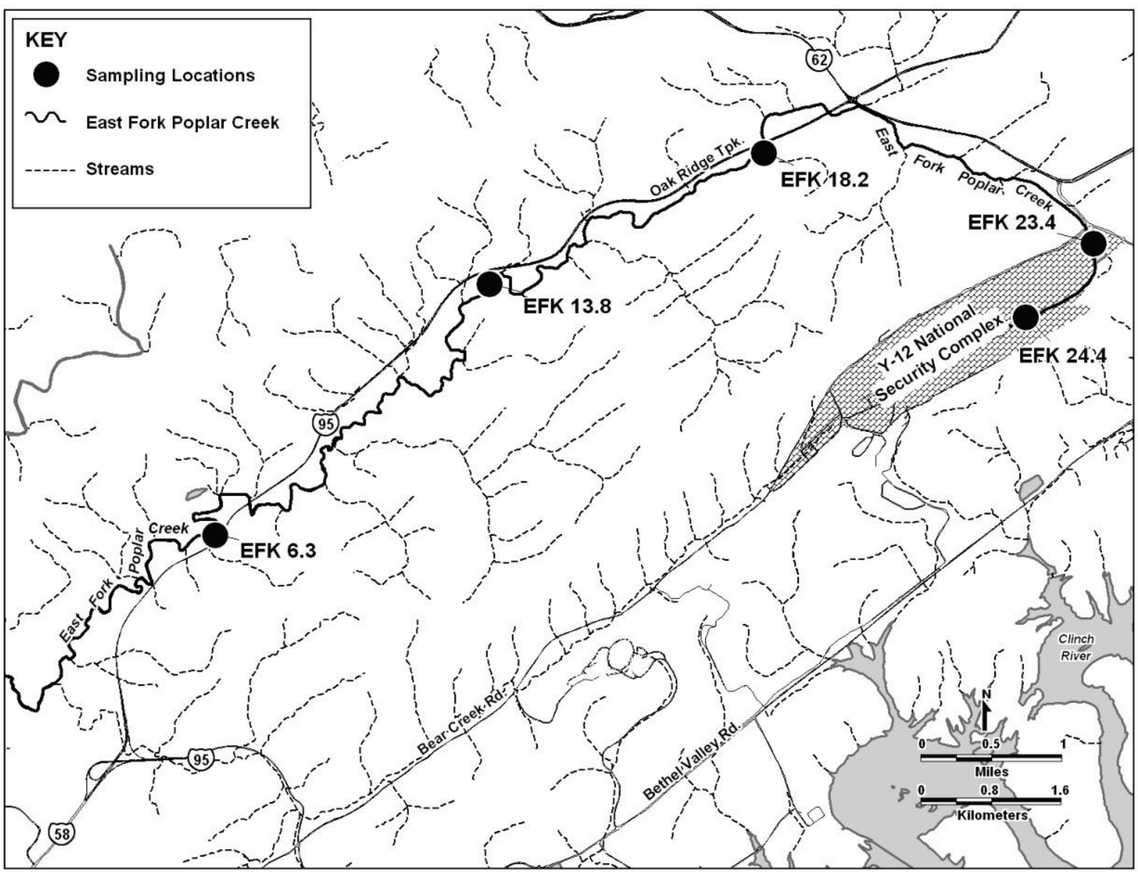


**Fig. 4.29. Locations of biological monitoring sites on East Fork Poplar Creek in relation to the Oak Ridge Y-12 National Security Complex.**

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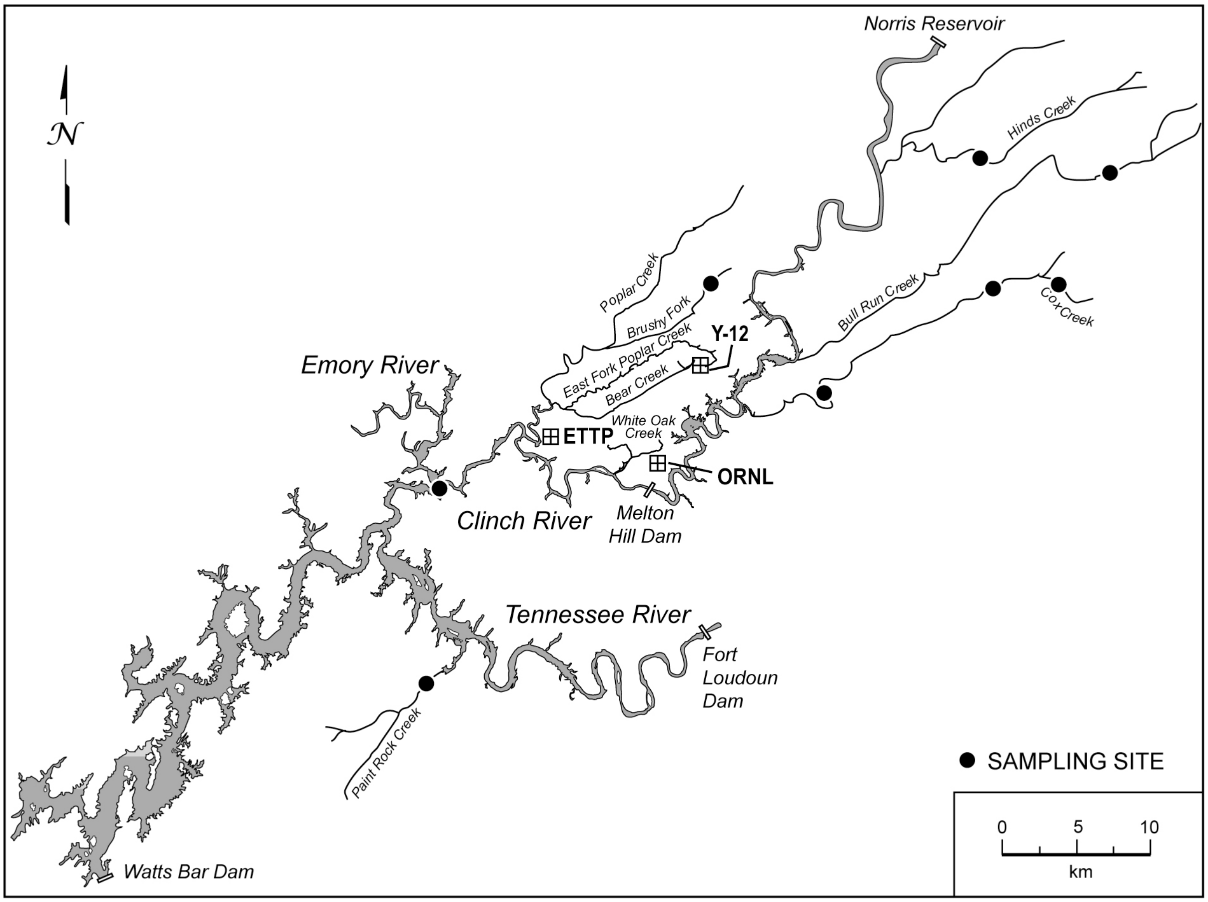


**Fig. 4.30. Locations of biological monitoring reference sites in relation to the Oak Ridge Y-12 National Security Complex.**

### 4.5.9.1 Bioaccumulation Studies

Mercury and PCB levels in fish from East Fork Poplar Creek (EFPC) have been historically elevated relative to fish in uncontaminated reference streams. Fish in EFPC are monitored regularly for mercury and PCBs to assess spatial and temporal trends in bioaccumulation associated with ongoing remedial activities and Y-12 Complex operations.

As part of this monitoring effort, redbreast sunfish (*Lepomis auritus*) and rock bass (*Ambloplites rupestris*) are collected twice a year from five sites throughout the length of EFPC and are analyzed for tissue concentrations of mercury (twice yearly) and PCBs (annually). Mercury concentrations remained higher in fish from East Fork Poplar Creek in 2010 than in fish from reference streams. Elevated mercury concentrations in fish from the upper reaches of EFPC indicate that the Y-12 Complex remains a continuing source of mercury to fish in the stream. Although waterborne mercury concentrations in the upper reaches of EFPC decreased substantially following the 2005 start-up of a treatment system on a mercury-contaminated spring (Fig. 4.31), mercury concentrations in fish have not yet decreased in response. Mean mercury concentrations in fish collected from this site were lower than in 2009 but comparable to the concentrations seen in recent years. In contrast, average aqueous mercury concentrations increased from 2009–2010, with mean concentrations in 2010 exceeding those observed prior to the implementation of the Big Spring Water Treatment System in 2005. Because the bioaccumulation of mercury in fish occurs predominantly through the food chain rather than aqueous exposure, there may be a time lag before the effects of this increase in aqueous mercury concentrations are seen in fish tissue concentrations. Continued monitoring is necessary to see whether aqueous mercury concentrations continue to increase, and whether this affects fish tissue mercury concentrations. Mean concentrations of PCBs in fish at EFK 23.4 (the site where PCBs in fish are highest) have been increasing since 2008 but continued to be much lower than peak concentrations observed in the mid-1990s (Fig. 4.32).

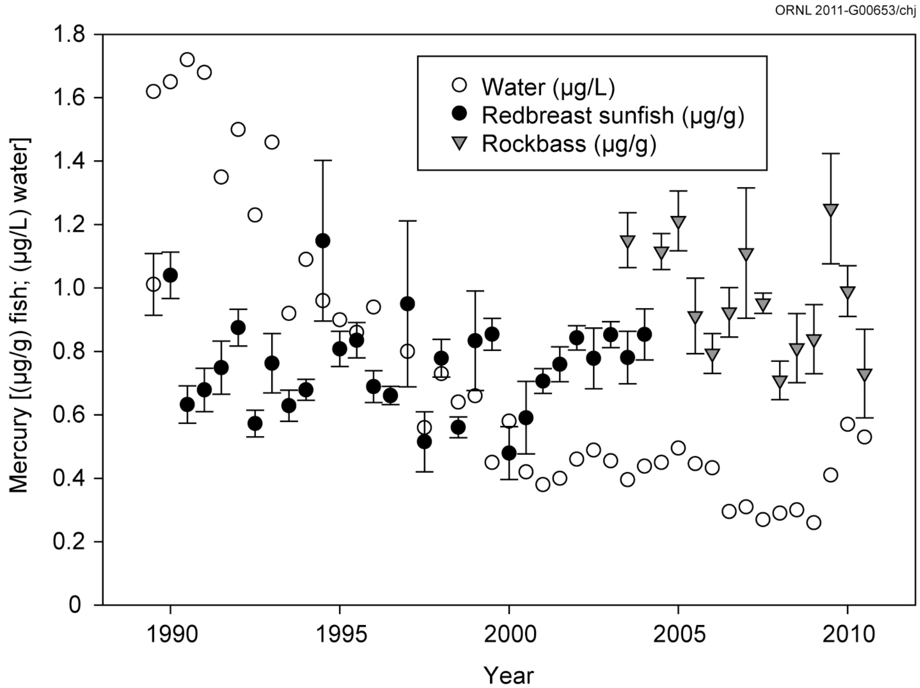


**Fig. 4.31. Semiannual average mercury concentration in water and muscle fillets of redbreast sunfish and rock bass in East Fork Poplar Creek at EFK 23.4 through spring 2010.**

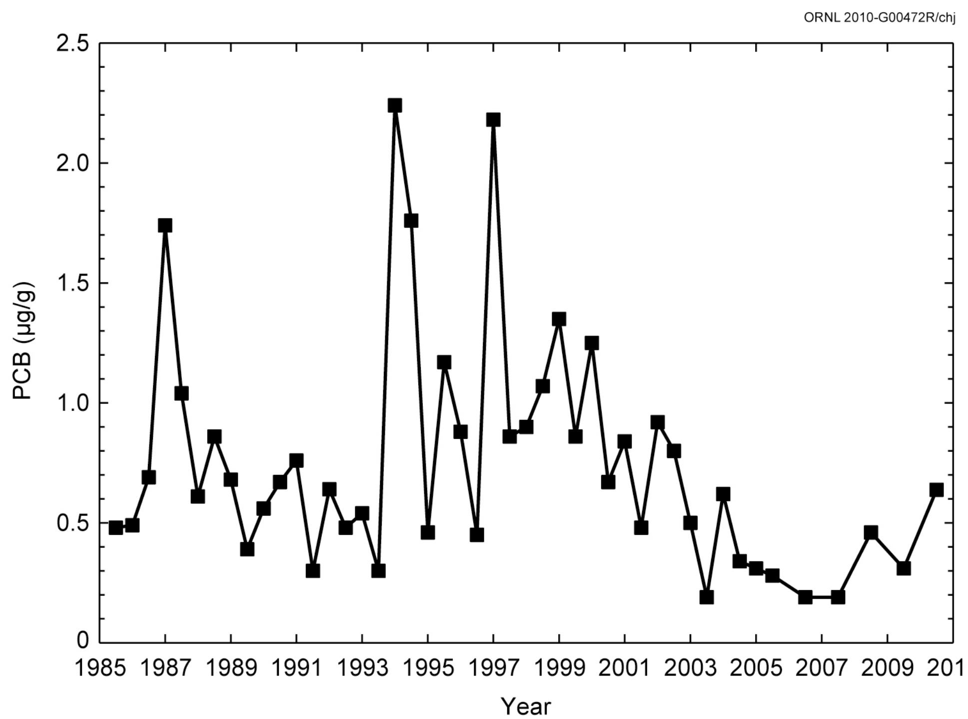


**Fig. 4.32. Mean concentrations of PCBs in redbreast sunfish and rock bass muscle fillets in East Fork Poplar Creek at EFK 23.4 through Spring 2010 (EFK = East Fork Poplar Creek kilometer).**

### 4.5.9.2 Benthic Invertebrate Surveys

Monitoring of benthic macroinvertebrate communities continued at three sites in East Fork Poplar Creek and at two reference streams in the spring of 2010. The macroinvertebrate community at EFK 23.4 and EFK 24.4 remained degraded as compared with reference communities, although recent trends at EFK 23.4 suggest improvement has occurred at that site since 2004. Trends at EFK 24.4, on the other hand, suggest that no substantial change has occurred at that site since 1999 (Fig. 4.33). Results from 2010 for EFK 13.8 continue to suggest that no substantial change has occurred at that site, and that mildly degraded conditions remain.

