CHAPTER 4: AFFECTED ENVIRONMENT

Chapter 4, Affected Environment, provides the context for understanding the environmental consequences described in Chapter 5. The affected environment serves as a baseline from which any environmental changes that would result from implementing the alternatives can be evaluated. The baseline conditions are the currently existing conditions. The affected environment at the Y-12 National Security Complex (Y-12) is described for the following resource areas: land, visual, site infrastructure, transportation, geology and soils, air quality and noise, water, ecological, cultural and paleontological, socioeconomics, environmental justice, occupational and public health and safety, and waste management.

4.0 INTRODUCTION

In accordance with the Council on Environmental Quality (CEQ), *National Environmental Policy Act* (NEPA) implementing regulations (40 *Code of Federal Regulations* [CFR] Parts 1500 through 1508) for preparing an Environmental Impact Statement (EIS), the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The affected environment descriptions in this chapter provide the context for understanding the environmental consequences described in Chapter 5. They serve as a reference from which any environmental changes that could result from implementing the alternatives can be evaluated. The existing conditions for each environmental resource area were determined for ongoing operations from information provided in previous environmental studies and other reports and databases.

This Site-Wide EIS (SWEIS) evaluates the environmental impacts of the alternatives within defined regions of influence. The regions of influence are specific to the type of effect evaluated and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the general public from exposure to airborne contaminant emissions are assessed for an area within a 50-mile radius of the center of the Y-12 site. Brief descriptions of the regions of influence are provided in Table 4-1. Descriptions of the methodology used to evaluate impacts are presented in Appendix E of this SWEIS.

Table 4-1. General Regions of Influence for the Affected Environment.

Environmental Resource	Region of Influence
Land resources	ORR, Y-12 and the areas immediately adjacent to Y-12
Visual resources	ORR, Y-12 and the areas immediately adjacent to Y-12
Site infrastructure	ORR, Y-12
Geology and soils	ORR, Y-12, and nearby offsite areas
Water resources	On-site and adjacent surface water bodies and groundwater
Air quality	Y-12 and nearby offsite areas within local air quality control region where significant air quality impacts could occur and Class I areas within 50 miles
Noise	Y-12, nearby offsite areas, access routes to Y-12, and transportation corridors

Table 4-1. General Regions of Influence for the Affected Environment (*continued*).

Environmental Resource	Region of Influence
Ecological resources	Y-12 and adjacent areas
Cultural resources	The area within Y-12 and adjacent to the site boundary
Socioeconomics	The counties where approximately 90 percent of site employees reside
Human health and Safety	Y-12, offsite areas within 50 miles of Y-12, and the transportation corridors between Y-12 and other sites where worker and general population radiation, radionuclide, and hazardous chemical exposures could occur
Environmental justice	The minority and low-income populations within 50 miles of Y-12
Waste management and pollution prevention	Y-12
Environmental restoration	Y-12

Source: Original.

