4. The Y-12 National Security Complex

The Y-12 Complex, a premier manufacturing facility operated by B&W Y-12 for NNSA, plays a vital role in DOE's Nuclear Security Enterprise. While drawing on more than 60 years of manufacturing excellence, the Y-12 Complex helps ensure a safe and reliable US 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 Complex that has a new level of flexibility and versatility. So while continuing its key role, the Y-12 Complex has evolved to become the resource 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.

Because of 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 xxv and xxvi is intended to help readers convert numeric values presented here 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 US national security. The roles of the Y-12 Complex include the following:

- receipt, storage, and protection of SNMs;
- 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 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.

The Y-12 Complex is one of four production facilities in the NNSA Nuclear Security Enterprise. The unique emphasis of the Y-12 Complex is processing and storage of uranium and development of technologies associated with those activities. Decades of precision machining experience make the Y-12 Complex a production facility with capabilities unequaled nationwide.

Located within the city limits of Oak Ridge, the Y-12 Complex covers more than 328 ha (810 acres) in the Bear Creek Valley, stretching 4.0 km (2.5 miles) in length down the valley and nearly 2.4 km (1.5 miles) in width across it. NNSA-related facilities located off the Y-12 Complex site but in Oak Ridge include the OST 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.

In 2012 the facility was operated by B&W Y-12 LLC, a partnership of the Babcock & Wilcox Company and Bechtel Corporation, under contract to DOE, of which NNSA is a separately organized agency.

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.

Government-owned facilities and operations are being challenged to become smaller, more efficient, and more responsive to changing national and global challenges. Nowhere in the National Security Enterprise is transformation more evident than at the Y-12 Complex.

Most of the Y-12 Complex mission-critical facilities are more than 60 years old (Fig. 4.1). To address this situation Y-12 has been consolidating operations, modernizing facilities and infrastructure, and reducing the legacy footprint for more than a decade. These actions are consistent with and supportive of NNSA enterprise transformation planning. Through modernization projects, deferred maintenance reduction, enhanced security measures, technology enhancements, infrastructure reduction, and innovative business practices, the Y-12 Complex is becoming a more responsive, sustainable enterprise as evidenced by the performance achievements presented in this year's ASER.

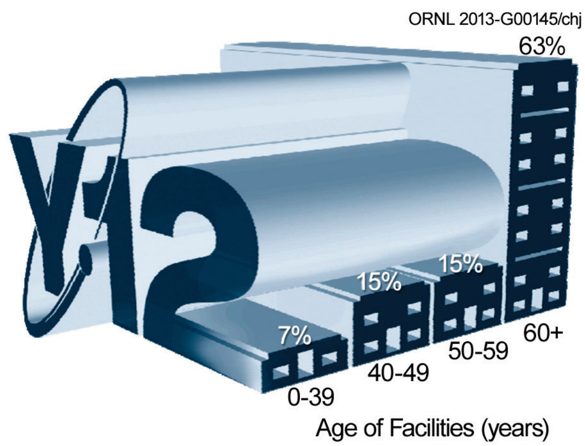

Fig. 4.1. Age of mission–critical facilities at the Y-12 Complex.

Since 2002, Y-12 has demolished more than 1.4 million ft^2 of excess facilities. The NNSA Facilities Disposition Program for FY 2014 is under development and will identify and evaluate excess assets, prioritize their disposition, and propose the budget resources required for their disposition. Without a defined program to eliminate excess facilities, the NNSA sites will continue to use limited resources to safely maintain those facilities that no longer have a mission use. The American Recovery and Reinvestment Act (ARRA) funding secured at Y-12 implemented early actions to deactivate and demolish some of these facilities. Results and progress on these projects is detailed in Section 4.8, "Environmental Management and Waste Management Activities."

UPF (Fig. 4.2) is an integral part of the Y-12 Complex transformation efforts and a key component of the NNSA Uranium Center of Excellence. UPF will be a modern manufacturing facility designed and constructed for health, safety, security, and operations efficiency. Built to today's codes and standards, the facility will leverage new technologies and provide life-cycle cost savings. Planning and design continued through 2012.

ORNL 2012-G00392/chj

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, the Y-12 Complex has implemented an EMS based on the rigorous requirements of the globally recognized ISO 14001-2004 (ISO 2004).

DOE O 436.1, *Departmental Sustainability*, (DOE 2011) provides requirements and responsibilities for managing sustainability within DOE in accordance with EO 13423, its implementing instructions, and EO 13514. The order further requires implementation of an EMS that is either certified to the requirements of ISO 14001:2004 (ISO 2004) by an accredited ISO 14001 registrar or self-declared to be in conformance to the standard in accordance with instructions issued by the Federal Environmental Executive.

The EMS requirements taken from DOE O 436.1 have been incorporated in the Environmental Protection Functional Area of the Y-12 Complex Standards/Requirements Identification Document.

4.2.1 Integration with Integrated Safety Management System

ISMS is DOE's umbrella of 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.

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; incorporated into General Employee Training (GET) for every employee, guest, and contractor; and made available for viewing on the internal Y-12 complex website. Y-12 Complex personnel are made aware of the commitments stated in the policies and how the commitments relate to Y-12 Complex work activities.

ORNL 2010-G00475/chj

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

The FY 2012 analysis identified the following as significant environmental aspects.

• Air Emissions	• Surface Water and Storm Water
• GHG Emissions (Scopes 1 and 3)	• Aging Infrastructure and Equipment
• Wastewater/Groundwater	• Legacy Contamination and Disturbance
• Excess Facilities and Unneeded Materials and Chemicals	• Storage or Use of Chemicals and Radioactive Materials
• Hazardous or Mixed Wastes	• Energy Consumption (Scope 2 GHGs)
• Radiological Waste	• Potable Water Usage
• Universal Waste and Other Recycle Streams	• Raw Materials and Other Natural Resource Procurement / Use

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 Section 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 NNSA Production Office (NPO) and B&W Y-12; and are consistent with the Y-12 Complex'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 2012 B&W Y-12 environmental targets achieved are presented in Section 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 Complex 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.

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. 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, TDEC, and EPA. 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 for these compliance programs are presented in this document.

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

Waste Management

The B&W Y-12 waste management programs support 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 Complex procedures and policies, the waste management programs provide technical support to generators on waste management, pollution prevention, and recycling issues and waste certification in accordance with DOE orders and NNSS waste acceptance criteria for waste to be shipped to that site for disposition.

Sustainability and Stewardship

The Sustainability and Stewardship Program has two major missions. The first is to establish and maintain companywide 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 EOs, DOE orders, state and federal regulations, and NNSA expectations and also eliminates duplication of efforts while providing an overall improved appearance at the Y-12 Complex.

Additionally, the implementation of these programs directly supports EMS objectives and targets to disposition UMC, continually improve recycle programs by adding new recycle streams as applicable, improve sustainable acquisition/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.

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 the Y-12 Complex 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 Y-12 2012) issued in December 2012.

4.2.4 Implementation and Operation

4.2.4.1 Roles, Responsibility, and Authority

The safe, secure, efficient, and environmentally responsible operation of the Y-12 Complex 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 the Y-12 Complex. 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 EMS as a tool to drive continual environmental improvement at the Y-12 Complex. Environmental officers coordinate their organizations' efforts to maintain environmental regulatory compliance and promote other proactive improvement activities.

4.2.4.2 Communication and Community Involvement

The Y-12 Complex is committed to keeping the community informed on 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 Complex 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. The following paragraphs describe some of the Y-12 Complex communication and community involvement activities.

B&W Y-12 sponsored and participated in community events in 2012, including Oak Ridge Earth Day (Fig 4.4), to provide highlights of Y-12's environmental management, sustainability and stewardship, and pollution prevention activities and to provide information about the Tennessee Pollution Prevention Partnership (TP3) to more than 1,000 members of the public. B&W Y-12 also sponsored the Southern Appalachian Science and Engineering Fair, East Tennessee Fuels Coalition, and the University of Tennessee Arboretum in 2012.

Fig. 4.4. Y-12 Complex "booth" at Oak Ridge Earth Day in 2012. [*Source*: Kathy Fahey, Y-12 Photographer]

As part of the Y-12 Complex America Recycles Day activities, four local charities received $200 donations from funds raised by the Y-12 Complex employee ABC recycling efforts. Since the ABC recycling program began in 1994, more than $81,600 has been donated to various local charities.

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 2012, B&W Y-12 shared information concerning the TP3 program with Eaton-Inoac, Volkswagen, Y-12 Complex employees, and members of the local community. As of October 1, 2012, the Tennessee Green Star Partnership replaced TP3 as TDEC's pollution prevention recognition program, and all of the current TP3 Partners and Performers have been grandfathered into the new program for the 2013 calendar year.

On February 23, 2012, the Y-12 Complex hosted its first annual "Introduce a Girl to Engineering" event at the New Hope Visitor Center (Fig. 4.5). The event was dedicated to girls in grades 9 through 12 to encourage them to pursue careers in science, technology, engineering, and mathematics. Three hundred seventy-six girls and 53 chaperones from 13 area schools attended the event. Twenty-four interactive exhibits, developed by 50 Y-12 women engineers and scientists, included hands-on activities ranging from surrogate material simulation to T-shirt chromatography. The University of Tennessee (UT) sponsored several booths, sharing information about preengineering curricula for high school and college planning. Also, various UT student chapters of professional engineering organizations were present.

Fig. 4.5. Y-12 National Security Complex hosted its first annual "Introduce a Girl to Engineering." [*Source*: Brian Wagner, Y-12 Photographer]

4.2.4.3 Emergency Preparedness and Response

Local, state, and federal emergency response organizations are fully involved in the Y-12 Complex 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 Watch Office participate in all Y-12 Complex emergency response exercises.

The Y-12 Complex conducted one full-participation exercise, one full-scale exercise, and three functional exercises in FY 2012. The focus of these exercises included responding to an active shooter event, a chemical spill, and Continuity of Operations events. Additionally, a tabletop exercise was conducted focusing on the response to a beyond design basis event. Eight building evacuation and accountability drills were also conducted.

Y-12 Emergency Management, Fire Protection Operations, and Public Affairs assisted Methodist Medical Center in Oak Ridge, Tennessee, with the conduct of their full-participation exercise by supplying the senior controller, two controllers, and two media role players radios and control vests on October 20, 2011. Additionally, B&W Y-12 provided moulage (injury simulations) to almost 30 role players.

Y-12 Emergency Management provided Off-Site Response to DOE Facilities training to 76 Anderson County Emergency Medical Service employees during their annual in-service training January 14 and 21, 2012.

Y-12 Complex expertise in emergency management continues to be recognized within DOE. Members of the Emergency Management Program Office staff participated in the DOE Emergency Management Issues Special Interest Group Conference held in Seattle, Washington, in May 2012. The Y-12 Complex staff made presentations, participated in steering committee meetings, and distributed Y-12 Complex Emergency Management Program information to other DOE facility emergency management professionals.

4.2.5 Checking

4.2.5.1 Monitoring and Measurement

The Y-12 Complex maintains procedures to monitor overall environmental performance and to monitor and measure key characteristics of its operations and activities that can have a significant environmental impact. Environmental effluent and surveillance monitoring programs are well-established, and the results of the 2012 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 Complex site-level performance measures. Progress is reviewed in periodic meetings with senior management and NPO.

4.2.5.2 Environmental Management System Assessments

To periodically verify that EMS is operating as intended, assessments are conducted as part of the Y-12 Complex internal assessment program. The assessments are designed to ensure that nonconformities with the ISO 14001:2004 standard (ISO 2004) are identified and addressed.

The Environmental Assessment Program comprises several types of assessments, each type serving a distinct but complementary purpose. Assessments range from informal observations of specific activities to rigorous audits of site-level programs.

To self-declare conformance to the ISO 14001:2004 standard in accordance with instructions issued by the Federal Environmental Executive and adhere to DOE O 436.1 (DOE 2011) requirements, EMS must be audited by a qualified party outside of the control or scope of EMS at least every 3 years. To fulfill this requirement, a four-person audit team from the University of Tennessee Center for Industrial Services (UTCIS) evaluated the Y-12 EMS April 23–26, 2012. The Y-12 EMS was found to fully conform, and no issues were identified. A final score of 525.5 out of 530.0 or 99.2% was awarded by the audit team.

4.2.6 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. The Y-12 Complex used a number of DOE's reporting systems, including the following, to report performance.

- Pollution Prevention Tracking and Reporting System, which collects environmental, sustainable acquisition and product purchases, and best practices data.
- Federal Automotive Statistical Tool (FAST), which collects fleet inventory and fuel use.
- Consolidated Energy Data Report, which collects additional data on metering requirements, water use, renewable energy generation and purchases, training, and sustainable buildings.
- Site Sustainability Plan Performance Reporting, which collects data on site-identified sustainability projects and supports Energy Independence and Security Act (EISA) Section 432 compliance.

The DOE Office of Health, Safety and Security annual environmental progress reports on implementation of EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* (EO 2007), and Office of Management and Budget's Environmental Stewardship Scorecard gave the Y-12 Complex an EMS scorecard rating for FY 2012 of green, indicating full implementation of EO 13423 requirements.

4.2.6.1 Environmental Management System Objectives and Targets

At the end of FY 2012 B&W Y-12 had achieved 11 of 12 targets that had been established the year before. Overall, 54 actions were completed through September. Highlights included the following, with additional details and successes presented in other sections of this report.

- Clean Air—Completed a laboratory evaluation of a uranium chip cleaning process that uses less solvent and could potentially reduce Y-12 Complex fugitive GHG emissions.
- Energy Efficiency—Achieved High-Performance Sustainable Building (HPSB) status for the Jack Case Center, completed fourteen energy audits, completed construction for all planned energy conservation measures (ECMs) under the FY 2012 Energy Savings Performance Contract (ESPC), issued a metering plan and installed 116 meters as part of the Energy Modernization Implementation Program (EMIP).
- Hazardous Materials—Completed shipment of uranium containing residues, generated during ARRA-funded activities, for final treatment and disposal; completed FY 2012 scope of work to disposition UMC.
- Land/Water Conservation—Continued progress to identify and correct inflow/infiltration (I/I) into the Y-12 Complex sanitary sewer by smoke testing throughout the Y-12 Complex and making repairs; implemented a mercury trap project to collect and remove mercury accumulation from storm drains.
- Reduce/Reuse/Recycle/Buy Green—Expanded installation of drinking water filtration and bottle filling stations to minimize bottled water expense and plastic wrap.

4.2.6.2 Sustainability and Stewardship

Numerous efforts at the Y-12 Complex 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 Section 4.2.7). Pollution prevention efforts at the Y-12 Complex have not only benefited the environment but have also resulted in cost efficiencies (Fig. 4.6).

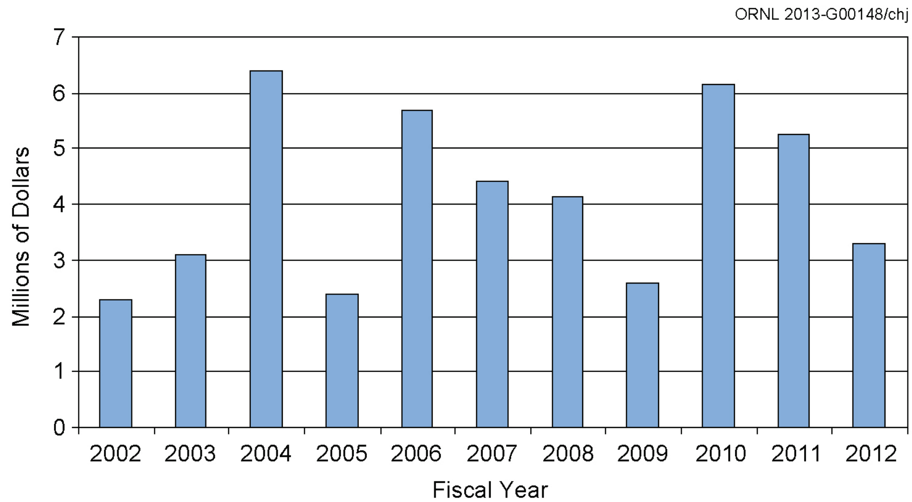

Fig. 4.6. Cost savings from Y-12 Complex pollution prevention activities.

In FY 2012 the Y-12 Complex implemented 104 pollution prevention initiatives (Fig. 4.7), with a reduction of more than 11.9 million kg (26.3 million lb) of waste and cost efficiencies of more than $3.3 million. The completed projects include the activities described below.

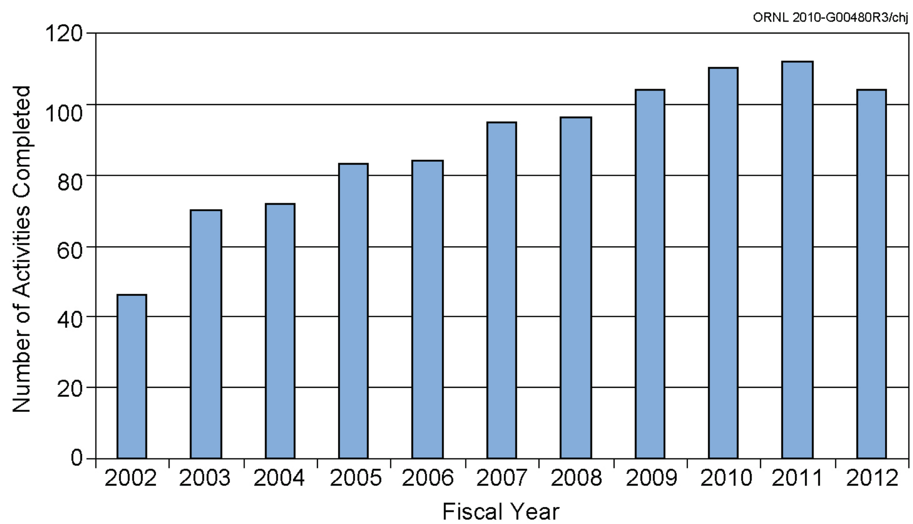

Fig. 4.7. Y-12 Complex pollution prevention initiatives.

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 the Y-12 Complex's sustainable initiatives have pollution prevention benefits or targets eliminating the source of pollution, including the 2012 activities highlighted in this section.

Sustainable Acquisition/Environmentally Preferable Purchasing. Sustainable products, including recycled-content materials, are procured for use across the Y-12 Complex. In 2012, B&W Y-12 procured recycled-content materials valued at more than $2.4 million for use at the site.

Unneeded Materials and Chemicals. The UMC initiative was implemented to assist in the potential use 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. 4.8) 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 the Y-12 Complex, (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 the Y-12 Complex has dispositioned more than 12,747 items.

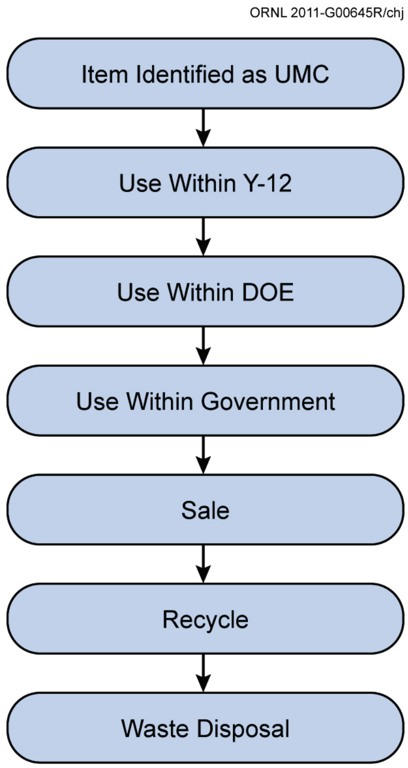

Fig. 4.8. Unneeded materials and chemicals disposition process at the Y-12 Complex.

Hazardous Chemical Minimization. The Y-12 Complex is committed to reducing the use of toxic and hazardous chemicals and minimizing the volume of hazardous waste generated by site operations. During FY 2012, the UMC program was instrumental in the processing of more than 60 kg of pyrophoric chemicals for reuse at Y-12 instead of disposing of the chemicals as hazardous waste. Y-12 has also completed various other reuse initiatives that have reduced the acquisition of hazardous chemicals such as filtering a material so that it could be reused in a process, completing equipment modifications to extend the life of a material to reduce the amount of materials that had to be purchased and disposed of, and isolating and containerizing a material so that it could be transferred for reuse in a different facility rather than becoming a waste.

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. 4.9, more than 1.36 million kg (3.0 million lb) of materials was diverted from landfills and into viable recycle processes during 2012. Currently recycled materials range from office-related materials to operations-related materials such as scrap metal, tires, and batteries. Y-12 adds at least one new recycle stream to the Recycle Program each year to continue to increase the waste diversion rate. Mutoh ink cartridges were added in Fiscal Year 2012. The Recycle Program has implemented the 7S process at the Recycle Center (Fig. 4.10). The 7S process includes the following seven steps: sort, set in order, shine, standardize, safety, security, and sustain. The 7S process was implemented to improve the overall organization, cleanliness, safety, security, and productivity of the Recycle Center. The 7S process has made the recycling program more efficient, which will contribute to the site's ongoing efforts for landfill diversion through reuse and recycling.

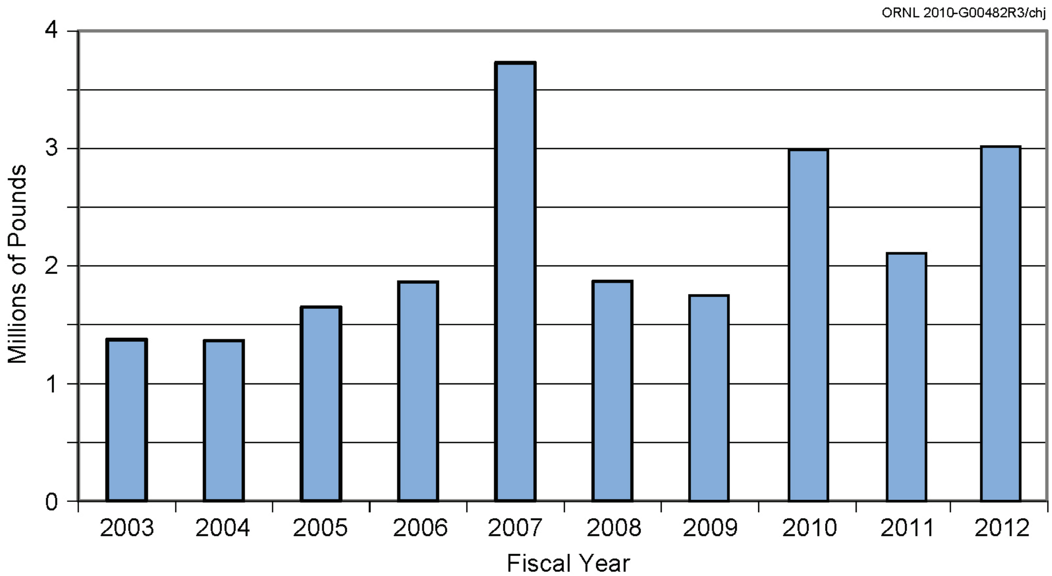

Fig. 4.9. Y-12 Complex recycling results.

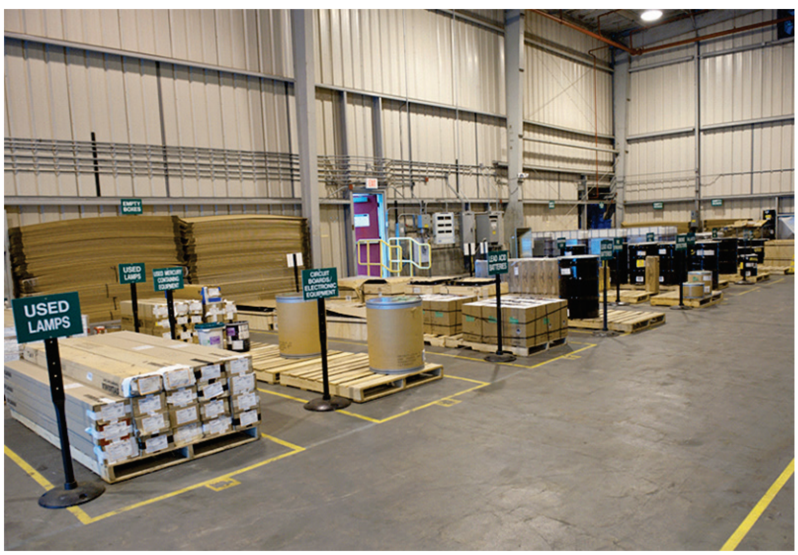

Fig. 4.10. Y-12 Recycle Center. [*Source*: Kathy Fahey, Y-12 photographer.]

Personal Electronic Equipment Collection Event. On September 14, 2012, the Y-12 Complex Sustainability and Stewardship Organization hosted a personal electronics and document recycling collection event for Y-12 Complex employees and subcontractors. An off-site recycling vendor collected the equipment from the employees in the New Hope Center Parking Lot. More than 95 employees and subcontractors participated in the collection event. More than 4,700 pounds of electronics and 1,124 pounds of paper were collected during the 4 h event. Examples of the types of items collected include CPUs, CRT monitors, LCD monitors, cell phones, printers, etc. Government-owned equipment was not collected during the event.

4.2.6.3 Energy Management

The Y-12 Energy Management Program identifies improvements in energy efficiency in facilities, coordinates energy-related efforts across the site, and promotes employee awareness of energy conservation programs and opportunities. The program also includes activities related to the accomplishment of the goals of EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*; EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*; and the DOE Transformational Energy Action Management Initiative.

The Energy Policy Act of 2005 (EPAct05) established the goal of reducing building energy intensity using 2003 as the baseline year. Y-12 is meeting the reduction goal and has achieved a 26.4% reduction in energy intensity from the 2003 baseline (Fig.4.11).

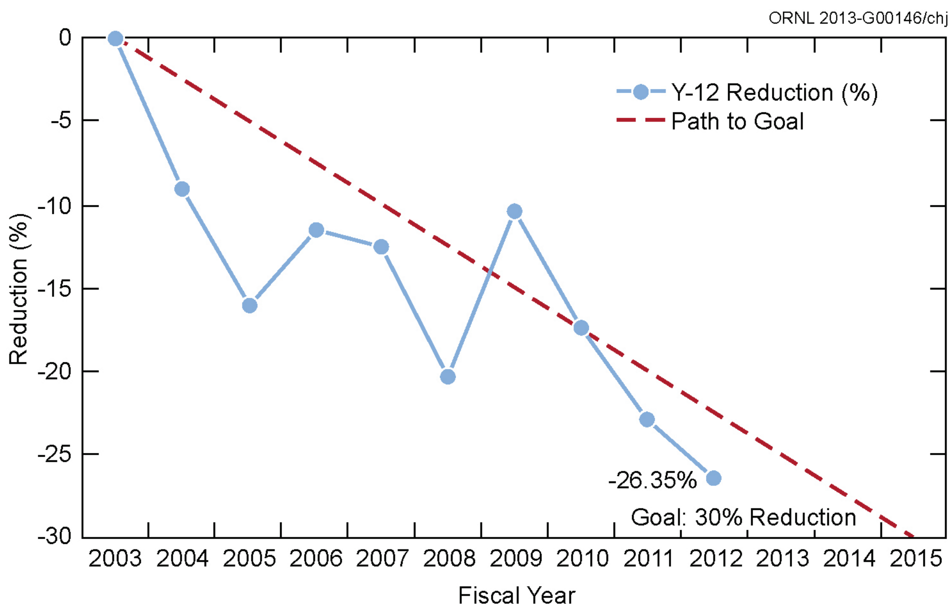

Fig. 4.11. Y-12 has achieved a 26.4% reduction in energy intensity from the 2003 baseline.

Based on FY 2012 data, energy use at Y-12 is 2,113,550M Btu. The square footage is 6,858,240; therefore, the FY 2012 estimated energy intensity is 308,177 Btu/gsf, which represents a 10% reduction compared to FY 2011. When compared to the baseline year of FY 2003, this represents a 26.4% reduction. The site has made good progress in implementing several energy reduction initiatives.

FY 2012 initiatives that contributed to the sustainability of facilities and aided in progress toward achieving the energy intensity reduction goal include

- energy reduction initiatives at Jack Case Center;
- retro-commissioning and heating, ventilating, and air conditioning (HVAC) improvements in Buildings 9201-03 and 9201-05N;
- chiller efficiency improvements in Building 9767-8/11;
- reconnecting HVAC controls to the Utilities Management System (UMS);

- off-shift temperature setbacks;
- steam trap replacements;
- lighting fixture upgrades;
- EMIP advanced meter installations; and
- low-flow fixture installations in Buildings 9113/9119.

In response to an inspector general audit (DOE 2012), the Y-12 Complex implemented an aggressive energy assessment schedule to ensure all EISA-covered facilities were evaluated. The evaluations have been provided to facility and utility management, and ECMs are included in project planning for facilities. ECMs have been prioritized and are implemented as funding is available. Specific examples include HVAC replacements and low-flow fixtures. To facilitate this aggressive program, employees in the condition assessment survey program were used. Y-12 recognized this as an available resource with existing knowledge of facility operations and conditions.

As a result of the EMIP effort, the site now has meter data available in the UMS energy management tool. Although electricity billing is not currently under consideration, monthly consumption data with equivalent cost is distributed to facility management for tenant awareness and general knowledge. Future plans include facility competition and building-specific ECMs and "what can you do" campaigns.

Future energy intensity reductions will be realized through continued construction of new facilities and demolition of legacy facilities combined with ongoing audits and ECMs and new efforts in building commissioning. Both Facility and Utilities Management are diligently focusing on improvements to achieve the goal. The following efforts can substantially reduce energy in all areas.

- Demolish inactive facilities when funding is identified.
- Execute the ECMs identified from EISA assessments.
- Implement delivery order 3 of the ESPC project for additional utility impact.
- Support construction of UPF to reduce production facility footprint (post-2020).
- Implement new energy-efficient lighting technologies throughout the site.
- Include ECMs from both EISA and ESPC processes in out-year budgets.
- Implement low-cost/no-cost efforts, including component replacements, into routine maintenance activities.
- Identify and consolidate data centers per Office of Management and Budget definition.
- Continue installation of advanced metering in accordance with meter plan.
- Work with site lighting team to upgrade lighting to efficient technologies in several facilities.
- Upgrade facilities for HPSB compliance, and implement building retro-commissioning.
- Continue implementation of cool roof applications.
- Encourage energy reduction through tenant awareness, including training and monthly meter reporting.