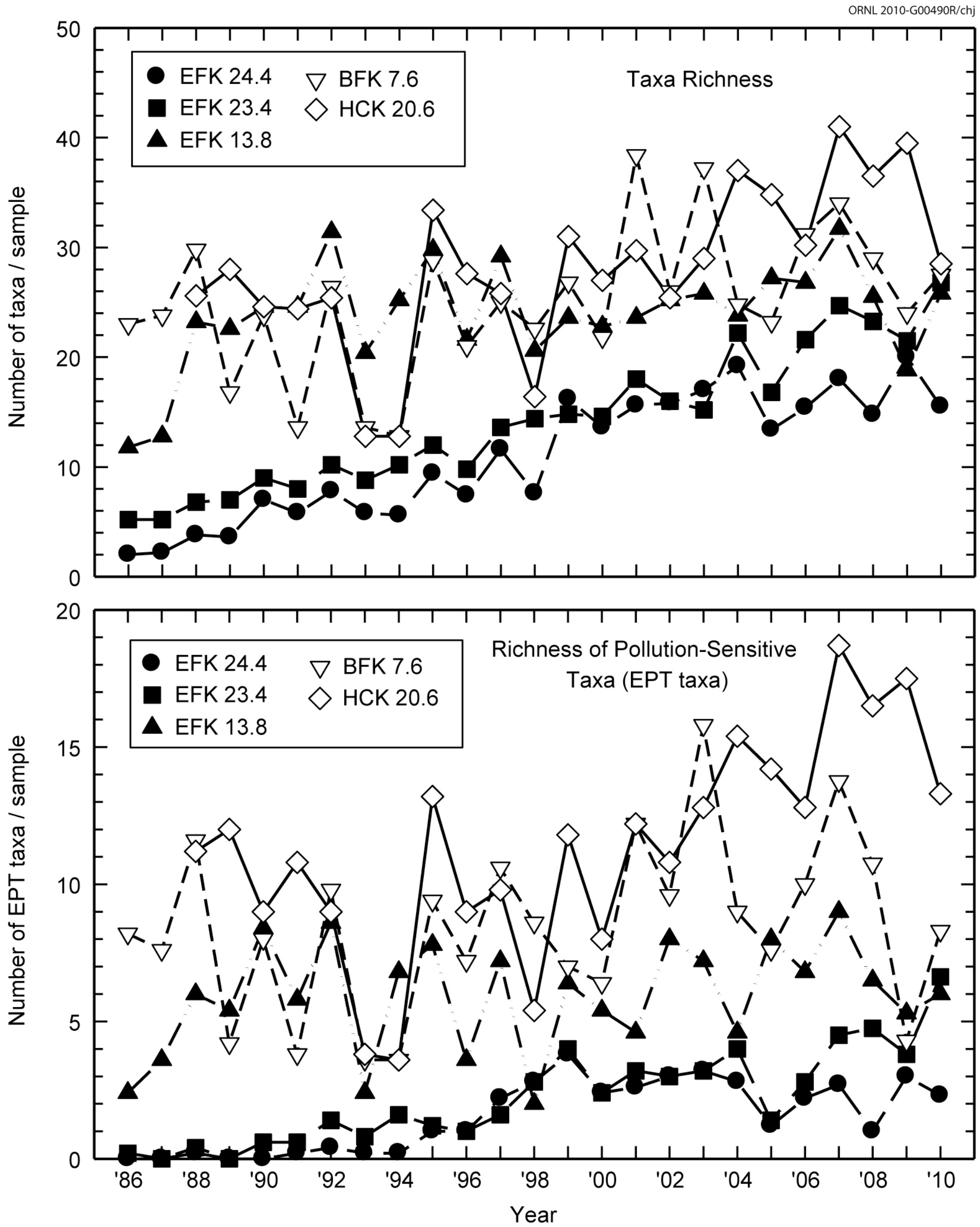


**Fig. 4.33. Total taxonomic richness (mean number of taxa/sample) and total taxonomic richness of the *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT) (mean number of EPT taxa/sample) of the benthic macroinvertebrate communities sampled in spring from East Fork Poplar Creek and reference sites on nearby Brushy Fork (BFK 7.6) and Hinds Creek (HCK 20.6).**

### 4.5.9.3 Fish Community Monitoring

Fish communities were monitored in the spring and fall of 2010 at five sites along East Fork Poplar Creek and at a reference stream. Over the past two decades, overall species richness, density, biomass, and the number of pollution-sensitive fish species (Fig. 4.34) have increased at all sampling locations below Lake Reality. However, the East Fork Poplar Creek fish community continues to lag behind the reference stream community in most important metrics of fish diversity and community structure. This is especially true at the monitoring sites closest to the Y-12 Complex where the sensitive species richness is only 25% of the reference value (EFK 23.4) or sensitive species are absent altogether (EFK 24.4).

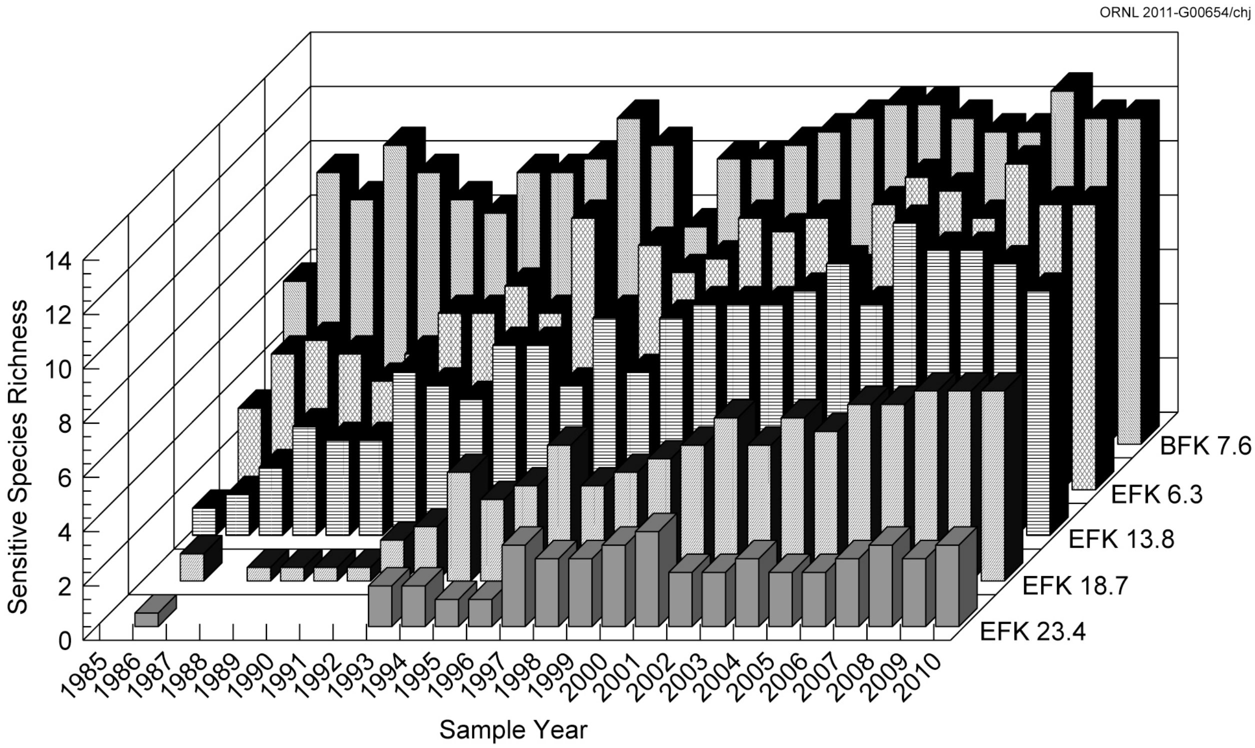


**Fig. 4.34. Comparison of mean sensitive species richness (number of species) collected each year from 1985 through 2010 from four sites in East Fork Poplar Creek and a reference site (Brushy Fork).**

## 4.6 Groundwater at the Y-12 Complex

Groundwater monitoring at Y-12 is performed to determine what impacts to the environment from legacy and current operations are occurring. More than 200 sites have been identified at the Y-12 Complex that represent known or potential sources of contamination to the environment as a result of past operational and waste management practices. Monitoring provides information on the nature and extent of contamination of groundwater, which is then used to determine what actions must be taken to protect the worker, public, and the environment in compliance with regulations and DOE orders. Figure 4.35 depicts the major facilities or areas for which groundwater monitoring was performed during CY 2010.

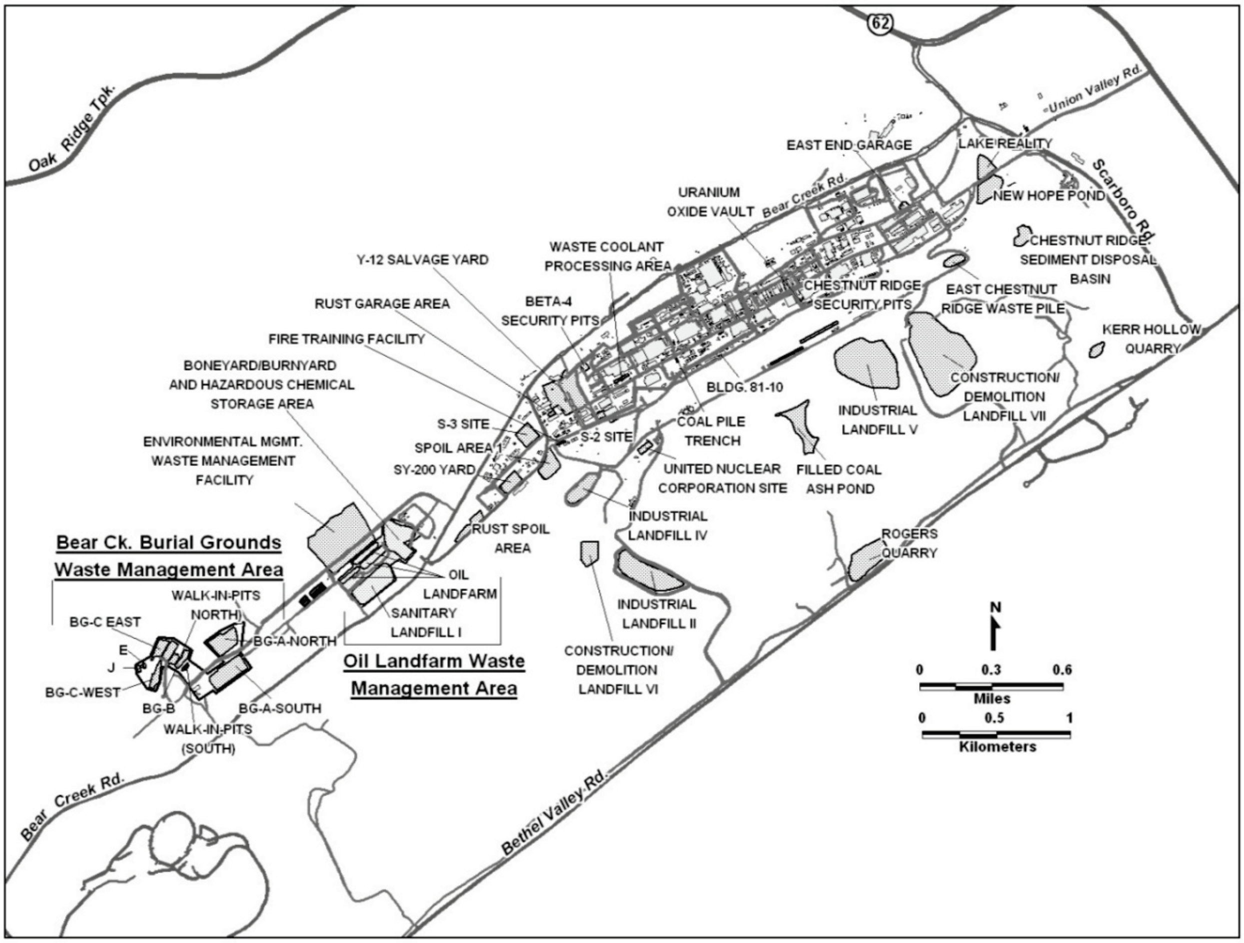


**Fig. 4.35. Known or potential contaminant sources for which groundwater monitoring was performed at the Y-12 Complex during CY 2010.**

## 4.6.1 Hydrogeologic Setting

The Y-12 Complex is divided into three hydrogeologic regimes (i.e., Bear Creek, Upper East Fork Poplar Creek, and Chestnut Ridge), which are delineated by surface water drainage patterns, topography, and groundwater flow characteristics (Fig. 4.36). Most of the Bear Creek and Upper East Fork Poplar Creek regimes are underlain by the shales, siltstones, and sandstones with a subordinate and locally variable amount of carbonate bedrock mentioned in Section 1.3.5 and hydrostratigraphically referred to as aquitards. Aquitards are rock units that contain water but do not readily yield significant water to pumping wells. Geologic units that are considered aquitards can often yield water in quantities sufficient for domestic or small farm use. (Domenico and Schwartz 1990). The southern portion of the two regimes is underlain by the Maynardville Limestone, which is part of the Knox Aquifer. The entire Chestnut Ridge regime is underlain by the Knox Aquifer. In general, groundwater flow in the water table interval follows the topography. Shallow groundwater flow in the Bear Creek and the Upper East Fork regimes is divergent from the topographic and groundwater divide located near the western end of the Y-12 Complex that defines the boundary between the two. In addition, flow converges on the primary surface streams (Bear Creek and Upper East Fork Poplar Creek) from Pine Ridge and Chestnut Ridge. In the Chestnut Ridge regime, a groundwater divide exists that approximately coincides with the crest of the ridge. Shallow groundwater flow tends to be toward either flank of the ridge, with discharge primarily to surface streams and springs located in Bethel Valley to the south and Bear Creek Valley to the north.

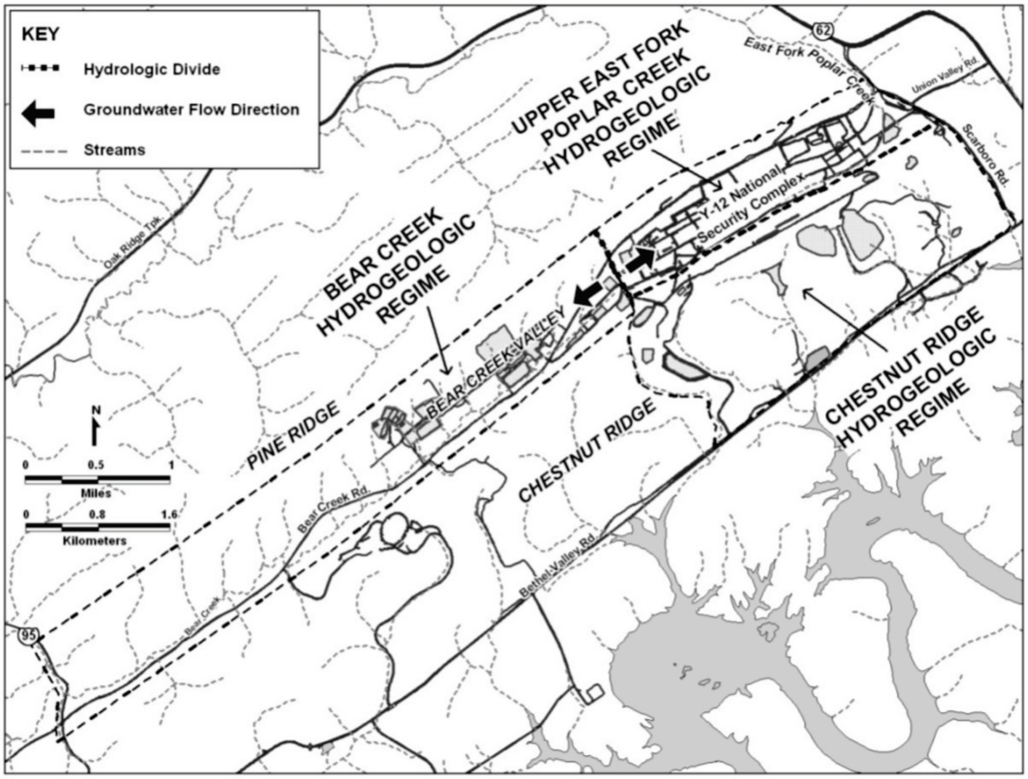


**Fig. 4.36. Hydrogeologic regimes at the Y-12 Complex.**

In Bear Creek Valley, groundwater in the intermediate and deep intervals moves predominantly through fractures in the aquitard, converging on and then moving through fractures and solution conduits in the Maynardville Limestone. Karst development in the Maynardville Limestone has a significant impact on groundwater flow paths in the water table and intermediate intervals. In general, groundwater flow parallels the valley and geologic strike. Groundwater flow rates in Bear Creek Valley vary widely; they are very slow within the deep interval of the fractured noncarbonate rock (<1 ft/year) but can be quite rapid within solution conduits in the Maynardville Limestone (tens to thousands of feet per day). The rate of groundwater flow perpendicular to geologic strike from the aquitard units of the lower Conasauga Group to the Maynardville Limestone is also very slow below the water table interval.

Contaminant migration is primarily advective (contaminants are transported along with flowing groundwater through the pore spaces, fractures, or conduits of the hydrogeologic system). Strike-parallel transport of some contaminants can occur within the aquitard units for significant distances, where they discharge to surface water tributaries or underground utility and stormwater distribution systems in industrial areas. Continuous elevated levels of nitrate (a groundwater contaminant from legacy waste disposals) within the fractured bedrock of the aquitards are known to extend east and west from the S-3 Site for thousands of feet. Volatile organic compounds (e.g., petroleum products, coolants, and solvents) at source units in the fractured clastic dominated bedrock, however, can remain close to source areas because they tend to adsorb to the bedrock matrix, diffuse into pore spaces within the matrix, and degrade prior to migrating to exit pathways, where more rapid transport occurs for longer distances. Regardless, extensive volatile organic compound contamination occurs throughout the groundwater system in both the Bear Creek and Upper East Fork regimes.