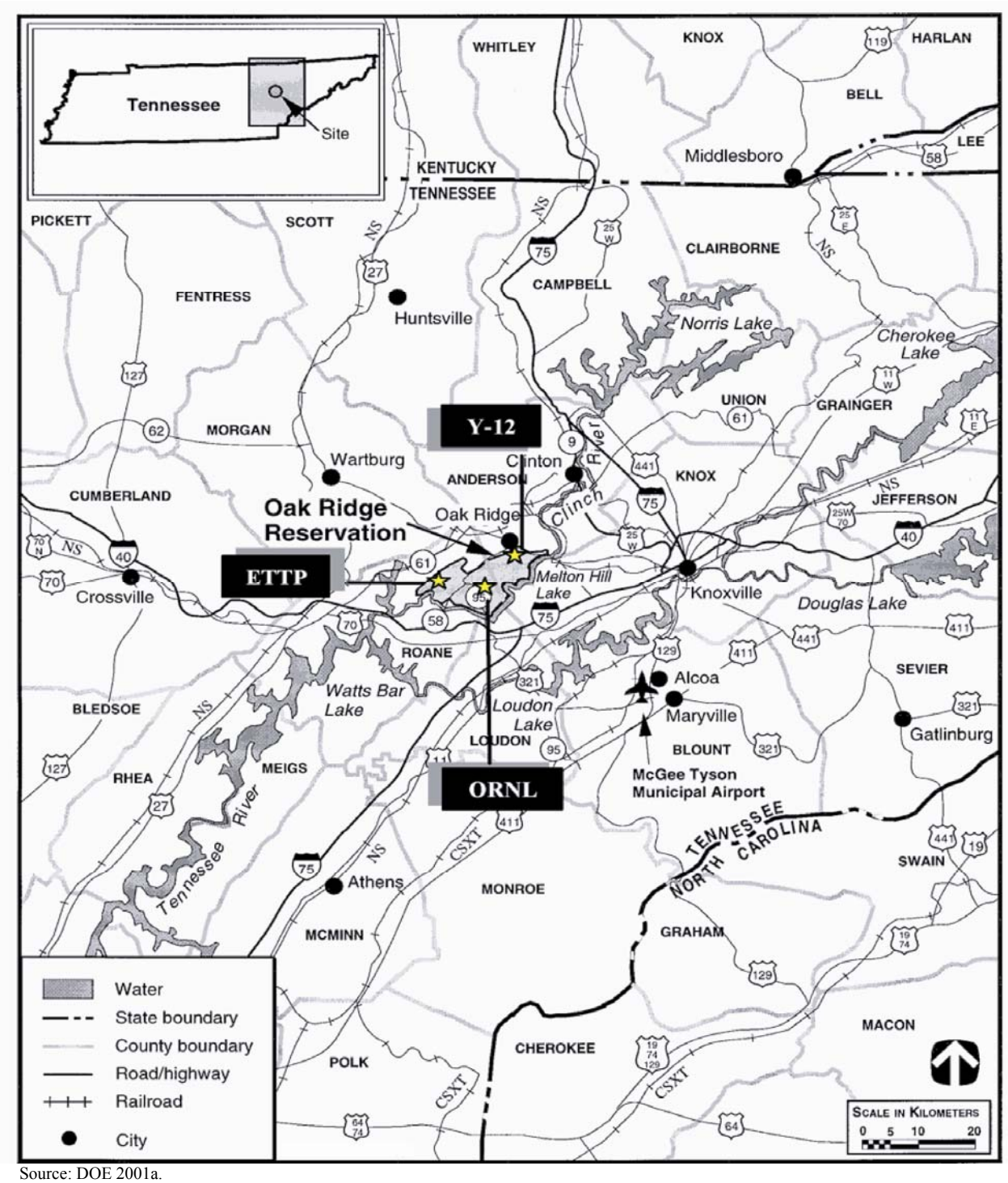
4.1 LAND RESOURCES

The Oak Ridge Reservation (ORR) was established in 1943 as one of the three original Manhattan Project sites, and includes Y-12, the Oak Ridge National Laboratory (ORNL), and the East Tennessee Technology Park (ETTP). ORR consists of approximately 35,000 acres and is located mostly within the corporate limits of the city of Oak Ridge; however, the city limits end 608 acres west of ETTP.

The city of Oak Ridge lies within the Great Valley of Eastern Tennessee between the Cumberland and Great Smoky Mountains and is bordered on two sides by the Clinch River. The Cumberland Mountains are 10 miles to the northwest; and the Great Smoky Mountains are 32 miles to the southeast. The location of ORR, principal facilities, and surrounding areas is presented in Figure 4.1-1.

Lands bordering ORR and Y-12 are predominantly rural and are used primarily for residences, small farms, forest land, and pasture land. The city of Oak Ridge, Tennessee, has a typical urban mix of residential, public, commercial, and industrial land uses. It also includes almost all of ORR. The residential section of Oak Ridge forms the northern boundary of ORR. There are four residential areas along the northern boundary of ORR, several of which have houses located within 98 feet of the site boundary.