As shown in Fig. 4.12, future reductions may be challenging due to a projected increase in the site's energy intensity. Current projections indicate increases may occur once UPF goes online but will again be reduced when an infrastructure reduction program can demolish the remaining facilities in the site transformation plan.

Energy Monitoring

The Y-12 Complex began entering facilities into the EPA Portfolio Manager[*] in FY 2011. A concerted effort to capture monthly meter data and enter Guiding Principle compliance began in FY 2012. At present, 103 facilities have been entered and are being tracked for compliance. Data from Portfolio Manager are shared with NNSA Sustainability contacts and are automatically migrated to the Compliance Tracking System for annual reporting.

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[*]Portfolio Manager is an interactive energy management tool that allows owners, managers, and various other property holders to track and assess energy and water consumption across their entire portfolio of buildings in a secure online environment. With Portfolio Manager, underperforming buildings can be identified and efficiency improvements verified.

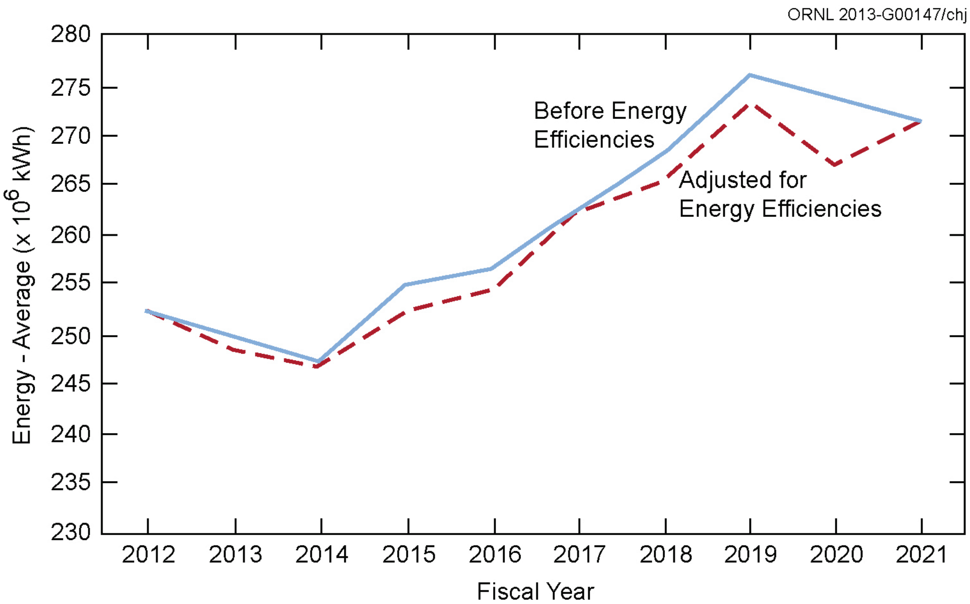

Fig. 4.12. Y-12 Complex electricity load forecast.

During FY 2012, the Y-12 Complex received funding from EMIP to install meters in support of EPAct05 goals. Efforts were concentrated on 13.8 kV advanced meter installations and on connectivity of existing and new meters to UMS. The project completed installation of 76 meters and connected a total of 118 meters to UMS. As these connections are progressing, data are being migrated to the energy management module for eventual use in site metrics, data reporting, and ECMs. Meter data are also entered into Portfolio Manager for benchmarking and reporting purposes.

Meter data are distributed to facility management and building tenants for educational purposes. Because a space chargeback system is not in use, the monthly cost for electricity if billed individually is provided with the total consumption. As more facilities are metered and historical trending is available, metrics will be provided to monitor progress toward goals at the building level. To further employee awareness, competitions between buildings and organizations may be implemented to emphasize the impact of employees.

Steam

A new steam plant (Building 9401-7) was constructed in 2009 and placed into service early in 2010. This new facility replaced the former steam plant at Building 9401-3, which was constructed in 1954. The new steam plant is located in the east end of the Y-12 Complex and consists of four 80,000 lbm/h, dual-fuel package boilers, which were manufactured by Nebraska Boilers. These boilers produce 240,000 lbm/h by design, with capacity for peak production of 320,000 lbm/h. The primary fuel is natural gas, which is supplied by East Tennessee Natural Gas.

Saturated steam is distributed throughout the Y-12 Complex at 235 psig through about 11.3 km (7 miles) of piping ranging in diameter from 4 in. to 18 in. All four boilers discharge to a common manifold inside the steam plant and then feed the plant through two main headers (one 10 in. and one 16 in.). The new steam plant provides improved metering capabilities and more energy-efficient equipment than the old steam plant (Building 9401-3). However, there is no real distribution system metering, and the billing is performed based on engineering estimates. Installation of a steam supply flowmeter at Building 9201-3 was completed September 2011.

As part of the energy savings plans for the Y-12 Complex, the energy savings contractor has established projects to replace steam traps and return condensate from the field to the steam plant. There also are areas of insulation that need repair, and condensate stations throughout the Y-12 Complex need to be evaluated for the potential to return more condensate to the steam plant. The condensate return ECM is expected to reduce water use by 23,652,000 gal (based on 45 gal/min condensate return) and natural gas usage by 31,338M Btu while increasing electricity use by 131,614 kWh annually. While the new condensate system and steam trap installations are complete, condensate return is not yet used for boiler feedwater makeup due to high iron content. Additional chemical treatment is being evaluated.

Site Sustainability Plan

The DOE SSPs are an annual reporting requirement intended to comply with the requirements of EOs 13423 and 13514, DOE O 436.1 (DOE 2011), and the DOE *Strategic Sustainability Performance Plan* (SSPP; DOE 2012b). The FY 2013 SSP (B&W Y-12 2012) serves as a deliverable to fulfill the planning and reporting requirements of the EOs and SSPP. The DOE sustainability goals and Y-12 Complex status and plans for these goals are summarized in Table 4.1.

Table 4.1. Y-12 Complex Site Sustainability Plan goal performance and review for 2012

SSPP goal	DOE goal	Performance status	Planned actions and contribution	Risk of nonattainment
1: Greenhouse Gas Reduction and Comprehensive Greenhouse Gas Inventory				
1.1	28% GHG reduction (Scopes 1 & 2) by FY 2020 from a FY 2008 baseline	**At Risk**—Scopes 1 & 2 emissions decreased by 30.1%. It is doubtful this goal will be sustainable once UPF construction begins	Continue to identify methods for reduction of GHG; further emphasize energy reductions	Low
1.2	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline.	**At Risk**—Site Scope 3 emissions have decreased by 4.3%	Site will increase teleconference and webinar capabilities to reduce business travel	Medium
2: Buildings, ESPC Initiative Schedule, and Regional and Local Planning				
2.1	30% energy intensity reduction by FY 2015 from a FY 2003 baseline	**On track**—the site has achieved a 26.4% reduction from the 2003 baseline	Continue implementation of planned energy reduction initiatives, including ESPC delivery order 3	Low
2.2	EISA Section 432 energy and water evaluations	**Goal has been met.** Y-12 completed all EISA-covered assessments during FY2012	Assessments will continue to include 25% of EISA-covered facilities for 2nd assessment cycle	
2.3	Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015)	**On track**—Currently 91.6% of electricity metered (76 advanced meters were installed in FY 2012, and an additional 27 meters were connected to UMS)	Continue procurement and installation of metering as funding is allocated in accordance with metering plan	Electricity: Low Steam: Medium Natural Gas: Low Chilled Water: Medium
2.4	Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30	**On track**—Investments in roofing have resulted in cool roof technology since 2008	Future roofing projects will continue to use cool roofs where practical, with 43,600 ft^2 planned for FY 2013	Low

Table 4.1. (continued)

SSPP goal	DOE goal	Performance status	Planned actions and contribution	Risk of nonattainment
2.5	15% of existing buildings larger than 5,000 gsf are compliant with the Guiding Principles of HPSB by FY 2015	**At Risk**—the site focused on meeting HPSB compliance for JCC; the site is yellow for gross square feet, with 12% complete, but still red for building count, with 2% complete	Will continue to implement initiatives to meet HPSB compliance as funding and resources allow	High
2.6	All new construction, major renovations, and alterations of buildings greater than 5,000 gsf must comply with the GPs	**On track**—the UPF project is seeking LEED certification	The UPF project team will continue efforts toward LEED certification	Low
2.7	7.5% of a site's annual electricity consumption from renewable sources by FY 2013 and thereafter	**On track**—Y-12 is at 8% renewable due to purchased Green-e certified RECs in the amount of 21,000 MWh per year	Based on DOE decision to accept RECs to satisfy this goal, Y-12 will extend current RECs	Without RECs: High With RECs: Low
3: Fleet Management				
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 from a FY 2005 baseline	**Goal has been met.** Y-12 has achieved a 554.3% increase in alternative fuel consumption within 7 years	Additional measures are being evaluated for continued improvement beyond the goals	
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 from a FY 2005 baseline	**Goal has been met.** Y-12 has achieved the petroleum reduction goal with a 32.9% reduction within 7 years	Additional measures are being evaluated for continued improvement beyond the goals	
3.3	100% of light duty vehicle purchases must consist of AFVs by FY 2015 and thereafter (75% FY 2000–2015)	**Goal has been met.** Y-12 purchases only AFVs for the on-site fleet	Future vehicle purchases will only include consideration for AFVs	
3.4	Reduce fleet inventory of non-mission-critical vehicles by 35% by FY 2013 from a FY 2005 baseline	**On Track**—NNSA has established a 35% reduction target complexwide; Y-12 has reduced by 26% during the last 7 years	With the inclusion of security force vehicles, Y-12 will evaluate the existing inventory and develop a path forward	Low
4: Water Use Efficiency and Management				
4.1	26% water intensity reduction by FY 2020 from a FY 2007 baseline	**Goal has been met.** Site has achieved 33.4% reduction from the baseline	Water conservation measures will continue to be implemented on a building by building basis in support of the HPSB initiative	
4.2	20% water consumption reduction of ILA water by FY 2020 from a FY 2010 baseline	No ILA water use at Y-12	ILA water is considered to be nonpotable freshwater used for aiding processes or irrigation. All water used at Y-12 is potable water and included in the potable water category	

Table 4.1. (continued)

SSPP goal	DOE goal	Performance status	Planned actions and contribution	Risk of nonattainment
5: Pollution Prevention and Waste Reduction				
5.1	Divert at least 50% of nonhazardous solid waste, excluding C&D debris, by FY 2015	**Goal has been met.** More than 51% of nonhazardous waste diverted from landfill	At least one new recycle material stream is added to the recycling program each fiscal year to further increase the diversion rate	
5.2	Divert at least 50% of C&D materials and debris by FY 2015	**Goal has been met.** More than 80% of C&D waste diverted from landfill	Systematic disposition evaluation method will continue to be used for C&D materials to ensure maximum waste diversion is achieved	
6: Sustainable Acquisition				
6.1	Procurements meet requirements by including necessary provisions and clauses (Sustainable Procurements/Biobased Procurements)	**Goal has been met.** Sustainable acquisition clause 952.223-78 was incorporated into Y-12 procurement clauses in FY 2011. The terms and conditions were revised in 2012 to include Federal Acquisition Regulation clause 52.223-15	Y-12 will incorporate additional clauses as requested and will continue to evaluate sustainable products for use at the site.	
7: Electronic Stewardship and Data Centers				
7.1	All data centers are metered to measure monthly PUE (100% by FY 2015)	**At Risk**—electric meter installations were planned for 2012 but have been postponed until 2013. The primary data centers are funded in FY 2013	The primary data centers are being consolidated. Efforts will consider additional metering to ensure PUE is effectively measured	Low
7.2	Maximum annual weighted average PUE of 1.4 by FY 2015	**At Risk**—PUE is currently estimated at lower than 1.4. However, this value is based solely on electricity use and does not account for chilled water energy intensity	Chilled water and electrical metering are planned for Buildings 9103 and 9117 in 2013. The data will verify PUE; it is not known at this time what actions will be required.	Medium
7.3	Electronic stewardship—100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	**On Track**—Y-12 has implemented power management to eligible CPUs and laptops; power management features are enabled on all monitors not deemed mission critical	100% implementation is not currently feasible with existing security network features. The site will continue active implementation of power management of computing devices while maintaining security network features.	Medium

Table 4.1. (continued)

SSPP goal	DOE goal	Performance status	Planned actions and contribution	Risk of nonattainment
8: Innovation and Governmentwide Support				
8.1	Innovation and governmentwide support		Continue working with the community and local government agencies to further efforts.	

Abbreviations

AFV = alternative fuel vehicle
C&D = construction and demolition
CD = Critical Design
CPU = central processing unit
EISA = Energy Independence and Security Act
ESPC = Energy Savings Performance Contract
FY = fiscal year
GHG = greenhouse gas
GP = Guiding Principles
gsf = gross square feet
HPSB = high-performance sustainable building
ILA = industrial, landscaping, and agricultural
JCC = Jack Case Center
LEED = Leadership in Energy and Environmental Design
NNSA = National Nuclear Security Administration
PUE = power usage effectiveness
REC = renewable energy certificate
SSPP = Strategic Sustainability Performance Plan (DOE)
UMS = Utilities Management System
UPF = Uranium Processing Facility
Y-12 = Y-12 National Security Complex

4.2.6.4 Water Conservation

The Y-12 Complex reduction in water intensity exceeds the FY 2016 target of 16% and the FY 2026 target of 26%. By the end of FY 2012, the site had achieved a 33.4% reduction in potable water use since the baseline was established (Fig. 4.13). During FY 2012, the site noted a reduction of 8.3%. Actions that have contributed to the overall reduction in potable water use include the following.

- Steam trap repairs and improvements.
- Condensate return repair and reroute (~10 million gal saved/year).
- Cleanout and shutdown of Buildings 9201-05, 9204-01, 9204-04, and 9401-03.
- Replacement of once-through air handling units (~5 million gal saved/year).
- Low-flow fixture installation (~660 thousand gal saved/year).
- The Y-12 Complex potable water system supplies numerous on-site facilities and supports
- fire protection systems (e.g., sprinkler systems),
- fire hydrants and emergency fire-fighting water storage),
- sanitary water systems (e.g., emergency showers and eyewash stations, personnel decontamination facilities, drinking fountains, restrooms, change houses, and the cafeteria),
- process water systems (e.g., feedwater for the steam plant and demineralizer, makeup water for cooling towers, process cooling, cleaning and decontamination systems, chemical makeup systems, laboratories, and other miscellaneous needs), and
- 16-in. emergency backup water feed for ORNL.

Meters are installed on the potable water tanks and on various facilities on the site. A minimal number of meters within the facilities are currently read, and although a verified listing does not exist, Y-12 is working on verifying all locations of water meters. Future metering will include advanced meter installations for all enduring facilities, as applicable, to comply with the 2015 goal. Additionally, new advanced meters will be installed on the potable water tanks because the existing meters are flow meters rather than totalizing meters.

Although Y-12 has made significant progress, future reductions in water consumption can still be achieved through continued improvements within facilities, metering, and replacement of inefficient HVAC units. Continued reductions in water use will be incorporated into ongoing facility repairs and renovations as funding becomes available.

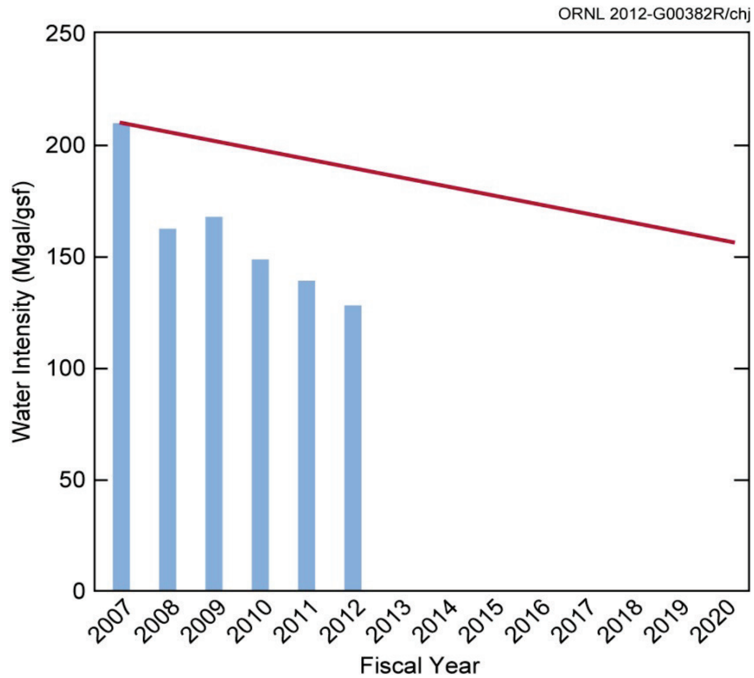

Fig. 4.13. Y-12 Complex water intensity (i.e., consumption per gross square foot) vs goal, FY 2007 through FY 2012. (Mgal = millions of gallons; gsf=gross square foot; red line is the consumption reduction goal.)

These efforts will include

- upgrading toilets and urinals to low-flow, hands-free units;
- installing flow restrictors on faucets and shower heads;
- repairing condenser loop connections to the cooling towers;
- replacing once-through water-cooled air conditioning systems with air-cooled equivalents;
- installing advanced potable water meters; and
- repairing Buildings 9212 and 9204-02E condensate returns.

4.2.6.5 Fleet Management

The Y-12 fleet comprises sedans, light duty trucks/vans, medium duty trucks/vans, and heavy duty trucks. Vehicles range from new to 28 years old with the majority (90%) of vehicles between the ages of 7 and 24 years old. To achieve the optimum fleet, Fleet Management is coordinating with other departments on-site (e.g., shuttle services) to develop a strategic plan for managing on-site transportation at the Y-12 Complex. Vehicles are used as tools to perform work and support the mission at the Y-12 Complex. Fleet Management is evaluating the current fleet and will focus on efforts to rightsize the fleet based on mission needs. In addition to the fleet size, petroleum and alternative fuel (E85) use is monitored to ensure executive orders are being met. Fleet Management has benchmarked other DOE sites and private industry to allow Y-12 to standardize its fleet and meet federal requirements. Fleet Management goals support executive orders associated with petroleum consumption reduction and alternative fuel usage.

The Y-12 Complex has already surpassed the petroleum reduction goal by achieving a 67.1% reduction within 7 years. Due to the expanding mission and increase in transformation-related activities on-site, it may be difficult for the site to continue to reduce fuel consumption by 2% each year and increase nonpetroleum consumption by 10% annually, but Y-12 continues to progress toward this goal.

The site has also achieved a 554.3% increase in alternative fuel use from the 2005 baseline. As there is a ready supply of E85 fuel on the site, all alternative fuel vehicles use the fuel 100% of the time. Biodiesel was introduced to the site in 2007. In 2008 the increase in the cost of biodiesel prompted an evaluation of the benefits of biodiesel use vs the costs, and it was determined that biodiesel was no longer cost-effective. Therefore, ultralow diesel was purchased and diesel vehicles were required to use the ultralow fuel. Table 4.2 is a Y-12 Complex fuel statistic pulled from FAST showing the goal will be reached through 2018.

Table 4.2. Summary of petroleum and alternative fuel use over a 7-year period

	2005 Baseline	2012	Increase/ decrease	EO 13423 goal
Petroleum (Fleet)	160,126 gal	51,791 gal	67.1% decrease	2% per year decrease
E85 fuel	4,801 gal	26,614 gal	554.3% increase	10% per year increase

To track the continued success of fuel-saving measures, the fleet manager monitors fuel consumption by both Y-12 Complex 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.

The NNSA fleet reduction goal for FY 2012 and FY 2013 is 35% for the organization. Although this goal continues to evolve, the FY 2012 reduction will contribute toward this goal. Given the unsustainable state of the current fleet and the existing funding constraints, Y-12 Complex Fleet Management is taking a multitiered approach to managing the current fleet while planning for a more sustainable future fleet to meet the mission needs of the site. The ultimate goal is a smaller, more modern, more cost-efficient, and sustainable fleet.

In FY 2012, Fleet Management removed 100 vehicles from the fleet. This initiative was aligned with the DOE requirement to rightsize the fleet and reduce inventory by 35% in 2 years. The reduction helped Y-12 maintain the average age of the fleet, decrease maintenance costs, and reinvest in the remaining mission-critical fleet. In conjunction with the fleet reduction, the existing shuttle service was transformed into a taxi service to provide a customer-focused alternative form of transportation. In addition, four heavy duty vehicles were procured to replace commercial leases.

The Y-12 Complex will continue to monitor vehicle use and redistribute or remove vehicles from the fleet as needed. Replacement vehicles will be evaluated on energy use in accordance with sustainable acquisition guidance and will be more fuel efficient. As additional guidance becomes available, Y-12 will evaluate the existing fleet to identify further reductions.

The following actions are planned for continued progress in fleet management.

- Increase the use of hybrid electric vehicles as they become available.
- Develop and implement a plan for installing electric charging stations throughout the plant.
- Evaluate a "preferred parking" initiative for energy-efficient and/or electric vehicles (Fig. 4.14).

ORNL 2012-G00383/chj

Fig. 4.14. Electric carts are used within the protected area of the Y-12 Complex.

4.2.6.6 Electronic Stewardship

The Y-12 Complex committed to the FEC pledge in 2008 to improve the management of electronic assets during all life-cycle phases: acquisition, operation and maintenance, and end-of-life management. In 2012, as an FEC Partner, B&W Y-12 completed all FEC annual reporting to account for acquisition and procurement of electronics and implementation of other practices to maximize Y-12 Complex energy efficiency, reduce electronic-related wastes, and improve end-of-life management. B&W Y-12 received a 2012 FEC Gold Level Award in September 2012 (see Section 4.2.7).

4.2.6.7 Greenhouse Gases

The Y-12 Complex developed a preliminary GHG inventory in August 2009. The inventory was developed for FY 2008 with an FY 2003 baseline year. Based on the requirements of EO 13514, the baseline year was changed to FY 2008. Table 4.3 provides a summary of Y-12 Complex GHG emissions for FY 2008 and FY 2012.

The Y-12 Complex reduced Scope 1 and 2 GHG emissions by 30% in FY 2012, primarily due to decreased Scope 1 emissions from steam generation, decreased Scope 2 emissions from energy efficiency projects, and cleaner regional electric power sources. Scope 3 GHG emissions have decreased by 6.5% since the 2008 baseline year. Employee commuting GHG emissions account for 60% of the Scope 3 emissions. It will be difficult for the Y-12 Complex to meet the reduction goal for Scope 3 GHG emissions without the addition of public transit to the Oak Ridge area and/or a telecommuting program. To further reduce employee commuting emissions, the Y-12 Complex will continue to encourage use of the Y-12 Complex carpooling and rideshare programs.

Table 4.3. Y-12 National Security Complex greenhouse gas emissions summary

GHG emission source	FY 2008 baseline (metric ton CO_2e/year)	FY 2012 (metric ton CO_2e/year)
Scope 1		
Steam (coal, natural gas, fuel oil)	128,654	66,746
Industrial fugitive emissions	22,549	12,274
On-site wastewater treatment	6.9	6.6
Fleet fuels	1,675	1,107
Scope 2		
Electricity	184,995	156,162
Total Scopes1 and 2	**337,872.9**	**236,295**
Scope 3		
T&D losses	12,185.8	10,287
Off-site municipal wastewater treatment	25.3	25.85
Employee commute	17,447	18,005
Business ground and air travel	2,251	1,517.3
Total Scope 3	**31,909.1**	**29,835.15**
TOTAL GHG Emissions	**369,782.1**	**266,130.15**

Abbreviations
CO_2e = CO_2 equivalent
FY = fiscal year
GHG = greenhouse gas
T&D = transmission and distribution

4.2.6.8 Storm Water Management and the Energy Independence and Security Act of 2007

During FY 2012, Y-12 implemented several initiatives to reduce storm water runoff by creating green spaces and installing permeable pavement on the new parking lot at the New Hope Center (Fig. 4.15).

Fig. 4.15. Permeable pavement and native plantings contribute to Energy Independence and Security Act Section 438 requirements. (*Source:* Kathy Fahey, Y-12 Photography)

Efforts included taking all the excess soil resulting from the new parking lot near New Hope Center and backfilling over "rubbleized" concrete slabs. This area was an inactive parking area adjacent to demolished buildings. Additionally, green space was created around several demolished facilities to remove roadways and parking spaces that are no longer needed. In all, about 1.3 hectares (3.3 acres) have been added to the "green bank" to offset future projects within the Y-12 Complex.

4.2.7 Awards and Recognition

Since November 2000, the Y-12 Complex commitment to environmentally responsible operations has been recognized with more than 95 external environmental awards from local, state, and national agencies. The awards received in 2012 are summarized below.

DOE Sustainability Awards. The "Reaching Beyond—Y-12 Sustainability Outreach" and "Y-12 Targeted Excess Materials (TEM) Program Pursues Sustainable Disposition Paths" activities were selected by DOE headquarters to receive DOE Sustainability Awards. DOE Sustainability Awards recognize innovation and/or excellence in pollution prevention and environmental sustainability stewardship efforts within DOE; recipients are selected by an independent panel.

Tennessee Chamber of Commerce and Industry. B&W Y-12 was recognized in two areas at awards ceremonies at the 30th Annual Tennessee Chamber of Commerce and Industry Environmental Conference in October 2012. Award winners were selected by a panel of state officials who reviewed the nominations, accomplishments, and compliance records of the respective environmental programs. B&W Y-12 received the following award.

- Environmental Excellence Award for Y-12's Sustainability Team

Additionally, B&W Y-12 received an achievement certificate for the following activity.

- Solid Waste Management Certificate for "Sustainable Scenarios: Y-12 Reduces Risk and Waste"

NNSA Awards. In 2012 the Y-12 Complex received three NNSA Pollution Prevention/Sustainability Best in Class Awards. This is the ninth 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 NNSA and DOE; recipients are selected by an independent panel.

Tennessee Pollution Prevention Partnership. In 2012**,** the Y-12 Complex was awarded Performer Level status in the TP3 program for another year. To maintain Performer Level status in the TP3 program, the Y-12 Complex must illustrate ongoing commitment to pollution prevention through the completion of a success story and mentoring and outreach activities. (The TP3 program has been replaced by the newly developed Tennessee Green Star Partnership.)

Federal Electronics Challenge. B&W Y-12 received a 2012 FEC Gold Level Award in September 2012. FEC awards recognize the achievements of FEC partners and their leadership in federal electronics stewardship. B&W Y-12 was one of five Gold Level Award winners.

4.3 Compliance Status

4.3.1 Environmental Permits

Table 4.4 lists environmental permits in force at the Y-12 Complex during 2012. More detailed information can be found in the following sections.

4.3.2 National Environmental Policy Act/National Historic Preservation Act

NNSA adheres to 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 2012, environmental evaluations were completed for 40 proposed actions, all of which were determined to be covered by a CX.

The DOE NEPA implementing procedures, 10 CFR 1021, require a 5-year evaluation of the current Y-12 Complex sitewide environmental impact statement (SWEIS). A new SWEIS was prepared to evaluate the new modernization proposals and to update the analyses presented in the original Y-12 Complex SWEIS (issued in November 2001). The final SWEIS was issued February 2011, and the notice of availability was published March 4, 2011. The final SWEIS (DOE 2011a) is available on the Internet at www.y12sweis.com.

In accordance with NHPA, NNSA is committed to identifying, preserving, enhancing, and protecting its cultural resources. The compliance activities in 2012 included completing NHPA Section 106 reviews and participating in various outreach projects with local organizations and schools.

Forty 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 40 proposed projects, it was determined that none of them would have an adverse effect on historic properties eligible for listing in the *National Register* and no further Section 106 documentation was required. The Y-12 Oral History Program continues 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 provide 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 will be available in various media, including DVDs shown in the Y-12 History Center.

The Y-12 History Center, located in The New Hope Center, continues to be a work in progress. Major renovations have been completed and the new Y-12 History Center, featuring a history library and video viewing area, reopened in May 2012. More interactive and video-based exhibits are planned for the future. The Y-12 History 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 will continue to be available free to the public.

Table 4.4. Y-12 National Security Complex environmental permits, 2012

Regulatory driver	Title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
CAA	Title V Major Source Operating Permit	562767	1/8/2012	1/8/2017	DOE	DOE	B&W Y-12
CWA	Industrial & Commercial User Wastewater Discharge (Sanitary Sewer) Permit	1-91	4/1/2010	3/31/2015	DOE	DOE	B&W Y-12
CWA	NPDES Permit	TN0002968	10/31/2011	11/30/2016	DOE	DOE	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 Storm Water Permit New Hope Center Parking Project	TNR 134147	5/8/2012	5/8/2017 (Project complete—notice of termination 11/8/12)	DOE	B&W Y-12	B&W Y-12
CWA	General Storm Water Permit Y-12 Complex (41.7 hectares/103 acres)	TNR 134022	10/27/2011	5/23/2016	DOE	B&W Y-12	B&W Y-12
RCRA	Hazardous Waste Transporter Permit	TN3890090001	12/4/2012	1/31/2014	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 cooperators of hazardous waste permits	UCOR
RCRA	Hazardous Waste Container Storage Units	TNHW-122	8/31/2005	8/31/2015	DOE	DOE/B&W Y-12	B&W Y-12/ Navarro co-operator

Table 4.4. (continued)

Regulatory driver	Title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
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 Postclosure Permit for the Chestnut Ridge Hydrogeologic Regime	TNHW-128	9/29/2006	9/29/2016	DOE	DOE/UCOR	UCOR
RCRA	RCRA Postclosure Permit for the Bear Creek Hydrogeologic Regime	TNHW-116	12/10/2003	12/10/2013	DOE	DOE/UCOR	UCOR
RCRA	RCRA Postclosure Permit for the Upper East Fork Poplar Creek Hydrogeologic Regime	TNHW-113	9/23/2003	9/23/2013	DOE	DOE/UCOR	UCOR
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/UCOR	UCOR
Solid Waste	Industrial Landfill V (Operating, Class II)	IDL-01-103-0083	Initial permit 4/26/1993	N/A	DOE	DOE/UCOR	UCOR
Solid Waste	Construction and Demolition Landfill (Overfilled, Class IV Subject to CERCLA ROD)	DML-01-103-0012	Initial permit 1/15/1986	N/A	DOE	DOE/UCOR	UCOR
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/UCOR	UCOR

Table 4.4. (continued)

Regulatory driver	Title/description	Permit number	Issue date	Expiration date	Owner	Operator	Responsible contractor
Solid Waste	Construction and Demolition Landfill VII (Operating, Class IV)	DML-01-103-0045	Initial permit 12/13/1993	N/A	DOE	DOE/UCOR	UCOR
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/UCOR	UCOR

Abbreviations

ARAP = Aquatic Resource Alteration Permit
B&W Y-12 = B&W Technical Services Y-12 L.L.C.
CAA = Clean Air Act
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CWA = Clean Water Act
DOE = US Department of Energy
Navarro = Navarro Research and Engineering, Inc.
NNSA = National Nuclear Security Administration
NPDES = National Pollutant Discharge Elimination System
ORR = Oak Ridge Reservation
RCRA = Resource Conservation and Recovery Act
ROD = record of decision
TDEC = Tennessee Department of Environment and Conservation
UCOR = URS | CH2M Oak Ridge LLC
Y-12 Complex = Y-12 National Security Complex

Outreach activities in 2012 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, which 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 the Y-12 Complex New Hope Visitor Center. The Y-12 Complex conducted a total of 36 tours. About 739 people from 22 states visited the Y-12 History Center and toured the Y-12 Complex's historic facility, Building 9731, known as the "Pilot Plant" (Fig. 4.16).