Groundwater flow in the Chestnut Ridge regime is through fractures and solution conduits in the Knox Group. Discharge points for intermediate and deep flow are not well known. Groundwater is currently presumed to flow toward Bear Creek Valley to the north and Bethel Valley to the south. Groundwater from intermediate and deep zones may discharge at certain spring locations along the flanks of Chestnut Ridge. Following the crest of the ridge, water table elevations decrease from west to east, demonstrating an overall easterly trend in groundwater flow.

## 4.6.2 Well Installation and Plugging and Abandonment Activities

A number of monitoring devices are routinely used for groundwater data collection at the Y-12 Complex. Monitoring wells are permanent devices used for the collection of groundwater samples; they are installed according to established regulatory and industry standards. Figure 4.37 shows a cross section of a typical groundwater monitoring well. Other devices or techniques are sometimes employed to gather groundwater data, including drive points and push probes.

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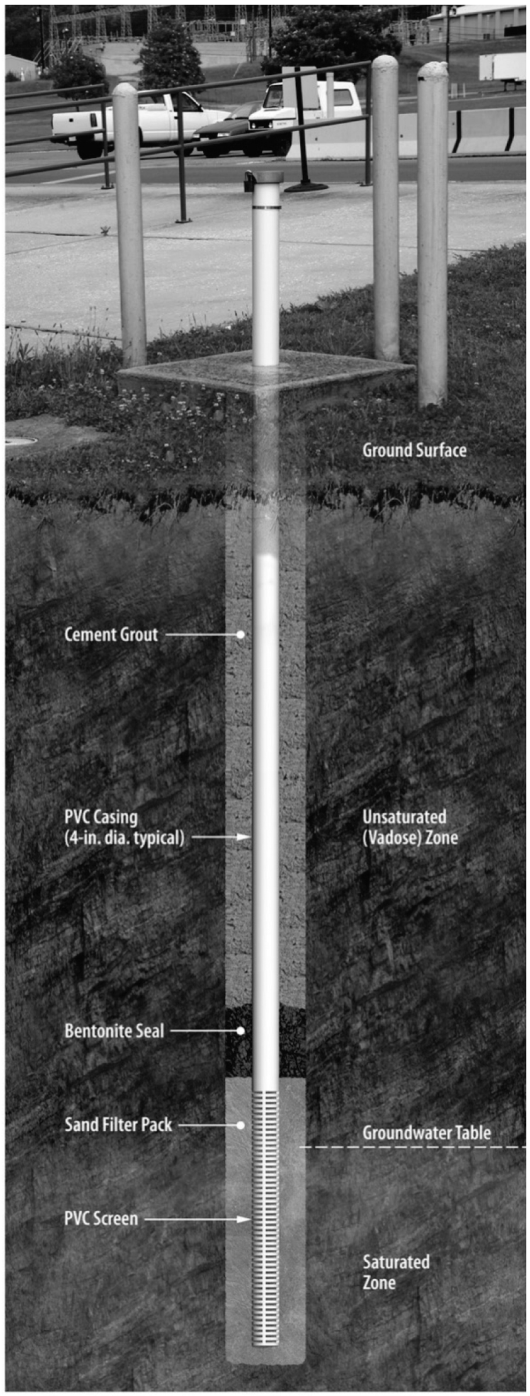


**Fig. 4.37. Cross section of a typical groundwater monitoring well.**

In CY 2010, eight monitoring wells were installed at Y-12. Two new wells were installed at the Environmental Management Waste Management Facility (EMWMF) to support monitoring requirements of a newly constructed disposal cell. Six wells were installed in support of research activities by the Environmental Remediation Sciences Oak Ridge Field Research Center. The purpose of the Field Research Center is to investigate the interactions and processes within a contaminated groundwater system to assist in the development of remediation strategies and tools for groundwater cleanup.

No monitoring wells were plugged and abandoned during the year.

### 4.6.3 CY 2010 Groundwater Monitoring

Groundwater monitoring in CY 2010 was performed to comply with DOE orders and regulations by the Y-12 Groundwater Protection Program, the Water Resources Restoration Program, and other projects. Compliance requirements were met by monitoring 203 wells and 43 surface water locations and springs (Table 4.18). Figure 4.38 shows the locations of Y-12 Complex perimeter/exit pathway groundwater monitoring stations.

**Table 4.18. Summary groundwater monitoring at the Y-12 Complex, 2010**

| | Purpose for which monitoring was performed | | | | |
|---|---|---|---|---|---|
| | **Restoration[a]** | **Waste management[b]** | **Surveillance[c]** | **Other[d]** | **Total** |
| Number of active wells | 60 | 31 | 112 | 125 | 328 |
| Number of other monitoring stations (e.g., springs, seeps, surface water) | 26 | 6 | 11 | 4 | 47 |
| Number of samples taken[e] | 190 | 40* | 149 | 2,120 | 2,459 |
| Number of analyses performed | 14,771 | 3,488* | 11,006 | 16,760 | 46,025 |
| Percentage of analyses that are non-detects | 80.2 | 88.9 | 80.8 | 27.0 | 61.6 |
| **Ranges of results for positive detections, VOCs (µg/L)[f]** | | | | | |
| Chloroethenes | 0.99–5,000 | 5–11 | 1–60,000 | NA[g] | |
| Chloroethanes | 1.3–510 | 11.2–38 | 1–2,200 | NA | |
| Chloromethanes | 1–1,200 | ND[h] | 1–4,100 | NA | |
| Petroleum hydrocarbons | 1–7,800 | ND | 1–2,000 | NA | |
| Uranium (mg/L) | 0.0041–0.4 | ND | 0.00052–0.56 | 0.145-61.059 | |
| Nitrates (mg/L) | 0.0046–7,600 | 0.59-2.5 | 0.055–10,999 | 614 -48,550 | |
| **Ranges of results for positive detections, radiological parameters (pCi/L)[i]** | | | | | |
| Gross alpha activity | 1.85–455 | 0.88–2.28 | 2.6–350 | NA | |
| Gross beta activity | 2.69–14,800 | 3.28–13.1 | 7.3–14,000 | NA | |

[a] Monitoring to comply with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements and with Resource Conservation and Recovery Act post closure detection and corrective action monitoring.

[b] Solid waste landfill detection monitoring and CERCLA landfill detection monitoring; * = excludes EMWMF

[c] DOE Order 450.1 surveillance monitoring

[d] Research-related groundwater monitoring associated with activities of the DOE Environmental Remediation Sciences Oak Ridge Field Research Center

[e] The number of unfiltered samples, excluding duplicates, determined for unique location/date combinations

[f] These ranges reflect concentrations of individual contaminants (not summed VOC concentrations):
Chloroethenes—includes tetrachloroethene, trichloroethene, 1,2-dichloroethene (*cis* and *trans*) 1,1-dichloroethene, and vinyl chloride
Chloroethanes—includes 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane
Chloromethanes—includes carbon tetrachloride, chloroform, and methylene chloride
Petroleum hydrocarbon—includes benzene, toluene, ethylbenzene, and xylene

[g] NA – not analyzed

[h] ND – not detected

[i] 1 pCi = $3.7 \times 10^2$ Bq

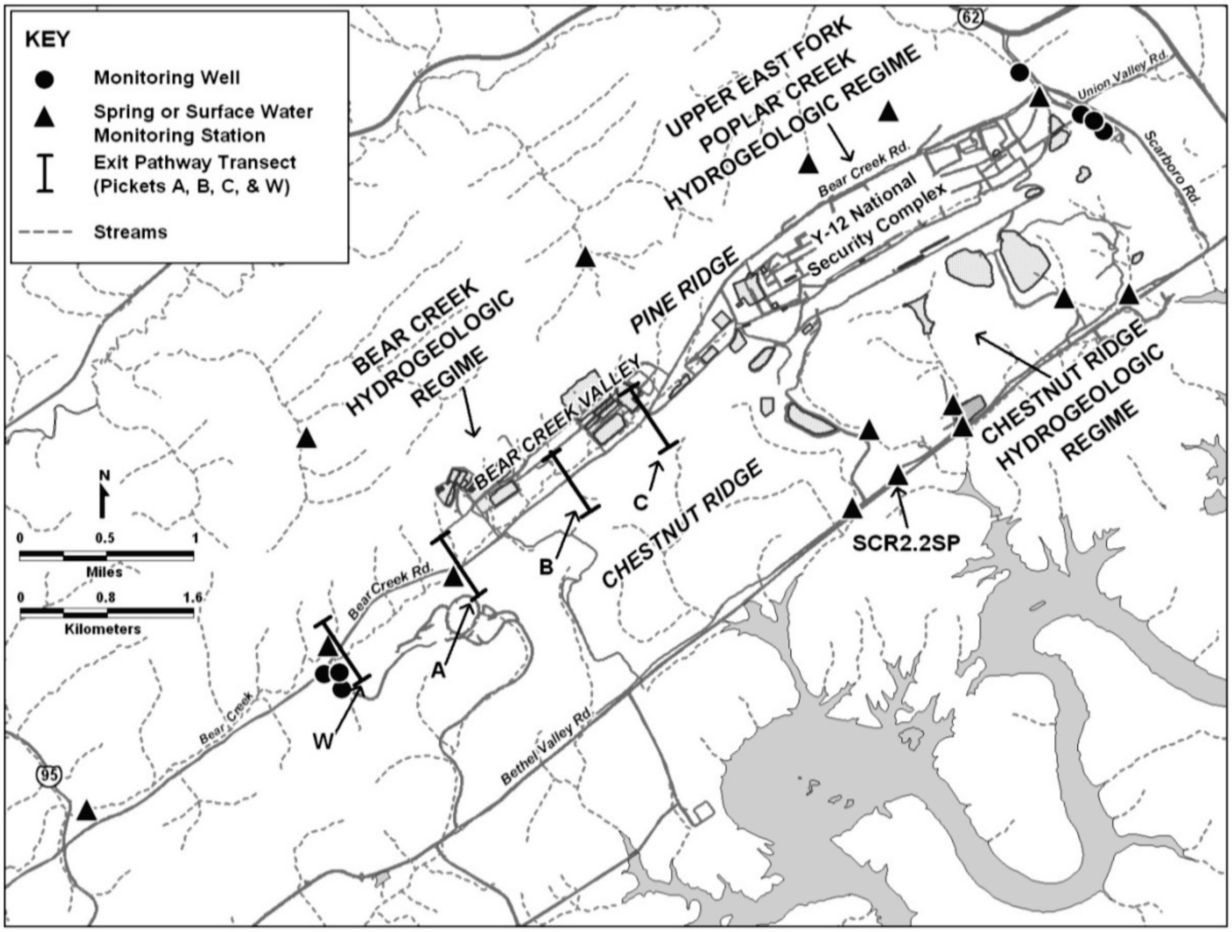


**Fig. 4.38. Location of Y-12 complex perimeter/exit pathway well, spring, and surface water monitoring stations.**

In an attempt to gain efficiencies in sampling activities, the Y-12 Groundwater Protection Program initiated the use of passive diffusion bag samplers in 2009 and continued to use them in 2010 (Fig. 4.39). The passive diffusion bag sampling method is suitable only for monitoring for the presence and concentration of selected volatile organic compounds in groundwater. This method involves suspending a polyethylene bag (semipermeable membrane) filled with deionized water at a selected depth within the monitored interval of the well and leaving the passive diffusion bag in place for a prescribed period (at least 2 weeks). The chemical concentration gradient between the uncontaminated deionized water in the passive diffusion bag and the surrounding contaminated groundwater induces volatile organic compounds in the groundwater to diffuse through the bag into the deionized water until equilibrium conditions are achieved. When retrieved, the water in the passive diffusion bag is decanted into volatile organic compound sample bottles and analyzed using standard procedures.

Comprehensive water quality results of groundwater monitoring activities at Y-12 in CY 2010 are presented in the annual *Calendar Year 2010 Groundwater Monitoring Report* (B&W Y-12 2011a).

Details of monitoring efforts performed specifically for CERCLA baseline and remediation evaluation are published in the FY 2010 and FY 2011 Water Resources Restoration Program sampling and analysis plans (Bechtel Jacobs Company 2009; Bechtel Jacobs Company 2010) and the 2010 and 2011 Remediation Effectiveness Reports (DOE 2010a and DOE 2011).

Groundwater monitoring compliance reporting to meet RCRA postclosure permit requirements can be found in the annual RCRA Groundwater Monitoring Report (Bechtel Jacobs Company 2011).

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**Fig. 4.39. Groundwater sampling at Y-12.**
Technicians use a passive diffusion bag to sample for volatile organic compounds in groundwater.

### 4.6.4 Y-12 Groundwater Quality

Historical monitoring efforts have shown that there are four primary contaminants that have impacted groundwater quality at the Y-12 Complex: nitrate, volatile organic compounds, metals, and radionuclides. Of those, volatile organic compounds are the most widespread due to their common use and disposal. Uranium and technetium-99 are the radionuclides of greatest concern. Trace metals, the least extensive groundwater contaminants, generally occur close to source areas. Historical data have shown that plumes from multiple-source units have mixed with one another and that contaminants (other than nitrate and technetium-99) are no longer easily associated with a single source.

#### 4.6.4.1 Upper East Fork Poplar Creek Hydrogeologic Regime

Among the three hydrogeologic regimes on the Y-12 Complex, the Upper East Fork regime encompasses most of the known and potential sources of surface water and groundwater contamination. A brief description of waste management sites is given in Table 4.19. Chemical constituents from the S-3 Site (primarily nitrate and technetium-99) and volatile organic compounds from multiple source areas are observed in the groundwater in the western portion of the Upper East Fork regime; groundwater in the eastern portion, including Union Valley, is predominantly contaminated with volatile organic compounds.

**Table 4.19. History of waste management units and underground storage tanks included in groundwater monitoring activities, Upper East Fork Poplar Creek Hydrogeologic Regime, 2010**

| Site | Historical data |
|---|---|
| New Hope Pond | Built in 1963. Regulated flow of water in Upper East Fork Poplar Creek before exiting the Y-12 Complex grounds. Sediments include PCBs, mercury, and uranium but not hazardous according to toxicity characteristic leaching procedure. An oil skimmer basin was built as part of the pond when constructed. This basin collected oil and floating debris from Upper East Fork Poplar Creek prior to discharge into the pond. Closed under RCRA in 1990 |
| Salvage Yard Scrap Metal Storage Area | Used from 1950 to present for scrap metal storage. Some metals contaminated with low levels of depleted or enriched uranium. Runoff and infiltration are the principal release mechanisms to groundwater. From 2009–2011 a CERCLA action to characterize and remove the scrap was performed. |
| Salvage Yard Oil/Solvent Drum Storage Area | Primary wastes included waste oils, solvents, uranium, and beryllium. Both closed under RCRA. Leaks and spills represent the primary contamination mechanisms for groundwater |
| Salvage Yard Oil Storage Tanks | Used from 1978 to 1986. Two tanks used to store PCB-contaminated oils, both within a diked area |
| Salvage Yard Drum Deheader | Used from 1959 to 1989. Sump tanks 2063-U, 2328-U, and 2329-U received residual drum contents. Sump leakage is a likely release mechanism to groundwater. |
| Building 81-10 Area | Mercury recovery facility operated from 1957 to 1962. Potential historical releases to groundwater and surface water from leaks and spills of liquid wastes or mercury. The building structure was demolished in 1995. |
| Rust Garage Area | Former vehicle and equipment maintenance area, including four former petroleum USTs. Petroleum product releases to groundwater are documented. |
| 9418-3 Uranium Oxide Vault | Originally contained an oil storage tank. Used from 1960 to 1964 to dispose of nonenriched uranium oxide. Leakage from the vault to groundwater is the likely release mechanism. |
| Fire Training Facility | Used for hands-on firefighting training. Sources of contamination to soil include flammable liquids and chlorinated solvents. Infiltration is the primary release mechanism to groundwater. |
| Beta-4 Security Pits | Used from 1968 to 1972 for disposal of classified materials, scrap metals, and liquid wastes. Site is closed and capped. Primary release mechanism to groundwater is infiltration. |
| S-2 Site | Used from 1945 to 1951. An unlined reservoir received liquid wastes. Infiltration is the primary release mechanism to groundwater. |
| Waste Coolant Processing Area | Used from 1977 to 1985. Former biodegradation facility used to treat waste coolants from various machining processes. Closed under RCRA in 1988 |
| East End Garage | Used from 1945 to 1989 as a vehicle fueling station. Five USTs used for petroleum fuel storage were excavated, 1989 to 1993. Petroleum releases to the groundwater are documented. |
| Coal Pile Trench | Located beneath the current steam plant coal pile. Disposals included solid materials (primarily alloys). Trench leachate is a potential release mechanism to groundwater. |

Abbreviations
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
UST = underground storage tank

## 4.6.4.1.1 Plume Delineation

Sources of groundwater contaminants monitored during CY 2010 include the S-2 Site, the Fire Training Facility, the S-3 Site, the Waste Coolant Processing Facility, petroleum USTs, New Hope Pond, the Beta-4 Security Pits, the Y-12 Salvage Yard, and process/production buildings throughout the Y-12 Complex. Although the S-3 Site, now closed under RCRA, is located west of the current hydrologic divide that separates the Upper East Fork regime from the Bear Creek regime, it has contributed to groundwater contamination in the western part of the Upper East Fork regime. As previously mentioned, contaminant plumes in the East Fork regime are elongated in shape due to the result of preferential transport of the contaminants parallel to strike (parallel to the valley axis) in both the Knox Aquifer and the fractured bedrock of the aquitard units.