Current Land Use at ORR. The U.S. Department of Energy (DOE) classifies land use on ORR into five categories: Institutional/Research, Industrial, Mixed Industrial, Institutional/Environmental Laboratory, and Mixed Research/Future Initiatives. Development on ORR accounts for about 35 percent of the total acreage, leaving approximately 65 percent of ORR undeveloped. Land bordering ORR is predominately rural, with agricultural and forest land being predominant (YSO 2007). About 15 percent of ORR is contaminated by hazardous and radioactive materials, including waste sites or remediation areas (TDEC 2005a). This legacy of contamination is being cleaned up to levels that comply with current laws, particularly the

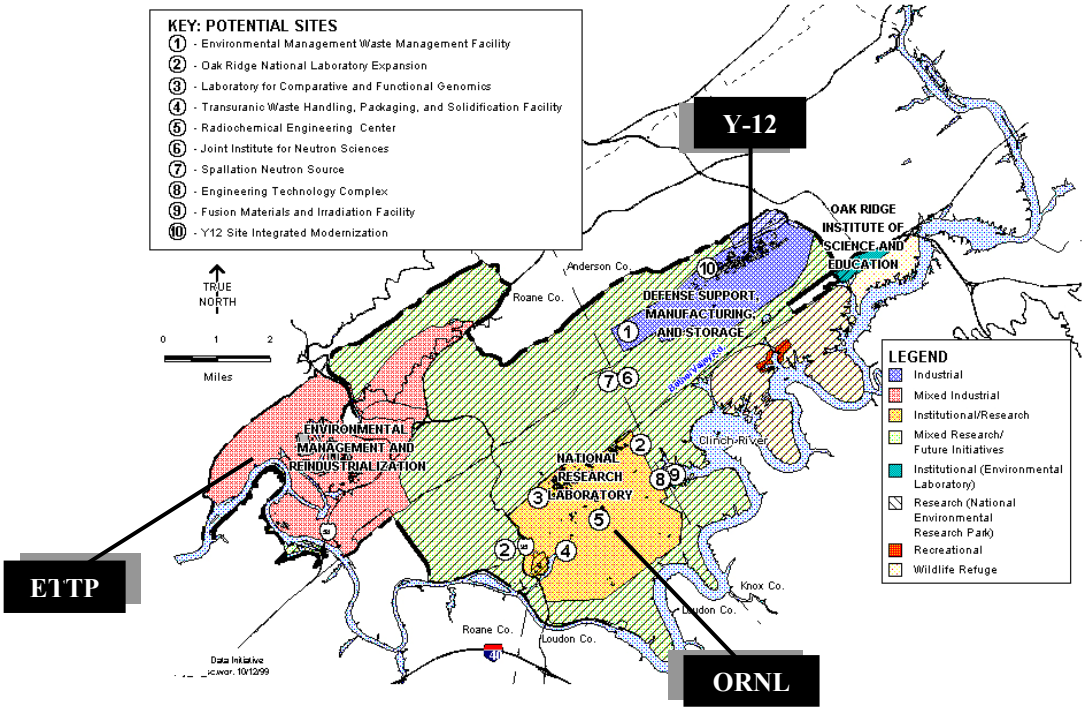


Source: DOE 2001a.

Figure 4.1-1. Location of the Oak Ridge Reservation, Principal Facilities, and Surrounding Areas.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Industrial and mixed industrial areas of the site include ORNL, Y-12, and the ETTP. The institutional/research category applies to land occupied by central research facilities at ORNL and the Natural and Accelerated Bioremediation Field Research Center in Bear Creek Valley near Y-12. The institutional/environmental laboratory category includes the Oak Ridge Institute for Science and Education. Land within the mixed research/future initiative category includes land that is used or available for use in field research and land reserved for future DOE initiatives.