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 included visiting local schools and conducting presentations on the history of the Y-12 Complex and Oak Ridge.

ORNL 2011-G00651/chj

Fig. 4.16. Building 9731 between two images of calutrons.

4.3.3 Clean Air Act Compliance Status

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 sitewide Title V operating permit. DOE was issued Title V Major Source Operating Permits 554701 and 554594 in 2004 for the Y-12 Complex. On January 9, 2012, TDEC issued to DOE the first renewal of the Y-12 Title V Major Source Operating Permit (permit number 562767), replacing both 554701 and 554594.

The permit requires annual and semiannual reports. More than 3,000 data points are obtained and reported each year. All reporting requirements were met during CY 2012, and there were no permit violations or exceedances during the report period.

The TDEC-Knoxville Office, Clean Air Compliance, completed the Y-12 annual Clean Air Compliance inspection on August 8 and 9, 2012. This is the ninth consecutive year in which no noncompliance findings were identified.

Ambient air monitoring, while not specifically required by any permit condition, is conducted at the Y-12 Complex 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 the Y-12 Complex (i.e., mercury monitoring) is supplemented by additional monitoring conducted for ORR and by both on-site and off-site monitoring conducted by TDEC.

Section 4.4 provides detailed information on 2012 activities conducted at Y-12 in support of CAA.

4.3.4 Clean Water Act Compliance Status

During 2012 the Y-12 Complex continued its excellent record for compliance with the NPDES water discharge permit. Data obtained as part of the NPDES program are provided in a monthly report to TDEC. The percentage of compliance with permit requirements for 2012 was >99.9%. About 3,200 data points were obtained from sampling required by the NPDES permit; only two noncompliance's were reported. The Y-12 NPDES permit in effect during 2012 (TN0002968) was issued on October 31, 2011, and became effective on December 1, 2011. It will expire on November 30, 2016.

The effluent limitations contained in the permit are based on the protection of water quality in the receiving streams. The permit emphasizes biological, toxicological, and radiological monitoring of storm water runoff.

Some of the key requirements and changes incorporated in the current permit are summarized below.

- The current NPDES permit continues to place emphasis on chlorine limitations based on water quality criteria at headwater outfalls 200 and 135. Outfall 125 is a storm water outfall and no longer requires dechlorination or toxicity testing.
- Whole effluent toxicity testing continues to be required at outfall 200 and outfall 135.
- The frequency of measurement for flow, pH, and chlorine at the small categorical outfalls has been reduced, and there has been a minor reduction in the number of parameters and measuring frequency at major outfalls.
- NPDES monitoring continues instream at two EFPC locations (station 17 and monitoring location C11).
- Requirements for monitoring and reporting of mercury at station 17 have been increased.
- The Y-12 NPDES permit requires implementation of a radiological monitoring plan for the sampling and reporting of uranium and other isotopes at pertinent locations.
- An annual biological monitoring abatement plan and associated sampling is required.
- The Y-12 permit requires implementation of an SWPPP, which requires sampling and characterization of storm water.
- Storm water sampling of stream-based sediment at four instream locations and an annual storm water monitoring report are completed each year as required by the SWPPP.
- Requirement to manage the flow of EFPC such that a minimum of 5 million gal/day (19 million L/day) is guaranteed by adding raw water from the Clinch River to the headwaters of EFPC.

The permit also included requirements for DOE to perform several activities to reduce the site mercury discharges. Substantial reductions in mercury loading are dependent on DOE successfully completing several cleanup projects previously identified in a CERCLA decision document. In November 2011 DOE filed an appeal to remove the performance of CERCLA actions, most of which were already subject to implementation under the Environmental Management Program under the ORR FAA. See Section 4.8.2 for details of the Mercury Reduction Project to facilitate reduction and lessened mobility of mercury at the Y-12 Complex. Removal of mercury from some storm drain locations has occurred and is noted in Section 4.5.2.

4.3.5 Safe Drinking Water Act Compliance Status

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 total coliform, chlorine residuals, lead, copper, disinfectant by-product, and propylene glycol is conducted by the Y-12 Utilities Management Organization.

In 2012, the Y-12 Complex potable water system retained its approved status for potable water with TDEC. TDEC instituted a requirement for sampling the site potable water system for propylene glycol in 2007 after learning that an unapproved cross-connection existed between the Y-12 potable water system and the antifreeze fire sprinkler systems containing propylene glycol. Sampling of the potable water system for propylene glycol was continued in 2012. Laboratory results for all of the samples collected during 2012 were below the detection limits. As of March 31, 2013, all unapproved cross-connections have been eliminated. As a result of the removal of these cross-connections the requirement to test for propylene glycol has been lifted.

All total coliform samples collected during 2012 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 Y-12 Complex water systems were below TDEC and Safe Drinking Water Act (SDWA) limits. The Y-12 Complex potable water system is currently sampled triennially for lead and copper, and the system sampling was last completed in 2011. These results were below TDEC and SDWA limits and met the established requirements.

4.3.6 Resource Conservation and Recovery Act Compliance Status

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, but EPA retains an oversight role. The Y-12 Complex 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 the site to licensed treatment and disposal facilities. The Y-12 Complex also has a number of satellite accumulation areas (SAAs) 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 2012) is updated annually and submitted to TDEC for review. The October 2012 plan documents the 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. The Y-12 Complex has developed new disposition milestones to address its remaining inventory of legacy mixed waste. Disposition milestones for this final inventory are in fiscal years from 2014 through 2018.

The quantity of hazardous and mixed wastes generated by the Y-12 Complex increased in 2012 (Fig. 4.17). The increase in hazardous waste generation is attributed to the treatment of an additional 1.3 million kg of contaminated leachate compared to 2011. Ninety-eight percent of the total hazardous and mixed waste generated in 2012 was generated as contaminated leachate from legacy operations. The Y-12 Complex currently reports waste on 88 active waste streams. The Y-12 Complex is a state-permitted treatment, storage, and disposal facility. Under its permits, the Y-12 Complex received 1,977 kg (4,358 lb) of hazardous and mixed waste from the off-site Union Valley analytical chemistry laboratory in 2012. In addition, 163,596 kg (360,647 lb) of hazardous and mixed waste was shipped to DOE-owned and commercial treatment, storage, and disposal facilities. More than 9 million kg (19 million lb) of hazardous and mixed wastewater was treated at on-site wastewater treatment facilities.

From June 18 to 21, 2012, TDEC and EPA Region 4 conducted a joint RCRA Compliance Evaluation Inspection of operations at the Y-12 Complex as a component of a multimedia inspection. During the inspection an alleged violation related to storage of CERCLA project investigation-derived waste was identified. (See Section 2.4 for more detailed information related to the alleged violation.) No other issues were identified.

TDEC conducted a comprehensive inspection of the Y-12 Complex hazardous waste program in November 2012, including permitted storage facilities, SAAs, and 90-day accumulation areas. No violations were noted during the inspection.

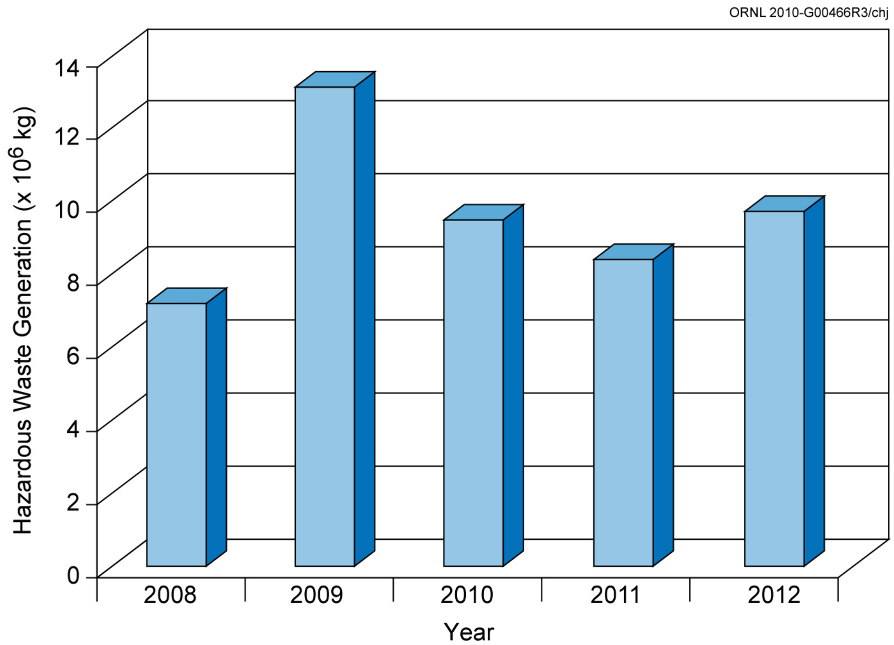

Fig. 4.17. Hazardous waste generation, 2008–2012.

4.3.6.1 Resource Conservation and Recovery Act Underground Storage Tanks

TDEC regulates the active petroleum USTs at the Y-12 Complex. Existing UST systems that are to remain in service at the Y-12 Complex must comply with performance requirements described in TDEC UST regulations (TN 0400-18-01). 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.

In 2012, two petroleum USTs at the East End Fuel Station, a 10,000 gal diesel tank and a 20,000 gal gasoline tank, were removed from the ground and permanently closed in accordance with TDEC UST regulations. Before the tanks were permanently removed from service, however, TDEC performed a compliance inspection of the facility. As a result of this January 31, 2012, compliance inspection, an NOV was received from the TDEC Division of Underground Storage Tanks for deficiencies observed at the East End Fuel Station. At the time of the inspection, Y-12 had begun preliminary activities to drain product and close and remove the tanks; however because of the level of fuel in the tanks, certain leak detection requirements still applied and were not being met. A change of status notification was submitted to TDEC personnel for the USTs at the East End Fuel Station. Placing the tanks in a “Temporarily Out of Service” status resolved the issues raised in the NOV. Closure of the East End Fuel station, including removal of the USTs, began in late June and was completed in August.

4.3.6.2 Resource Conservation and Recovery Act Subtitle D Solid Waste

The ORR landfills operated by the DOE Office of Environmental Management program are located within the boundary of the Y-12 Complex. 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 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 RI/FS. A CERCLA 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. Additional information about the operation of these landfills is addressed in Section 4.8.3, “Waste Management.”

4.3.7 Resource Conservation and Recovery Act–Comprehensive Environmental Response, Compensation, and Liability Act Coordination

The ORR FFA 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 the Y-12 Complex, have been issued to address the eight major closed waste disposal areas at the Y-12 Complex. 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). 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 annual groundwater monitoring report for the Y-12 Complex (UCOR 2013).

Table 4.5. Y-12 National Security Complex RCRA postclosure status for former treatment, storage, and disposal units on ORR

Unit	Major components of closure	Major postclosure requirements
Upper East Fork Poplar Creek Hydrogeologic Regime (RCRA Postclosure Permit 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 Complex
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 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 TNHW-116)		
Former S-3 Ponds (S-3 Pond 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

Table 4.5. (continued)

Unit	Major components of closure	Major postclosure requirements
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. Postclosure corrective action monitoring. Inspection and maintenance of monitoring network and survey benchmarks

Abbreviations
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
ORR = Oak Ridge Reservation
RCRA = Resource Conservation and Recovery Act
Y-12 Complex = Y-12 National Security Complex

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 remediation actions and that they do not adversely impact future CERCLA environmental remediation actions.

4.3.8 Toxic Substances Control Act Compliance Status

The storage, handling, and use of PCBs are regulated under TSCA. Capacitors manufactured before 1970 that are believed to be oil-filled are handled as though they contained PCBs, even when that cannot be verified from manufacturer records. Certain equipment containing PCBs and PCB waste containers must be inventoried and labeled. The inventory is updated by July 1 of each year and was last submitted June 19, 2012.

Given the widespread historical uses of PCBs at the Y-12 Complex and fissionable material requirements that must be met, an agreement between EPA and DOE was negotiated to assist 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 Complex operations involving TSCA-regulated materials were conducted in accordance with TSCA regulations and the ORR PCB FFCA.

The removal of legacy PCB waste, some of which had been stored since 1997, in accordance with the terms of the ORR PCB FFCA was completed last year. The final shipment of legacy PCB waste occurred on August 22, 2011.

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

EPCRA requires that facilities report inventories (i.e., Tier II Report sent to state and local emergency responders) and releases (i.e., Toxic Release Inventory Report submitted to state and federal environmental agencies) of certain chemicals that exceed specified thresholds. The Y-12 Complex submitted reports in 2012 in accordance with requirements under EPCRA Sections 302, 303, 311, 312, and 313.

The Y-12 Complex had no unplanned releases of extremely hazardous substances as defined by EPCRA in 2012. Section 311 notifications were made to TEMA and local emergency responders in 2012 because two chemicals newly exceeded the reporting threshold. The chemicals were not new to Y-12 operations, but it was the first time they had exceeded inventory thresholds. Inventories, locations, and associated hazards of over-threshold hazardous and extremely hazardous chemicals were submitted to TEMA and local emergency responders in the annual Tier II Report as required in Section 312. This is the first year data submittal was made through the E-Plan web-based reporting system, as requested by TEMA. Some local emergency responders also accepted data through the E-Plan system, but others still require paper copies of the Tier II Reports. Y-12 reported 54 chemicals that were over Section 312 inventory thresholds in 2012.

Y-12 Complex operations are evaluated annually to determine the applicability for submittal of a Toxic Release Inventory Report to TEMA and EPA in accordance with EPCRA Section 313 requirements. The amounts of certain chemicals manufactured, processed, or otherwise used are calculated to identify those that exceed reporting thresholds. After threshold determinations are made, releases and off-site transfers are calculated for each chemical that exceeds a threshold. Submittal of the data to TEMA and EPA is made through the TRI-MEweb (Toxics Release Inventory-Made Easy) web-based reporting system operated by EPA. Total 2012 reportable toxic releases to air, water, and land and waste transferred off-site for treatment, disposal, and recycling were 21,775 kg (48,004 lb). Table 4.6 lists the reported chemicals for the Y-12 Complex for 2011 and 2012 and summarizes releases and off-site waste transfers for those chemicals.

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, 2011 and 2012

Chemical	Year	Quantity[a] (lb)[b]
Chromium	2011	*c*
	2012	1,447
Cobalt	2011	*c*
	2012	*d*
Copper	2011	7,043
	2012	9,474
Lead compounds	2011	8,467
	2012	5,182
Manganese	2011	*d*
	2012	5,540
Mercury	2011	3,322
	2012	981
Methanol	2011	43,505
	2012	12,941
Nickel	2011	2,286
	2012	12,439
Silver	2011	*c*
	2012	*d*
Total	2011	64,623
	2012	48,004

[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 = 0.4536 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).

Abbreviations

Y-12 Complex = Y-12 National Security Complex

4.3.10 Spill Prevention, Control, and Countermeasures

CWA Section 311 regulates the discharge of oils or petroleum products to waters of the United States and requires the development and implementation of spill prevention, control, and countermeasures (SPCC) plans to minimize the potential for oil discharges. The major requirements for SPCC plans are contained in Title 40 CFR Part 112. These regulations require that SPCC plans be reviewed, evaluated, and amended at least once every 5 years, or earlier if significant changes occur. The SPCC rule includes requirements for oil spill prevention, preparedness, and response to prevent oil discharges to navigable waters and adjoining shorelines. The rule requires specific facilities to prepare, amend, and implement SPCC plans.

The Y-12 Complex *Spill Prevention, Control, and Countermeasures Plan* (SPCC Plan) (B&W Y-12 2010) was last revised in September 2010 to update general Y-12 Complex spill prevention techniques and changing site infrastructure. This plan presents the SPCC to be implemented by the Y-12 Complex to prevent spills of oil and hazardous constituents and the countermeasures to be invoked should a spill occur. 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 Complex personnel and subcontractors are required to have initial spill and emergency response training before they can work on the site. This training is received as part of the GET program.

An inspection of the Y-12 SPCC Plan was performed on September 18 by an EPA Region 4 representative. The inspection was focused on management of on-site oil and fuel and the related risk of spills. Interviews with Y-12 personnel were conducted that identified how oil and spills are managed. Inspections were made in the field, with particular attention given to secondary containment. While there were no issues identified during the inspection, a letter of deficiency dated October 25, 2012, was received from EPA regarding the plan. A statement of correction was provided on December 18, 2012, that included a table to cross-reference requirements and clarification regarding how the plan meets those requirements indicated as deficient in the EPA letter.

4.3.11 Unplanned Releases

The Y-12 Complex has procedures for notifying off-site authorities for categorized events at the Y-12 Complex. Off-site notifications are required for specified events according to federal statutes, DOE orders, and TOA. As an example, any observable oil sheen on EFPC and any release impacting surface water must be reported to the EPA National Response Center in addition to other reporting requirements. Spills of CERCLA RQ limits must be reported to the EPA National Response Center, DOE, TEMA, and the Anderson County Local Emergency Planning Committee.

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

Y-12 Complex 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.

During CY 2012 there were no releases of hazardous substances exceeding an RQ nor were there any observed oil sheens on EFPC. There was a reportable occurrence [NA--YSO-BWXT-Y12SITE-2012-0043] due to a potable waterline break that occurred on September 6, 2012. Chlorinated water from the point of the break entered the storm drain system and resulted in a fish kill. (See Section 4.5.1.)

4.3.12 Audits and Oversight

A number of federal, state, and local agencies oversee Y-12 Complex activities. In 2012, the Y-12 Complex was inspected by federal, state, or local regulators on seven occasions. One NOV was issued, but no penalties were issued by regulatory agencies.

A TDEC-Knoxville Office UST auditor completed a compliance inspection of the UST system. An NOV was received for a past due line tightness test.

A team of six inspectors from EPA Region 4 and five inspectors from TDEC conducted a surprise multimedia environmental compliance audit of Y-12 the week of June 18, 2012. This inspection included as focus areas hazardous waste management, SWPP, USTs, clean water compliance, wastewater discharges, and EPCRA reporting. There were no findings. During the inspection of a UCOR CERCLA project waste storage area, a concern was expressed regarding storage of two drums of waste purge water stored longer than 1 year. (See Section 2.4 for detailed information.) The containers were shipped for disposal soon afterwards.

A TDEC-Knoxville Office Clean Air Compliance auditor completed the Annual Clean Air Compliance inspection on August 8 and 9, 2012, for 17 air emission sources located at the Y-12 Complex. For the ninth consecutive year, no findings were noted.

TDEC inspectors completed their annual compliance inspection of Y-12 Complex hazardous waste management practices November 15. The four-member audit team inspected more than 30 RCRA permitted storage and accumulation areas and examined training records, spill control equipment, waste characterization records, hazardous waste manifests, the annual waste activity report, and waste reduction report. This year is the fifth consecutive year that no violations were identified.

Table 4.7 provides a summary of external regulatory audits and reviews for 2012.

Table 4.7. Summary of external regulatory audits and reviews, 2012

Date	Reviewer	Subject	Issues
January 31	TDEC-Knoxville	UST Compliance Inspection	1
February 28	City of Oak Ridge	Semiannual Industrial Pretreatment Compliance Inspection	0
June 18–21	EPA Region 4 and TDEC	Multimedia Environmental Compliance Audit	0[a]
August 8–9	TDEC-Knoxville	Annual CAA Compliance Audit	0
September 18	EPA Region 4	SPCC Plan	0[b]
September 18	City of Oak Ridge	Semiannual Industrial Pretreatment Compliance Inspection	0
November 13–15	TDEC	Annual RCRA Inspection	0

[a]See Section 2.4 for information related to an alleged violation related to CERCLA project investigation-derived waste.

[b]A statement of correction was issued to address alleged SPPC Plan deficiency. See Section 4.3.10.

Abbreviations

CAA = Clean Air Act
EPA = US Environmental Protection Agency
RCRA = Resource Conservation and Recovery Act
SPCC = Spill Prevention Control and Countermeasures Plan
TDEC = Tennessee Department of Environment and Conservation
UST = underground storage tank

4.3.13 Radiological Release of Property

Clearance of property from the Y-12 Complex is conducted in accordance with approved procedures that comply with DOE O 458.1, *Radiation Protection of the Public and the Environment* (DOE 2011b). Property consists of real property (i.e., land and structures), personal property, and material and equipment (M&E). At the Y-12 Complex there are three paths for releasing property to the public based on the potential for radiological contamination:

- survey and release of property potentially contaminated on the surface (using preapproved authorized limits for releasing property),
- evaluation of materials with a potential to be contaminated in volume (volumetric contamination) to ensure no radioactivity has been added, and
- evaluation using process knowledge (surface and volumetric).

These three release paths are discussed below.

Property Potentially Contaminated on the Surface

Property that is potentially contaminated on the surface is subject to a complete survey unless it can be released based on process knowledge or a *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)/*Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual* (MARSAME)* (NRC 2000 and 2009) survey plan that provides survey instructions along with the technical (process knowledge) justification for the survey plan. The surface contamination limits the Y-12 Complex uses to determine whether M&E are suitable for release to the public are provided in Table 4.8.

Y-12 uses an administrative limit for total activity of 2,400 dpm/100 cm^2 for radionuclides in groups 3 and 4. The use of the more restrictive administrative limits ensures that M&E do not enter into commerce exceeding the 49 CFR 173, *Shippers-General Requirements for Shipments and Packagings,* definition of “contamination.”

Property Potentially Contaminated in Volume (Volumetric Contamination)

Materials such as activated material, smelted contaminated metals, liquids, and powders are subject to volumetric contamination (e.g., radioactivity per unit volume or per unit mass) and are treated separately from surface contaminated objects. No authorized volumetric contamination limits have been approved for material released from the Y-12 Complex. Materials that are subject to volumetric contamination are evaluated for release by the following three methods.

1. Unopened, Sealed Containers—Material is still in an original commercial manufacturer’s sealed, unopened container. A seal can be a visible manufacturer’s seal (i.e., lock tabs, heat shrink) or a manufacturer’s seal that cannot be seen (i.e., unbroken fluorescent bulbs, sealed capacitors, etc.), as long as the container remains unopened once received from the manufacturer.
2. Process Knowledge—If it can be determined that there is no likelihood of contamination being able to enter a system then this is documented and used to justify release; then the basis for release is documented. Often this is accompanied by confirmatory surveys.
3. Analytical—The material is sampled and the analytical results are evaluated against measurement method critical levels or background levels from materials that have not been impacted by Y-12 Complex activities. If the results meet defined criteria, then they are documented and the material released.

*The *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) provides guidance on how to demonstrate that a site is in compliance with a radiation dose or risk-based regulation, otherwise known as a release criterion. The *Multi-Agency Radiation Survey and Assessment of Materials and Equipment* manual is a supplement to MARSSIM that provides technical information on approaches for determining proper disposition of materials and equipment.

Table 4.8. DOE O 458.1 preapproved authorized limits[a, b]

Radionuclide[c]	Average[d, e]	Maximum[d, e]	Removable[f]
Group 1—Transuranics, ^{125}I, ^{129}I, ^{227}Ac, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{231}Pa	100	300	20
Group 2—Th-natural, ^{90}Sr, ^{126}I, ^{131}I, ^{133}I, ^{223}Ra, ^{224}Ra, ^{232}U, ^{232}Th	1,000	3,000	200
Group 3—U-Natural, ^{235}U, ^{238}U, associated decay products, alpha emitters	5,000	15,000	1,000
Group 4—Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above[g]	5,000	15,000	1,000
Tritium (applicable to surface and subsurface)[h]	N/A	N/A	10,000

[a]The values in this table (except for tritium) apply to radioactive material deposited on but not incorporated into the interior or matrix of the property. No generic concentration guidelines have been approved for release of material that has been contaminated in depth, such as activated material or smelted contaminated metals (e.g., radioactivity per unit volume or per unit mass). Authorized limits for residual radioactive material in volume must be approved separately.

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

[c]Where surface contamination by both alpha-emitting and beta-gamma-emitting radionuclides exists, the limits established for alpha-emitting and beta-gamma-emitting radionuclides should apply independently.

[d]Measurements of average contamination should not be averaged over an area of more than 1 m^2. Where scanning surveys are not sufficient to detect levels in the table, static counting must be used to measure surface activity. Representative sampling (static counts on the areas) may be used to demonstrate by analyses of the static counting data. The maximum contamination level applies to an area of not more than 100 cm^2.

[e]The average and maximum dose rates associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 millirad per hour (mrad/h) and 1.0 mrad/h, respectively, at 1 cm.

[f]The amount of removable material per 100 cm^2 of surface area should be determined by wiping an area of that size with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wiping with an appropriate instrument of known efficiency. When removable contamination of objects on surfaces of less than 100 cm^2 is determined, the activity per unit area should be based on the actual area, and the entire surface should be wiped. It is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate the total residual surface contamination levels are within the limits for removable contamination.

[g]This category of radionuclides includes mixed fission products, including the ^{90}Sr that is present in them. It does not apply to ^{90}Sr that has been separated from the other fission products or mixtures where the ^{90}Sr has been enriched.

[h]Measurement should be conducted by a standard smear measurement but using a damp swipe or material that will readily absorb tritium, such as polystyrene foam. Property recently exposed or decontaminated should have measurements (smears) at regular time intervals to prevent a buildup of contamination over time. Because tritium typically penetrates material it contacts, the surface guidelines in group 4 do not apply to tritium. Measurements demonstrating compliance of the removable fraction of tritium on surfaces with this guideline are acceptable to ensure nonremovable fractions and residual tritium in mass will not cause exposures that exceed DOE dose limits and constraints.

Abbreviations

N/A = not applicable

DOE = US Department of Energy

Source: Vázquez 2011.

Process Knowledge

Process knowledge is used to release property from the Y-12 Complex without monitoring or analytical data and to implement a graded approach (less than 100% monitoring) for monitoring of some M&E (MARSAME Classes II and III). A conservative approach (nearly 100% monitoring) is used to release older M&E for which a complete and accurate history is difficult to compile and verify (MARSAME Class I). The process knowledge evaluation processes are described in Y-12 Complex procedures.

The following M&E are released without monitoring based on process knowledge; this does not preclude conducting verification monitoring, for example, before sale.

- All M&E from buildings evaluated and designated as "RAD-Free Zones"
- Pallets generated from administrative buildings
- Pallets that are returned to shipping during the same delivery trip
- Lamps from administrative buildings
- M&E approved for release from Nonradioactive Material Management Areas
- Porta-potties used in nonradiological areas
- Documents, mail, diskettes, compact disks, and other office media; personal M&E; paper, plastic products, water bottles, ABCs, and toner cartridges; office trash, house-keeping materials, and associated waste; breakroom, cafeteria, and medical wastes; and medical and bioassay samples generated in nonradiological areas
- Subcontractor/vendor/privately owned vehicles, tools, and equipment used in nonradiological areas
- M&E that are administratively released

Summary of Materials Released in CY 2012

The quantities of property released in 2012 are summarized in Table 4.9.

Table 4.9. Summary of materials released in calendar year 2012

Category	Amount released
Property sales (auctioned items)	452,306 pounds
Computer/Telecommunications equipment recycled	117,967 pounds
Vehicles	34
Real Property	None

4.4 Air Quality Program

Sections of the Y-12 Complex Title V permit 562767 contain requirements that are generally applicable to most industrial sites. Examples include requirements associated with asbestos controls, control of stratospheric ozone-depleting chemicals, control of fugitive emissions, and 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 the Y-12 Complex. Major requirements in that section include the Rad-NESHAPs (40 CFR 61) requirements and the numerous requirements associated with emissions of criteria pollutants and other HAPs (nonradiological). In addition, a number of sources that are exempt from permitting requirements under state rules but subject to listing on the Title V permit application are documented, and information about them is available upon request from the state.

4.4.1 Construction and Operating Permits

In 2012, the Y-12 Complex had no construction air permits issued by TDEC. The Title V renewal operating air permit, number 562767, from TDEC was issued to DOE January 9, 2012, and incorporates all the change requests that were previously submitted to TDEC.

Permit administration fees are paid to TDEC annually in support of the Title V program. B&W Y-12 has chosen to pay the fees based on a combination of actual emissions (steam plant, methanol, solvent

140 VOC) and allowable emissions (balance of plant). In 2012, emissions categorized as actual emissions totaled 47,247 kg (52.08 tons), and emissions calculated by the allowable method totaled 639,966 kg (705.43 tons). The total emissions fee paid was $22,136.03.

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 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. 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.

The Y-12 Complex sitewide permit requires annual and semiannual reports. One report is the overall ORR radiological NESHAPs report (40 CFR 61.94, Subpart H), 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. Table 4.10 gives the actual emissions versus allowable emissions for the Y-12 Complex Steam Plant.