### 4.6.4.1.2 Nitrate

Nitrate concentrations in groundwater at the Y-12 Complex exceed the 10-mg/L drinking water standard in a large part of the western portion of the Upper East Fork regime (a complete list of national drinking water standards is presented in Appendix D). The two primary sources of nitrate contamination are the S-2 and S-3 sites. The extent of the nitrate plume is essentially defined in the unconsolidated and shallow bedrock zones. In CY 2010, groundwater containing nitrate concentrations as high as 8,850 mg/L (Well GW-275) occurred in the shallow bedrock just east of the S-3 Site (Fig. 4.40). These results are consistent with results from previous years.

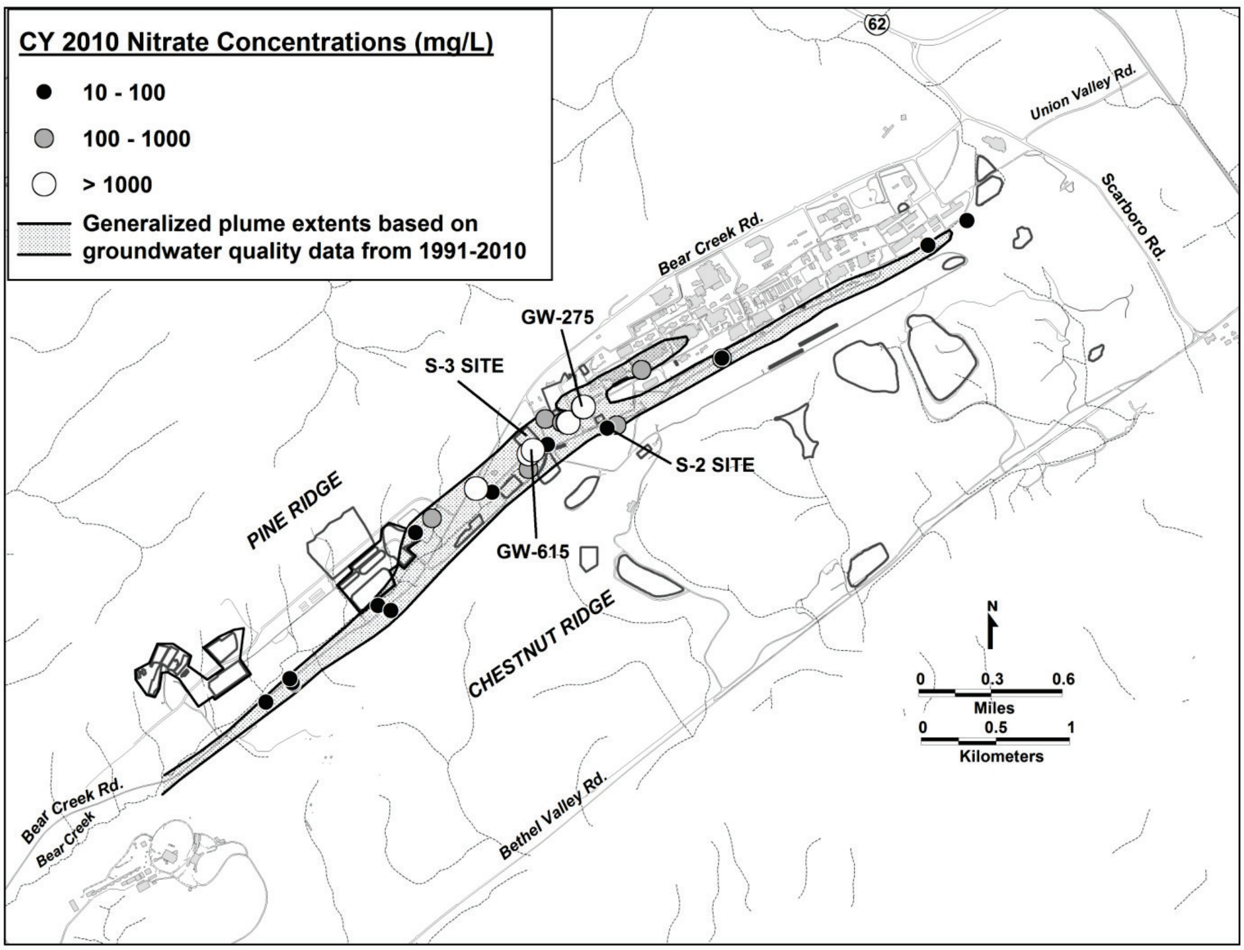


**Fig. 4.40. Nitrate observed in groundwater at the Y-12 Complex, 2010.**

### 4.6.4.1.3 Trace Metals

Concentrations of barium, beryllium, cadmium, chromium, lead, nickel, thallium, and uranium exceeded drinking water standards during CY 2010 in samples collected from various monitoring wells and surface water locations downgradient of the S-2 Site, the S-3 Site, the Salvage Yard, and throughout the complex. Trace metal concentrations above standards tend to occur only adjacent to the source areas due to their low solubility in natural water systems.

Concentrations of uranium exceed the standard (0.03 mg/L) in a number of source areas (e.g., S-3 Site, production areas and the Former Oil Skimmer Basin) and contribute to the uranium concentration in Upper East Fork Poplar Creek.

One trace metal absent from the list of those that exceed drinking water standards in CY 2010 is mercury. Due to very low solubility in water and a very high affinity for clay-rich soils such as those on the ORR, mercury exhibits little tendency for extensive transport in diffuse groundwater plumes. Additionally, the hydrogeologic complexities of the fracture/conduit flow system underlying Y-12 make it challenging to delineate the vertical and horizontal extents of any groundwater contamination. Elevated mercury concentrations (above analytical detection limits) in groundwater have been consistently observed only near known source areas (Fig. 4.41). In the past, mercury concentrations above the drinking water standard (0.002 mg/L) have been observed in groundwater monitoring wells at the identified source areas presented in Fig. 4.41.

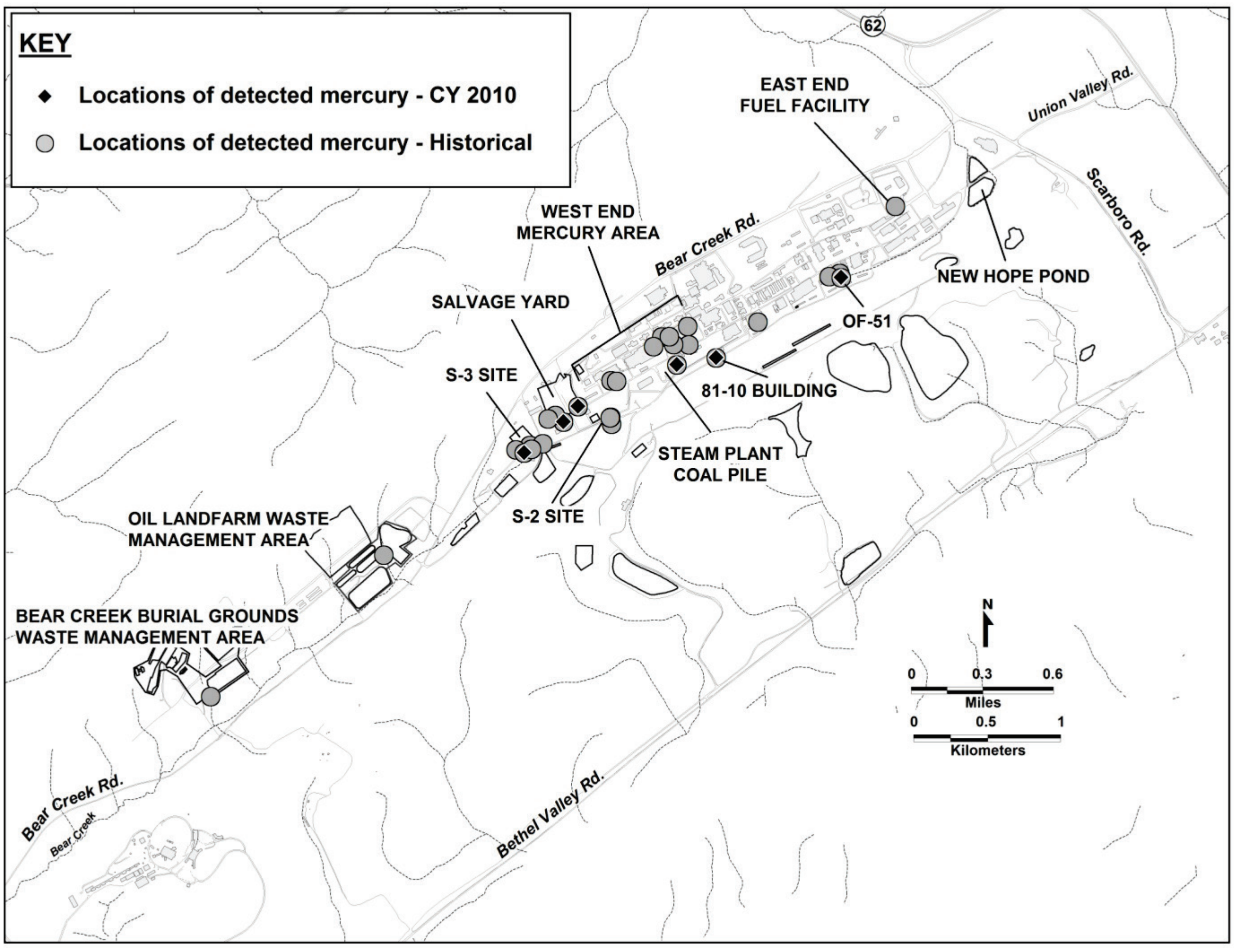


**Fig. 4.41. Y-12 groundwater monitoring stations where mercury has been detected.**

Due to past processes and disposal practices, mercury is a legacy contaminant at Y-12. It is commonly found in the soils near specific areas where it was used in processes in the 1950s and 1960s. This metal is a contaminant of concern in surface waters discharging from these areas. However, the transport mechanisms and connections between soil contamination, storm drains, shallow groundwater, buried tributaries, and stream channels are not well understood. When mercury is discharged from the storm drain system into the open creek channel, it is rapidly sequestered by particulate materials, and sediment/particle transport becomes the primary mechanism of mobility.

In tightly fractured shale and other noncarbonate bedrock, the natural flow paths are such that significant transport of mercury is not likely. In industrialized areas of Y-12 where the shallow subsurface has been reworked extensively, some preferential transport along building foundations and underground utilities is occurring. This is evident from elevated surface water concentrations of mercury.

Interconnection between the surface water and groundwater systems have been demonstrated by tracer investigations (DOE 2001) and the discharge of elevated concentrations of mercury from a buried spring (i.e., OF-51) adjacent to East Fork Poplar Creek. This discharge is presently captured and treated to remove the mercury at the Big Springs Water Treatment System. It has been proposed that dissolved mercury in the spring discharge arises from metallic mercury that has infiltrated into the solution cavities and conduits of the karstic Maynardville Limestone Formation below the water table. Although the subsurface inventory of metallic mercury in the limestone bedrock has not been determined, it could account for a part of the quantities lost during operational use. Subsurface storage may also minimize mobility of mercury due to decreased surface area (i.e., immobilized in filled seams, fractures, and conduits, in contrast to the surface exposure of mercury as particles) (Rothschild et al. 1984).

### 4.6.4.1.4 Volatile Organic Compounds

Because of the many legacy source areas, volatile organic compounds are the most widespread groundwater contaminants in the East Fork regime. Dissolved volatile organic compounds in the regime primarily consist of chlorinated solvents and petroleum hydrocarbons. In CY 2010, the highest summed concentration of dissolved chlorinated solvents (69,764 µg/L) was again found in groundwater at Well 55-3B in the western portion of the Y-12 Complex adjacent to manufacturing facilities. The highest dissolved concentration of petroleum hydrocarbons (19,070 µg/L) was obtained from Well GW-658 at the closed East End Garage.

The CY 2010 monitoring results generally confirm findings from the previous years of monitoring. A continuous dissolved plume of volatile organic compounds in groundwater in the bedrock zone extends eastward from the S-3 Site over the entire length of the regime (Fig. 4.42). The primary sources are the Waste Coolant Processing Facility, fuel facilities (Rust Garage and East End), Y-12 Salvage Yard, and other waste-disposal and production areas throughout the Y-12 Complex. Chloroethene compounds (tetrachloroethene, trichloroethene, dichloroethene, and vinyl chloride) tend to dominate the volatile organic plume composition in the western and central portions of the Y-12 Complex. However, tetrachloroethene and isomers of dichloroethene are almost ubiquitous throughout the extent of the plume, indicating many source areas. Chloromethane compounds (carbon tetrachloride, chloroform, and methylene chloride) are the predominant volatile organic compounds in the eastern portion of the Complex.

Variability in concentration trends of chlorinated volatile organic compounds near source areas is seen within the Upper East Fork regime. As seen in previous years, data from most of the monitoring wells have remained relatively constant (i.e., stable) or have decreased since 1988. Increasing trends are observed in monitoring wells associated with the Rust Garage and S-3 site in western Y-12, some production/process facilities in central areas, and the chloroethene component of the East End volatile organic compound plume, indicating that some portions of the plume are still showing activity.

Within the exit pathway the general trends are also stable or decreasing. The trends west of New Hope Pond are indicators that the contaminants from source areas are attenuating due to factors such as (1) dilution by surrounding uncontaminated groundwater, (2) dispersion through a complex network of fractures and conduits, (3) degradation by chemical or biological means, or (4) adsorption by surrounding bedrock and soil media. Wells to the southwest to southeast of New Hope Pond are displaying the effects of the pumping well (GW-845) operated to capture the plume prior to migration off of the ORR into Union Valley. Wells east of the New Hope Pond and north of Well GW-845 exhibit an increasing trend in volatile organic compound concentrations, indicating that little impact or attenuation from the plume capture system is apparent across lithologic units (perpendicular to strike). However, no subsequent downgradient detection of these compounds is apparent, so either migration is limited or some downgradient across-strike influence by the plume capture system is occurring.