The largest of the mixed industrial uses is biological and ecological research in the Oak Ridge National Environmental Research Park, which is on 20,000 acres. The National Environmental Research Park, established in 1980, is used by the nation's scientific community as an outdoor laboratory for environmental science research on the impact of human activities on the eastern deciduous forest ecosystem. In 2005, DOE and the State of Tennessee completed arrangements to place approximately 3,000 acres of land on ORR into a conservation easement that will be managed by the State of Tennessee in accordance with state laws regarding natural areas and wildlife management areas (TDEC 2006). The land located on the western end of ORR has served as an undeveloped buffer for the former K-25 uranium facility. The agreement preserves both East and West Black Oak Ridge and McKinley Ridge for conservation and public recreation. Additional details on land use plans at the site are provided in the *Oak Ridge National Laboratory Land and Facilities Plan* (ORNL 2002). Most mixed research and future initiatives areas are forested. Undeveloped forested lands on ORR are managed for multiple uses and the sustained yield of quality timber products. Figure 4.1-2 shows the research and forested areas within ORR.



Source: ORNL 2002.

Figure 4.1-2. Current and Future Land Use at ORR.

Two major firearm ranges, along with their surface danger zones or buffer areas, encompass approximately 2,500 acres on ORR. The range areas, which are located at the south side of Bear Creek Road about 5 miles west of Y-12, extend from the DOE ORR boundary on the west to Highway 95 on the east and from Bear Creek Road on the north to the Clinch River on the south.

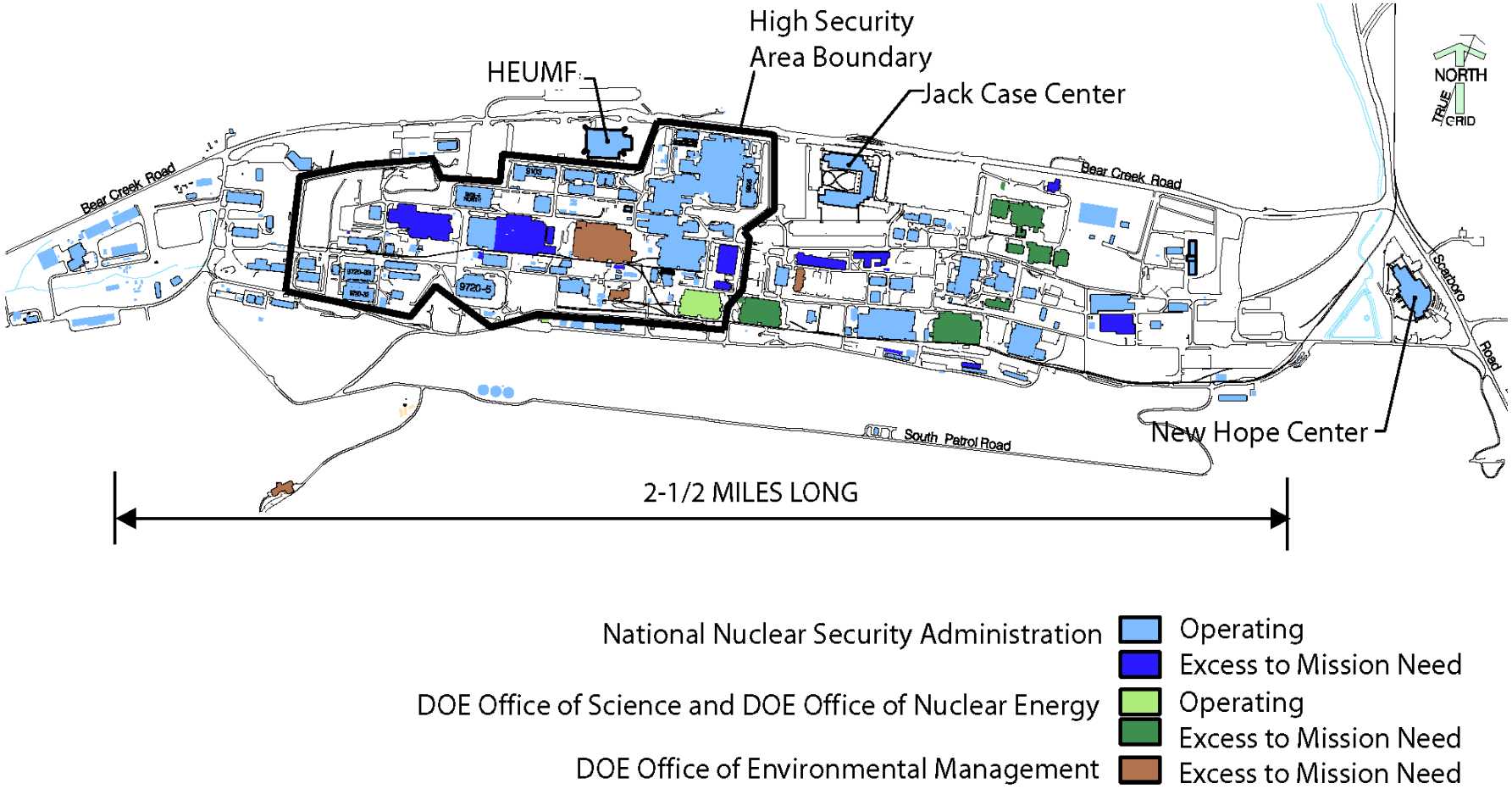
The eastern portion of the site is operated by DOE's Office of Secure Transportation Agent Operations Eastern Command and consists of four individual live-fire ranges and associated support facilities. The western portion of the range site, formerly operated by Lockheed Martin Energy Systems (LMES), is currently operated for DOE by Wackenhut Services International (effective January 10, 2000) as a Central Training Facility and consists of an indoor range, five outdoor ranges, a shooting tower, three live-fire facilities, and assorted tactical facilities.