Table 4.10. Actual versus allowable air emissions from the Y-12 Complex Steam Plant, 2012

Pollutant	Emissions (tons/year)[a]		Percentage of allowable
	Actual	Allowable	
Particulate	4.5	41	11.0
Sulfur dioxide	0.35	39	0.9
Nitrogen oxides[b]	19	81	23.5
Volatile organic compounds[b]	3.1	9.4	33.0
Carbon monoxide[b]	47.6	139	34.2

NOTE: The emissions are based on fuel usage data for January through December 2012. 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 8,760 h/year). The emissions for both the actual and allowable emissions were calculated based on the latest US Environmental Protection Agency 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).

Abbreviations

Y-12 Complex = Y-12 National Security Complex

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, ODSs, 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 2012. There were six notifications of asbestos demolition or renovation and two records of oral regulatory communication submitted to TDEC in 2012 for its review and records.

4.4.1.1.2 Stratospheric Ozone Protection

The *Y-12 Complex Ozone Depleting Substances (ODS) Phase-Out and Management Plan* (B&W Y-12 2009) provides a complete discussion of requirements and compliance activities at the Y-12 Complex. Past ODS reduction initiatives began in the early 1980s and focused on elimination of Class I ODS use in refrigerants and solvent cleaning operations. In 2012, the last remaining chiller system at the Y-12 Complex with Class I ODSs was taken out of service. The refrigerant from that system was sent to the Defense Logistics Agency.

Y-12 Complex initiatives have also involved elimination of ODS solvents in cleaning processes. Operations personnel developed and implemented changes in one process which eliminated ODS solvent from that process. 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.

All 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 Y-12 Complex operations. To prevent ODSs from coming on-site, procurement documents are written to ensure that no additional equipment or processes using Class I ODSs are brought on-site, and Class II ODS usage is limited wherever possible.

Site procedures are in place for disposition of excess refrigerant or refrigerant-containing equipment. Recovered refrigerant is recycled/reused in equipment in the Y-12 Complex whenever feasible. Refrigerant is recovered from refrigerant-containing equipment before disposal of the equipment. Class I ODSs which cannot be used on-site are first made available to the Defense Logistics Agency. Remaining refrigerants, including Class I and Class II ODSs, are sold to refrigerant reclamation facilities or properly disposed.

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 National Emission Standards for Hazardous Air Pollutants for Radionuclides

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 ^{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 when calculating the total uranium emissions are

- those that exhaust through monitored stacks;
- unmonitored processes for which calculations are performed per Appendix D of 40 CFR 61;
- processes or operations exhausting through laboratory hoods, also involving Appendix D calculations; and
- emissions from room ventilation exhausts (calculated 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 2012, 39 process exhaust stacks were continuously monitored, 33 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 2012, unmonitored uranium emissions at the Y-12 Complex occurred from 34 emission points associated with on-site, unmonitored processes and laboratories operated by B&W Y-12. Emission estimates for the unmonitored processes and laboratory stacks were made using inventory data with emission factors provided in 40 CFR Part 61, Appendix D. The Y-12 Complex source term includes an estimate of those unmonitored emissions.

The B&W Y-12 Analytical Chemistry Organization operates out of two main laboratories. One is located on the site in Building 9995 and is included in the discussion above. The other is located in a leased facility on Union Valley Road, about 0.3 miles east of the Y-12 Complex, and is not within the ORR boundary. In 2012, there were no emission points (or sources) in the off-site 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 ORR radionuclide 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. Two emission points from room ventilation exhausts were identified in 2012 where emissions exceeded 10% of 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 sitewide, 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 requires the annual actual mass emission particulate emissions to be generated using the same monitoring methods required for Rad-NESHAPs compliance. An estimated 0.0067 Ci (0.35 kg) of uranium was released into the atmosphere in 2012 as a result of Y-12 Complex process and operational activities (Figs. 4.18 and 4.19).

The calculated radiation dose to the maximally exposed off-site individual from airborne radiological release points at the Y-12 Complex during 2012 was 0.1 mrem. This dose is well below the NESHAPs standard of 10 mrem and is less than 0.04% of the roughly 300 mrem that the average individual receives from natural sources of radiation. (See Section 7.1.2. for an explanation of how the airborne radionuclide dose was determined.)

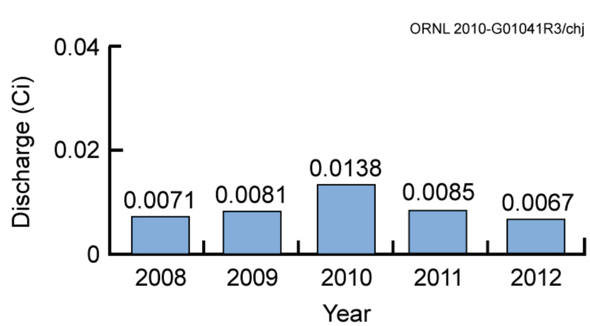

Fig. 4.18. Total curies of uranium discharged from the Y-12 Complex to the atmosphere, 2008–2012.

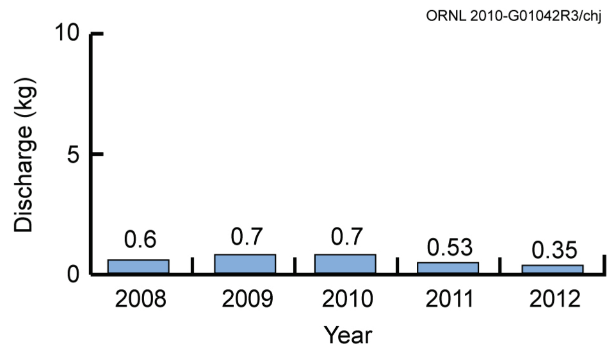

Fig. 4.19. Total kilograms of uranium discharged from the Y-12 Complex to the atmosphere, 2008–2012.

4.4.1.3 Quality Assurance

QA activities for the Rad-NESHAPs 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* (B&W Y-12 2010a). The plan satisfies the QA requirements in 40 CFR Part 61, Method 114, 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 Complex radionuclide emission measurements data from the continuous samplers, breakthrough monitors, and minor radionuclide release points. It specifies the procedures for management of activities affecting the quality of data. QA objectives for completeness, sensitivity, accuracy, and precision are discussed. Major programmatic elements addressed in the QA plan are the sampling and monitoring program, emissions characterization, analytical program, and minor source emission estimates.

4.4.1.4 Source-Specific Criteria Pollutants

Proper maintenance and operation of a number of control devices (e.g., HEPA filters 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 natural gas and Number 2 fuel oil were burned in 2012. Information regarding actual vs allowable emissions from the steam plant is provided in Table 4.10.

Particulate emissions from point sources result from many operations throughout the Y-12 Complex. 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.

Use of Solvent 140 and methanol throughout the complex and 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 calculated amount of Solvent 140 and methanol emitted for CY 2012 is 0.417 pounds (0.000209 tons) and 12,896 pounds (6.448 tons), respectively. The amount of acetonitrile emitted to the atmosphere was less than the permitted value of 9 tons/year.

4.4.1.5 Mandatory Reporting of Greenhouse Gas Emissions under 40 CFR 98

Title 40 of the Code of Federal Regulations Part 98, *Mandatory Greenhouse Gas Reporting*, establishes mandatory GHG reporting requirements for owners and operators of certain facilities that directly emit GHGs and for certain fossil fuel suppliers and industrial GHG suppliers. The purpose of the rule is to collect accurate and timely data on GHG emissions that can be used to inform future policy decisions.

The mandatory reporting of GHGs rule requires reporting of annual emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons, perfluorochemicals, and other fluorinated gases (e.g., nitrogen trifluoride and hydrofluorinated ethers). These gases are often expressed in metric tons of CO_2 equivalent (CO_2e).

The Y-12 Complex is subject only to the Subpart A general provisions and reporting from stationary fuel combustion sources covered in Subpart C, General Stationary Fuel Combustion. Currently the rule does not require control of GHGs; rather, it requires only that sources emitting above the 25,000 CO_2e threshold level monitor and report emissions.

The Y-12 Complex Steam Plant is subjected to this rule. The steam plant consists of four boilers. The maximum heat input capacity of each boiler shall not exceed 99 MM Btu/h. Natural gas is the primary fuel source for these boilers with Number 2 fuel oil as a backup source of fuel. Other limited stationary combustion sources are metal forming operations and production furnaces that use natural gas. In Building 9212, a gas-fired furnace used for drying wet residues and burning solids in a recovery process has a maximum heat input of 700,000 Btu/h. In Building 9215, 10 natural gas torches, each at 300 standard ft^3/h, are used to preheat tooling associated with a forging and forming press. In Building 9204-2, natural gas is used to heat two electrolytic cells. The maximum rated heat input to the burners on each cell is 550,000 Btu/h.

All of the combustion units burning natural gas are served through the fuel supply and distribution system and are reported as combined emissions consistent with the provisions of 40 CFR 98.36(c)(3). The Tier 1 Calculation Method was used to calculate GHGs from the Y-12 Complex. The amount of natural gas supplied to the site, along with the fuel usage logs provides the basic information for calculation of the GHG emissions.

The emission report is submitted electronically in a format specified by the EPA administrator. Each report is signed by a designated representative of the owner or operator, certifying under penalty of law that the report has been prepared in accordance with the requirements of the rule. The total amount of GHGs, subject to the mandatory reporting rule, emitted from the Y-12 Complex is shown in Table 4.11. The decrease from 2010 to 2012 in emissions is associated with the fact that coal is no longer burned since the natural-gas-fired steam plant came online.

Table 4.11. Greenhouse gas emissions from Y-12 Complex stationary fuel combustion sources

Year	GHG emissions (metric tons CO_2e)
2010	97,610
2011	70,187
2012	63,177

Abbreviations
CO_{2e} = CO_2 equivalent
GHG - greenhouse gas
Y-12 Complex = Y-12 National Security Complex

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/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 2012 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 Section 4.4.2, "Ambient Air."

In 2007 EPA vacated a proposed Maximum Achievable Control Technology (MACT) standard which was intended to minimize hazardous air pollution emissions. At that time a case-by-case MACT review was conducted as part of the construction permitting process for the Y-12 Complex replacement steam plant. The new natural-gas-fired steam plant came online on April 20, 2010, and coal is no longer combusted. Specific conditions aimed at minimizing HAP emissions from the new steam plant were incorporated into the operating permit issued January 9, 2012 (see Section 4.4.1). In addition, the boiler MACT was revised and reissued on January 31, 2013. The new requirements will be incorporated in the Title V operating air permit no later than January 31, 2016. This is the date the new steam plant must comply with the new requirements.

Unplanned releases of HAPs are regulated through the Risk Management Planning regulations. Y-12 Complex personnel have determined there are no processes or facilities containing inventories of chemicals in quantities exceeding thresholds specified in rules pursuant to CAA, 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 the Y-12 Complex, DOE reservationwide monitoring, and on- and off-site monitoring conducted by TDEC personnel must be considered. No federal regulations, state regulations, or DOE orders 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 NESHAPs 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 the Y-12 Complex. Originally four monitoring stations were operated at the Y-12 Complex, including two within WEMA (i.e., the former west end mercury-use area at Y-12). The two atmospheric mercury monitoring stations currently operating at the Y-12 Complex, ambient air station 2 (AAS2) and AAS8, are located near the east and west boundaries of the Y-12 Complex, respectively (Fig. 4.20). 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 the Y-12 Complex, two additional monitoring sites were operated: a reference site (rain gauge 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, and a site was operated at New Hope Pond for a 25-month period from August 1987 to September 1989.

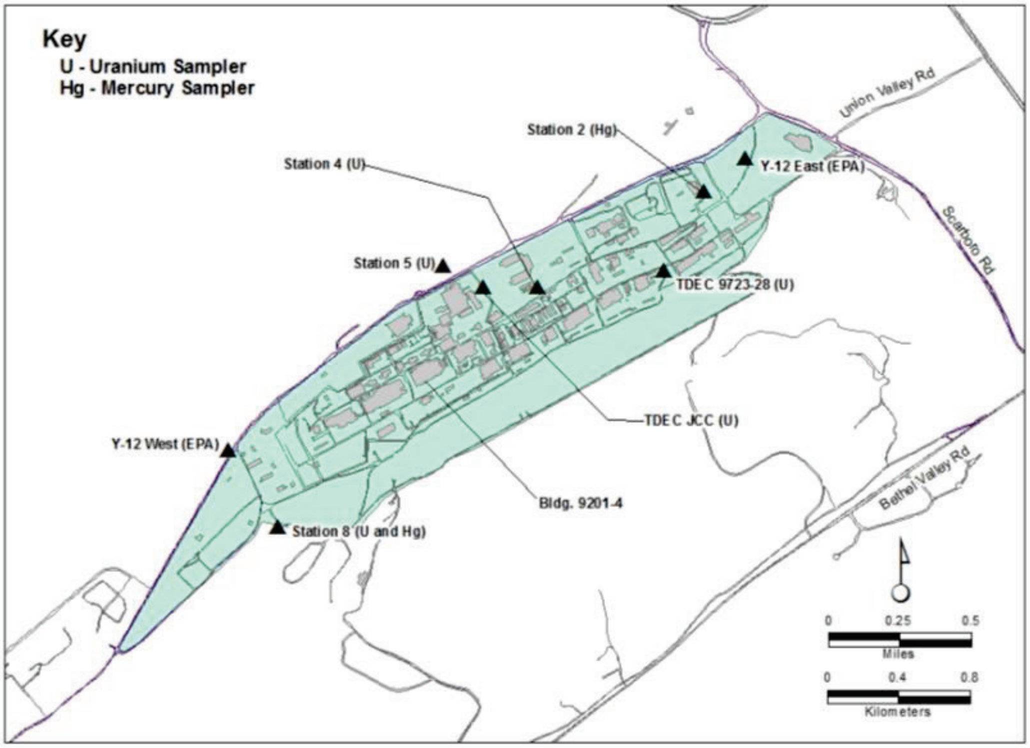

Fig. 4.20. Locations of ambient air monitoring stations at the Y-12 Complex.

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 iodinated-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 then calculated by dividing the total mercury per trap by the volume of air pulled through the trap during the corresponding 7-day sampling period.

As reported previously, 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 4.12). Average mercury concentration at the AAS2 site for 2012 is 0.0038 $\mu g/m^3$ (N = 48), comparable to averages measured since 2003. After an increase in average concentration at AAS8 for the period 2005 through 2007, thought to be possibly due to increased D&D work on the west end, the average concentration at AAS8 for 2012 was 0.0051 $\mu g/m^3$ (N=48), similar to levels reported for 2008 and the early 2000s.

Table 4.12 summarizes the 2012 mercury results and results from the 1986 through 1988 period for comparison. Figure 4.21 illustrates temporal trends in mercury concentration for the two active mercury monitoring sites since the inception of the program in 1986 through 2012 [parts (a) and (b)] and seasonal trends at AAS8 from 1993 through 2012 [part (c)]. The dashed line superimposed on the plots in Fig. 4.21(a) and (b) is the EPA reference concentration of 0.3 $\mu g/m^3$ for chronic inhalation exposure. The large increase in mercury concentration at AAS8 observed in the late 1980s [part (b)] was thought to be related to disturbances of mercury-contaminated soils and sediments during the Perimeter Intrusion Detection Assessment System installation and storm drain restoration projects under way at that time within WEMA. In 4.21(c), a monthly moving average has been superimposed over the AAS8 data to highlight seasonal trends in mercury at AAS8 from January 1993 through 2012.

Table 4.12. Summary of data for the Y-12 National Security Complex ambient air monitoring program for mercury for CY 2012

Ambient air monitoring stations	Mercury vapor concentration (μg/m^3)			
	2012 Minimum	2012 Maximum	2012 Average	1986-1988[a] Average
AAS2 (east end of the Y-12 Complex)	0.0015	0.0080	0.0038	0.010
AAS8 (west end of the Y-12 Complex)	0.0020	0.0200	0.0051	0.033
Reference site, rain gauge 2 (1988[b])	N/A	N/A	N/A	0.006
Reference site, rain gauge 2 (1989[c])	N/A	N/A	N/A	0.005

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

Abbreviations
AAS = ambient air station
CY = calendar year
Y-12 Complex = Y-12 National Security Complex

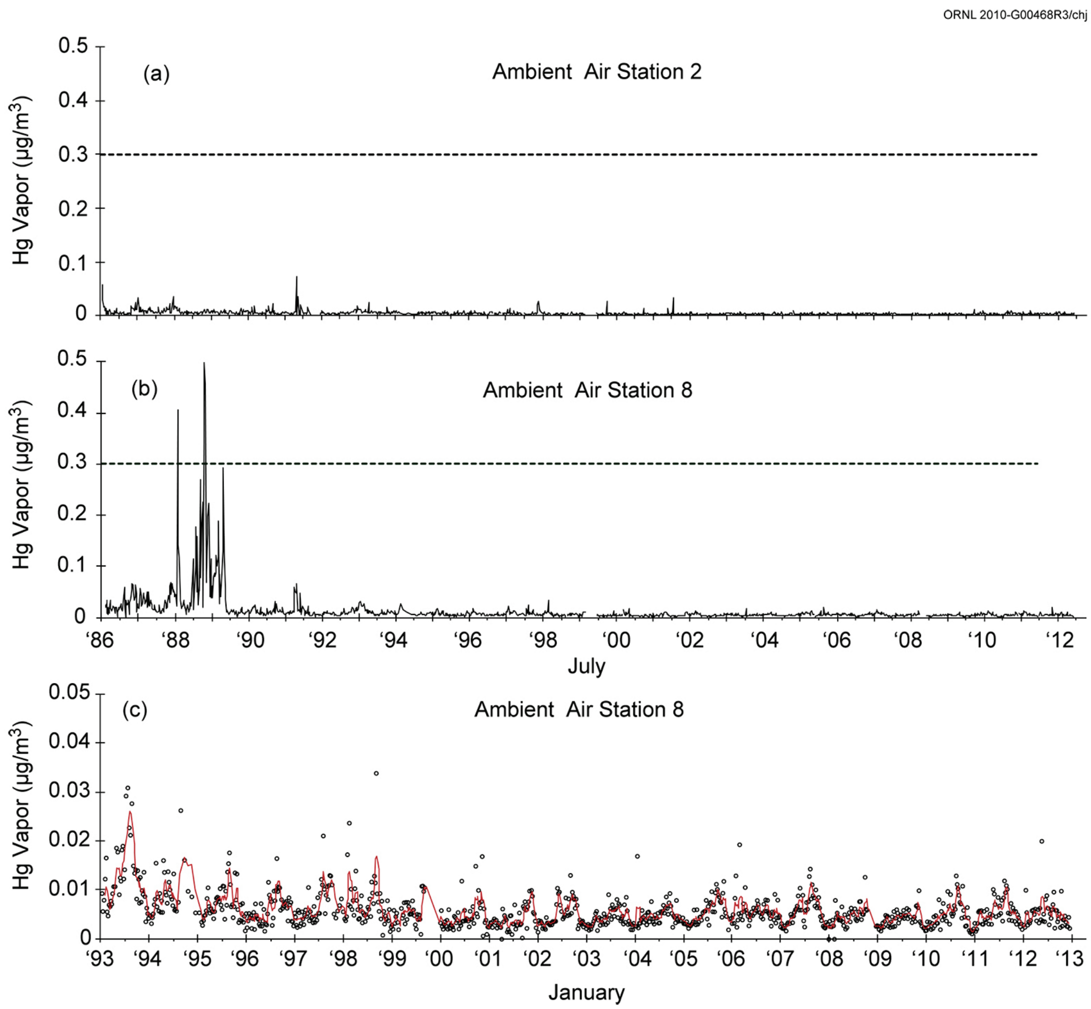

Fig. 4.21. Temporal trends in mercury vapor concentration for the boundary monitoring stations at the Y-12 Complex, July 1986 to January 2013 [(a) and (b)] and January 1993 to January 2013 for ambient air station 8 [(c)]. The dashed lines superimposed on (a) and (b) represent the US Environmental Protection Agency reference concentration of 0.3 μg/m^3 for chronic inhalation exposure. In (c) (note different concentration scale), a monthly moving average has been superimposed over the data to highlight seasonal trends in mercury at ambient air station 8 from January 1993 to January 2013, with higher concentrations generally measured during the warm weather months.

In conclusion, 2012 average mercury concentrations at the two mercury monitoring sites were comparable to reference levels measured for the Chestnut Ridge reference site in 1988 and 1989. More importantly, measured concentrations continue to be well below current environmental and occupational health standards for inhalation exposure to mercury vapor [i.e., the National Institute for Occupational Safety and Health recommended exposure limit of 50 µg/m3, time-weighted average (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/m3 as a TWA for a normal 8 h workday and 40 h workweek; and the current EPA reference concentration of 0.3 µg/m3 for elemental mercury for a continuous inhalation exposure to the human population without appreciable risk of harmful effects during a lifetime].

4.4.2.2 Quality Control

A number of QA/quality control (QC) steps are taken to ensure the quality of the data for the Y-12 Complex 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 annually or, if not new, shipped back to the manufacturer annually for calibration in accordance with standards set by the National Institute of Standards and Technology (NIST).

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 before analysis.

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, December 20, 2012.

Analytical QA/QC requirements include the following:

- 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
- archiving of all primary laboratory records for at least 1 year.

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

Ambient air monitoring is conducted at multiple locations near 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 HAPs, 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 Y-12 Complex 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).

In addition to the monitoring described above, the State of Tennessee (TDEC) and EPA perform ambient air monitoring to characterize the region in general and to characterize and monitor DOE operations locally. Specific to Y-12 Complex operations, there are three uranium ambient air monitors within the Y-12 Complex boundary that, since 1999, have been used 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 about 2 standard ft^3/min. During 2012, these uranium monitors at stations 4, 5, and 8 were phased out of service, and two additional high volume samplers (Fig. 4.20) are now being used by TDEC to provide isotopic uranium monitoring capability. These are located on the east side of the Jack Case Center and on the south side of the Building 9723-28 change house. EPA performs ambient air monitoring on the east end of the plant near the intersection of Scarboro Road and Bear Creek Road and on the west end of the plant near the intersection of Bear Creek Road and Old Bear Creek Road.

In addition, TDEC DOE Oversight Division air quality monitoring includes several other types of monitoring on 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 National Pollutant Discharge Elimination System Permit and Compliance Monitoring

The current Y-12 Complex NPDES permit (TN0002968) requires sampling, analysis, and reporting for about 56 outfalls. Major outfalls are noted in Fig. 4.22. 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: EFPC, Bear Creek, and several tributaries on the south side of Chestnut Ridge, all of which eventually drain to the Clinch River.

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 Y-12 Complex processes flow into EFPC before the water exits the Y-12 Complex. EFPC 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.

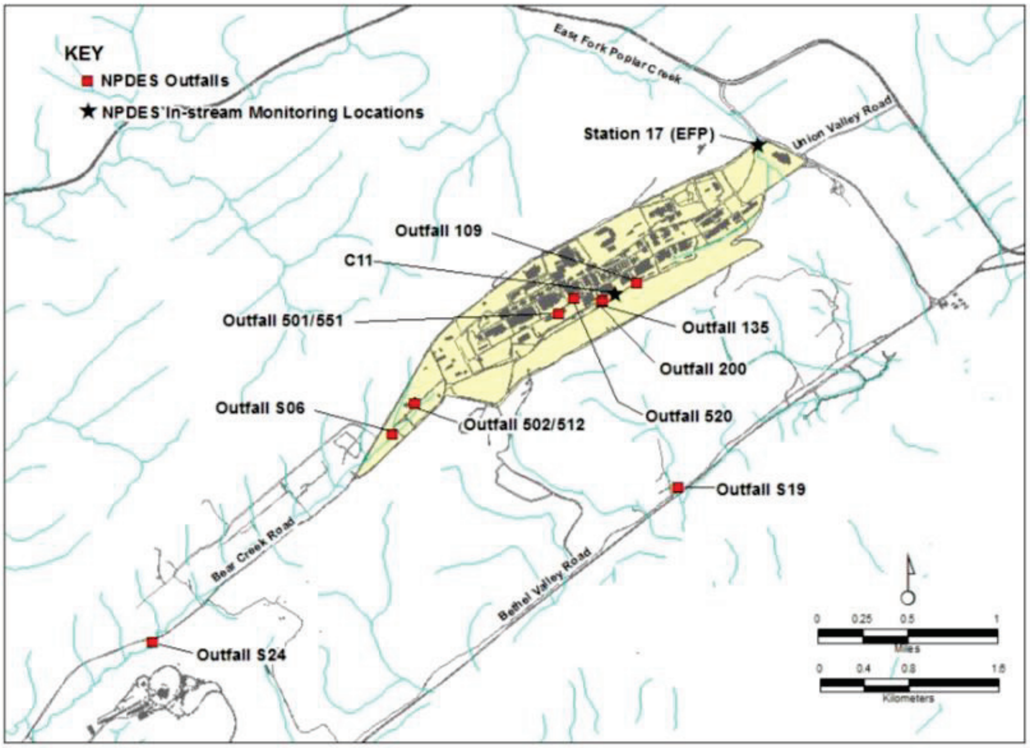

Fig. 4.22. Major Y-12 Complex National Pollutant Discharge Elimination System (NPDES) outfalls and monitoring locations.

Requirements of the NPDES permit for 2012 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 TDEC. The percentage of compliance with permit requirements for 2012 was >99.9%.

There were two NPDES permit limit excursions for cadmium (monthly average permit limit 0.001 mg/L). At the time of these readings, there were no observed adverse effects on the receiving stream.

- At outfall 200 samples were taken on March 6, March 20, and March 29, 2012. Cadmium results obtained from analysis of the samples were 0.00106 mg/L, 0.00114 mg/L, and 0.00133 mg/L, respectively. All values were below the permit daily maximum value. The average of March cadmium values (0.00118 mg/L) exceeded the monthly average permit value of 0.001 mg/L cadmium.
- At outfall 200 during April 2012 measured monthly average cadmium was 0.00131 mg/L.

Other events and observations during 2012 include the following.

Outfall 520 is condensate from a chemical process that requires hold up of pH adjustment and monitoring before discharge. When the process is running, a weekly grab sample for pH (value 6–9) and weekly grab for total dissolved solids (report only) are obtained. The pH reading obtained for the week ending January 22, 2012, was 6.5. The grab sample taken for total dissolved solids was refrigerated for analysis. On removing the sample bottle from refrigeration, the bottle was dropped, it broke, and the sample was lost. Because the weekly period had ended, a replacement sample could not be obtained. Dissolved solids values obtained during January 2012 were 14 mg/L, 10 mg/L, and 13 mg/L.

On June 21, 2012, discolored water (about the color of tea) was observed at the outfall 200 location. The discharge was short duration and did not appear to affect fish or aquatic life. The cause was traced to testing of a backflow preventer with high pressure water flow. The discharge caused rusty water to reach a nearby storm drain grating.

On September 6, 2012, at about 1 p.m., a potable waterline break near the center of the Y-12 Complex was reported to the Y-12 plant shift superintendent. The break occurred in a large waterline, and the discharge included chlorinated water and eroded soil at the point of the break. Y-12 Utilities Department personnel took immediate action to close off water to the break and minimized the impact by placing dechlorination tablets in the discharge before it entered the storm drain system. Personnel were able to stop the flow at about 2 p.m. An estimated 500,000 gal may have entered EFPC during the waterline break.

A sudden rise of muddy water was noticed in the creek and by 3:45 p.m. Environmental Compliance personnel observed the upper reach of the stream begin to clear as conditions returned to normal. To assess the impact on the creek, ORNL aquatic biologists were requested to survey the creek and aquatic life.

A total of 229 minnow-sized fish were found dead in the afternoon of September 6. On the morning of September 7, a survey crew found 272 dead fish, all minnow species. Close observation by the biologist indicated that most of the fish likely died on September 6, the day of the waterline break. Live fish were seen throughout the stream on both survey days.

Based on past surveys, the number of fish killed is a very small percentage (about 2% to 3%) of the total number of fish in the upper reach of EFPC. The estimated long-term impact on the resident fish population associated with this event is likely minimal. This event was reported to TDEC according to regulations and was a reportable occurrence (NA--YSO-BWXT-Y12SITE-2012-0043) reported through ORPS.

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 4.13 lists the NPDES compliance monitoring requirements with the 2012 record of compliance.

Table 4.13. National Pollutant Discharge Elimination System compliance monitoring requirements and record for the Y-12 Complex, January through December 2012

Discharge point	Effluent parameter	Daily avg (lb)	Daily max (lb)	Monthly 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	0.07	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	1.2	*b*	0
	PCB				0.001	*b*	0
Outfall 502 (West End Treatment Facility)	pH, standard units			*a*	9.0	100	2
	Total suspended solids		31		40	100	2
	Total toxic organic				2.13	100	2
	Hexane extractables			10	15	100	2
	Cadmium		0.4		0.15	100	2
	Chromium		1.7		1.0	100	2
	Copper		2.0		1.0	100	2
	Lead		0.4		0.2	100	2

Table 4.13. (continued)

Discharge point	Effluent parameter	Daily avg (lb)	Daily max (lb)	Monthly avg (mg/L)	Daily max (mg/L)	Percentage of compliance	Number of samples
	Nickel		2.4		3.98	100	2
	Nitrate/Nitrite				100	100	2
	Silver		0.26		0.05	100	2
	Zinc		0.9		1.48	100	2
	Cyanide		0.72		1.20	100	2
	PCB				0.001	100	2
Outfall 512 (Groundwater Treatment Facility)	pH, standard units			*a*	9.0	100	12
	PCB				0.001	100	1
Outfall 520	pH, standard units			*a*	9.0	100	5
Outfall 200 (North/South pipes)	pH, standard units			*a*	9.0	100	54
	Hexane extractables			10	15	100	13
	Cadmium			0.001	0.023	98	26
	Lead			0.041	1.190	100	13
	PCB				0.002	100	1
	IC_{25} *Ceriodaphnia*			37% Minimun		100	1
	IC_{25} *Pimephales*			37% Minimun		100	1
	Total residual chlorine			0.024	0.042	100	12
Outfall 551	pH, standard units			*a*	9.0	100	52
	Mercury			0.002	0.004	100	52
Outfall C11	pH, standard units			*a*	9.0	100	12
Outfall 135	pH, standard units			*a*	9.0	100	13
	IC_{25} *Ceriodaphnia*			37% Minimum		1100	1
	IC_{25} *Pimephales*			37% Minimum		1100	1
Outfall 109	pH, standard units			*a*	9.0	100	5
	Total residual chlorine			0.010	0.017	100	4
Outfall S19	pH, standard units			*a*	9.0	100	1
Outfall S06	pH, standard units			*a*	9.0	100	2
Outfall S24	pH, standard units			*a*	9.0	100	4
Outfall EFP	pH, standard units			*a*	9.0	100	14
Category I outfalls	pH, standard units			*a*	9.0	100	31
Category II outfalls	pH, standard units			*a*	9.0	100	17
	Total residual chlorine				0.5	100	17
Category III outfalls	pH, standard units			*a*	9.0	100	10
	Total residual chlorine				0.5	100	10

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

Abbreviations
Y-12 Complex = Y-12 National Security Complex

4.5.2 Mercury Removal from Storm Drain Catch Basins

The storm drain line on which the catch basins are located flows into EFPC at outfall 200. Mercury tends to collect at those low spots in the drain system following heavy rains. During 2012, spill response and waste services personnel continued to perform work in this area of the Y-12 storm drain system. Devices designed to fit in storm drain catch basins to collect mercury at low spots were installed at nine locations during 2012. The traps are devised to allow mercury collected in the trap to be routinely removed by hoisting from the ground surface. Two mercury traps were placed in storm drain subsystem 150; one trap on subsystem 160; two traps on subsystem 163, and four traps in catch basins on drain subsystem 169. Mercury traps were also placed on Buildings 9201-5 and 9201-4 exterior roof drains. In addition, an impervious surface was applied to the north and south sides of Building 9201-4 and south side of 9201-5. This was done as an aid in preventing mercury migration from soils to the drain system. During the period from mid-June 2012 to the end of the year about 11 kg (25 lb) of mercury was collected from the storm system. Since 2003 about 50 kg (110 lb) of mercury has been removed from the storm system.