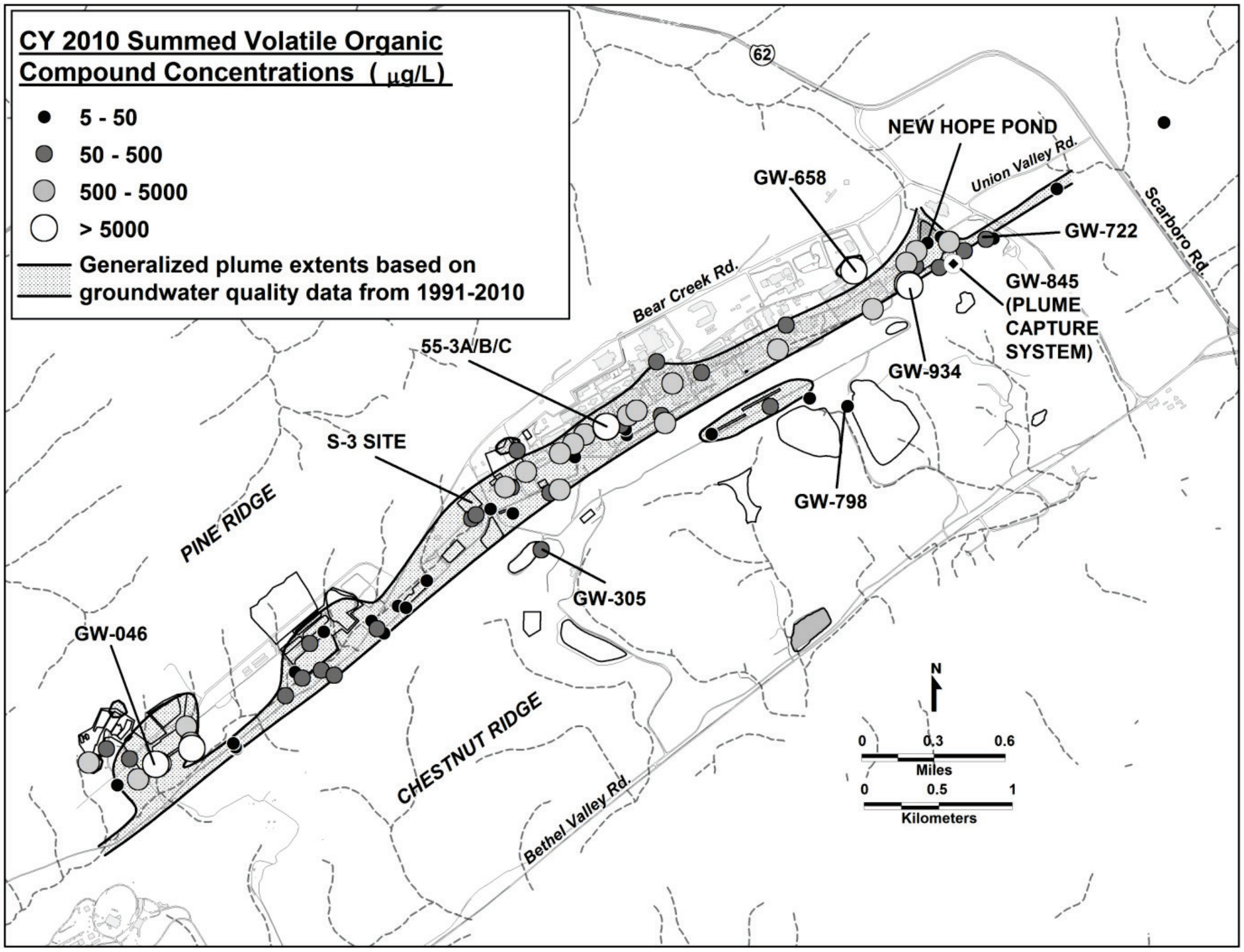


**Fig. 4.42. Summed volatile organic compounds observed in groundwater at the Y-12 Complex, 2010.**

A multiport Westbay Well, GW-934, was sampled by the Y-12 Groundwater Protection Program for the first time in August 2010. This well is located in the southeast area of Y-12 and was installed in 2002 for downgradient monitoring of a proposed (and never installed) injection well. The proposed injection well was to be installed and used to evaluate in situ technologies to enhance or improve performance of the pump and treat system. There are eight sample ports at various depths along the length of well GW-934. The summed concentrations of volatile organics in several of these ports and in an adjacent conventional well are significantly higher (368–5822 µg/L) than results obtained over the past 15 years from wells in this area. Also noteworthy is that the bottom port (378.8 ft below ground surface) of GW-934 yielded a summed VOC concentration of 5,453 µg/L, indicating that a deeper contaminant plume within the Maynardville Limestone persists upgradient of the plume capture system (GW-845).

### 4.6.4.1.5 Radionuclides

The primary alpha-emitting radionuclides found in the East Fork regime during CY 2010 are isotopes of uranium. Historical data show that gross alpha activity consistently exceeds the drinking water standard (15 pCi/L) and that it is most extensive in groundwater in the unconsolidated zone in the western portion of the Y-12 Complex near source areas such as the S-3 Site and the Y-12 Salvage Yard. However, the highest gross alpha activity (455 pCi/L) in groundwater continues to be observed on the east end of the Y-12 Complex in Well GW-154, east of the Former Oil Skimmer Basin (Fig. 4.43).

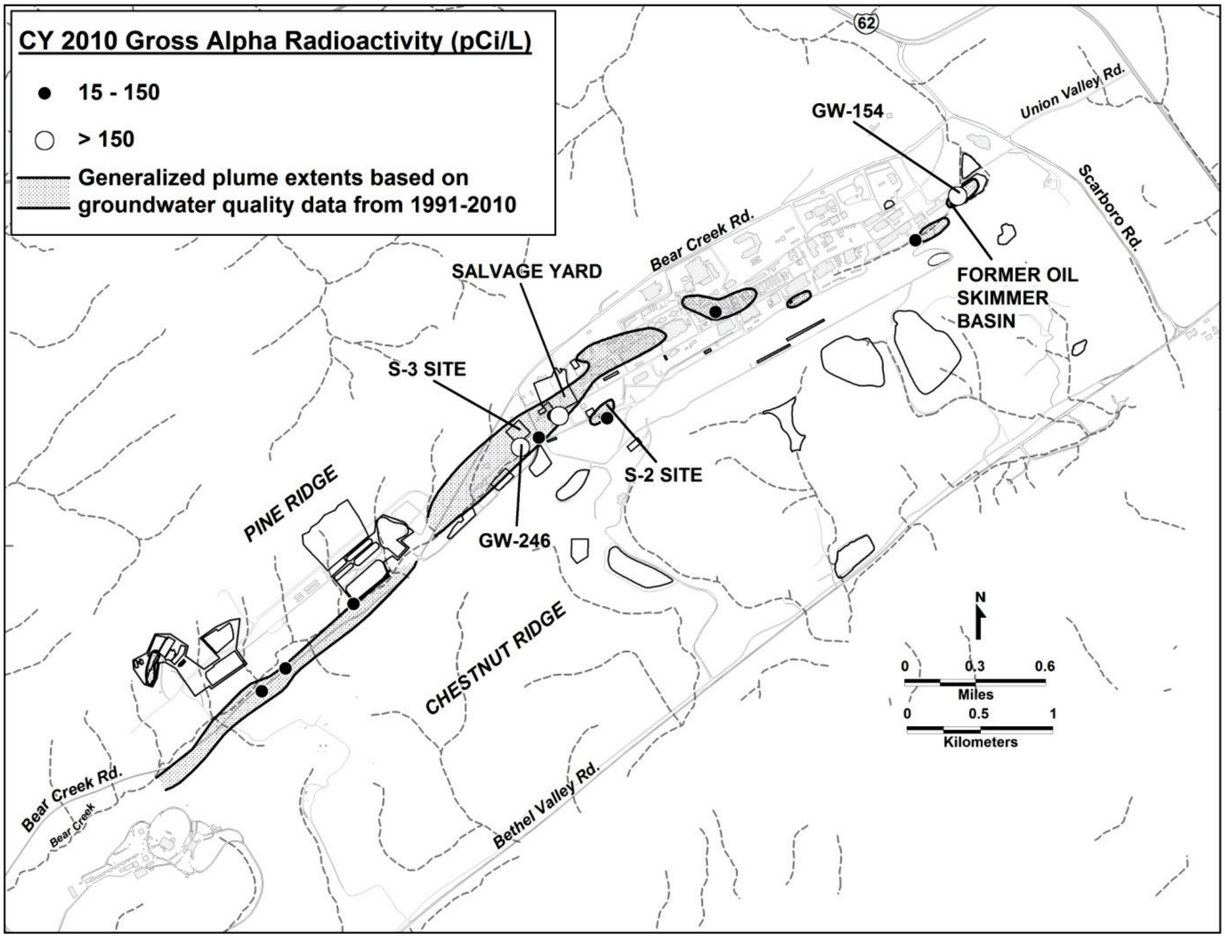


**Fig. 4.43. Gross alpha radioactivity observed in groundwater at the Y-12 Complex, 2010.**

The primary beta-emitting radionuclides observed in the Upper East Fork regime during CY 2010 were $^{99}$Tc, isotopes of uranium, and associated daughter products. Elevated gross beta activity in groundwater in the Upper East Fork regime shows a pattern similar to that observed for gross alpha activity, where $^{99}$Tc is the primary contaminant exceeding the screening level of 50 pCi/L in groundwater in the western portion of the regime, with the primary source being the S-3 Site (Fig. 4.44). The highest gross beta activity in groundwater was observed during CY 2010 from well GW-108 (14,800 pCi/L), east of the S-3 site.

## 4.6.4.1.6 Exit Pathway and Perimeter Monitoring

Data collected to date indicate that volatile organic compounds are the primary class of contaminants that are migrating through the exit pathways in the Upper East Fork regime. Historically, the compounds have been observed at depths of almost 500 ft in the Maynardville Limestone, the primary exit pathway on the east end of the Y-12 Complex. The deep fractures and solution channels that constitute flow paths within the Maynardville Limestone appear to be well connected, resulting in contaminant migration for substantial distances off the ORR into Union Valley to the east of the complex.

In addition to the intermediate-to-deep pathways within the Maynardville Limestone, shallow groundwater within the water table interval of that geologic unit near New Hope Pond, Lake Reality, and Upper East Fork Poplar Creek is also monitored. Historically, volatile organic compounds have been observed near Lake Reality from wells, a dewatering sump, and the New Hope Pond distribution channel underdrain. In that area, shallow groundwater flows north-northeast through the water table interval east of New Hope Pond and Lake Reality, following the path of the distribution channel for Upper East Fork Poplar Creek.

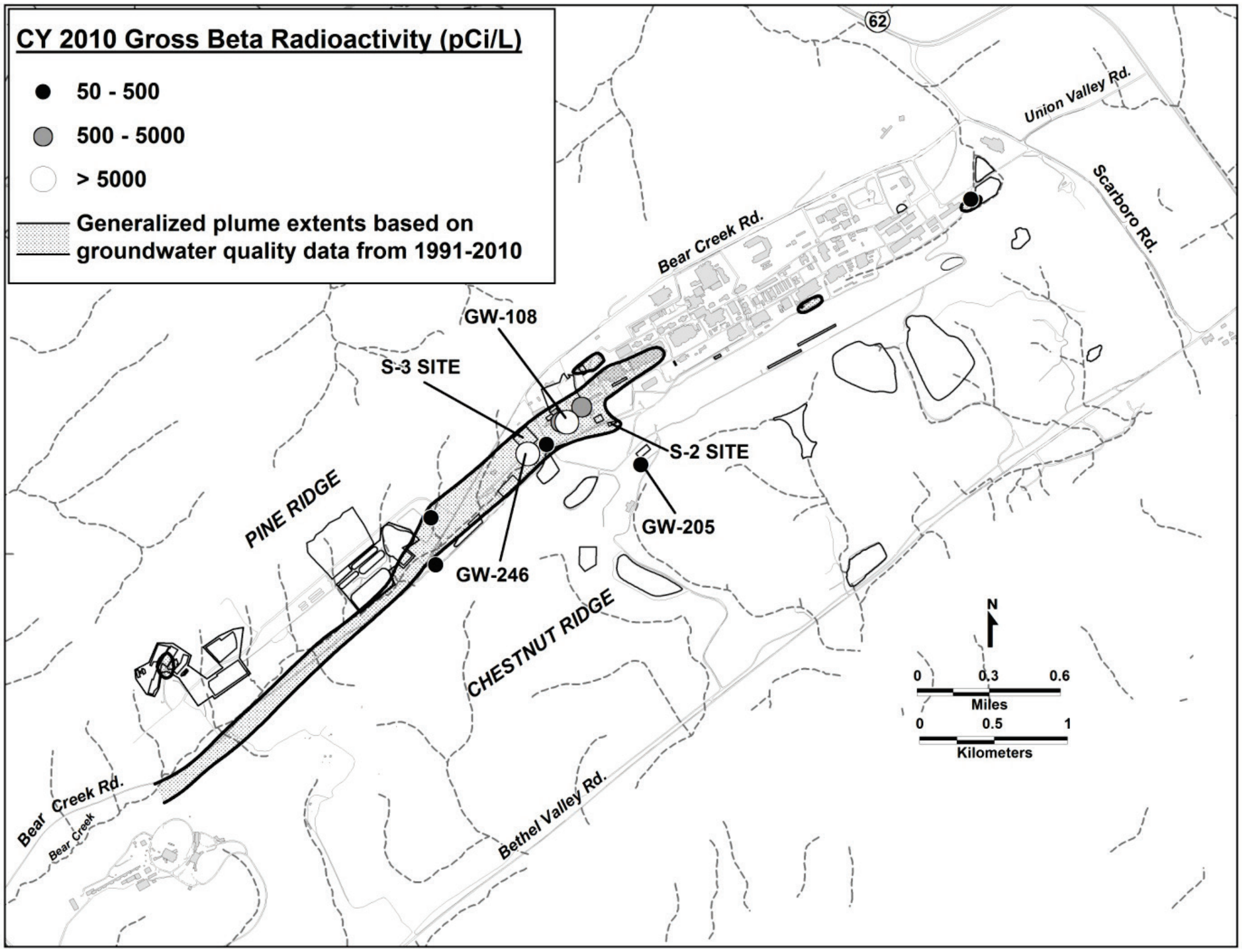


**Fig. 4.44. Gross beta radioactivity observed in groundwater at the Y-12 Complex, 2010.**

During CY 2010, the observed concentrations of volatile organic compounds at the New Hope Pond distribution channel underdrain continued to remain low (<25 µg/L). This may be because the continued operation of the groundwater plume–capture system in Well GW-845 southeast of New Hope Pond is effectively reducing the levels of volatile organic compounds in the area. The installation of the plume capture system was completed in June 2000. This system pumps groundwater from the intermediate bedrock depth to mitigate off-site migration of volatile organic compounds. Groundwater is continuously pumped from the Maynardville Limestone at about 95 L/min (25 gal/min), passes through a treatment system to remove the volatile organic compounds, and then discharges to Upper East Fork Poplar Creek.

Monitoring wells near Well GW-845 continue to show an encouraging response to the pumping activities. The multiport system installed in Well GW-722, approximately 153 m (500 ft) east and downgradient of Well GW-845, permits sampling of vertically discrete zones within the Maynardville Limestone between 27 and 130 m (87 and 425 ft) below ground surface. This well has been instrumental in characterizing the vertical extent of the east-end plume of volatile organic compounds and is critical in the evaluation of the effectiveness of the plume capture system. Monitoring results from the sampled zones in Well GW-722 indicate reductions in volatile organic compounds due to groundwater pumping upgradient at Well GW-845 (Fig. 4.45). Other wells also show decreases that may be attributable to the plume capture system operation. These indicators show that operation of the plume capture system is decreasing volatile organic compounds upgradient and downgradient of Well GW-845.