Federal statutes require each state, tribal, or local government to protect its citizens from releases of hazardous materials (40 CFR Parts 301, 302, 304, and 355). Emergency planning zones spanning 5 miles are defined around ORNL, ETTP, and Y-12. Each zone is then subdivided into emergency planning sectors, with each defined by easily recognizable terrain features (DOE 2001a). Although ORR is generally not open to the public, opportunities for public use of numerous facilities and land areas do exist. For example, DOE has granted a license for hunting on ORR.

Y-12. The main area of Y-12 is largely developed and encompasses approximately 800 acres, nearly 600 of which are considered a high security boundary area that is enclosed by perimeter security fences. The main site, which has restricted access, is roughly 2.5 miles in length and 0.5 miles wide. The Y-12 Site Map is presented in Figure 4.1-3.

The eastern portion of Y-12 is occupied by Lake Reality and the former New Hope Pond (now closed), maintenance facilities, office space, training facilities, change houses, and former ORNL Biology Division facilities. The far western portion of Y-12 consists primarily of waste management facilities and construction contractor support areas. The central and west-central portions of Y-12 encompass the high-security portion, which supports core National Nuclear Security Administration (NNSA) missions. There are a few small wetlands within the Y-12 fenced boundary. Land outside the SWEIS area includes buffer for the Walker Branch watershed long term research area and other environmental research sites.

At the start of fiscal year (FY) 2008, real property included over 393 facilities in various states of utilization that total approximately 5.8 million square feet of NNSA-owned space and leased space. While NNSA is the site landlord and is responsible for approximately 75 percent of the floor space, other DOE program offices have responsibility for the remaining 25 percent. DOE's Offices of Science (SC) and Nuclear Energy (NE) is responsible for 21 buildings containing approximately 1.3 million square feet of space and DOE's Office of Environmental Management (DOE-EM) owns approximately 0.6 million square feet (NNSA 2008a). Within the next 5 years, the current and projected excess DOE and NNSA footprint on the Y-12 will total over 2.6 million square feet. Of this total, over 2 million square feet of NNSA, DOE-SC, DOE-NE, and DOE-EM is excess today (NNSA 2008a).



Source: NNSA 2008a.

Figure 4.1-3. Y-12 Site Map.