4.5.3 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 TN0002968. 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 4.14). The current radiological monitoring plan for the Y-12 Complex (B&W Y-12 2012b) was last revised and reissued in January 2012.

Table 4.14. Radiological parameters monitored at the Y-12 Complex, 2012

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 the Y-12 Complex 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 the Y-12 Complex, 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

Abbreviations
Y-12 Complex = Y-12 National Security Complex

Radiological monitoring during storm water events is accomplished as part of the storm water monitoring program. Uranium is monitored at three major EFPC storm water outfalls, two instream monitoring locations and raw water flow, and an outfall on Bear Creek. Results of storm event monitoring during 2012 were reported in the annual storm water report (B&W Y-12 2012a), which was last issued in December 2012. In addition, the monthly 7-day composite sample for radiological parameters taken at Station 17 on EFPC likely includes rain events.

Radiological monitoring plan locations sampled in 2012 are noted on Fig. 4.23. Table 4.15 identifies the monitored locations, the frequency of monitoring, and the sum of the percentages of the DCGs for radionuclides measured in 2012. Radiological data were well below the allowable DCGs.

In 2012, the total mass of uranium and associated curies released from the Y-12 Complex at the easternmost monitoring station, station 17 on upper EFPC, was 121 kg or 0.039 Ci (Table 4.16). Figure 4.24 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 gal 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.

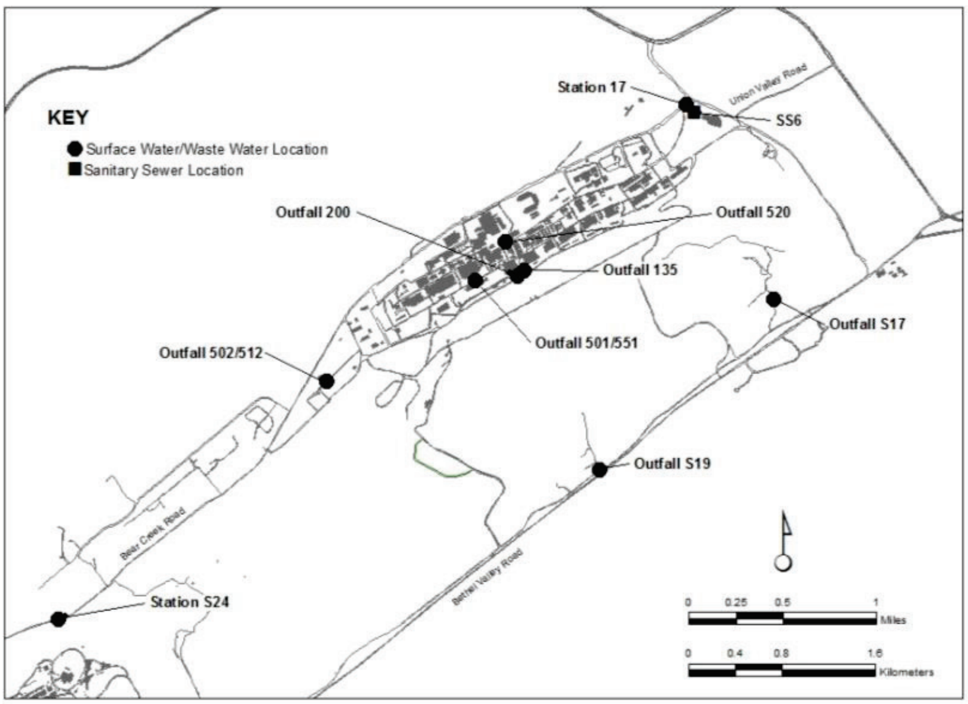

Fig. 4.23. Surface water and sanitary sewer radiological sampling locations at the Y-12 Complex.

Table 4.15. Summary of Y-12 Complex radiological monitoring plan sample requirements and 2012 results

Location	Sample frequency	Sample type	Sum of DCG percentages
	Y-12 Complex wastewater treatment facilities		
Central Pollution Control Facility	1/batch	Composite during batch operation	No flow
West End Treatment Facility	1/batch	24 h composite	4.5
Groundwater Treatment Facility	4/year	24 h composite	1.3
Steam condensate	1/year	Grab	0

Table 4.15. (continued)

Location	Sample frequency	Sample type	Sum of DCG percentages
Central Mercury Treatment Facility	4/year	24 h composite	0
	Other Y-12 Complex point and area source discharges		
Outfall 135	4/year	24 h composite	0
Kerr Hollow Quarry	1/year	24 h composite	0.2
Rogers Quarry	1/year	24 h composite	0
	Y-12 Complex instream locations		
Outfall S24	1/year	7-day composite	0.69
East Fork Poplar Creek, complex exit (east)	1/month	7-day composite	3.8
North/south pipes	1/month	24 h composite	3.8
	Y-12 Complex Sanitary Sewer		
East End Sanitary Sewer Monitoring Station	1/year	7-day composite	2.0

Abbreviations
DCG = derived concentration guide
Y-12 Complex = Y-12 National Security Complex

Table 4.16. Release of uranium from the Y-12 Complex to the off-site environment as a liquid effluent, 2008–2012

Year	Quantity released	
	Ci[a]	kg
	Station 17	
2008	0.046	75
2009	0.067	187
2010	0.075	326
2011	0.104	124
2012	0.039	121

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

Abbreviations
Y-12 Complex = Y-12 National Security Complex

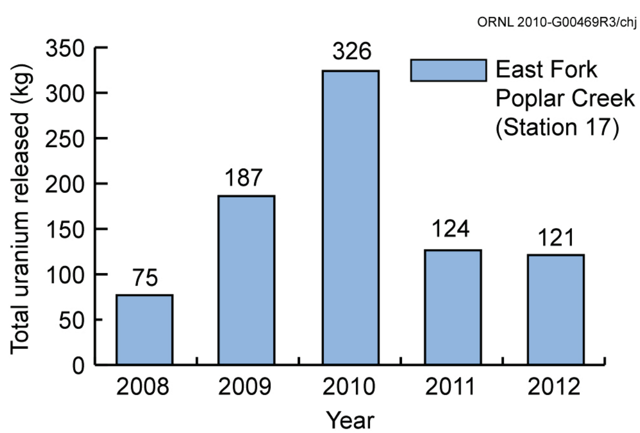

Fig. 4.24. Five-year trend of Y-12 Complex release of uranium to East Fork Poplar Creek.

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 "as low as reasonably achievable" goals. Results of radiological monitoring were reported to the city of Oak Ridge in 2012 quarterly monitoring reports.

4.5.4 Storm Water Pollution Prevention

The SWPPP 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 Y-12 SWPPP underwent a significant rewrite in September 2012. This was due to the issuance of a new NPDES permit in November 2011. Significant changes include the elimination of two instream monitoring locations (C05 and C08) and the removal of the requirement to perform instream base-load sediment sampling. Other requirements remained essentially the same, with the exception of the lowering of a few benchmark values for certain sector outfalls. 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 benchmark values and some have defined sector mean values. The "rationale" portion of the NPDES permit for the Y-12 Complex states "These benchmark values 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 benchmark concentrations are target values and should not be construed to represent permit limits."

Storm water sampling was conducted for 2012 during rain events which occurred in April, August, and September. Results were published in the annual storm water report (B&W Y-12 2012a), which was submitted to the Division of Water Pollution Control in January 2013. 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 two instream monitoring locations on EFPC (Fig. 4.25). The permit no longer calls for sampling of stream base load sediment that is being transported as a result of the heavy flow.

In general, the quality of storm water exiting the Y-12 Complex via EFPC continued to improve in 2012. Improved best management practices and reductions of outside material storage are suspected to be the primary reasons for this continued improvement.

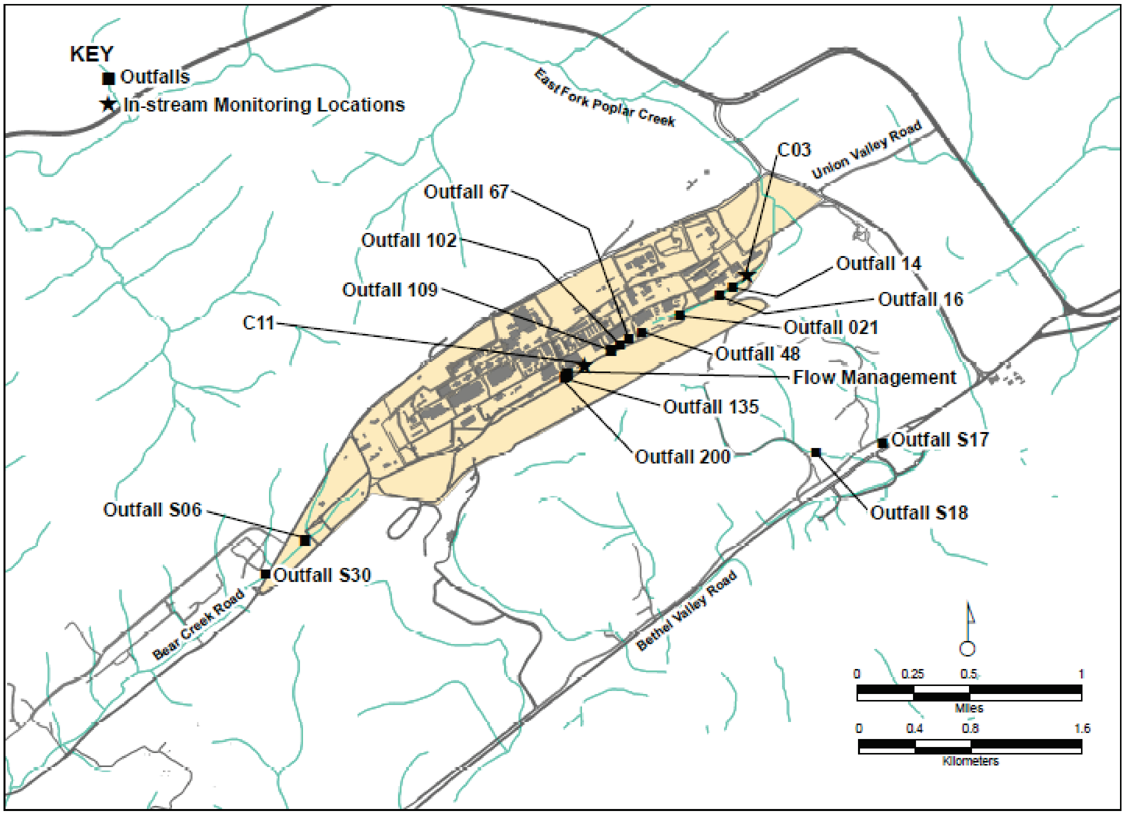

Fig. 4.25. Y-12 Complex storm water monitoring locations.

4.5.5 Flow Management (or Raw Water)

Because of concern about maintaining water quality and stable flow in the upper reach of EFPC, the 2006 NPDES permit required the addition of Clinch River water to the headwaters of EFPC (North/South Pipe–outfall 200 area). The addition of Clinch River water to EFPC decreased instream water temperatures by about 5°C (from about 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 L/day (5 million gal/day) was made, and on December 30, 2008, TDEC modified the permit. The modified permit requires 19 million L (5 million gal) rather than 26 million L (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.

A new NPDES permit that became effective December 1, 2011, contains a requirement to provide a schedule for the relocation of the addition of raw water to EFPC downstream of its current location to reduce the potential for mercury being suspended by the higher flow due to raw water addition at the headwaters of EFPC. A schedule for relocation of raw water addition to EFPC was submitted to TDEC in accordance with the NPDES permit indicating the raw addition will be relocated and associated water quality studies will be completed in 2015. Subsequently, an engineering report was transmitted to TDEC in December 2012, and design is expected to commence pending approval of this document.

4.5.6 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 EFPC 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. 4.26. The primary function of

SWHISS is to provide an indication of potential adverse conditions that could be causing an impact on the quality of water in upper EFPC. 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 Section 4.6).

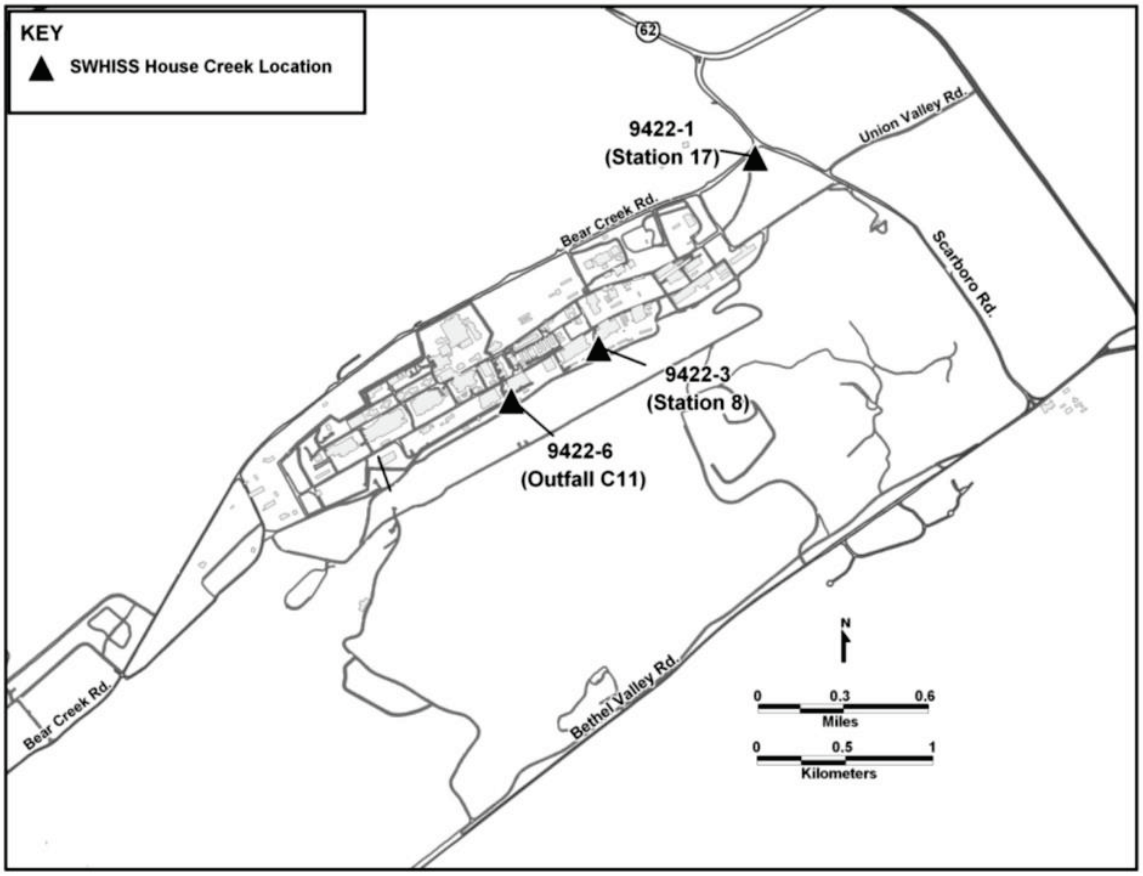

Fig. 4.26. Surface Water Hydrological Information Support System (SWHISS) monitoring locations.

4.5.7 Industrial Wastewater Discharge Permit

The Industrial and Commercial User Wastewater Discharge Permit 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 in 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/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 2012 (Table 4.17) indicate one exceedance of the permit. This was for a daily flow in excess of the permit limit that occurred on September 18, 2012.

Over the last several years, Y-12 Complex personnel have conducted flow monitoring at key locations in 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 I/I 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 continued through 2012. Progress continues to be made in identifying and correcting sources of storm water inflow.

Table 4.17. Y-12 Complex Discharge Point SS6, Sanitary Sewer Station 6 January through December 2012 (All Units are mg/L unless noted otherwise)

Effluent parameter	Number of samples	Average value	Daily maximum (effluent limit)[a]	Monthly average (effluent limit)[a]	Number of limit exceedances
Flow (gallons per day)	366	373,519	1,400,000	1,400,000	1
pH (standard units)	14	7.45	9/6[b]	9/6[b]	0
Silver	14	0.002	0.10	0.05	0
Arsenic	14	<0.004	0.025	0.010	0
Biochemical oxygen demand	14	75.7	300	200	0
Cadmium	14	<0.0004	0.005	0.0033	0
Chromium	14	<0.003	0.075	0.05	0
Copper	14	0.0358	0.21	0.14	0
Cyanide	14	<0.007	0.062	0.041	0
Iron	14	0.619	30	10	0
Mercury	14	0.0043	0.035	0.023	0
Kjeldahl nitrogen	14	19.3	90	45	0
Nickel	14	<0.004	0.032	0.021	0
Oil and grease	14	<6.8	50	25	0
Lead	14	<0.0017	0.074	0.049	0
Phenols—total recoverable	24	<0.033	0.3	0.15	0
Suspended solids	15	115	300	200	0
Zinc	14	0.1467	0.75	0.35	0
Molybdenum	14	0.0648	0.05[c]	0.05[c]	Not Applicable
Selenium	14	<0.008	0.01[c]	0.01[c]	Not Applicable
Toluene	4	0.005U	0.005[c]	0.005[c]	Not Applicable
Benzene	4	0.005U	0.005[c]	0.005[c]	Not Applicable
111 Trichloroethane	4	0.005U	0.005[c]	0.005[c]	Not Applicable
Ethylbenzene	4	0.005U	0.005[c]	0.005[c]	Not Applicable
Carbon Tetrachloride	4	0.005U	0.005[c]	0.005[c]	Not Applicable
Chloroform	4	0.0048	0.005[c]	0.005[c]	Not Applicable

Table 4.17. (continued)

Effluent parameter	Number of samples	Average value	Daily maximum (effluent limit)[a]	Monthly average (effluent limit)[a]	Number of limit exceedances
Tetrachloroethylene	4	0.003	0.005[c]	0.005[c]	Not Applicable
Trichloroethylene	4	0.005U	0.005[c]	0.005[c]	Not Applicable
1,2 trans Dichloroethylene	4	0.005U	0.005[c]	0.005[c]	Not Applicable
Methylene Chloride	4	0.005U	0.005[c]	0.005[c]	Not Applicable

[a]Industrial and Commercial Users Wastewater Permit limits
[b]Maximum Value/Minimum Value
[c]There is not a permit limit for this parameter. This value is the required detection limit

Abbreviations
Y-12 Complex = Y-12 National Security Complex

4.5.8 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.

4.5.9 Biomonitoring Program

In accordance with the requirements of the new 2011 NPDES permit effective December 1, 2011, Part III-E, p. 31, two outfalls that discharge to the headwaters of EFPC (outfalls 200 and 135) were evaluated for toxicity in the summer of 2012 using fathead minnow larvae and *Ceriodaphnia dubia*. A third outfall, outfall 125, no longer has sufficient base flows for toxicity to be evaluated. Table 4.18 summarizes the inhibition concentration (IC_{25}) results of biomonitoring tests conducted during 2012 at outfalls 200 and 135. IC_{25} is the concentration of effluent that causes a 25% reduction in *C. dubia* survival or reproduction or fathead minnow survival or growth. The lower the value of the IC_{25}, the more toxic the effluent. The IC_{25} was greater than the highest tested concentration of each effluent (100% for outfall 200; 36% for outfall 135) during each test conducted, indicating that no toxicity was detected during 2012.

Table 4.18. Y-12 Complex Biomonitoring Program summary information for outfalls 200 and 135 in 2012[a]

Site	Test date	Species	IC_{25}[b] (%)
Outfall 200	7/25/12	*Ceriodaphnia dubia*	>100
Outfall 200	7/25/12	Fathead minnow	>100
Outfall 135	7/25/12	*Ceriodaphnia dubia*	>36
Outfall 135	7/25/12	Fathead minnow	>36

[a]Inhibition concentration (IC_{25}) is summarized for the discharge monitoring locations, outfalls 200 and 135.

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

Abbreviations
Y-12 Complex = Y-12 National Security Complex

4.5.10 Biological Monitoring and Abatement Programs

The NPDES permit issued for the Y-12 Complex mandates a BMAP with the objective of demonstrating that the effluent limitations established for the facility protect the classified uses of the receiving stream, EFPC. The 2012 BMAP sampling reported here follows the 2011 permit requirements. BMAP, which has been monitoring the ecological health of EFPC 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 EFPC. 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 currently being conducted at five primary EFPC sites although sites may be excluded or added depending on the specific objectives of the various tasks. The primary sampling sites include upper EFPC at EFPC kilometers (EFKs) 24.4 and 23.4 (upstream and downstream of Lake Reality, respectively); EFK 18.7 (also EFK 18.2), located off 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 about 1.4 km downstream of the ORR boundary (Fig. 4.27). Brushy Fork at Brushy Fork kilometer 7.6 is used as a reference stream in two BMAP tasks. Additional sites off ORR are also occasionally used for reference, including Beaver Creek, Bull Run, Cox Creek, Hinds Creek, Paint Rock Creek, and Emory River in the Watts Bar Reservoir (Fig. 4.28).

Significant increases in species richness and diversity in EFPC over the last two decades demonstrate that the overall ecological health of the stream continues to improve. However, the pace of improvement in the upper reach of EFPC 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.

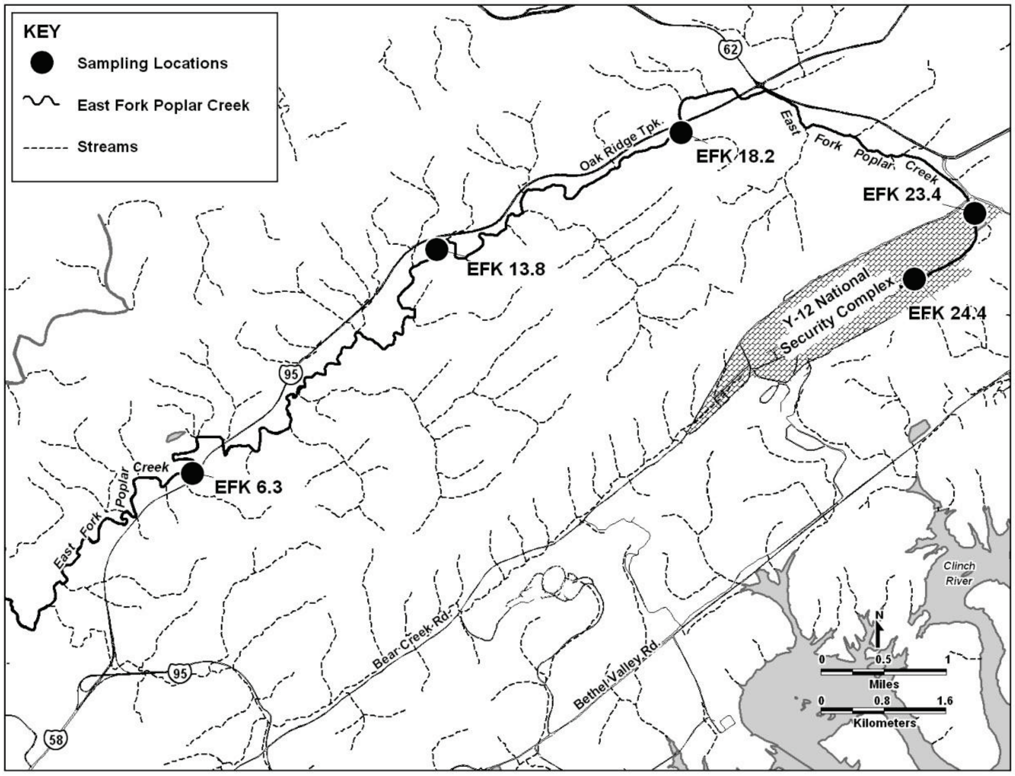

Fig. 4.27. Locations of biological monitoring sites on East Fork Poplar Creek in relation to the Y-12 National Security Complex. (EFK = East Fork Poplar Creek kilometer.)

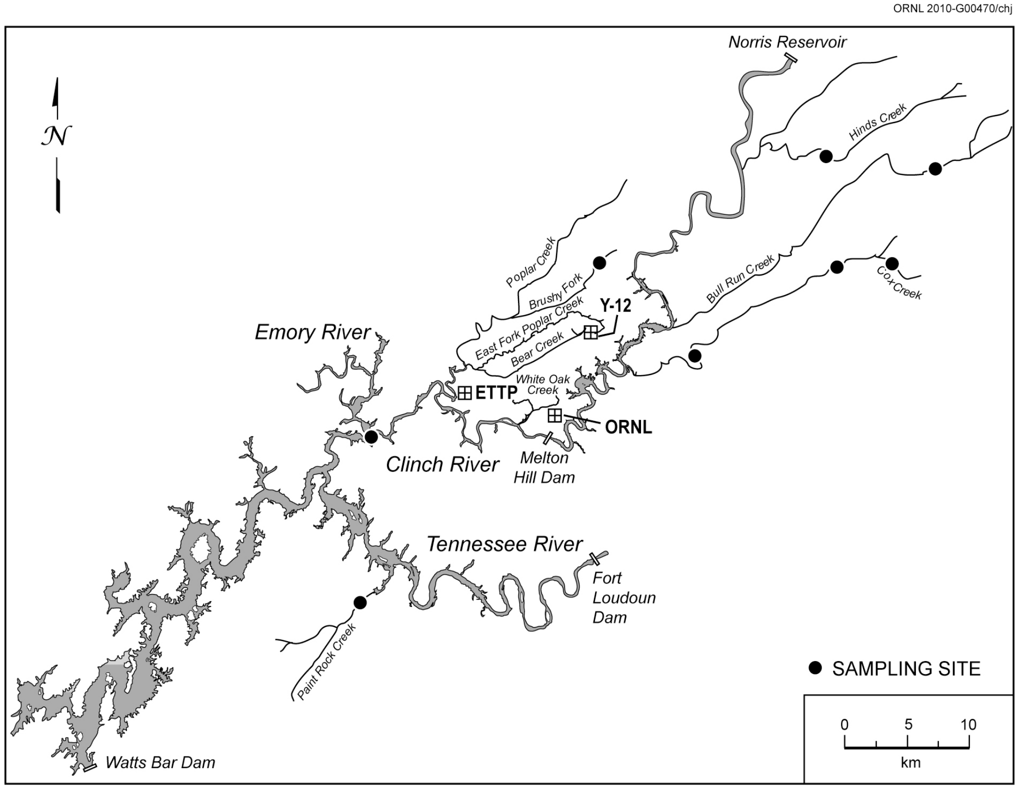

Fig. 4.28. Locations of biological monitoring reference sites in relation to the Y-12 National Security Complex.

4.5.10.1 Bioaccumulation Studies

Mercury and PCB levels in fish from 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 EFPC in 2012 than in fish from reference streams. Elevated mercury concentrations in fish from the upper reach of EFPC indicate that the Y-12 Complex remains a continuing source of mercury to fish in the stream. Waterborne mercury concentrations in the upper reach of EFPC have decreased substantially over the years in response to various remedial actions, first over the 1990s time period and then again in response to the Big Springs Treatment System in 2006 (Fig. 4.29). Although mercury concentrations in fish over time have not decreased commensurate with mercury levels in water in the lower sections of EFPC, mercury concentrations in fish at the uppermost sampling site (EFK 24.4) decreased steadily in the 1990s, consistent with decreased concentrations in water (Fig. 4.29). Significant increases in aqueous mercury concentrations (thought to be the result of storm drain relining and cleanout) have been seen at EFK 23.4 since 2009, but fish tissue concentrations at EFK 24.4 did not increase until fall 2011–spring 2012. The increase in mercury concentrations in fish seen at this site was statistically significant; these fish tissue concentrations were the highest recorded in more than a decade at this site. Mean concentrations of PCBs in fish at EFK 24.4 have not changed substantially since 2008 but continued to be much lower than peak concentrations observed in the mid-1990s (Fig. 4.30).