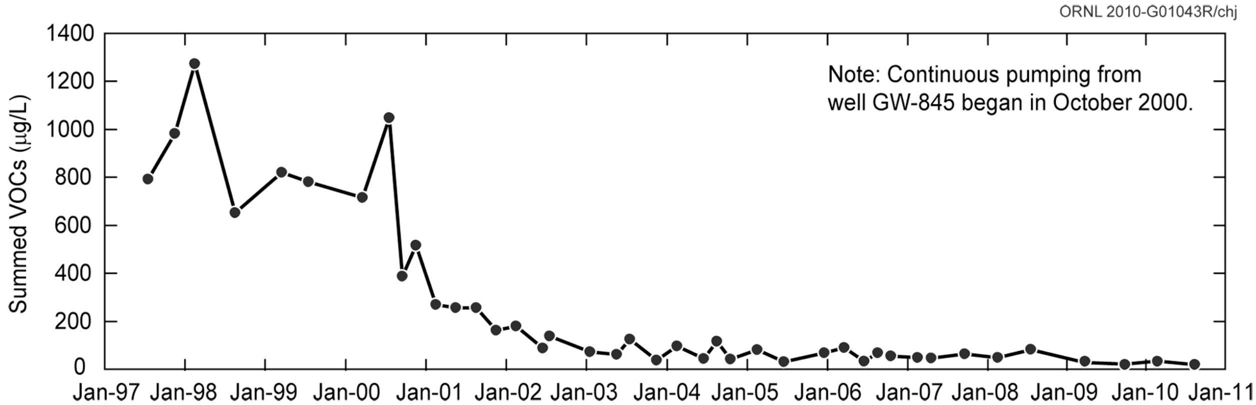


**Fig. 4.45. Decreasing summed volatile organic compounds observed in exit pathway Well GW-722-17 near the New Hope Pond, 2010.**

Upper East Fork Poplar Creek flows north from the Y-12 Complex through a large gap in Pine Ridge. Shallow groundwater moves through the exit pathway, and very strong upward vertical flow gradients exist. Continued monitoring of the wells since about 1990 has shown no indication of any contaminants moving via that exit pathway (Fig. 4.38). Only one shallow well was monitored in CY 2010, and no groundwater contaminants were observed.

Three sampling locations continue to be monitored north and northwest of the Y-12 Complex to evaluate possible contaminant transport from the ORR. Those locations are considered unlikely groundwater or surface water contaminant exit pathways; however, monitoring was performed due to previous public concerns regarding potential health impacts from Y-12 operations to nearby residences. One of the stations monitored a tributary that drains the north slope of Pine Ridge on the ORR and discharges into the adjacent Scarboro Community. One location monitors an upper reach of Mill Branch, which discharges into the residential areas along Wiltshire Drive. The remaining location monitors Gum Hollow Branch as it discharges from the ORR and flows adjacent to the Country Club Estates community. Samples were obtained and analyzed for metals, inorganic parameters, volatile organic compounds, and gross alpha and gross beta activities. No results exceeded a drinking water standard, nor were there any indications that contaminants were being discharged from the ORR into those communities.

### 4.6.4.1.7 Union Valley Monitoring

Groundwater monitoring data obtained during the early 1990s provided the first strong indication that volatile organic compounds were being transported off the ORR through the deep Maynardville Limestone exit pathway. The Upper East Fork Poplar Creek remedial investigation (DOE 1998) provided a discussion of the nature and extent of the volatile organic compounds.

In CY 2010, monitoring of locations in Union Valley continued, showing an overall decreasing trend in the concentrations of contaminants forming the groundwater contaminant plume in Union Valley.

Under the terms of an interim Record of Decision (ROD), administrative controls, such as restrictions on potential future groundwater use, have been established and maintained. Additionally, the previously discussed plume capture system (Well GW-845) was installed, and operations were initiated to mitigate the migration of groundwater contaminated with volatile organic compounds into Union Valley (DOE 2010a; DOE 2011).

In July 2006, the Agency for Toxic Substances and Diseases Registry, the principal federal public health agency charged with evaluating the human health effects of exposure to hazardous substances in the environment, published a report in which they evaluated groundwater contamination across the ORR (ATSDR 2006). In the report, it was acknowledged that extensive groundwater contamination exists throughout the ORR, but the authors concluded that there is no public health hazard from exposure to contaminated groundwater originating from the ORR. The Y-12 Complex east end volatile organic compound groundwater contaminant plume was acknowledged as the only confirmed off-site contaminant plume migrating across the ORR boundary. The report recognized that the institutional and administrative controls established in the ROD do not provide for reduction in toxicity, mobility, or volume of contaminants of concern, but they conclude that the controls are protective of public health to the extent that they limit or prevent community exposure to contaminated groundwater in Union Valley.

#### 4.6.4.2 Bear Creek Hydrogeologic Regime

Located west of the Y-12 Complex in Bear Creek Valley, the Bear Creek regime is bounded to the north by Pine Ridge and to the south by Chestnut Ridge. The regime encompasses the portion of Bear Creek Valley extending from the west end of the Y-12 Complex to State Highway 95. Table 4.20 describes each of the waste management sites within the Bear Creek regime.

##### 4.6.4.2.1 Plume Delineation

The primary groundwater contaminants in the Bear Creek regime are nitrate, trace metals, volatile organic compounds, and radionuclides. The S-3 Site is a source of all four contaminants. The Bear Creek Burial Grounds and the Oil Landfarm waste management areas are significant sources of uranium and other trace metals and volatile organic compounds. High concentrations of chlorinated hydrocarbons and PCBs have been observed as deep as 82 m (270 ft) below the Bear Creek Burial Grounds.

Contaminant plume boundaries are essentially defined in the bedrock formations that directly underlie many waste disposal areas in the Bear Creek regime, particularly the Nolichucky Shale. This fractured noncarbonate rock unit is positioned north of and adjacent to the exit pathway unit, the Maynardville Limestone. The elongated shape of the contaminant plumes in the Bear Creek regime is the result of preferential transport of the contaminants parallel to strike (parallel to the valley axis) in both the Maynardville Limestone and the fractured noncarbonate rock.

##### 4.6.4.2.2 Nitrate

Unlike many groundwater contaminants, nitrate is highly soluble and moves easily with groundwater. The limits of the nitrate plume probably define the maximum extent of subsurface contamination in the Bear Creek regime. The horizontal extent of the nitrate plume is essentially defined in groundwater in the upper to intermediate bedrock intervals of the aquitard and aquifer [less than 92 m (300 ft) below the ground surface].

Data obtained during CY 2010 indicate that nitrate concentrations in groundwater exceed the drinking water standard in an area that extends west from the source area at the S-3 Site. The highest nitrate concentration (10,999 mg/L) was observed at Well GW-615 adjacent to the S-3 Site at a depth of 68 m (223 ft) below ground surface (Fig. 4.40), indicating that high concentrations persist deeper in the subsurface groundwater system. In previous years, elevated concentrations of nitrate have been observed as deep as 226 m (740 ft) below ground surface.

**Table 4.20. History of waste management units included in CY 2010 groundwater monitoring activities, Bear Creek Hydrogeologic Regime**

| Site | Historical data |
|---|---|
| S-3 Site | Four unlined surface impoundments constructed in 1951. Received liquid nitric acid/uranium–bearing wastes via the Nitric Acid Pipeline until 1983. Closed and capped under RCRA in 1988. Infiltration was the primary release mechanism to groundwater |
| Oil Landfarm | Operated from 1973 to 1982. Received waste oils and coolants tainted with metals and PCBs. Closed and capped under RCRA in 1989. Infiltration was the primary release mechanism to groundwater |
| Boneyard | Used from 1943 to 1970. Unlined shallow trenches used to dispose of construction debris and to burn magnesium chips and wood. Excavated and restored in 2002–2003 as part of Boneyard/Burnyard remedial activities |
| Burnyard | Used from 1943 to 1968. Wastes, metal shavings, solvents, oils, and laboratory chemicals were burned in two unlined trenches. Excavated and restored in 2002–2003 |
| Hazardous Chemical Disposal Area | Used from 1975 to 1981. Built over the Burnyard. Handled compressed gas cylinders and reactive chemicals. Residues placed in a small, unlined pit. The northwest portion was excavated and restored in 2002–2003 as part of Boneyard/Burnyard remedial activities |
| Sanitary Landfill I | Used from 1968 to 1982. Nonhazardous industrial landfill. May be a source of certain contaminants to groundwater. Closed and capped under TDEC requirements in 1985. Evaluation under CERCLA determined that no further action was need. |
| Bear Creek Burial Grounds: A, C, and Walk-in Pits | A and C received waste oils, coolants, beryllium and uranium, various metallic wastes, and asbestos into unlined trenches and standpipes. Walk-in Pits received chemical wastes, shock-sensitive reagents, and uranium saw fines. Activities ceased in 1981. Final closure certified for A (1989), C (1993), and the Walk-in Pits (1995). Infiltration is the primary release mechanism to groundwater |
| Bear Creek Burial Grounds: B, D, E, J, and Oil Retention Ponds 1 and 2 | Burial Grounds B, D, E, and J, unlined trenches, received depleted uranium metal and oxides and minor amounts of debris and inorganic salts. Ponds 1 and 2, built in 1971 and 1972, respectively, captured waste oils seeping into two Bear Creek tributaries. The ponds were closed and capped under RCRA in 1989. Certification of closure and capping of Burial Grounds B and part of C was granted February 1995 |
| Rust Spoil Area | Used from 1975 to 1983 for disposal of construction debris, but may have included materials bearing solvents, asbestos, mercury, and uranium. Closed under RCRA in 1984. Site is a source of volatile organic compounds to shallow groundwater according to CERCLA remedial investigation |
| Spoil Area I | Used from 1980 to 1988 for disposal of construction debris and other stable, nonradioactive wastes. Permitted under TDEC solid waste management regulations in 1986; closure began shortly thereafter. Soil contamination is of primary concern. CERCLA record of decision issued in 1997 |
| SY-200 Yard | Used from 1950 to 1986 for equipment and materials storage. No documented waste disposal at the site occurred. Leaks, spills, and soil contamination are concerns. CERCLA ROD issued in 1996 |
| Above-Grade LLW Storage Facility | Constructed in 1993. Consists of six above-grade storage pads used to store inert, low-level radioactive debris and solid wastes packaged in steel containers |
| Environmental Management Waste Management Facility | Constructed in 2002. CERCLA Landfill receiving legacy wastes from ETTP, ORNL, Y-12, and nearby offsite CERCLA action sites within the state of Tennessee. |

Abbreviations
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
LLW = low-level radioactive waste
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation

### 4.6.4.2.3 Trace Metals

During CY 2010, arsenic, uranium, barium, cadmium, chromium, lead, beryllium, and nickel were identified from groundwater monitoring as the trace metal contaminants in the Bear Creek regime that exceeded drinking water standards. Historically, elevated concentrations of many of the trace metals were observed at shallow depths near the S-3 Site. In the Bear Creek regime, where natural geochemical conditions prevail, the trace metals may occur sporadically and in close association with source areas because conditions are typically not favorable for dissolution and migration. Disposal of acidic liquid wastes at the S-3 Site reduced the pH of the groundwater, which allows the metals to remain in solution longer and migrate further from the source area.

The most prevalent trace metal contaminant observed within the Bear Creek regime is uranium, indicating that geochemical conditions are favorable for its migration. Early characterization indicated that the Boneyard/Burnyard site was the primary source of uranium contamination of surface water and groundwater. Historically, uranium has been observed at concentrations exceeding the drinking water standard of 0.03 mg/L in shallow monitoring wells, springs, and surface water locations downgradient from all of the waste areas. In 2003, the final remedial actions at the Boneyard/Burnyard were performed with the objective of removing materials contributing to surface water and groundwater contamination to meet existing ROD goals. Approximately 65,752 $m^3$ (86,000 $yd^3$) of waste materials was excavated and placed in the EMWMF (DOE 2007). There were significant decreases in uranium concentration and flux in the surface water tributary immediately downstream of the Boneyard/Burnyard (NT-3), which indicate that the remedial actions performed from 2002 to 2003 were successful in removing much of a primary source of uranium in Bear Creek Valley. However, beginning in 2007, flow proportionate composite samples from NT-3 show an increase in the uranium flux that continues to be observed. These increases indicate that even with overall decreasing uranium concentrations (Table 4.21), certain areas still present a significant impact to the overall health of Bear Creek.

Additional monitoring has been initiated to attempt to determine uranium inputs to the stream from source areas and the karst groundwater system underlying Bear Creek. Other trace metal contaminants that have been observed in the Bear Creek regime are mercury, selenium, strontium, thallium, and zinc. Concentrations have commonly exceeded background values in groundwater near contaminant source areas.

**Table 4.21. Nitrate and uranium concentrations in Bear Creek**[a]

| Bear Creek Monitoring Station (distance from S-3 site) | Contaminant | Average Concentration (mg/L) | | | | |
|---|---|---|---|---|---|---|
| | | 1990–1993 | 1994–1997 | 1998–2001 | 2002–2005 | 2006–2010 |
| BCK[b]-11.84 to 11.97 | Nitrate | 119 | 80 | 80 | 79.5 | 42.2 |
| (~0.5 miles downstream) | Uranium | 0.196 | 0.134 | 0.139 | 0.133 | 0.128 |
| BCK-09.20 to 09.47 | Nitrate | 16.4 | 9.6 | 10.6 | 11.3 | 8.2 |
| (~2 miles downstream) | Uranium | 0.091 | 0.094 | 0.171 | 0.092 | 0.060 |
| BCK-04.55 | Nitrate | 4.6 | 3.6 | 2.6 | 2.9 | 1.1 |
| (~5 miles downstream) | Uranium | 0.034 | 0.031 | 0.036 | 0.026 | 0.017 |

[a] Excludes results that do not meet data quality objectives.
[b] BCK = Bear Creek kilometer

### 4.6.4.2.4 Volatile Organic Compounds

Volatile organic compounds are widespread in groundwater in the Bear Creek regime. The primary compounds are tetrachloroethene, trichloroethene, 1,2-dichloroethene, 1,1-dichloroethane, and vinyl chloride. In most areas, they are dissolved in the groundwater and can occur in bedrock at depths up to 92 m (300 ft) below ground surface. Groundwater in the fractured bedrock of the aquitard units that contains detectable levels of volatile organic compounds occurs primarily within about 305 m (1,000 ft) of the source areas. The highest concentrations observed in CY 2010 in the Bear Creek regime occurred in the intermediate bedrock zone at the Bear Creek Burial Ground waste management area, with a maximum summed volatile organic compound concentration of 9,460 µg/L in Well GW-046 (Fig. 4.42).

High concentrations of volatile organic compounds like this and in other near source wells, coupled with increasing trends observed downgradient of the Bear Creek Burial Ground waste management area in the clastic (noncarbonated) dominated fractured bedrock of the aquitard units (Fig. 4.46), indicate that a considerable mass of dense non-aqueous phase organic compounds is still present at a depth below the Bear Creek Burial Grounds, providing a source for dissolved phase migration of volatile organic compounds. This migration through the fractured aquitard units parallel to the valley axis and toward the exit pathway (Maynardville Limestone) is occurring in both the unconsolidated and bedrock intervals.

Significant transport of volatile organic compounds has occurred in the Maynardville Limestone. Data obtained from exit pathway monitoring locations show that in the shallow groundwater interval, an apparently continuous dissolved plume extends at least 2,440 m (8,000 ft) westward from the S-3 Site to just southeast of the Bear Creek Burial Ground waste management area.

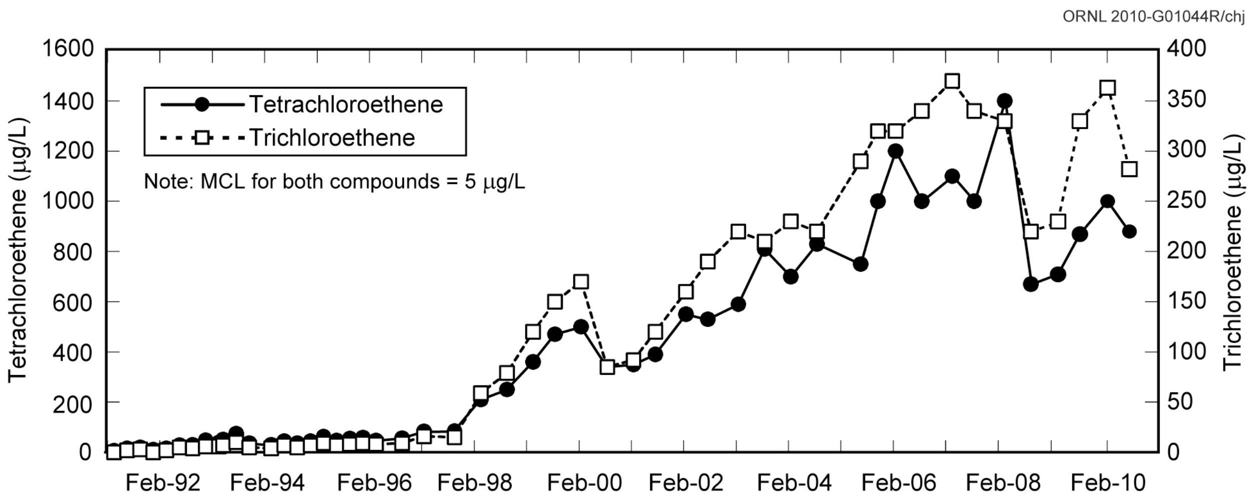


**Fig. 4.46. Increasing volatile organic compounds observed in groundwater at Well GW-627 west and downgradient of the Bear Creek Burial Grounds, 2010.**

### 4.6.4.2.5 Radionuclides

The primary radionuclides identified in the Bear Creek regime are isotopes of uranium and $^{99}$Tc. Neptunium, americium, radium, strontium, thorium, plutonium, and tritium are secondary and less widespread radionuclides, primarily present in groundwater near the S-3 Site. Evaluations of their extent in groundwater in the Bear Creek regime during CY 2010 were based primarily on measurements of gross alpha activity and gross beta activity. If the annual average gross alpha activity in groundwater samples from a well exceeded 15 pCi/L (the drinking water standard for gross alpha activity), then one (or more) of the alpha-emitting radionuclides (e.g., uranium) was assumed to be present at elevated levels in the groundwater monitored by the well. A similar rationale was used for annual average gross beta activity that exceeded 50 pCi/L. Technetium-99, a more volatile radionuclide, is qualitatively screened by gross beta activity analysis and, at certain monitoring locations, is evaluated isotopically.