4.2 VISUAL RESOURCES

The landscape at ORR is characterized by a series of ridges and valleys that trend in a northeast-to-southwest direction. The vegetation is dominated by deciduous forest mixed with some coniferous forest. Most of the original open field areas on the site have been planted in shortleaf and loblolly pine, although smaller areas have been planted in a variety of deciduous and coniferous trees. The viewshed, which is the extent of the area that may be viewed from ORR, consists mainly of rural land. The city of Oak Ridge is the only adjoining urban area. Viewpoints affected by DOE facilities are primarily associated with the public access roadways, the Clinch River/Melton Hill Lake, and the bluffs on the opposite side of the Clinch River. Views are limited by the hilly terrain, heavy vegetation, and generally hazy atmospheric conditions. Some partial views of the city of Oak Ridge Water Treatment Plant facilities, located at Y-12, can be seen from the urban areas of the city of Oak Ridge.

Y-12 is situated in Bear Creek Valley at the eastern boundary of ORR. It is bounded by Pine Ridge to the north and Chestnut Ridge to the south. The area surrounding Y-12 consists of a mixture of wooded and undeveloped areas. Facilities at Y-12 are brightly lit at night, making them especially visible. Structures at Y-12 are mostly low profile, reaching heights of three stories or less, and built in the 1940s of masonry and concrete. The tallest structure is the meteorological tower erected in 1985 located on the west end of the Complex. There was also an east tower constructed in 1985, which has since been removed. Today the New Hope Center is located where the east tower once was. The west tower is located on a slight rise across from the intersection of Old Bear Creek Road and Bear Creek Road. Although this tower only reaches a height of 197 feet, it is actually higher in elevation than the east tower was. The west tower is used to measure and collect meteorological data for ETTP databases. There are no visible daytime plumes over Y-12 (DOE 2001a).

The Scarboro Community is the closest developed area to Y-12 (approximately 0.6 mile), and is located to the north of Y-12. However, as a result of their separation by Pine Ridge, Y-12 is not visible from the Scarboro Community (DOE 2001a).

For the purpose of rating the scenic quality of Y-12 and surrounding areas, the Bureau of Land Management's (BLM) Visual Resource Management (VRM) Classification System was used. Although this classification system is designed for undeveloped and open land managed by BLM, this is one of the only systems of its kind available for the analysis of visual resource management and planning activities. Currently, there is no BLM classification for Y-12; however, the level of development at Y-12 is consistent with VRM Class IV which is used to describe a highly developed area. Most of the land surrounding the Y-12 site would be consistent with VRM Class II and III (i.e., left to its natural state with little to moderate changes).