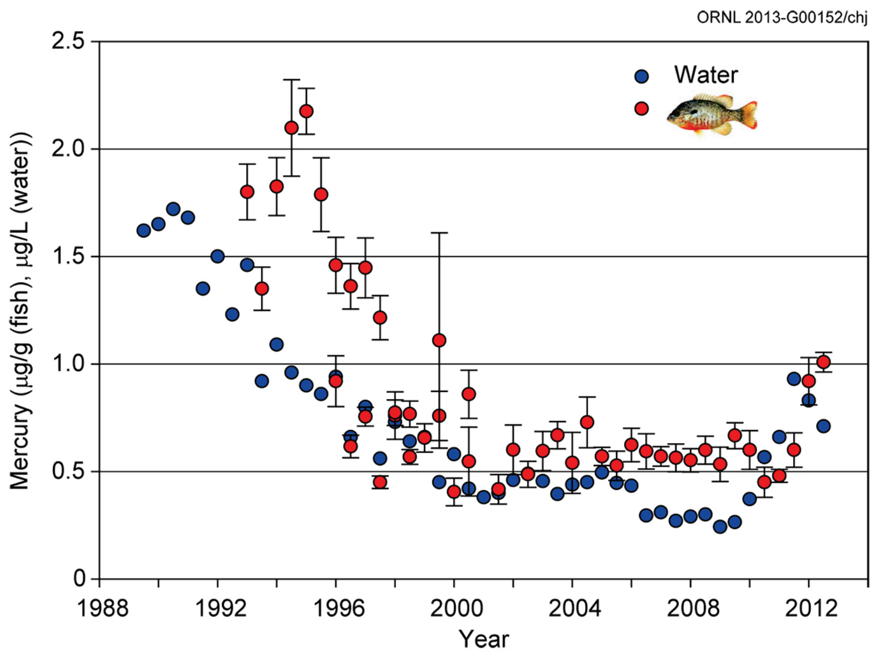

Fig. 4.29. Semiannual average mercury concentration in water and muscle fillets of redbreast sunfish in East Fork Poplar Creek (EFPC) at EFPC kilometer 24.4 through spring 2012.

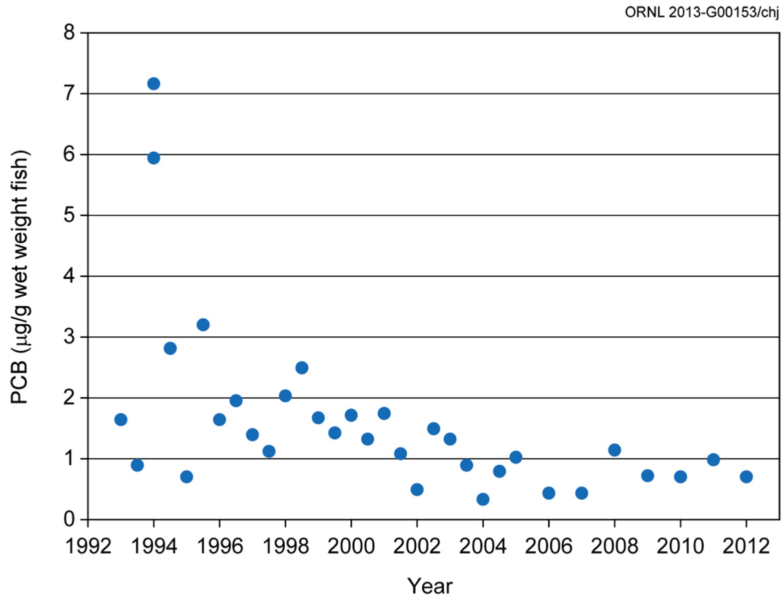

Fig. 4.30. Mean concentrations of PCBs in redbreast sunfish muscle fillets in East Fork Poplar Creek (EFPC) at EFPC kilometer 24.4 through spring 2012.

4.5.10.2 Benthic Invertebrate Surveys

Monitoring of benthic macroinvertebrate communities continued at three sites in EFPC and at two reference streams in the spring of 2012. 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 2005. Trends at EFK 24.4, on the other hand, suggest that no substantial change has occurred at that site since 2000 (Fig. 4.31). Results for EFK 13.8 in 2012 continue to suggest that no substantial change has occurred at that site since the late 1980s and that mildly degraded conditions remain.

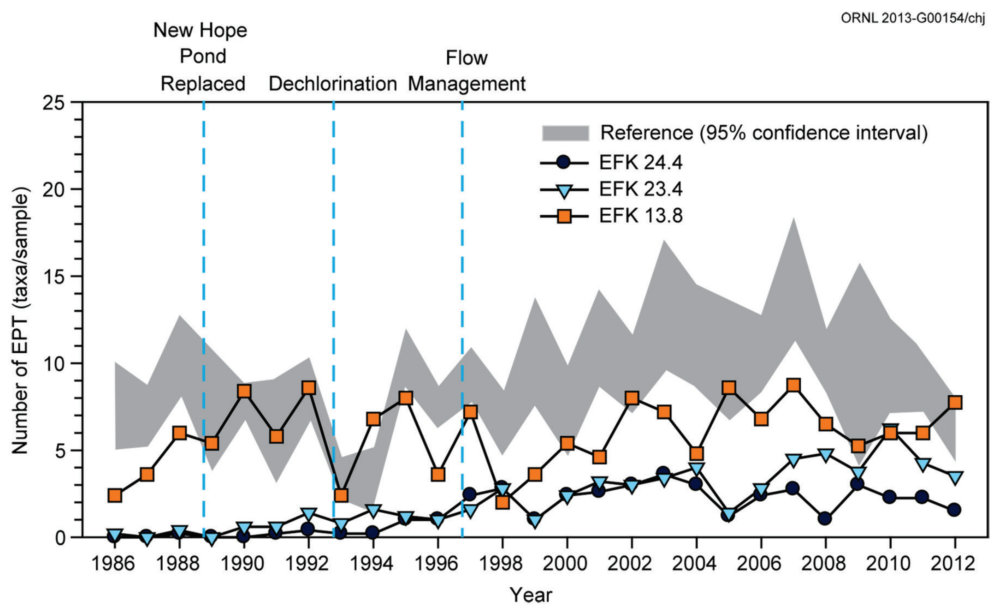

Fig. 4.31. Total taxonomic richness of the Ephemeroptera, Plecoptera, and Trichoptera (EPT) (mean number of EPT taxa/sample) of the benthic macroinvertebrate communities sampled in spring from East Fork Poplar Creek and two nearby reference streams (Brushy Fork and Hinds Creek). (EFK = East Fork Poplar Creek kilometer.)

4.5.10.3 Fish Community Monitoring

Fish communities were monitored in the spring and fall of 2012 at five sites along EFPC and at a reference stream. Over the past two decades, overall species richness, density, biomass, and number of pollution-sensitive fish species have increased at all sampling locations below Lake Reality. The number of sensitive species over time is shown in Fig. 4.32 and dramatically highlights the major improvements in the fish community in the middle to lower sections of EFPC. However, the EFPC 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 ranges from 0 to 25% of the reference value.

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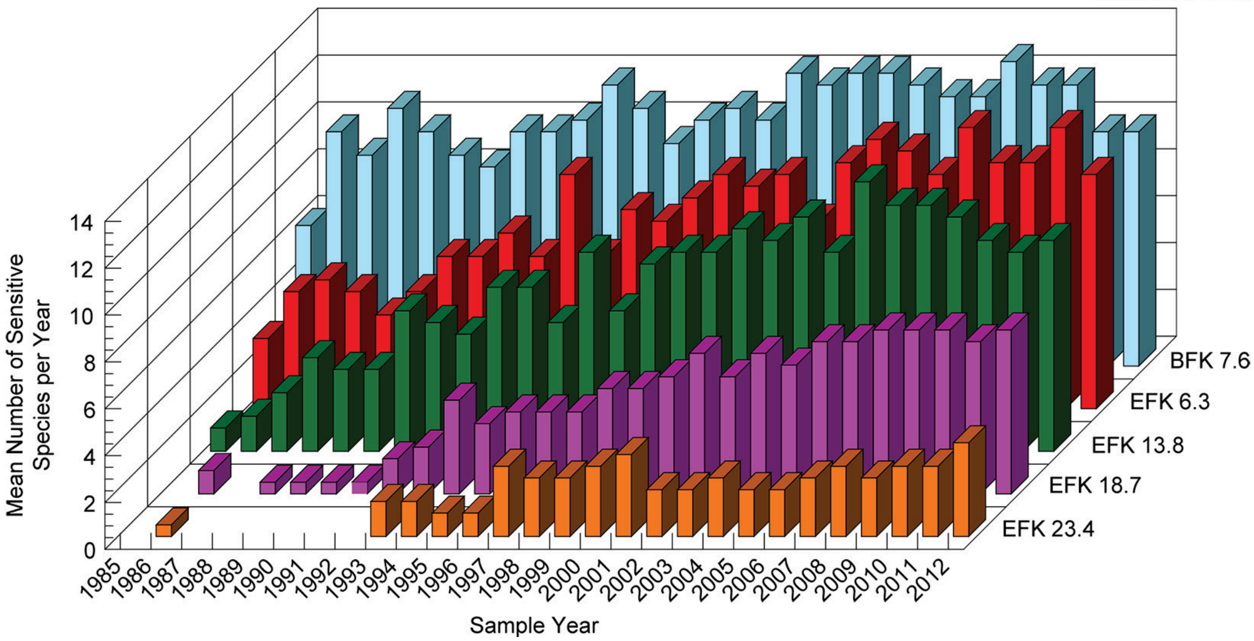

Fig. 4.32. Comparison of mean sensitive species richness (number of species) collected each year from 1985 through 2012 from four sites in East Fork Poplar Creek and a reference site (Brushy Fork). (EFK = East Fork Poplar Creek kilometer; BFK = Brushy Fork kilometer.)

4.6 Groundwater at the Y-12 Complex

Groundwater monitoring at the Y-12 Complex is performed to comply with federal and state requirements and 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 environment in compliance with regulations and DOE orders. Figure 4.33 depicts the major facilities or areas for which groundwater monitoring was performed during CY 2012.

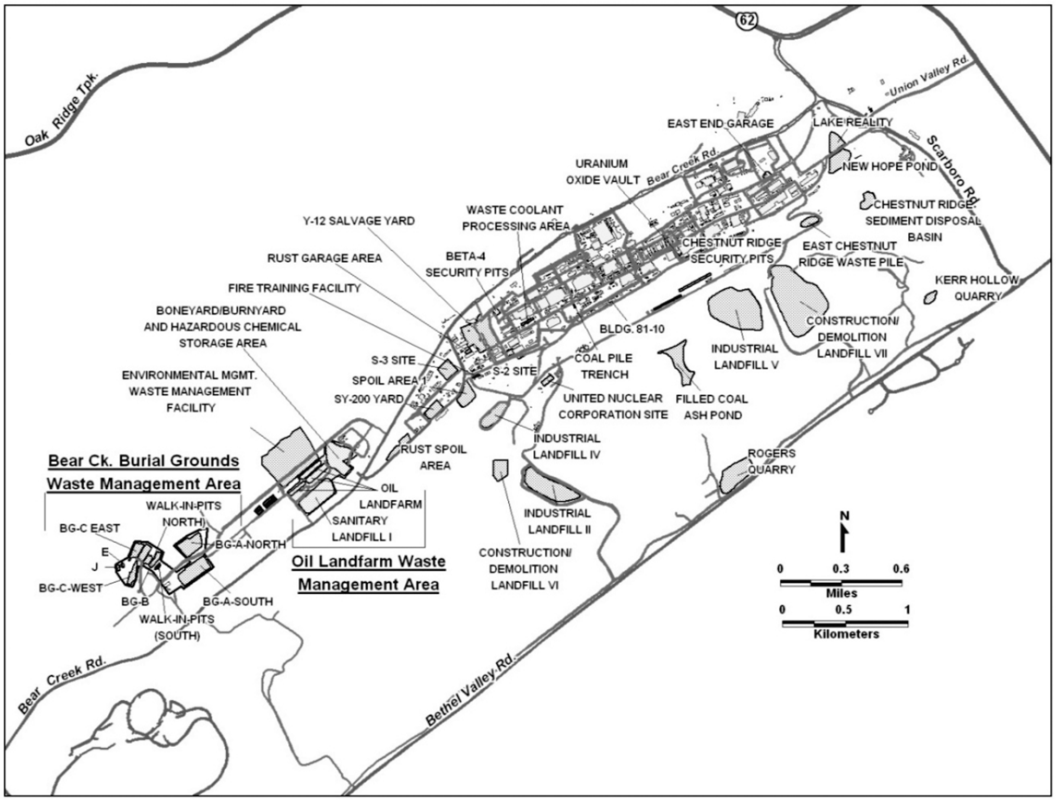

Fig. 4.33. Known or potential contaminant sources for which groundwater monitoring was performed at the Y-12 National Security Complex during CY 2012.

4.6.1 Hydrogeologic Setting

The Y-12 Complex is divided into three hydrogeologic regimes (Bear Creek, upper EFPC, and Chestnut Ridge), which are delineated by surface water drainage patterns, topography, and groundwater flow characteristics (Fig. 4.34). Most of the Bear Creek and upper EFPC 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. However, 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 Chestnut Ridge regime is almost entirely underlain by the Knox Aquifer. The southernmost portion near Bethel Valley Road consists of the lowest members of the Chickamauga Group. In general, groundwater flow in the water table interval follows the topography. Shallow groundwater flow in the Bear Creek and upper EFPC 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 EFPC) from Pine Ridge and Chestnut Ridge. In the Chestnut Ridge regime, a groundwater divide exists that nearly 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.

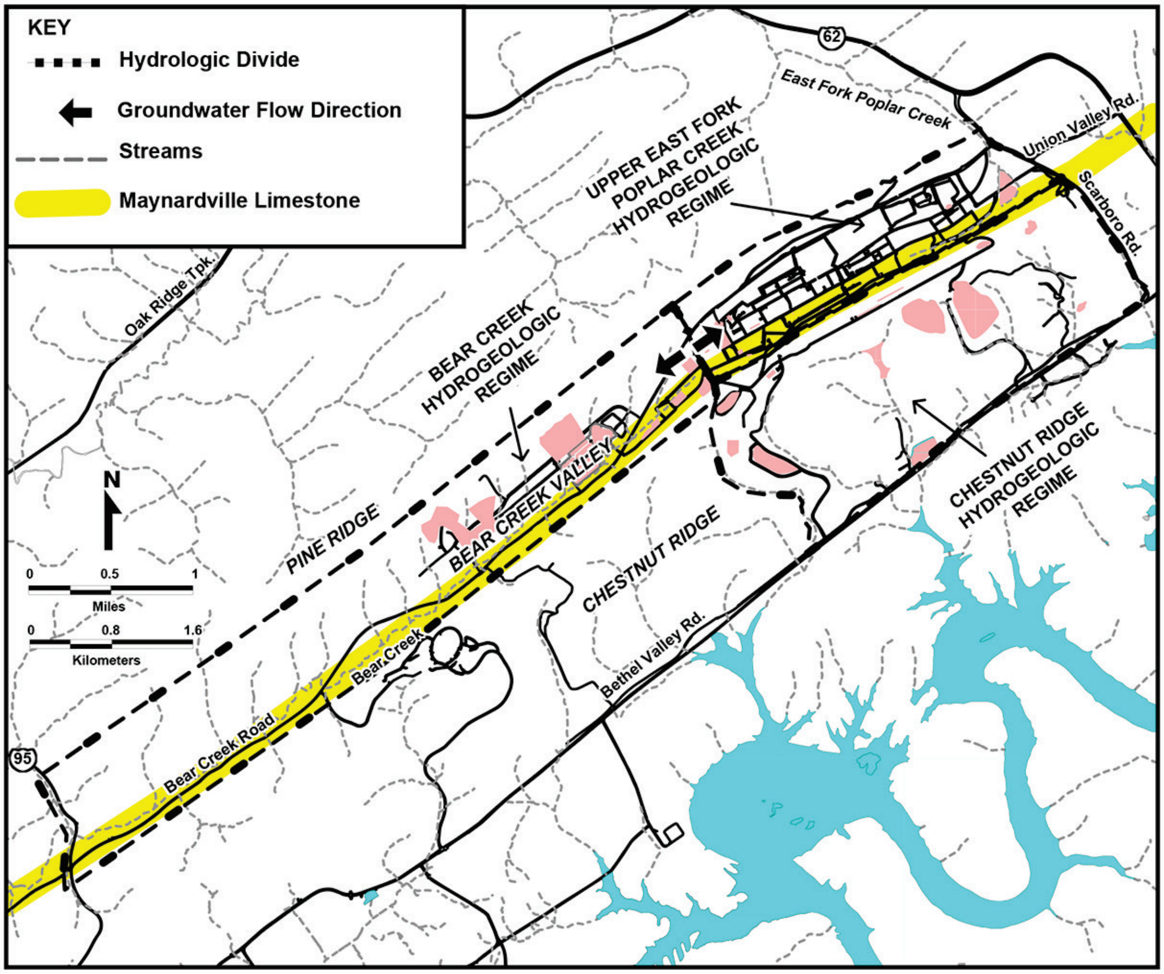

Fig. 4.34. Hydrogeologic regimes at the Y-12 National Security Complex and the position of the Maynardville Limestone in Bear Creek Valley.

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 (Fig. 4.34). 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 (less than 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 storm water 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. VOCs (e.g., petroleum products, coolants, and solvents) at source units over or in the fractured clastic dominated bedrock can remain close to source areas because they tend to adsorb to the bedrock matrix, diffuse into pore spaces within the matrix, and degrade before migrating to exit pathways where more rapid transport occurs for longer distances. However, extensive VOC contamination from multiple sources is observable throughout the groundwater system in both the Bear Creek and upper EFPC 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 4.35 shows a cross section of a typical groundwater monitoring well. Other devices or techniques (e.g., drive points and direct push installations) are sometimes used to gather groundwater data.

In CY 2012, one monitoring well was installed at the Y-12 Complex to support closure of the UST at the East End Garage (Fig. 4.33).

Eight monitoring wells were plugged and abandoned during the year in support of DOE-EM CERCLA site activities. Seven of these were located at the ORAU South Campus Facility located at the corner of Scarboro and Bethel Valley Roads (not shown on Fig. 4.33). One well that was plugged and abandoned was located at the White Wing Scrap Yard northwest of the Y-12 Complex off of State Highway 95 (also not shown on Fig. 4.33).

4.6.3 CY 2012 Groundwater Monitoring

Groundwater monitoring in CY 2012 was performed to comply with DOE orders and regulations by the Y-12 Groundwater Protection Program, DOE EM programs such as WRRP, and other projects. Compliance requirements were met by monitoring 207 wells and 61 surface water locations and springs (Table 4.19). Figure 4.36 shows the locations of Y-12 Complex perimeter/exit pathway groundwater monitoring stations.

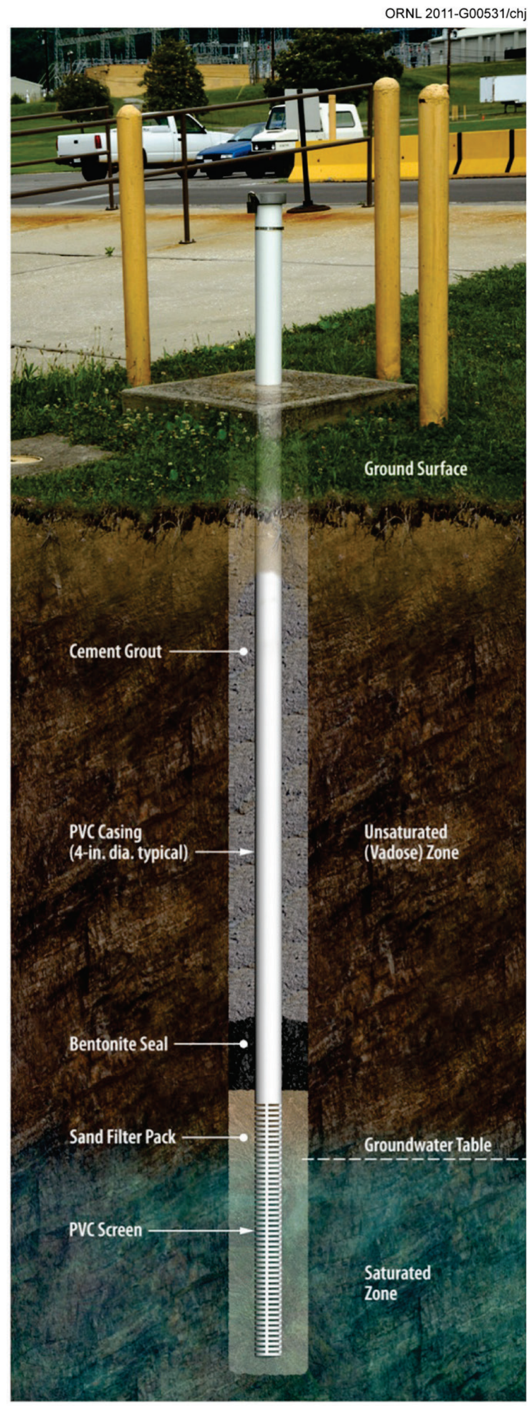

Fig. 4.35. Cross section of a typical groundwater monitoring well.

Table 4.19. Summary groundwater monitoring at the Y-12 National Security Complex, 2012

	Purpose for which monitoring was performed				
	Restoration[a]	Waste management[b]	Surveillance[c]	Other[d]	Total
Number of active wells	61	33	113	140	347
Number of other monitoring stations (e.g., springs, seeps, surface water)	35	6	20	0	61
Number of samples taken[e]	176	151	155	1,859	2,341
Number of analyses performed	8,859	19,855	11,998	6,189	46,901
Percentage of analyses that are nondetects	74.3	86.8	80.8	40.9	76.8
Ranges of results for positive detections, VOCs (µg/L)[f]					
Chloroethenes	1–2,600	4.74–31.8	2–55,000	NA	
Chloroethanes	1.1–500	9.63–48.4	2–520	NA	
Chloromethanes	1–1,000	ND	2–4,100	NA	
Petroleum hydrocarbons	1–8,400	ND	1–2,000	NA	
Uranium (mg/L)	0.004–0.6	0.004–0.0074	0.00053–0.986	0.000237–55.29	
Nitrates (mg/L)	0.012–7,500	0.54–1.82	0.054–10,799	0.089–24,578	
Ranges of results for positive detections, radiological parameters (pCi/L)[g]					
Gross alpha activity	2.15–313	0.8–5.99	3.2–580	NA	
Gross beta activity	3.17–15,500	2.54–27.5	5.4–15,000	NA	

[a]Monitoring to comply with CERCLA requirements and with RCRA postclosure detection and corrective action monitoring.
[b]Solid waste landfill detection monitoring and CERCLA landfill detection monitoring.
[c]DOE order surveillance monitoring.
[d]Research-related groundwater monitoring associated with activities of the DOE Natural and Accelerated Bioremediation Research 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—include tetrachloroethene, trichloroethene, 1,2-dichloroethene (*cis* and *trans*) 1,1-dichloroethene, and vinyl chloride
- chloroethanes—include 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane
- chloromethanes—include carbon tetrachloride, chloroform, and methylene chloride
- petroleum hydrocarbons—include benzene, toluene, ethylbenzene, and xylene

[g]1 pCi = 3.7×10^2 Bq.

Abbreviations
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
NA = not analyzed
ND = not detected
RCRA = Resource Conservation and Recovery Act
VOC = volatile organic compound

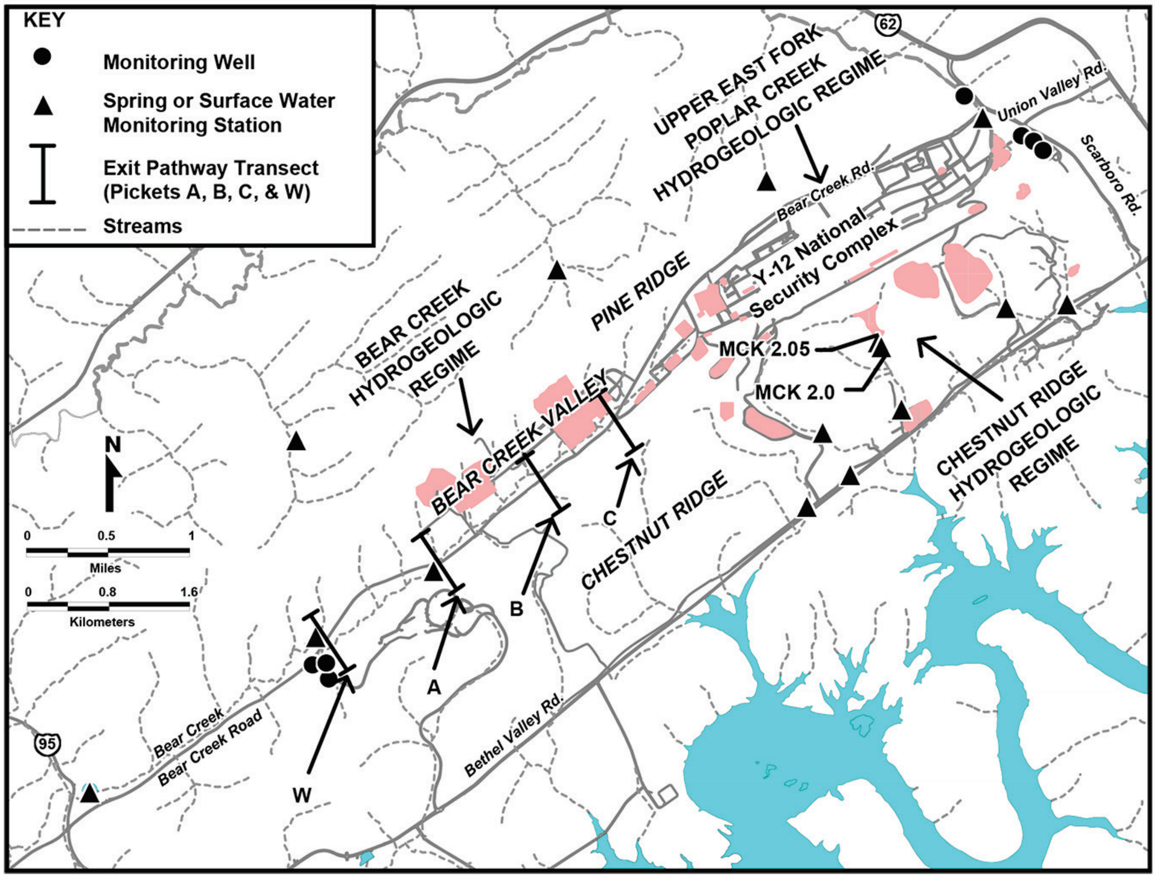

Fig. 4.36. Location of Y-12 National Security Complex perimeter/exit pathway well, spring, and surface water monitoring stations. (MCK = McCoy Branch kilometer.)

Most of the conventional monitoring wells at the Y-12 Complex were sampled using industry standard methods approved by TDEC and EPA (Fig. 4.37). The Y-12 Groundwater Protection Program continued to use passive diffusion bag samplers in 2012 at selected monitoring wells. The passive diffusion bag sampling method is suitable only for monitoring for the presence and concentration of selected VOCs 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 four weeks). The chemical concentration gradient between the uncontaminated deionized water in the passive diffusion bag and the surrounding contaminated groundwater induces VOCs 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 VOC sample bottles and analyzed using standard procedures.

Comprehensive water quality results of groundwater monitoring activities at the Y-12 Complex in CY 2012 are presented in *Calendar Year 2012 Groundwater Monitoring Report* (B&W Y-12 2013).

Details of monitoring efforts performed specifically for CERCLA baseline and remediation evaluation are published in the FY 2012 and FY 2013 WRRP sampling and analysis plans (UCOR 2011, UCOR 2012) and the annual CERCLA remediation effectiveness reports (DOE 2013).

Groundwater monitoring compliance reporting to meet RCRA postclosure permit requirements can be found in the annual RCRA groundwater monitoring report (UCOR 2013).

Fig. 4.37. Groundwater monitoring well sampling at Y-12. [*Source:* Kathryn Fahey, Y-12 photographer.]

4.6.4 Y-12 Complex Groundwater Quality

Historical monitoring efforts have shown that there are four primary contaminants that have impacted groundwater quality at the Y-12 Complex: nitrate, VOCs, metals, and radionuclides. Of those, VOCs are the most widespread as a result of their common use and disposal at the site. Uranium and ^{99}Tc are the radionuclides of greatest concern. Trace metals (e.g., barium, cadmium, chromium, arsenic), the least extensive groundwater contaminants, generally occur close to source areas because of their generally high adsorption characteristics. Historical data have shown that plumes from multiple-source units have mixed with one another and that contaminants (other than nitrate and ^{99}Tc) are not always easily associated with a single source.

4.6.4.1 Upper East Fork Poplar Creek Hydrogeologic Regime

Among the three hydrogeologic regimes underlying the Y-12 Complex, the upper EFPC 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 4.20. Chemical constituents from the S-3 site (primarily nitrate and ^{99}Tc) and VOCs from multiple source areas are observed in the groundwater in the western portion of the upper EFPC regime; groundwater in the eastern portion, including Union Valley, is predominantly contaminated with VOCs.

Table 4.20. Description of waste management units and underground storage tanks included in groundwater monitoring activities, upper East Fork Poplar Creek hydrogeologic regime, 2012

Site	Description
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 before discharge into the pond. Closed under RCRA in 1990.
Salvage Yard Scrap Metal Storage Area	Used from 1950 to 1999 for scrap metal storage. Some metals contaminated with low levels of uranium. Runoff and infiltration are the principal release mechanisms to groundwater. In 2011 a CERCLA action to characterize and remove the scrap was completed. Soil characterization and analysis performed in 2010 and 2011 determined that this facility is not a significant risk to groundwater.
Salvage Yard Oil/Solvent Drum Storage Area	Operated from 1976 to 1989. Primary wastes included waste oils, solvents, uranium, and beryllium. Closed under RCRA with all drums removed. Leaks and spills represent the primary contamination mechanisms for groundwater. Soil characterization and analysis performed in 2010 and 2011 determined that this facility is not a significant risk to groundwater.
Salvage Yard Oil Storage Tanks	Used from 1978 to 1986. Two tanks used to store PCB-contaminated oils, both within a diked area. Tanks were removed after 1993. Soil characterization and analysis performed in 2010 and 2011 determined that this facility is not a significant risk to groundwater.
Salvage Yard Drum Deheader	Used from 1959 to 1989. Sump tanks 2063-U, 2328-U, and 2329-U received residual drum contents. Tanks removed in 1989. Sump leakage is a likely release mechanism to groundwater. The facility was demolished and removed and the soils beneath this facility were excavated and replaced with clean fill and gravel to remediate the site in 2011.
Building 81-10 Area	Mercury recovery facility operated from 1957 to 1962. Potential historical releases to soil, 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. All tanks were removed by 1990. Petroleum product releases to groundwater are documented.
Building 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. In 2011, the coal pile overlying the coal pile trench was removed and the area resurfaced with gravel.