Groundwater with elevated levels of gross alpha activity occurs near the S-3 Site and the Oil Landfarm and Bear Creek Burial Grounds waste management areas. In the bedrock interval, gross alpha activity exceeds 15 pCi/L in groundwater in the fractured bedrock of the aquitard units only near source areas (Fig. 4.43). Data obtained from exit pathway monitoring stations during CY 2010 show that gross alpha activity in groundwater in the Maynardville Limestone and in the surface waters of Bear Creek exceeds the drinking water standard for over 2,286 m (7,500 ft) west of the S-3 Site. The highest gross alpha activity observed in CY 2010 was 350 pCi/L in Well GW-246 located adjacent to the S-3 Site.

The distribution of gross beta radioactivity in groundwater is similar to that of gross alpha radioactivity. During CY 2010, the lateral extent of gross beta activity within the exit pathway groundwater interval and surface water above the drinking water standard has decreased from those observed in recent years. Gross beta activities exceeded 50 pCi/L within the Maynardville Limestone exit pathway for 914 m (3,000 ft) from the S-3 Site (Fig. 4.44). This apparent oscillation in the plume length is dependent on rainfall and other seasonal factors The highest gross beta activity in groundwater in the Bear Creek Regime in 2010 was 14,000 pCi/L at Well GW-246 located adjacent to the S-3 Site.

#### 4.6.4.2.6 Exit Pathway and Perimeter Monitoring

Exit pathway monitoring began in 1990 to provide data on the quality of groundwater and surface water exiting the Bear Creek regime. The Maynardville Limestone is the primary exit pathway for groundwater. Bear Creek, which flows across the Maynardville Limestone in much of the Bear Creek regime, is the principal exit pathway for surface water. Various studies have shown that the surface water in Bear Creek, the springs along the valley floor, and the groundwater in the Maynardville Limestone are hydraulically connected. Surveys have been performed that identify gaining (groundwater discharging into surface waters) and losing (surface water discharging into a groundwater system) reaches of Bear Creek. The western exit pathway well transect (Picket W) serves as the perimeter well location for the Bear Creek regime (Fig. 4.38).

Exit pathway monitoring consists of continued monitoring at four well transects (pickets) and selected springs and surface water stations. Groundwater quality data obtained during CY 2010 from the exit pathway monitoring wells indicate that groundwater is contaminated above drinking water standards in the Maynardville Limestone as far west as Picket A and trends are generally decreasing (Fig. 4.47).

Surface water samples collected during CY 2010 indicate that water in Bear Creek contains many of the compounds found in the groundwater. Additionally, nitrate and uranium concentrations and gross beta activities exceeding their respective drinking water standards have been observed in surface water west of the burial grounds as far as Picket W. The concentrations in the creek decrease with distance downstream of the waste disposal sites (Table 4.21). Even though increases in uranium flux have been observed in surface water, which will require additional evaluation to pinpoint ungauged sources, individual monitoring locations along Bear Creek also show a general decrease in concentration with respect to time.

### 4.6.4.3 Chestnut Ridge Hydrogeologic Regime

The Chestnut Ridge Hydrogeologic Regime is flanked to the north by Bear Creek Valley and to the south by Bethel Valley Road (Fig. 4.36). The regime encompasses the portion of Chestnut Ridge extending from Scarboro Road, east of the complex, to Dunaway Branch, located just west of Industrial Landfill II.

The Chestnut Ridge Security Pits area is the only documented source of groundwater contamination in the regime. Contamination from the Security Pits is distinct and does not mingle with plumes from other sources. Table 4.22 summarizes the operational history of waste management units in the regime.

#### 4.6.4.3.1 Plume Delineation

Through extensive monitoring of the wells on Chestnut Ridge, the horizontal extent of the volatile organic compound plume at the Chestnut Ridge Security Pits seems to be reasonably well defined in the water table and shallow bedrock zones. With two possible exceptions, historical monitoring indicates that the volatile organic compound plume from the Chestnut Ridge Security Pits has not migrated very far in any direction [305 m (<1,000 ft)]. Groundwater quality data obtained during CY 2010 indicate that the western lateral extent of the plume of volatile organic compounds at the site has not changed significantly from previous years. The continued observation of volatile organic compound contaminants over the past several years at a well approximately 458 m (1,500 ft) southeast of the Chestnut Ridge Security Pits shows that some migration of the eastern plume is apparent. Additionally, dye tracer test results and the intermittent detection of volatile organic compounds (similar to those found in wells adjacent to the Chestnut Ridge Security Pits) at a natural spring approximately 2745 m (9,000 ft) to the east and along geologic strike may indicate that Chestnut Ridge Security Pits groundwater contaminants have migrated much further than the monitoring well network indicates.

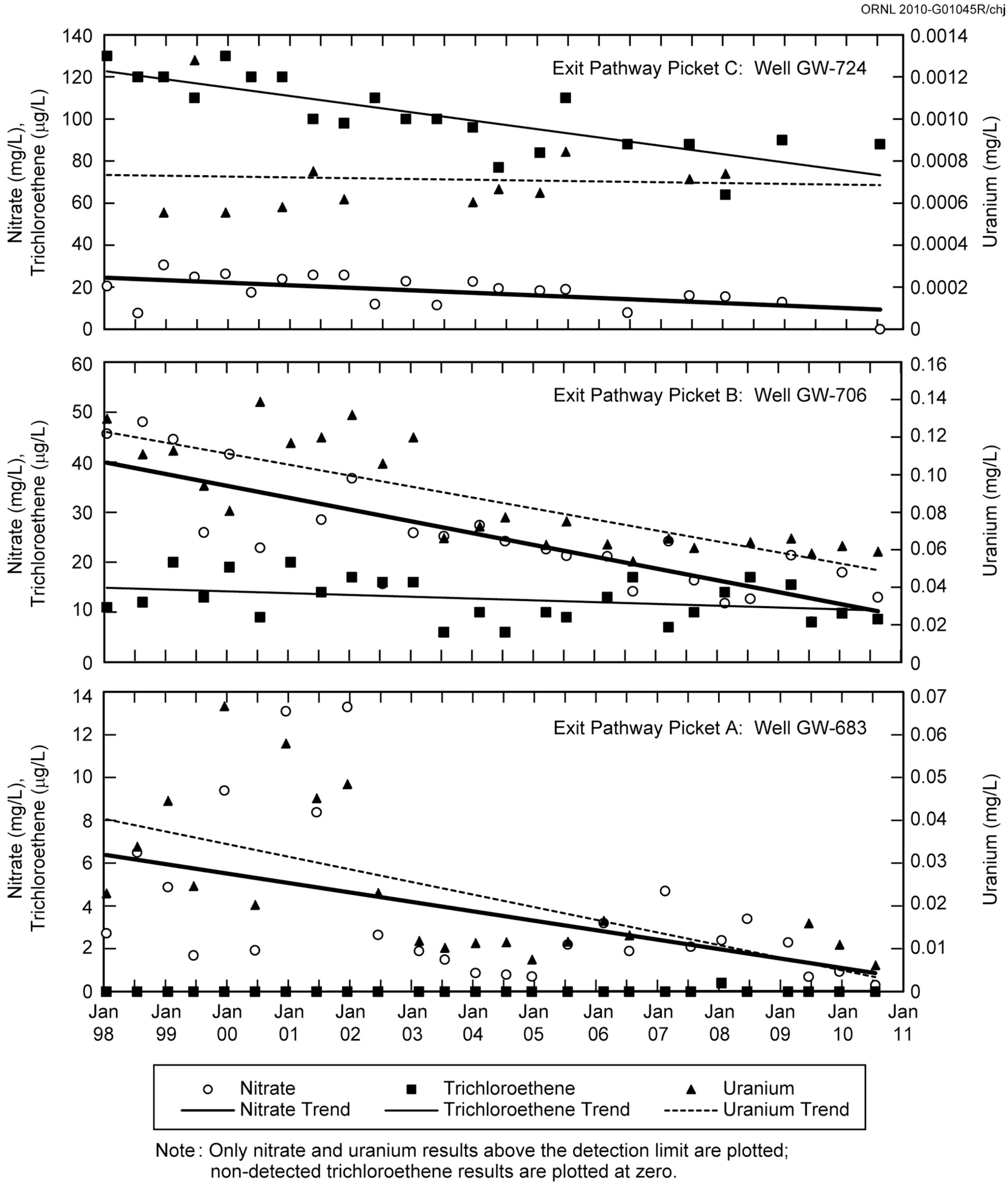


**Fig. 4.47. CY 2010 concentrations of selected contaminants in exit pathway monitoring wells GW-724, GW-706, and GW-683 in the Bear Creek Hydrogeologic Regime.**

**Table 4.22. History of waste management units included in groundwater monitoring activities, Chestnut Ridge Hydrogeologic Regime, 2010**

| Site | Historical data |
|---|---|
| Chestnut Ridge Sediment Disposal Basin | Operated from 1973 to 1989. Received soil and sediment from New Hope Pond and mercury-contaminated soils from the Y-12 Complex. Site was closed under RCRA in 1989. Not a documented source of groundwater contamination |
| Kerr Hollow Quarry | Operated from 1940s to 1988. Used for the disposal of reactive materials, compressed gas cylinders, and various debris. RCRA closure (waste removal) was conducted between 1990 and 1993. Certification of closure with some wastes remaining in place was approved by TDEC February 1995 |
| Chestnut Ridge Security Pits | Operated from 1973 to 1988. Series of trenches for disposal of classified materials, liquid wastes, thorium, uranium, heavy metals, and various debris. Closed under RCRA in 1989. Infiltration is the primary release mechanism to groundwater |
| United Nuclear Corporation Site | Received about 29,000 drums of cement-fixed sludges and soils demolition materials and low-level radioactive contaminated soils. Closed in 1992; CERCLA record of decision has been issued |
| Industrial Landfill II | Operated from 1983–1995. Central sanitary landfill for the Oak Ridge Reservation. Detection monitoring under postclosure plan has been ongoing since 1996 |
| Industrial Landfill IV | Opened for operations in 1989. Permitted to receive only nonhazardous industrial solid wastes. Detection monitoring under TDEC solid-waste-management regulations has been ongoing since 1988. Assessment monitoring began in 2008 because of consistent exceedence of a TDEC Groundwater Protection Standard |
| Industrial Landfill V | Facility completed and initiated operations April 1994. Currently under TDEC solid-waste-management detection monitoring |
| Construction/Demolition Landfill VI | Facility operated from December 1993 to November 2003. The postclosure period ended and the permit was terminated March 2007 |
| Construction/Demolition Landfill VII | Facility construction completed in December 1994. TDEC granted approval to operate January 1995. Permit-required detection monitoring per TDEC was temporarily suspended October 1997 pending closure of construction/demolition Landfill VI. Reopened and began waste disposal operations in April 2001 |
| Filled Coal Ash Pond | Site received Y-12 Steam Plant coal ash slurries from 1955–1968. A CERCLA record of decision has been issued. Remedial action complete |
| East Chestnut Ridge Waste Pile | Operated from 1987 to 1989 to store contaminated soil and spoil material generated from environmental restoration activities at Y-12. Closed under RCRA in 2005 and incorporated into RCRA Postclosure Permit issued by TDEC in 2006. |

Abbreviations

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
RCRA = Resource Conservation and Recovery Act
TDEC = Tennessee Department of Environment and Conservation

#### 4.6.4.3.2 Nitrate

Nitrate concentrations were below the drinking water standard at all monitoring stations in the Chestnut Ridge Hydrogeologic Regime.

### 4.6.4.3.3 Trace Metals

A chromium result exceeding the drinking water standard (0.1 mg/L) was observed in a groundwater sample from one well (GW-141) at the Industrial Landfill IV (Fig. 4.35) with a maximum concentration of 0.113 mg/L. The presence of this trace metal in groundwater at the Y-12 Complex, with the exception of the S-3 Site, is not due to historical waste disposal but to corrosion of well casings. Chromium is a primary component of stainless steel, and its presence indicates the occurrence of corrosion and subsequent dissolution of stainless steel well casing and screen materials due to chemical or biochemical processes (LMES 1999).

### 4.6.4.3.4 Volatile Organic Compounds

Monitoring of volatile organic compounds in groundwater attributable to the Chestnut Ridge Security Pits has been in progress since 1987. A review of historical data indicates that concentrations of volatile organic compounds in groundwater at the site have generally decreased since 1988. However, a shallow increasing trend in volatile organic compounds in groundwater samples from monitoring well GW-798 to the southeast and downgradient of the Chestnut Ridge Security Pits has been developing since CY 2000 (Fig. 4.42). Elevated concentrations observed in GW-798 appear to fluctuate with changing precipitation conditions. The volatile organic compounds detected in CY 2010 in Well GW-798 continue to be characteristic of the Chestnut Ridge Security Pits plume.

At Industrial Landfill IV, a number of volatile organic compounds have been observed since 1992. Monitoring well GW-305, located immediately to the southeast of the facility, has historically displayed concentrations of compounds below applicable drinking water standards, but the concentrations have exhibited a shallow increasing trend. In CY 2010, samples continue to exceed the drinking water standard for 1,1-dichloroethene (7 μg/L). This has resulted in an increased level of monitoring to further evaluate the trend.

### 4.6.4.3.5 Radionuclides

In CY 2010, no gross alpha activity above the drinking water standard of 15 pCi/L was observed in any groundwater samples collected in the Chestnut Ridge Hydrogeologic Regime. Gross beta activities continue to exceed the screening level of 50 pCi/L at monitoring well GW-205 (Fig. 4.44) at the United Nuclear Corporation site (the maximum detected activity was 50.6 pCi/L). This location has consistently exceeded the screening level since August 1999. Isotopic analyses show a correlative increase in the beta-emitting radionuclide $^{40}K$, which is not a known contaminant of concern at the United Nuclear Corporation Site. The source of the radioisotope is not known.

### 4.6.4.3.6 Exit Pathway and Perimeter Monitoring

Contaminant and groundwater flow paths in the karst bedrock underlying the Chestnut Ridge regime have not been well characterized by conventional monitoring techniques. A number of tracer studies have been conducted that show groundwater from Chestnut Ridge discharging into Scarboro Creek and other tributaries that feed into Melton Hill Lake. However, no springs or surface streams that represent discharge points for groundwater have been conclusively correlated to a waste management unit at Y-12 that is a known or potential groundwater contaminant source. Water quality from a spring along Scarboro Creek is monitored quarterly by the TDEC DOE Oversight Office, and trace concentrations of volatile organic compounds are intermittently detected. The detected volatile organic compounds are suspected to originate from the Chestnut Ridge Security Pits; however, this has not been confirmed.

Monitoring of natural groundwater exit pathways is a basic monitoring strategy in a karst regime such as that of Chestnut Ridge. Perimeter springs and surface water tributaries were monitored to determine whether contaminants are exiting the downgradient (southern) side of the regime. Five springs and three surface water monitoring locations were sampled during CY 2010. No contaminants were detected in any of these natural discharge points above drinking water standards.

### 4.6.5 Quality Assurance

All groundwater monitoring is performed under quality controls to ensure that representative samples and analytical results are obtained. Since there are a number of organizations responsible for performing groundwater sampling and analysis activities to meet separate requirements, there may be some minor differences in sampling and analysis procedures and methodology, but ultimately the final results are comparable for use by all projects and programs. This permits the integrated use of groundwater quality data obtained at the Y-12 Complex.

A number of quality assurance measures are performed to ensure accurate, consistent, and comparable groundwater results. These measures are described in sampling and analysis plans and include the following:

- Groundwater sampling is performed across the Y-12 Complex using a number of sampling methods and procedures. The predominant method of sampling is by using a low-flow minimum drawdown method. Using this method, a sample is obtained from a discrete depth interval without introducing stagnant water from the well casing. Groundwater is pumped from the well at a flow rate low enough to minimize drawdown of the water level in the well; field readings are also taken to ensure that the sample is representative of the groundwater system and not the well casing itself. All sampling methods follow industry/regulator–recognized protocols to ensure that consistent and repeatable samples are obtained.
- Quality controls such as field blank, trip blank, duplicate, and equipment rinsate samples are collected.
- All groundwater samples are controlled under chain of custody from their collection in the field through the analytical laboratory that performed the analyses.
- Laboratory analyses are performed using standard methodologies and protocols within established holding times.

During 2010 all groundwater monitoring and related analytical activities were performed in accordance with the established protocols.

## 4.7 Quality Assurance Program

It is the intent of the B&W Y-12 Quality Assurance Program to be fully consistent with and supportive of the ISMS program's functions and guiding principles. Management requirement Y60-101PD, *Quality Program Description*, details the methodologies employed to carry out work processes safely and securely and in accordance with established procedures. It also describes mechanisms in place to seek continuous improvements by identifying and correcting findings and preventing recurrence.

Many factors can potentially affect the results of environmental data collection activities, including sampling personnel, methods, and procedures; field conditions; sample handling, preservation, and transport; personnel training; analytical methods; data reporting; and record keeping. Quality assurance programs are designed to minimize these sources of variability and to control all phases of the monitoring process.

Field sampling QA encompasses many practices that minimize error and evaluate sampling performance. Some key quality practices include the following:

- use of work control processes and standard operating procedures for sample collection and analysis;
- use of chain-of-custody and sample-identification procedures;
- instrument standardization, calibration, and verification;
- sample technician and laboratory analyst training;
- sample preservation, handling, and decontamination; and
- use of QC samples, such as field and trip blanks, duplicates, and equipment rinses.

Analytical results may be affected by a large number of factors inherent to the measurement process. Laboratories that support the Y-12 environmental monitoring programs employ internal QA/QC programs to ensure the early detection of problems that may arise from contamination, inadequate calibrations, calculation errors, or improper procedure performance. Internal laboratory QA/QC programs include routine calibrations of counting instruments, yield determinations, frequent use of check sources and background counts, replicate and spiked sample analyses, matrix and reagent blanks, and maintenance of control charts to indicate analytical deficiencies. These activities are supported by the use of standard materials or reference materials (e.g., materials of known composition that are used in the calibration of instruments, methods standardization, spike additions for recovery tests, and other practices). Certified standards traceable to the National Institute of Standards and Technology (NIST), DOE sources, or EPA are used (when available) for such work.

The Y-12 Analytical Chemistry Organization (ACO) Quality Assurance Plan describes QA program elements that are based on the B&W Y-12 Quality Assurance Program; customer-specific requirements; certification program requirements, International Standard ISO/IEC 17025, General Requirements for Competence of Testing and Calibration Laboratories; federal, state and local regulations; and Waste Acceptance Criteria. As a government-owned client-operated (GOCO) laboratory that performs work for the DOE, the ACO laboratory operates in accordance with DOE Order 414.1C, "Quality Assurance," and DOE Order 450.1A, "Environmental Protection Program." In order to meet these requirements, the ACO laboratory adheres to the latest edition of the *DOE Quality Systems for Analytical Services* (DOE 2010b) where it applies.

Other internal practices employed to ensure that laboratory results are representative of actual conditions include staff training and management; adequacy of the laboratory environment; safety; the storage, integrity, and identity of samples; record keeping; the maintenance and calibration of instruments; and the use of technically validated and properly documented methods.

Verification and validation of environmental data are performed as components of the data collection process, which includes planning, sampling, analysis, and data review. Some level of verification and validation of field and analytical data collected for environmental monitoring and restoration programs is necessary to ensure that data conform with applicable regulatory and contractual requirements. Validation of field and analytical data is a technical review performed to compare data with established quality criteria to ensure that data are adequate for the intended use. The extent of project data verification and validation activities is based on project-specific requirements.

For routine environmental effluent monitoring and surveillance monitoring, data verification activities may include processes of checking whether (1) data have been accurately transcribed and recorded, (2) appropriate procedures have been followed, (3) electronic and hard-copy data show one-to-one correspondence, and (4) data are consistent with expected trends. Typically, routine data verification actions alone are sufficient to document the validity and accuracy of environmental reports. For restoration projects, routine verification activities are more contractually oriented and include checks for data completeness, consistency, and compliance against a predetermined standard or contract.

Certain projects may require a more thorough technical validation of the data as mandated by the project's data quality objectives. Sampling and analyses conducted as part of a remedial investigation to support the CERCLA process may generate data that are needed to evaluate risk to human health and the environment, to document that no further remediation is necessary, or to support a multimillion-dollar construction activity and treatment alternative. In these cases, the data quality objectives of the project may mandate a thorough technical evaluation of the data against rigorous predetermined criteria. The validation process may result in the identification of data that do not meet predetermined QC criteria or in the ultimate rejection of data for their intended use. Typical criteria evaluated in the validation of Contract Laboratory Program data include the percentage of surrogate recoveries, spike recoveries, method blanks, instrument tuning, instrument calibration, continuing calibration verifications, internal standard response, comparison of duplicate samples, and sample-holding times.

## 4.8 Environmental Management and Waste Management Activities

### 4.8.1 Upper East Fork Poplar Creek Remediation

Remediation of the Upper East Fork Poplar Creek Watershed is being conducted in two stages under Records of Decision using a phased approach. Phase 1 addresses remediation of mercury-contaminated soil, sediment, and groundwater discharges that contribute contamination to surface water.

The initial project of the Phase 1 Record of Decision, construction of the Big Springs Water Treatment System, was completed in 2006. The system has been fully operational since September 2006, removing mercury from local spring and sump waters that discharge to Upper East Fork Poplar Creek.

With ARRA funding, cleanup and repair of storm sewers in the West End Mercury Area (historic mercury use area) was initiated in FY 2009 and continued in 2010 (see Sect. 4.8.2).

### 4.8.2 ARRA-Funded Removal Actions at Y-12

ARRA funding is being used to expedite removal of legacy wastes and building demolition at the Y-12 National Security Complex. As of the end of December, B&W Y-12 had completed

- all 34 planned milestones, many of them ahead of schedule;
- almost 1,500,000 job-hours without a lost workday injury (as of the end of December);
- a total of 63,623 cubic meters of waste disposal shipments; and
- had awarded $73.1 million in procurements, 77% of them to small businesses.

**Building 9735 D&D**

Demolition of Building 9735, the last building to be removed from Engineering Row, was completed in June 2010. Demolition of Engineering Row reduced the Y-12 facility footprint by 92,690 ft$^2$. The other six buildings that once comprised Engineering Row were demolished in 2008. In addition to eliminating safety and environmental risks, this project provided space for Y-12 to add an employee parking lot, as part of a separate NNSA-funded site improvement project (Fig. 4.48).

ORNL 2011-G00655/chj

**Fig. 4.48. Building 9735 deactivation and demolition.**

**Biology Complex D&D**

The Biology Complex Deactivation and Demolition (D&D) project is part of Y-12's ongoing footprint reduction effort, designed to minimize maintenance and security costs. The project eliminates 135,812 ft$^2$ of unused building space and the risk associated with the deteriorated facilities. These buildings have been vacant since late 2003. Building sites demolished to slab in 2010 are Buildings 9220, 9224, 9769, and 9211. Buildings 9769 and 9211 (a four-story structure) presented unique challenges in dismantling structural anomalies while maintaining a high level of commitment to worker safety. Site stabilization activities will be completed in January 2011, and the project was 92% complete at end of 2010 (Fig. 4.49).

ORNL 2011-G00656/chj

**Fig. 4.49. Building 9211 demolition.**

**9204-4 Legacy Material Removal Project**

This project comprises removal and disposal of legacy materials from the second floor of Building 9204-4, also known as Beta 4, to prepare for deactivation and demolition of the facility as part of the site transformation plan. Beta 4 is a large, three-story building that features a flat roof and is supported by a cast-concrete foundation.

Disposition plans for Beta 4 waste were accelerated with ARRA funding. Results of these efforts are improved site safety and security, reduced operating costs, and reduced environmental risk to site personnel and to the immediate and surrounding areas. The Beta 4 project was 97% complete at the end of 2010.

**9201-5 Legacy Materials Removal Project**

Building 9201-5, also known as Alpha-5, is the largest building at Y-12, measuring 613,642 $ft^2$. The project is tasked with removing and disposing legacy materials from the building as well as characterizing the building structure to prepare for eventual deactivation and demolition by the EM Program. Y-12 reached the first project milestone in March with the completion of the fourth-floor cleanup (1,857 $m^3$ removed). The second floor was cleared in July, and total material removal on that floor was 7,082 $m^3$. The project was 74% complete at the end of December 2010. The building is scheduled to be emptied completely by September 30, 2011 (Fig. 4.50).

**Building 9206 Filter House Removal**

The Building 9206 Filter House Removal Project involves the removal of a contaminated process system. It includes the deactivation and demolition of the filter baghouse, secondary furnace, associated piping and ductwork, heat exchanger, cyclone separator, spark arrester, and associated utilities. All material will be packaged, characterized, and shipped to an appropriate disposal facility. Removal of this process system reduces exposure from the potential release of radiological and hazardous materials in out-of-service equipment. Deactivation also eliminates the need for daily monitoring of the process systems. As of December 2010, the Building 9206 Filter House Project was 83% complete.

**West End Mercury Area Storm Sewer Remediation Project**

The initial phase of this project involved videotaping the storm sewer system using a track-mounted video camera. An engineering study, completed in 2009, documented the results of the camera survey and the extent of remediation required, as the pipes are a known mercury pathway to Upper East Fork Poplar Creek. A Remedial Action Work Plan/Waste Management Plan was prepared during 2010 that specifies the method of accomplishment for storm sewer remediation and was approved by the Environmental Protection Agency and the state of Tennessee. As of December 2010, the project was 22% complete, the remediation subcontract was awarded, and storm sewer remediation is expected to start in spring of 2011.

ORNL 2011-G00657/chj

**Fig. 4.50. Teamwork and ingenuity are necessary in clearing the legacy materials from Alpha-5.**

**Old Salvage Yard Cleanup Project**

The 7-acre site, established in the early 1970s, was used for storing scrap metal and liquid hazardous wastes from Y-12 operations until 1999. The Old Salvage Yard received scrap into open piles until 1995, when new procedures required that all scrap metal be placed inside containers. As of December 2010, the cleanup project was 91% complete and had removed approximately 20,445 cubic meters of potentially radioactively contaminated scrap metal, including material in piles and approximately 1,100 containers (B-24 and B-25) of radioactive scrap metal.

The primary contaminants of concern in the scrap yard include uranium and thorium. Forklifts, an abandoned crane, and other equipment were also removed. In addition to the material removal and disposition, the Old Salvage Yard Scrap Removal Project received additional ARRA funding in August 2010 to characterize the underlying soils. Based on the results of that characterization, Y-12 anticipates remediating those soils to the extent required by regulators (Fig 4.51).

ORNL 2011-G00658/chj

**Fig. 4.51. Old Salvage Yard cleanup project.**

### 4.8.3 Waste Management

Much of the waste generated during FY 2010 cleanup activities was disposed at facilities on the Oak Ridge Reservation. Environmental Management Waste Management Facility (EMWMF), located in Bear Creek Valley west of the Y-12 Complex, is an engineered landfill that accepts waste generated from Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response actions and cleanup activities on the Oak Ridge Reservation. It currently consists of four active disposal cells, with a fifth cell awaiting final regulatory approval for use and a sixth cell under construction at the end of FY 2010. Construction of the ARRA-funded Cell 5 EMWMF expansion was completed in May 2010. The addition of Cell 5 brings the capacity of EMWMF up to 1,650,000 $yd^3$. A sixth cell is being added and will bring the total facility capacity to 2,180,000 $yd^3$. The Cell 6 construction effort is scheduled to conclude in April 2011.

Further expansion, beyond Cell 6, at EMWMF is constrained by physical limitations of the site. Therefore, DOE is considering other locations to build a new disposal facility. DOE began evaluating disposal alternatives in FY 2010 for future Reservation cleanup waste.

EMWMF accepts low-level radioactive and hazardous wastes that meet specific waste acceptance criteria developed in accordance with agreements with state and federal regulators. Waste types that qualify for disposal include soil, dried sludge and sediment, solidified wastes, stabilized waste, building debris, scrap equipment, and personal protective equipment.

During FY 2010, EMWMF operations collected, analyzed, and dispositioned approximately 4.8 million gallons of leachate and 1.3 million gallons of contact water at the ORNL Liquid/Gaseous Waste Operations Facility. An additional 10 million gallons of contact water was collected, analyzed, and released to the storm water retention basin after determining that it met the release criteria. Operating practices also effectively controlled site erosion and sediments.

EMWMF received approximately 22,700 truckloads of waste accounting for approximately 262,000 tons during FY 2010. Projects that have disposed of waste at EMWMF during the year include the following:

- K-25 Building Demolition Project, including waste generated from the west wing demolition;
- ETTP Decontamination and Decommissioning Project, including K-770 Scrapyard, K-1070-B Burial Ground, and K-1036/K-1058 demolition debris;
- Y-12 Old Salvage Yard Project, Alpha 5 Project, and Biology Project; and
- ORNL Building 3026 and 2000 Complex.

DOE also operates the Oak Ridge Reservation Landfills (ORRL), which are solid waste disposal facilities located south the Y-12 Complex on Chestnut Ridge. The ORRL are engineered facilities used for the disposal of sanitary, industrial, construction, and demolition waste. In FY 2010, approximately 139,000 $yd^3$ of industrial wastes, construction/demolition wastes, and spoil materials waste were disposed in the ORRL. Operation of the ORRL generated approximately 1.48 million gallons of leachate that was collected, monitored, and discharged to the Y-12 National Security Complex sanitary sewer system, which discharges to the Oak Ridge sewer system under an industrial sewer user permit.

Construction of the ARRA-funded expansion at the ORRL, located near the Y-12 Complex, started in April 2010. When completed, Area 4 at Industrial Landfill V will add 385,000 $yd^3$ of capacity. A new Truck Receiving Station will enhance the safety and productivity of operations by providing permanent steel platforms for performing the required load inspections instead of having to use ladders. Also, a leachate header was installed at Industrial Landfill IV to pump leachate into the city of Oak Ridge sewer system for disposal.

### 4.8.4 Wastewater Treatment

The National Nuclear Security Administration (NNSA) at the Y-12 Complex treated 116.5 million gallons of contaminated ground/sump water at the Groundwater Treatment Facility, the Central Mercury Treatment System, Big Springs Water Treatment System, and the East End Volatile Organic Compounds (VOC) Treatment System.

The Big Springs Water Treatment System treated 104 million gallons of mercury-contaminated groundwater. The East End Volatile Organic Compound Treatment System treated 11 million gallons of VOC-contaminated groundwater. The West End Treatment Facility and the Central Pollution Control Facility at the Y-12 Complex processed 1.2 million gallons of wastewater primarily in support of NNSA operational activities.

The Central Pollution Control Facility also down-blended more than 37,000 gallons of enriched wastewaters using legacy and newly generated uranium oxides from on-site storage.

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