Abbreviations

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
UST = underground storage tank
Y-12 Complex = Y-12 National Security Complex

4.6.4.1.1 Plume Delineation

Sources of groundwater contaminants monitored during CY 2012 include the S-2 site, the Fire Training Facility, the S-3 site, the Waste Coolant Processing Facility, petroleum UST sites, New Hope Pond, the Beta-4 Security Pits, the 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 EFPC regime from the Bear Creek regime, it has contributed to groundwater contamination in the western part of the upper EFPC regime. As previously mentioned, contaminant plumes in the EFPC regime are elongated in shape as a 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

Unlike many groundwater contaminants, nitrate is highly soluble and moves easily with groundwater. Nitrate concentrations in groundwater at the Y-12 Complex exceed the 10 mg/L drinking water standard in part of the western portion of the upper EFPC regime in the aquitard units (a complete list of national drinking water standards is presented in Appendix C) and in the Maynardville Limestone unit of the Knox Aquifer. 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 2012, groundwater concentrations of nitrate as high as 9,320 mg/L (well GW-275) were observed in the shallow bedrock 16.7–19.8 m (55–65 ft) below ground surface) about 396 m (1,300 ft) east of the S-3 site (Fig. 4.38). These results are consistent with results from previous years.

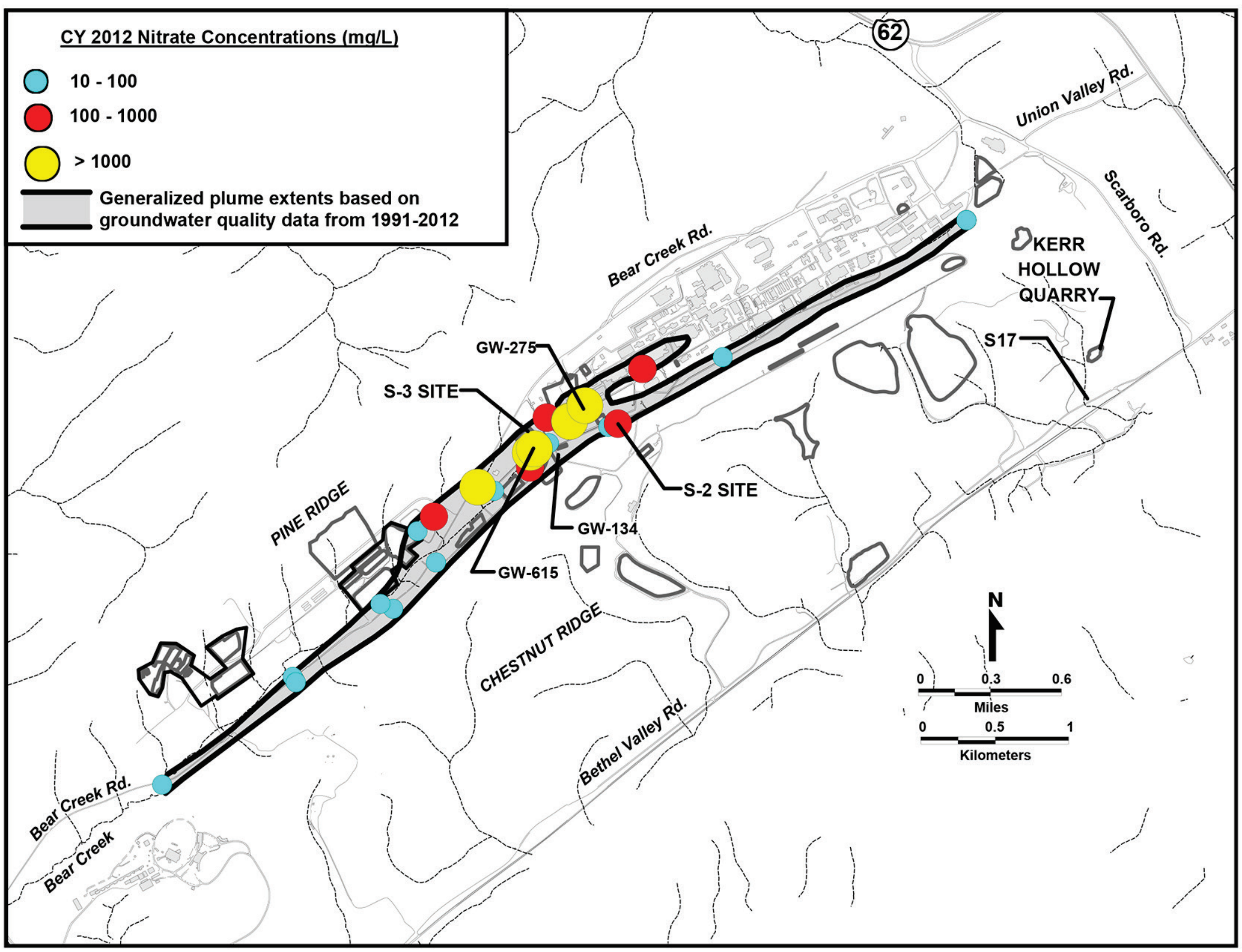

Fig. 4.38. Nitrate observed in groundwater at the Y-12 National Security Complex, 2012.

4.6.4.1.3 Trace Metals

Concentrations of barium, beryllium, cadmium, chromium, copper, lead, nickel, thallium, and uranium exceeded drinking water standards during CY 2012 in samples collected from various monitoring wells and surface water locations downgradient of the S-2 site, the S-3 site, and 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., the S-3 site, the Uranium Oxide Vault, production areas, and the former Oil Skimmer Basin) and contribute to the uranium concentration in upper EFPC.

One trace metal absent from the list of those that exceed drinking water standards in groundwater in CY 2012 is mercury. Due to very low solubility in water and a very high affinity for clay-rich soils such as those on ORR, mercury exhibits little tendency for extensive transport in diffuse groundwater plumes. Additionally, the hydrogeologic complexities of the fracture/conduit flow system underlying the Y-12 Complex 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. 4.39). 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. 4.39.

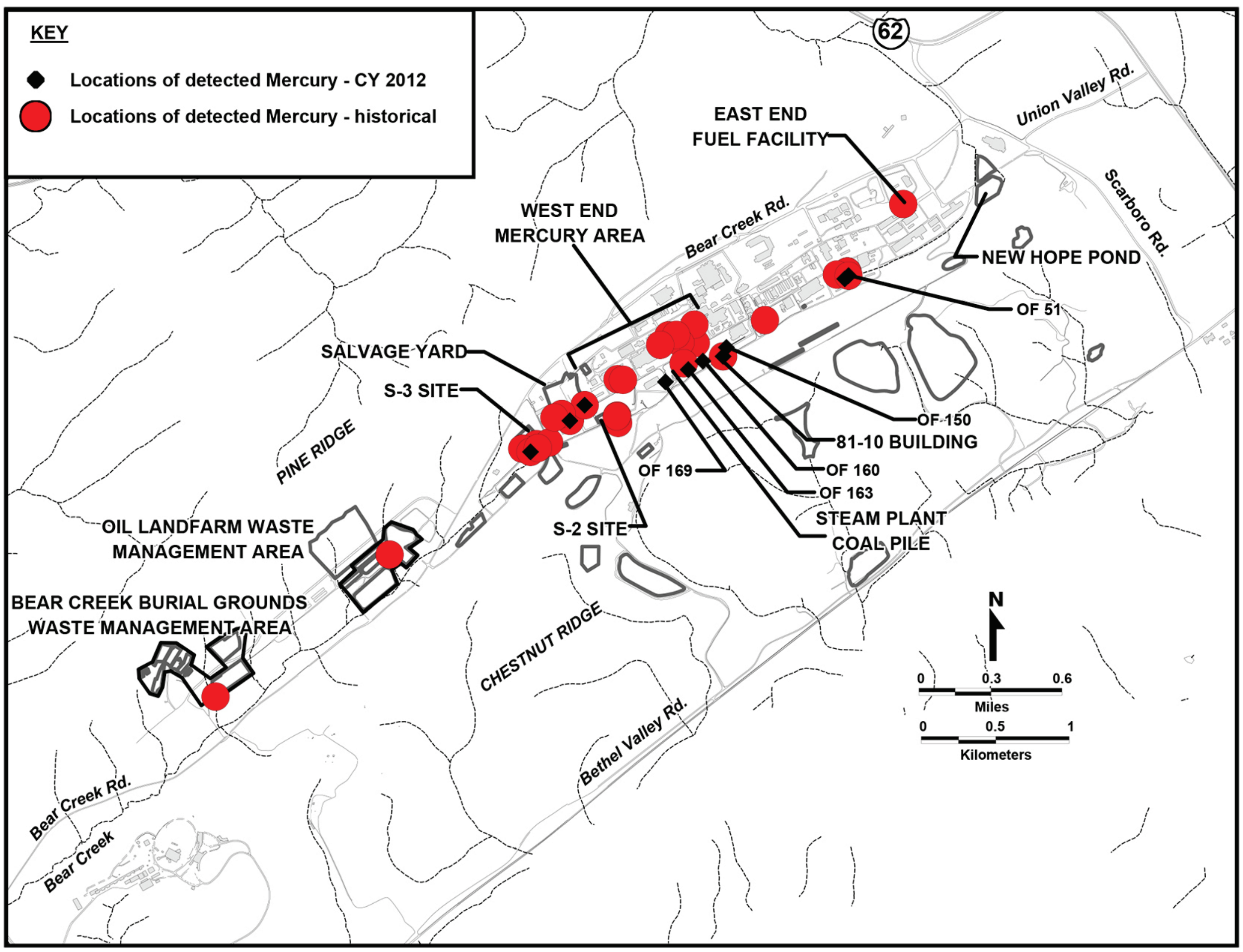

Fig. 4.39. Y-12 groundwater and surface water monitoring stations where mercury has been detected.

Because of past processes and disposal practices, mercury is a legacy contaminant at the Y-12 Complex. 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 COC in surface waters discharging from these areas. However, the transport mechanisms and connections between process buildings, 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 an attempt to understand the fate and transport of mercury at the Y-12 Complex, researchers have developed a conceptual model integrating known hydrologic, geochemical, and physical data (Peterson et al. 2011).

In tightly fractured shale with high clay content and other noncarbonate bedrock, the natural flow paths are such that significant advective transport of mercury through the groundwater is not likely. This is supported by extensive groundwater surveillance monitoring data. In industrialized areas of the Y-12 Complex where the shallow subsurface has been reworked extensively, some preferential transport along building foundations and underground utilities is apparent as evident from elevated surface water concentrations of mercury. The actual mechanism of transport (e.g., advective, chemically diffusive, colloidal) is uncertain.

Interconnections 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., outfall 51) adjacent to EFPC. This discharge is presently captured and treated to remove the mercury at the Big Springs Water Treatment System. Additionally, the regular observation of elemental mercury in storm drains in the western area of the Y-12 Complex has resulted in an increase in monitoring in recent years in several catch basins [e.g., outfall 169, outfall 163, outfall 160, and outfall 150 (Fig. 4.39)]. In recent years, storm drain lines in this area have undergone extensive cleaning and lining. In 2012, mercury traps that were developed and fabricated by Y-12 Complex personnel were installed in an attempt to capture and remove as much mercury as possible from the environment.

4.6.4.1.4 Volatile Organic Compounds

Because of the many legacy source areas, VOCs are the most widespread groundwater contaminants in the EFPC regime. Dissolved VOCs in the regime primarily consist of chlorinated solvents and petroleum hydrocarbons. In CY 2012, the highest summed concentration of dissolved chlorinated solvents (66,527 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 (19,707 µg/L) was obtained from well GW-658 at the closed East End Garage.

These monitoring results generally confirm findings from the previous years of monitoring. A continuous dissolved plume of VOCs in groundwater in the bedrock zone extends eastward from the S-3 site over the entire length of the regime (Fig. 4.40). The primary sources are the Waste Coolant Processing Facility, fuel facilities (Rust Garage and East End), Salvage Yard, and other waste-disposal and production areas throughout the Y-12 Complex. Chloroethene compounds (PCE, TCE, DCE, and vinyl chloride) tend to dominate the volatile organic plume composition in the western and central portions of the Y-12 Complex. However, PCE and isomers of DCE are almost ubiquitous throughout the extent of the plume, indicating many source areas. Chloromethane compounds (carbon tetrachloride, chloroform, and methylene chloride) are the predominant VOCs in the eastern portion of the Y-12 Complex.

Variability in concentration trends of chlorinated VOCs near source areas is seen within the upper EFPC 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 have been observed in monitoring wells associated with the Rust Garage, Old Salvage Yard, and S-3 site in the western part of the Y-12 Complex; some legacy sources at production/process facilities in central areas; and the East End VOC plume, indicating that some portions of the plume are still showing activity.

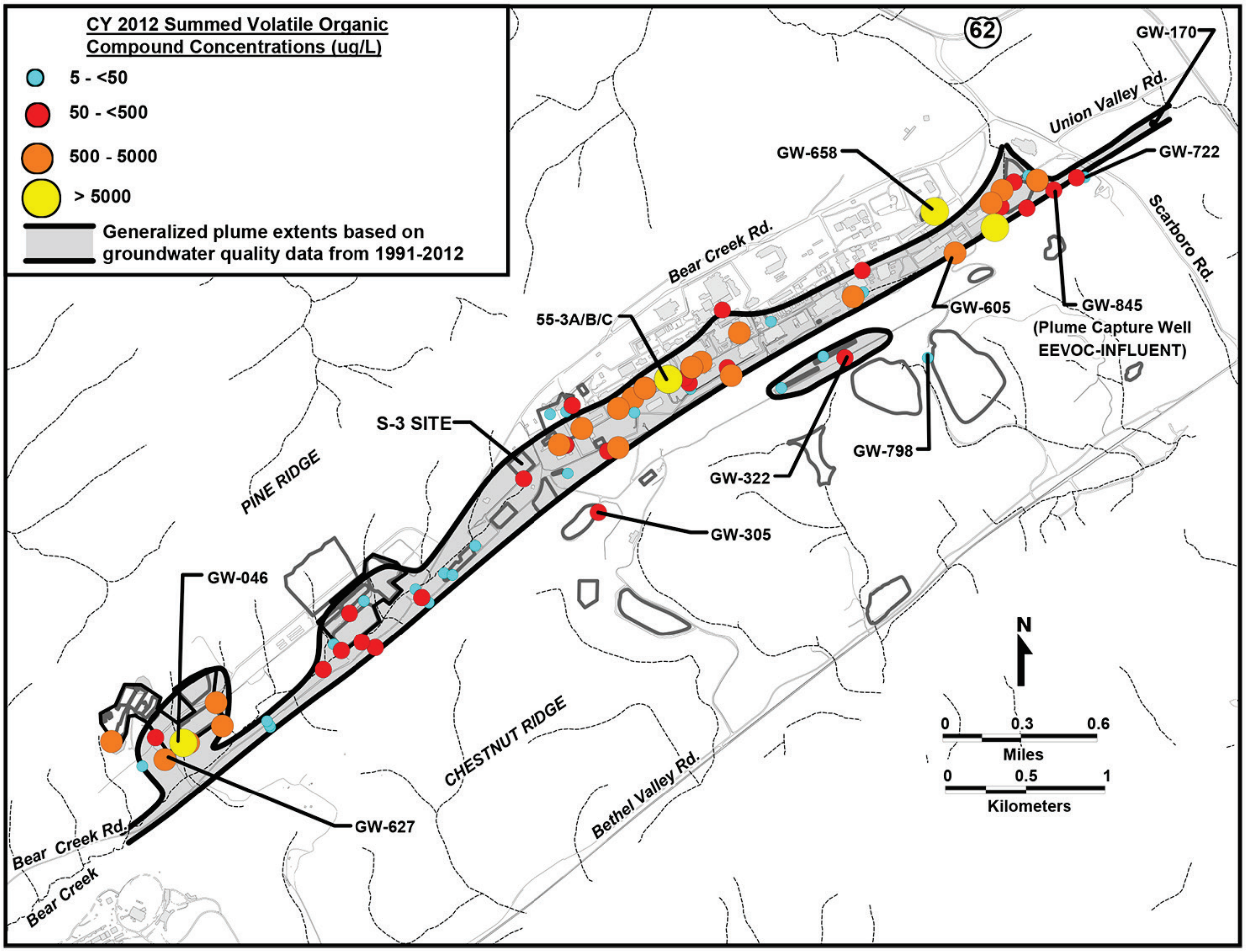

Fig. 4.40. Summed volatile organic compounds observed in groundwater at the Y-12 National Security Complex, 2012.

Within the exit pathway (the Maynardville Limestone, underlying EFPC) the general trends are also stable or decreasing, with one exception. One shallow well (GW-605) exhibits an increasing trend in chloroethenes, indicating active transport in this region of the groundwater plume. This well is west and upgradient of the pumping well (GW-845) operated to capture the East End VOC plume before it migrates off ORR into Union Valley. The pumping well may be influencing plume stability causing mobilization in the region of well GW-605. Other than well GW-605, 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 pumping well GW-845. Wells east of New Hope Pond and north of well GW-845 exhibit increasing trends in VOC 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.

4.6.4.1.5 Radionuclides

The primary alpha-emitting radionuclides found in the EFPC regime during CY 2012 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 Salvage Yard. However, the highest gross alpha activity in groundwater (313 pCi/L) 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. 4.41).

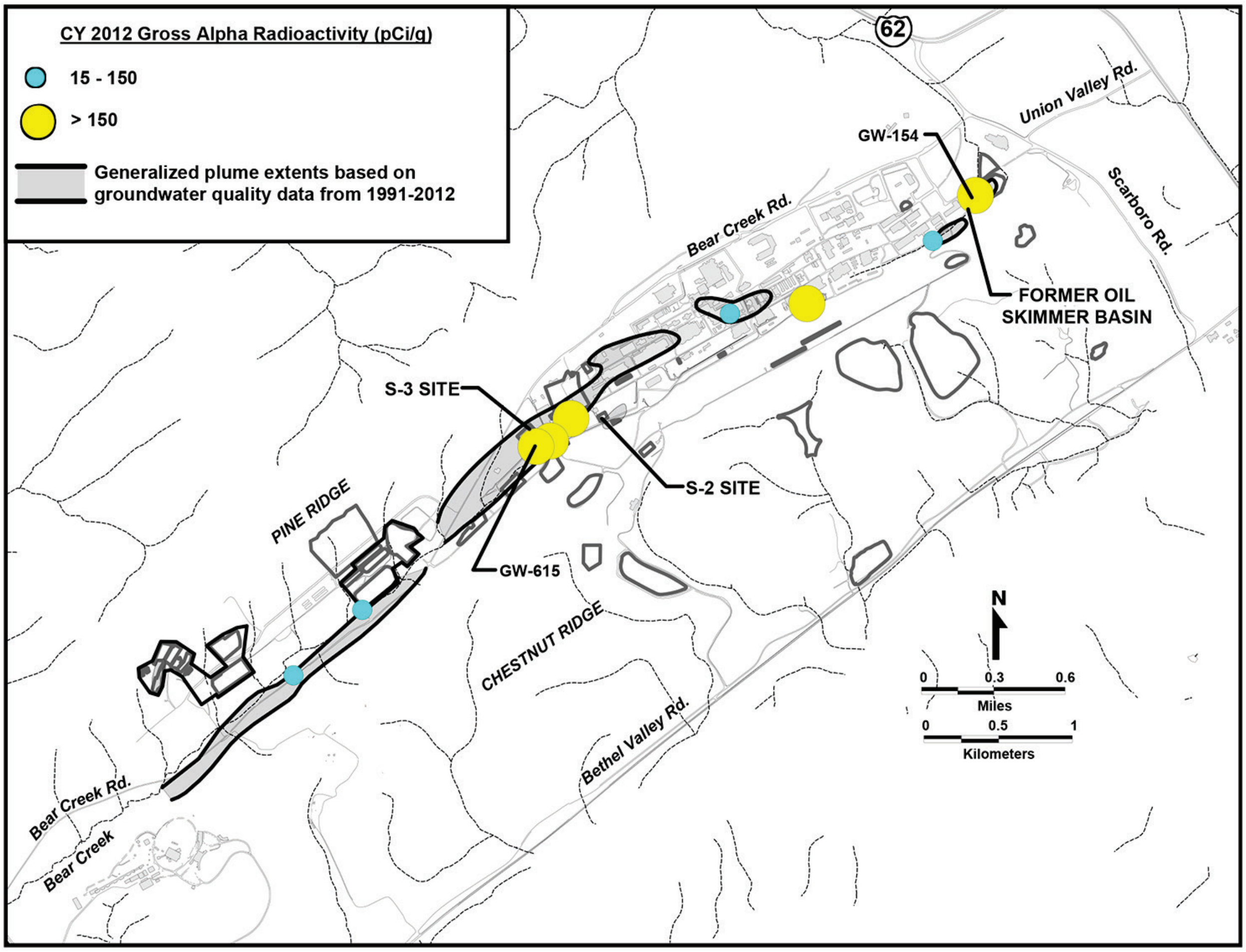

Fig. 4.41. Gross alpha activity observed in groundwater at the Y-12 National Security Complex, 2012.

The primary beta-emitting radionuclides observed in the upper EFPC regime were ^{99}Tc and isotopes of uranium. Elevated gross beta activity in groundwater in the upper EFPC 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 source being the S-3 site (Fig. 4.42). The highest gross beta activity in groundwater was observed during CY 2012 from well GW-108 (15,500 pCi/L), east of the S-3 site.

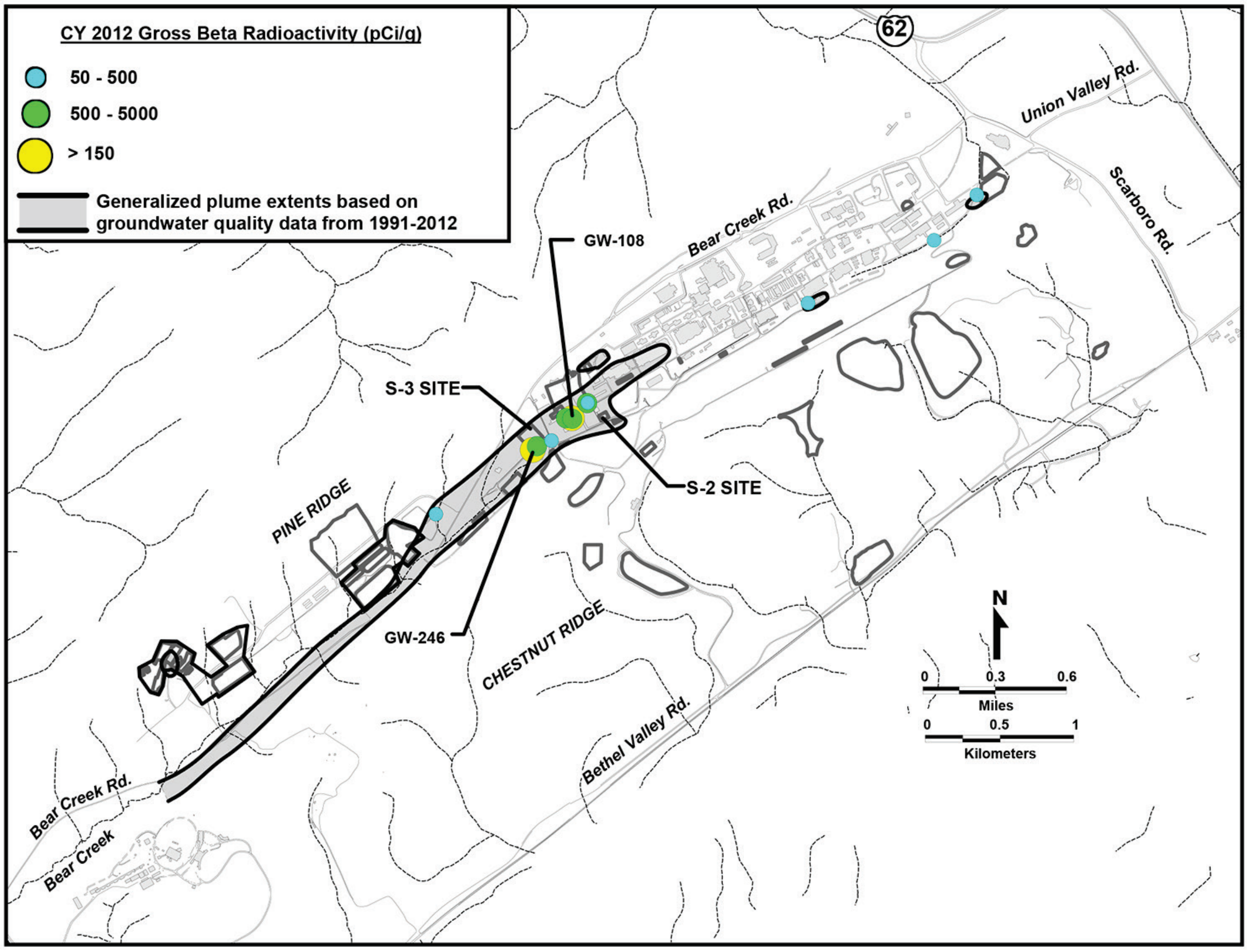

Fig. 4.42. Gross beta activity observed in groundwater at the Y-12 National Security Complex, 2012.

4.6.4.1.6 Exit Pathway and Perimeter Monitoring

Data collected to date indicate that VOCs are the primary class of contaminants that are migrating through the exit pathways in the upper EFPC 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 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 EFPC are also monitored. Historically, VOCs have been observed near Lake Reality from monitoring 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 EFPC.

During CY 2012, the observed concentrations of VOCs at the New Hope Pond distribution channel underdrain continued to remain low (21.9 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 VOCs in the area. The installation of the plume capture system was completed in June 2000. This system pumps groundwater from the intermediate bedrock 48 to 134 m (157 to 438 ft) below ground surface to mitigate off-site migration of VOCs. Groundwater is continuously pumped from the

Maynardville Limestone at about 95 L/min (25 gal/min), passes through a treatment system to remove the VOCs, and then discharges to upper EFPC.

Monitoring wells near well GW-845 continue to show an encouraging response to the pumping activities. The multiport system installed in well GW-722, about 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 (Fig. 4.40). This well has been instrumental in characterizing the vertical extent of the east-end plume of VOCs 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 VOCs due to groundwater pumping upgradient at well GW-845 (Fig. 4.43). Other wells also show decreases that may be attributable to the plume capture system operation. These indicators demonstrate that operation of the plume capture system is decreasing VOCs upgradient and downgradient of well GW-845, minimizing exposure to the public and the environment.

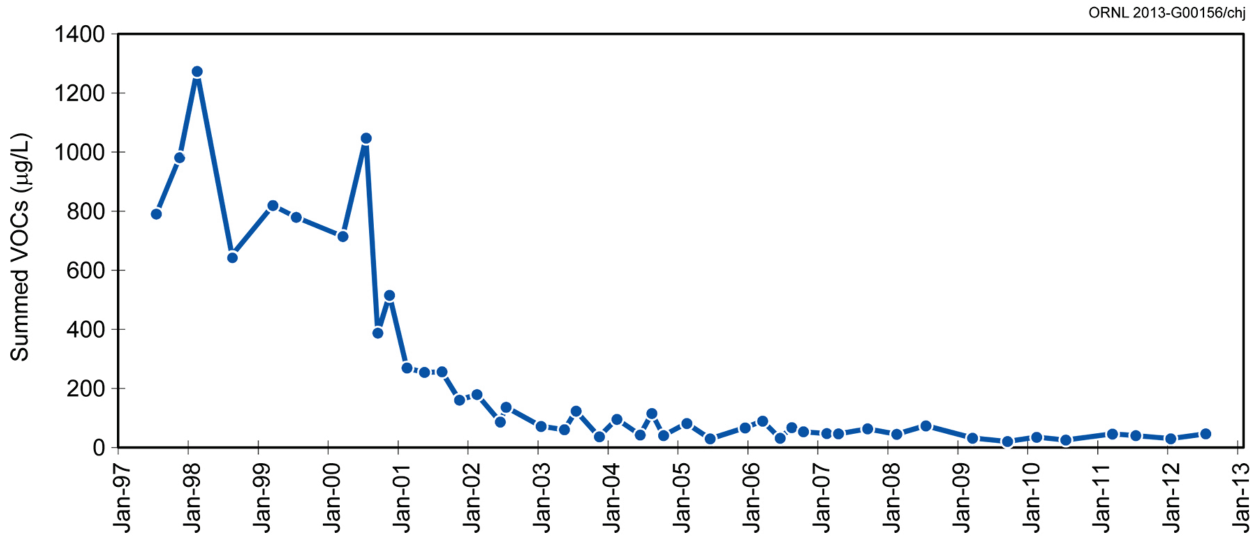

Fig. 4.43. Decreasing summed volatile organic compounds observed in exit pathway well GW-722-17 near the New Hope Pond, 2012.

Upper EFPC flows north from the Y-12 Complex through a large gap in Pine Ridge. Shallow groundwater moves through this exit pathway, and very strong upward vertical flow gradients exist. Continued monitoring of the wells in this pathway gap since about 1990 has shown no indication of any contaminants moving via that exit pathway (Fig. 4.36). Only one shallow well was monitored in CY 2012, 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 ORR. Those locations are considered unlikely groundwater or surface water contaminant exit pathways; however, monitoring continues to be performed due to previous public concerns regarding potential health impacts from Y-12 Complex operations to nearby residences. One of the stations monitored a tributary that drains the north slope of Pine Ridge on 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 ORR and flows adjacent to the Country Club Estates community. Samples were obtained and analyzed for metals, inorganic parameters, VOCs, 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 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 VOCs were being transported off ORR through the deep Maynardville Limestone exit pathway. The upper EFPC remedial investigation (DOE 1998) provided a discussion of the nature and extent of the VOCs.

In CY 2012, monitoring of locations in Union Valley continued, showing overall decreasing or very low concentration stable trends (less than drinking water standards) in the individual concentrations of contaminants forming the groundwater contaminant plume in Union Valley.

Under the terms of an interim 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 VOCs into Union Valley (DOE 2013).

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 groundwater contamination across ORR was evaluated (ATSDR 2006). In the report, it was acknowledged that extensive groundwater contamination exists throughout ORR, but the authors concluded that there is no public health hazard from exposure to contaminated groundwater originating at ORR. The Y-12 Complex east end VOC 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 COCs, but it concluded 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 4.21 describes each of the waste management sites within the Bear Creek regime.

Table 4.21. Description of waste management units included in calendar year 2012 groundwater monitoring activities, Bear Creek hydrogeologic regime

Site	Description
S-3 Site	Four unlined surface impoundments constructed in 1951. Received liquid nitric acid/uranium–bearing wastes via the nitric acid pipeline until 1983. Other disposals included ^{99}Tc. 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.

Table 4.21. (continued)

Site	Description
Bear Creek Burial Grounds A and C and Walk-In Pits	Burial grounds 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, and 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 VOCs to shallow groundwater according to CERCLA remedial investigation and current surveillance monitoring.
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 ROD 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.
Environmental Management Waste Management Facility	Constructed in 2002. CERCLA landfill receiving legacy wastes from ETTP, ORNL, the Y-12 Complex, and nearby off-site CERCLA action sites within the state of Tennessee.

Abbreviations

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
ETTP = East Tennessee Technology Park
ORNL = Oak Ridge National Laboratory
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
ROD = record of decision
TDEC = Tennessee Department of Environment and Conservation
VOC = volatile organic compound
Y-12 Complex = Y-12 National Security Complex

4.6.4.2.1 Plume Delineation

The primary groundwater contaminants in the Bear Creek regime are nitrate, trace metals, VOCs, 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 VOCs. High concentrations of chlorinated hydrocarbons and PCBs have been observed as deep as 82 m (270 ft) below the Bear Creek Burial Grounds (MMES 1990).

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 aquitard 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 the Maynardville Limestone and the aquitard units.

4.6.4.2.2 Nitrate

The limits of the nitrate plume probably define the maximum extent of groundwater 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 units and Knox Aquifer [less than 92 m (300 ft) below the ground surface].

Data obtained during CY 2012 indicate that nitrate concentrations in groundwater continue to exceed the drinking water standard in an area that extends west from the source area at the S-3 site. The highest nitrate concentration (10,799 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. 4.38), indicating that high concentrations persist deeper in the subsurface groundwater system. A multiport monitoring well, GW-134, was sampled in CY 2011 and continues to show elevated concentrations of nitrate (1,420 mg/L) as deep as 226 m (740 ft) below ground surface.

4.6.4.2.3 Trace Metals

During CY 2012, barium, beryllium, boron, cadmium, chromium, lead, manganese, nickel, and uranium 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. About 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. Even though there is an overall decrease in uranium concentrations (Table 4.22), certain areas still present a significant impact to the overall health of Bear Creek.

Table 4.22. Nitrate and uranium concentrations in Bear Creek

Bear Creek Monitoring Station (distance from S-3 site)	Contaminant	Average concentration[a] (mg/L)					
		1990–1993	1994–1997	1998–2001	2002–2005	2006–2009	2010–2012
BCK[b]-11.84 to 11.97	Nitrate	119	80	80	79.5	33.4	45.1
(~0.5 miles downstream)	Uranium	0.196	0.134	0.139	0.133	0.122	0.135
BCK-09.20 to 09.47	Nitrate	16.4	9.6	10.6	11.3	9.1	3.3
(~2 miles downstream)	Uranium	0.091	0.094	0.171	0.092	0.067	0.047
BCK-04.55	Nitrate	4.6	3.6	2.6	2.9	1.1	0.9
(~5 miles downstream)	Uranium	0.034	0.031	0.036	0.026	0.022	0.015

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

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 previous years in the Bear Creek regime are arsenic, mercury, selenium, strontium, thallium, and zinc. Concentrations have commonly exceeded background values in groundwater near contaminant source areas.

4.6.4.2.4 Volatile Organic Compounds

VOCs are widespread in groundwater in the Bear Creek regime. The primary compounds are PCE, TCE, 1,2-DCE, vinyl chloride, and 1,1-DCA. 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 contain detectable levels of VOCs occurs within about 305 m (1,000 ft) of the source areas. The highest concentrations observed in CY 2012 in the Bear Creek regime occurred in the shallow unconsolidated zone at the Bear Creek Burial Ground waste management area, with a maximum summed VOC concentration of 5,083 µg/L in well GW-046 (Fig. 4.40).

High concentrations of VOCs 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. 4.44), indicate that a considerable mass of dense nonaqueous phase organic compounds is still present at a depth below the Bear Creek Burial Grounds, providing a source for dissolved phase migration of VOCs. This migration parallel to the valley axis and toward the exit pathway (Maynardville Limestone) is occurring in both the unconsolidated and bedrock intervals.

ORNL 2013-G00157/chj

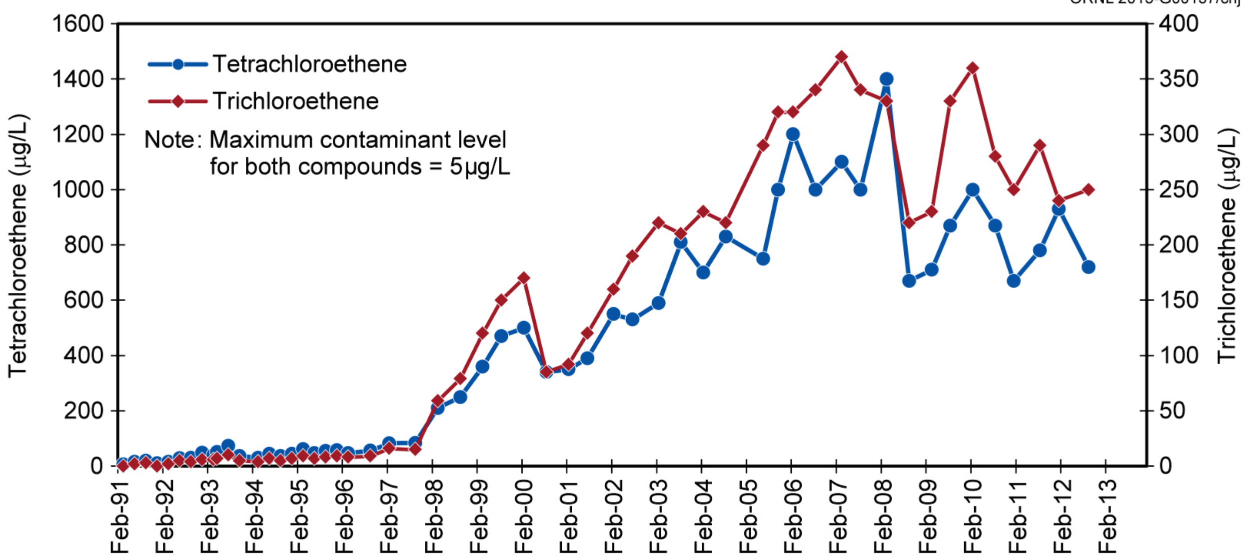

Fig. 4.44. Increasing volatile organic compounds observed in groundwater at well GW-627 west and downgradient of the Bear Creek Burial Grounds, 2012.

Significant transport of VOCs has occurred in the Maynardville Limestone. Data obtained from exit pathway monitoring locations show that in the intermediate groundwater interval, an apparently continuous dissolved plume extends at least 2,195 m (7,200 ft) westward from the S-3 site to just south of the Bear Creek Burial Ground waste management area.

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 which historically have been observed in groundwater near the S-3 site. Evaluations of the extents of radionuclides in groundwater in the Bear Creek regime during CY 2012 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. 4.41). Data obtained from exit pathway monitoring stations during CY 2012 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 3,353 m (11,000 ft) west of the S-3 site. The highest gross alpha activity observed in groundwater in CY 2012 was 580 pCi/L in well GW-615 located adjacent to the S-3 site.

The distribution of gross beta activity in groundwater is similar to that of gross alpha activity. During CY 2012, the lateral extent of gross beta activity within the exit pathway groundwater interval and surface water above the drinking water standard diminished dramatically. There are no monitoring locations within the Maynardville Limestone exit pathway where gross beta activity has exceeded the 50 pCi/L standard. Gross beta activity exceeded 50 pCi/L within the fractured bedrock of the aquitard units 762 m (2,500 ft) from the S-3 site (Fig. 4.42). This apparent oscillation in the plume length is dependent on rainfall and other seasonal factors, but this is an encouraging demonstration of a potentially diminishing contaminant plume. The highest gross beta activity in groundwater in the Bear Creek regime in 2012 was 15,000 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. 4.36).

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 2012 from the exit pathway monitoring wells indicate that groundwater is contaminated above drinking water standards in the Maynardville Limestone as far west as Picket B, and trends continue to be generally stable to decreasing (Fig. 4.45).

Surface water samples collected during CY 2012 indicate that water in Bear Creek contains many of the compounds found in the groundwater. Nitrate and uranium concentrations exceeding their respective drinking water standards have been observed in surface water west of the burial grounds as far as Picket A. The concentrations in the creek decrease with distance downstream of the waste disposal sites (Table 4.22).

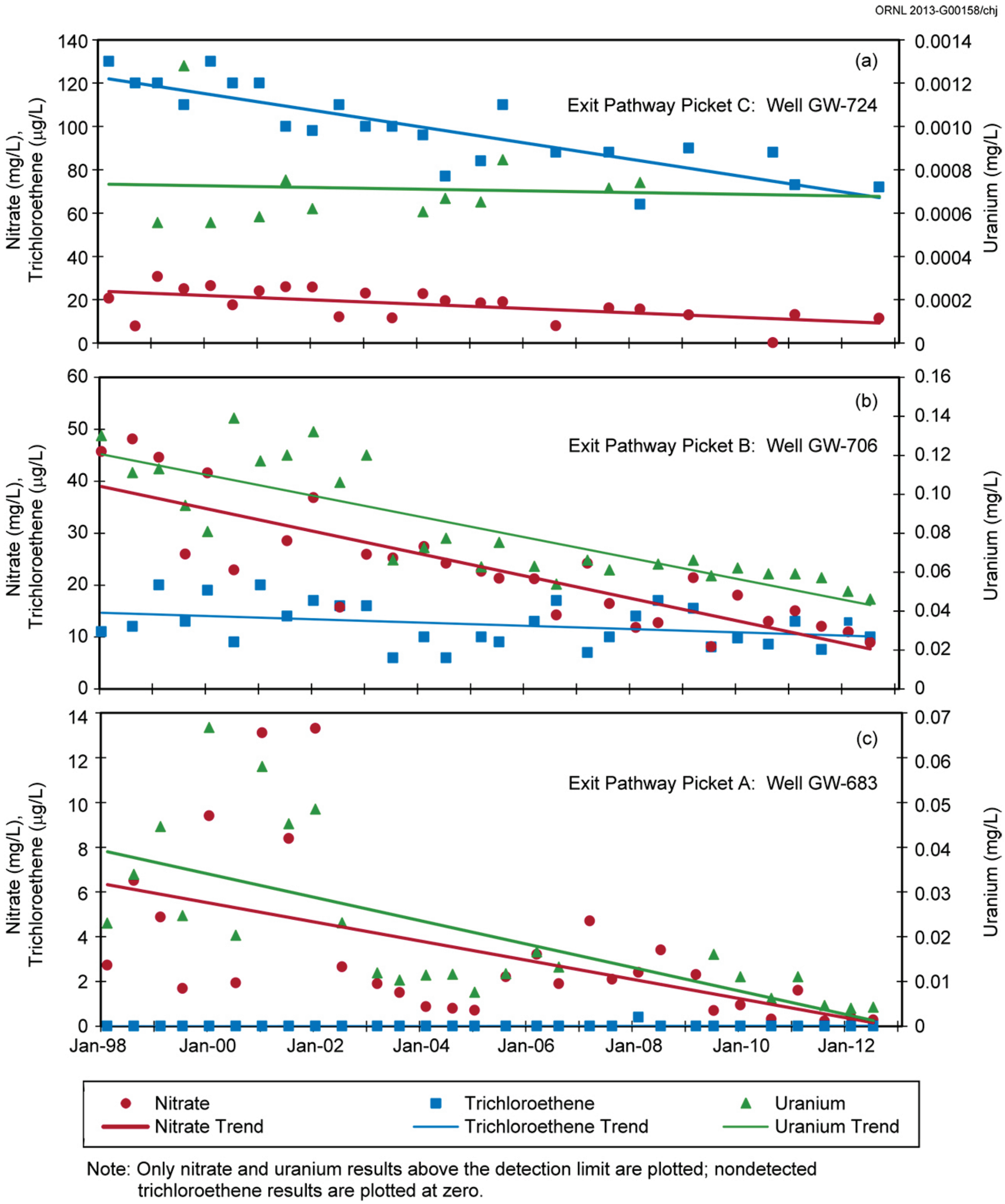

Fig. 4.45. CY 2012 concentrations of selected contaminants in exit pathway monitoring wells GW-724 (a), GW-706 (b), and GW-683 (c) in the Bear Creek hydrogeologic regime.

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. 4.34). 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 4.23 summarizes the operational history of waste management units in the regime.

Table 4.23. Description of waste management units included in groundwater monitoring activities, Chestnut Ridge hydrogeologic regime, 2012

Site	Description
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. CERCLA ROD issued in 1991.
Industrial Landfill II	Operated from 1983–1995. Central sanitary landfill for ORR. 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	Initiated operations April 1994. Currently under TDEC solid-waste-management detection monitoring.
Construction/Demolition Landfill VI	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 to 1968. A CERCLA ROD was issued in 1996. 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 the Y-12 Complex. 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
ORR = Oak Ridge Reservation
RCRA = Resource Conservation and Recovery Act
ROD = record of decision
TDEC = Tennessee Department of Environment and Conservation
Y-12 Complex = Y-12 National Security Complex

4.6.4.3.1 Plume Delineation

Through extensive monitoring of the wells on Chestnut Ridge, the horizontal extent of the VOC 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 VOC 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 2012 indicate that the western lateral extent of the plume of VOCs at the site has not changed significantly from previous years. The continued observation of VOC contaminants over the past several years at a well about 458 m (1,500 ft) southeast of the Chestnut Ridge Security Pits (well GW-798, Fig. 4.40) shows that some migration of the eastern plume has occurred. Additionally, dye tracer test results and the intermittent detection of very low concentrations of VOCs (similar to those found in wells adjacent to the Chestnut Ridge Security Pits) at a natural spring about 2,745 m (9,000 ft) to the east and along geologic strike may suggest that Chestnut Ridge Security Pits groundwater contaminants have migrated much further than the monitoring well network indicates.

4.6.4.3.2 Nitrate

Nitrate concentrations were below the drinking water standard at all monitoring stations in the Chestnut Ridge hydrogeologic regime. Exit pathway/perimeter surveillance monitoring location S17 (Fig. 4.38) presented an increasing trend in nitrate as nitrogen that just exceeded the drinking water standard in August 2011 (10.1 mg/L). This surface water monitoring station is located on the tributary that drains Chestnut Ridge adjacent to Kerr Hollow Quarry and is monitored due to the known interrelationship between the groundwater and surface waters on Chestnut Ridge. Following this detection, a detailed survey of the tributary was performed in an attempt to pinpoint the possible source of this contaminant. This survey, completed in December 2011, determined that no further elevated concentrations of nitrate as nitrogen above the drinking water standard have been observed and that one natural spring appears to be the source of the elevated nitrate concentrations. Quarterly monitoring of 28 locations along this tributary (including surface water, springs, Kerr Hollow Quarry, and an upgradient pond) continued throughout CY 2012. Some locations presented detectable concentrations of nitrate but nothing that exceeded the drinking water standard (10 mg/L). The CY 2011 exceedence at S17 has not been repeated, and a source could not be determined. One spring location upstream from S17 did consistently present the highest concentrations and may be discharging from a source; however, no activities upgradient of this spring could definitively be identified. Monitoring location S17 will continue to be sampled under the routine surveillance monitoring program.

4.6.4.3.3 Trace Metals

Elevated concentrations of arsenic were observed in two surface water monitoring locations downstream from the Filled Coal Ash Pond, which is monitored under a CERCLA ROD (DOE 2013). Under the ROD a constructed wetland area is being used to reduce surface water contamination by effluent from the Filled Coal Ash Pond. During CY 2012, elevated arsenic levels were detected both upgradient [McCoy Branch kilometer (MCK) 2.05] and downgradient (MCK 2.0) of this wetland area (Fig. 4.36). Even though both MCK 2.05 and MCK 2.0 monitoring station concentrations were higher than the drinking water standard for arsenic (0.01 mg/L), the results were 82% and 97% less than the preremediation average concentrations, respectively (DOE 2013). An exit pathway/perimeter surface water monitoring location about 610 m (2,000 ft) downstream from the Filled Coal Ash Pond was also sampled during CY 2012 with no detectable arsenic. These locations will continue to be monitored in CY 2013.

4.6.4.3.4 Volatile Organic Compounds

In 2012, the highest summed VOC concentration observed in the Chestnut Ridge hydrogeologic regime was at Chestnut Ridge Security Pits well GW-322 (134 µg/L) (Fig. 4.40). Monitoring VOCs in groundwater attributable to the Chestnut Ridge Security Pits has been in progress since 1987. A review of historical data indicates that concentrations of VOCs in groundwater at the site have generally decreased since 1988. However, a stable to very shallow increasing trend in VOCs in groundwater samples from monitoring well GW-798 (Fig. 4.40) to the southeast and downgradient of the Chestnut Ridge Security Pits has been developing since CY 2000. The maximum summed VOC concentration observed at well GW-798 during CY 2012 was 45 µg/L. The VOCs detected in well GW-798 continue to be characteristic of the Chestnut Ridge Security Pits plume.

At Industrial Landfill IV, a number of VOCs 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 2012, samples continue to exceed the drinking water standard for 1,1-DCE (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 2012, no gross alpha or gross beta activity above the drinking water standard of 15 pCi/L and 50 pCi/L, respectively, was observed in any groundwater samples collected in the Chestnut Ridge hydrogeologic regime.

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 or operation at the Y-12 Complex 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 VOCs are intermittently detected. The detected VOCs are suspected to originate from the Chestnut Ridge Security Pits; however, this has not been confirmed.

Monitoring 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 2012. No contaminants at any of these monitoring stations were detected at levels above drinking water standards.

4.6.5 Quality Assurance

All groundwater monitoring is performed under QCs to ensure that representative samples and analytical results are obtained. Because 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 methods, but the final results are comparable and therefore useful for all projects and programs. This permits the integrated use of all groundwater quality data obtained at the Y-12 Complex.

A number of QA 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 monitoring wells is by using a low-flow minimum drawdown method. Using this method, a sample is obtained from a discrete depth interval of the monitoring interval (screened or open borehole) 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.

- QCs 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 to the analytical laboratory that performs the analyses.
- Laboratory analyses are performed using standard methods and protocols within established holding times.

During 2012 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 B&W Y-12 that the Y-12 Complex Quality Assurance Program be fully consistent with and supportive of the ISMS program's functions and guiding principles. Management requirement Y60-101PD, *Quality Program Description*, details the methods used 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 recurrences.

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. QA 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 Complex environmental monitoring programs use 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 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 Y-12 Complex 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 laboratory that performs work for DOE, the ACO laboratory operates in accordance with DOE O 414.1D, *Quality Assurance.* To meet these requirements, the ACO laboratory adheres to the latest edition of the *DOE Quality Systems for Analytical Services* (DOE 2010) where it applies.

Other internal practices used to ensure that laboratory results are representative of actual conditions include training and managing staff; maintaining adequacy of the laboratory environment; safety; controlling the storage, integrity, and identity of samples; record keeping; maintaining and calibrating instruments; and the using 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 to 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 with 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

A report, *Explanation of Significant Differences for the Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area, Oak Ridge, Tennessee* (DOE 2012a), was approved on August 29, 2012. This report made changes to the *Record of Decision for Phase I Interim Source Control Actions in the Upper East Fork Poplar Creek Characterization Area*, *Oak Ridge, Tennessee* (DOE 2002) that are designed to be consistent with the new remediation strategy to conduct remedial actions in upper EFPC generally in an upgradient to downgradient sequence to reduce the potential for recontamination. These changes included elimination of asphalt capping of unpaved areas and changes to special studies identified in the Phase I ROD (DOE 2002).

DOE EM is intently focused on mercury remediation at Y-12. In 2012, engineers began projects that focused on mercury abatement through treatability studies, removing mercury tanks, cleaning storm drains, and designing treatment facilities that will reduce mercury migration into EFPC. Results and progress on these projects are summarized in Section 4.8.2.

4.8.2 American Recovery and Reinvestment Act–Funded Projects at the Y-12 National Security Complex

ARRA work at the Y-12 Complex continued toward completion. Most of the original ARRA work scope is now complete. Remaining ARRA work includes the Mercury Reduction Project (consisting of subprojects) and project closeout activities.

Alpha 5 characterization work performed

Alpha 5 (Building 9201-5) is the largest building at Y-12, measuring 613,642 ft^2. Previously completed work scope for the project included removal and disposal of legacy materials from the building (floors 1 through 4). About 464,000 ft^3 of legacy waste was disposed.

In FY 2012, characterization of building materials and equipment that was physically connected to the building was completed. This effort was a critical necessary step in preparation for the eventual deactivation and decommissioning of the building. The final characterization report was completed in January 2012.

Storm drain material disposal completed

Cleaning and lining of storm sewers in upper EFPC were completed in September 2011. A phased construction completion report was submitted to the regulators in May 2012, and their approval was received in August 2012. The cleanout project generated 518,000 gal of wastewater, 16,980 yd^3 of solid wastes, and 24.5 kg (54 lb) of elemental mercury that were properly treated and disposed (Fig. 4.46).

ORNL 2012-G00356/chj

Fig. 4.46. Contaminated storm sewers were the primary source of mercury contamination in Poplar Creek.

Old Salvage Yard soil characterized, disposed

A single 50 ft by 50 ft area of the Old Salvage Yard was determined to be contaminated to a level that required remediation of the soil and disposal as LLW. The area was remediated to a depth of 2 ft and backfilled and stabilized in late 2011. The excavated soil was characterized, profiled, and disposed in FY 2012. About 988 yd^3 of contaminated soils and miscellaneous debris were disposed at EMWMF. Site restoration was completed for remediated and nonremediation areas.

Exposure Unit 9

A 4.74 ha (11.7-acre) exposure unit (EU), EU-9, was addressed in FY 2012. This project included characterization of the EU and development of a remedial design report (RDR) that had an FFA milestone of September 30, 2012. The characterization strategy followed the upper EFPC remedial action work plan and included radiation walkover surveys and soil sampling and analyses. The goal was to identify contaminants exceeding industrial worker remediation limits and contaminants that were a threat to surface and groundwater below 2 ft.

Characterization results were presented in a technical memorandum and indicated that a remedial action is required in the former 81-10 area for protection of the industrial work force. The proposed remedial action is excavation of a 45 ft by 70 ft by 2 ft deep area with an estimated volume of 6,300 ft^3 of soil in the remedial action boundary. An RDR detailing the method of accomplishment, waste management, and waste disposition was prepared and submitted to EPA and TDEC ahead of the FFA milestone.

Mercury Reduction Planning and Remediation Projects

The Mercury Reduction Project was initiated in FY 2012 to facilitate reduction and lessened mobility of mercury at the Y-12 Complex. Subprojects under the Mercury Reduction Project began in 2012 and will continue into FY 2013.

Outfall 200 Conceptual Design—Outfall 200 is the major outfall at which mercury entrained with storm sewer effluents discharges into upper EFPC. During FY 2012, a treatability study and conceptual design were begun to remove mercury and decrease discharge of mercury at outfall 200. A draft alternatives analysis was performed for an outfall 200 treatment system, and a conceptual design based on the alternatives was started. The conceptual design is expected to be completed in FY 2013.

Secondary Pathways—An evaluation of mercury pathways of direct discharge points and/or structural factors that mobilize soil movement was conducted in the immediate vicinity of Alpha 4 (9201-4), Alpha 5 (9201-5), and Beta 4 (9204-4). Drains that could potentially discharge to soils were inspected. Designs were completed to retrofit selected building drains with mercury collection devices before building drain discharge to the storm sewer system. Additionally, designs for installation of impervious surfaces and direct drainage to the storm sewer system were completed. Installation of impervious surfaces at Alpha 4 and Alpha 5 is planned for FY 2013. The impervious surfaces will prevent percolation of water through the mercury-contaminated soils and direct rain water to the storm sewer system.

Mercury Recovery—Free mercury is free phase elemental mercury. Under the Free Mercury Recovery project innovative, passive free mercury recovery traps were designed and installed at locations upstream of outfalls 150, 160, 163, and 169. The traps will collect free mercury, and Y-12 personnel will remove that mercury from the traps. As part of the Free Mercury Recovery project, Y-12 began collecting free mercury from storm sewer structures and has removed roughly 9 kg (20 lb) of mercury from the storm sewers since August 2012. Also, design was completed and procurements were begun for a decanting facility necessary to separate mercury from co-collected gravel and water and potentially amalgamate collected free mercury for disposal purposes. Trapping and removing free mercury from the storm sewers will benefit upper EFPC by removing free mercury from the storm sewers before that mercury is discharged into upper EFPC.

Mercury Soils Treatability Study—A treatability study for mercury-contaminated Y-12 soils started in FY 2012. The treatability study was initiated to define treatment options and available disposal options for Y-12 soils contaminated with mercury. Mercury-contaminated soil samples from EU-9 were shipped to three laboratories for treatment. Each of the laboratories used a different treatment method for stabilizing mercury in the soil matrix to ensure the mercury could not leach out of the soil. In addition, the process of identifying posttreatment disposal pathway and regulatory requirements for the soils was begun as part of the study.

If the study proves successful and results are approved by EPA and TDEC, it may be possible to dispose of treated soils in an environmentally sound method at a lower cost than is currently possible for disposal of untreated soils. In FY 2013 a mercury-contaminated soils treatability study report will be produced that captures the results of all of these activities.

Disposal of Five Tanks—The project was initiated to remove five tanks used for mercury-related activities at Y-12. Characterization was completed along with the necessary documentation needed for disposal of these tanks. After size reduction, the tank residuals and debris will be disposed. Disposal of each tank will take place in FY 2013.

4.8.3 Waste Management

CERCLA Waste Disposal

Much of the waste generated during FY 2012 cleanup activities was disposed at ORR facilities (DOE 2012). EMWMF, located in Bear Creek Valley west of the Y-12 Complex, is an engineered landfill that accepts waste generated from CERCLA response actions and cleanup activities on ORR (low-level, mixed, and classified waste).

This engineered landfill consists of six disposal cells and accepts low level radioactive and hazardous wastes that meet specific waste acceptance criteria. 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 2012 EMWMF received 16,600 truckloads (about 185,000 tons) of waste. EMWMF operations collected, analyzed, and dispositioned about 5.59 million gal of leachate at the ORNL Liquid/Gaseous Waste Operations Facility in FY 2012. An additional 16.5 million gal of contact water was collected, analyzed, and released to the storm water retention basin after it was determined that it met the release criteria. Operating practices also effectively controlled site erosion and sediment.

Projects that disposed of waste at EMWMF during FY 2012 include

- K-25 Building Demolition Project;
- K-33 Building Demolition Project;
- ETTP D&D Project, including K-1070-B burial ground;
- Y-12 Complex Old Salvage Yard;
- Y-12 Complex Alpha 5; and
- several ORNL demolition projects.

EMWMF, is predicted to reach capacity before all ORR CERCLA cleanup waste has been generated and disposed. To evaluate alternatives for disposal of future cleanup waste, DOE issued an RI/FS report in September 2012. Following regulator review and approval, the report will serve as the initial document supporting DOE’s selection of a preferred alternative for waste disposal post-EMWMF.

Similar to a previous study completed for EMWMF, the report analyzes three alternatives.

- The no action alternative provides a benchmark for comparison with the action alternatives. Under the no action alternative, no coordinated ORR-wide strategy to manage wastes generated by future CERCLA actions would be implemented.
- The on-site disposal alternative would provide consolidated disposal of most future-generated CERCLA waste in a newly constructed, engineered facility referred to as the Environmental Management Disposal Facility (EMDF).
- The off-site disposal alternative would provide for transport, primarily by rail, of future-generated CERCLA waste off-site for disposal in approved disposal facilities in Nevada and Utah.

The RI/FS report concludes that both the on-site and off-site disposal alternatives would be protective of human health and the environment long-term by disposal of waste in a landfill designed for site-specific conditions.

The off-site disposal alternative would more effectively isolate the wastes due to the arid climate and fewer receptors at facilities in western states. While the on-site disposal alternative would require permanent commitment of additional ORR land for waste disposal and would impact environmental resources, it would be less costly and provide a greater level of certainty that long-term disposal capacity would be available.

Solid Waste Disposal

DOE also operates solid waste disposal facilities called the Oak Ridge Reservation Landfills (ORRLs), which are located near the Y-12 Complex. ORRLs are engineered facilities used for the disposal of sanitary, industrial, construction, and demolition waste.

In FY 2012, about 44,451 yd^3 of industrial wastes and construction/demolition debris were disposed in the landfill. Operation of ORRLs generated about 1.17 million gal of leachate that was collected, monitored, and discharged to the Y-12 Complex sanitary sewer system, which discharges to the Oak Ridge sewer system under an industrial sewer user permit.

4.8.4 Wastewater Treatment

NNSA at the Y-12 Complex treated 134 million gal of contaminated ground/sump water at the Groundwater Treatment Facility, the Central Mercury Treatment System, the Big Springs Water Treatment System, and the East End Volatile Organic Compounds Treatment System.

The Big Springs Water Treatment System treated 116 million gal of mercury-contaminated groundwater. The East End Volatile Organic Compounds Treatment System treated 12 million gal of VOC-contaminated groundwater.

The West End Treatment Facility and the Central Pollution Control Facility at the Y-12 Complex processed 955,020 gal of wastewater primarily in support of NNSA operational activities. The Central Pollution Control Facility also downblended more than 64,020 gal of enriched wastewaters using legacy and newly generated uranium oxides from on-site storage.

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