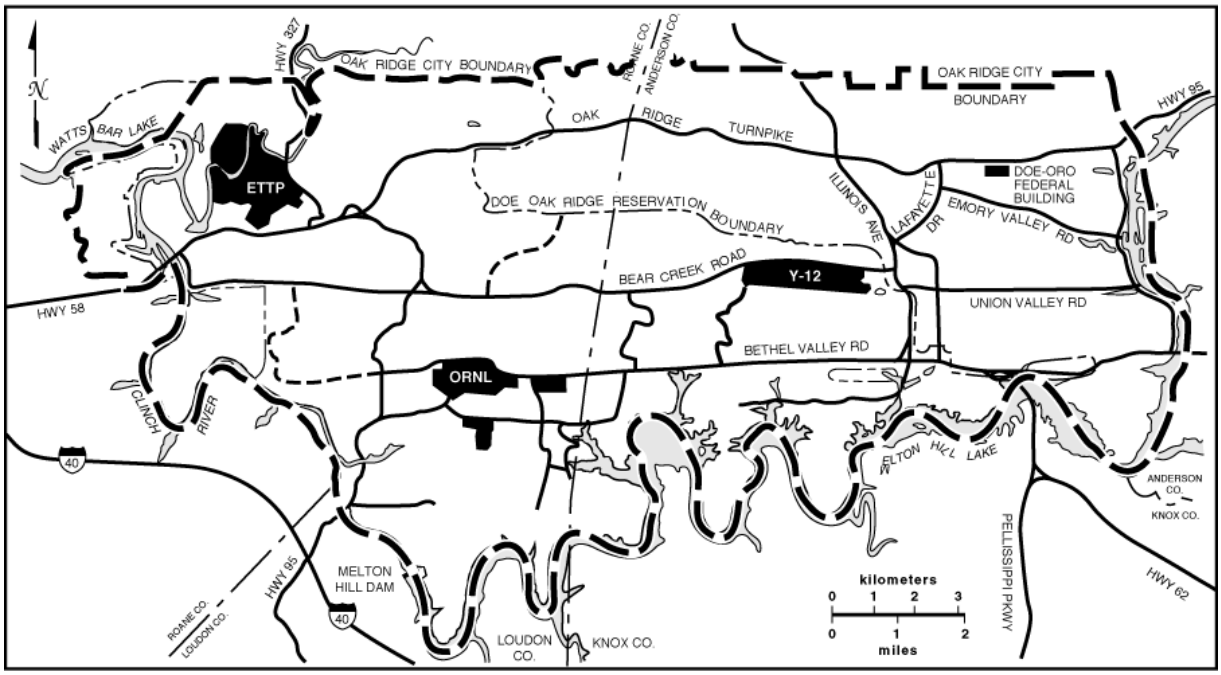
4.3 SITE INFRASTRUCTURE

An extensive network of existing infrastructure supports Y-12 facilities and activities. Site infrastructure available at Y-12 includes an extensive road and railroad system; electric power provided by the Tennessee Valley Authority (TVA); natural gas supplied by the East Tennessee Natural Gas Company, and Sigcorp Energy Services; steam; raw, treated, demineralized, and

chilled water; sanitary sewer; industrial gases; and telecommunications. These systems are described in the sections that follow.

4.3.1 Roads and Railroads

The Y-12 Site contains 65 miles of roads ranging from well-maintained paved roads to remote, seldom-used roads that provide occasional access. Primary roads serving Y-12 include Tennessee State Routes (TSRs) 58, 62, 95, and 170 (Bethel Valley Road) and Bear Creek Road. Except for Bethel Valley and Bear Creek roads, all are public roads. In addition, Y-12 is located within 50 miles of three interstate highways, I-40, I-75, and I-81. A 4-mile rail spur from the CSX main line east of the city of Oak Ridge serves Y-12. There are approximately 70 acres of parking lots on the Y-12 site. Figure 4.3.1-1 shows the road network around Y-12.



Source: DOE 2001a.

Figure 4.3.1-1. Road Network around Y-12.

4.3.2 Electrical Power

Electric power is supplied by TVA. Within Y-12, power is transmitted to the major distribution systems by three 161-kilovolts (kV) overhead radial feeder lines. There are eleven 13.8-kV distribution systems that range in size from 20 megavolt amperes (MVA) to 50 MVA, and reduce the 161 kV to 13.8 kV and distribute that power to unit substations located at facilities throughout Y-12. Each distribution system consists of a high-voltage outdoor transformer with indoor switchgear, 15-kV feeder cables, power distribution transformers, and auxiliary substation equipment. In total, the 13.8-kV distribution systems include approximately 30 miles of overhead lines, 10 miles of underground cable, and 740 pole- and pad-mounted transformers (B&W 2002).

At Y-12, the average monthly power usage is less than approximately 30 to 40 megawatts (MWe). The available capacity, approximately 430 MWe, greatly exceeds current demands. This is due to the fact that the original uses of Y-12 required a large, robust electrical system to support the uranium enrichment mission. The change in mission, from uranium enrichment to weapons manufacturing and subsequent evolution to the current missions, has greatly reduced Y-12's electrical needs (B&W 2002).

Y-12 also has a significant emergency and standby power generator system. The emergency power system provides backup power to critical safety-related loads, such as the emergency egress lighting systems and the fire alarm system. The standby power system provides backup power to loads that are less critical and not safety-related, but that nevertheless are extremely important to Y-12's mission, such as security systems and mission-related process systems. The emergency and standby power generator system is composed of 37 fixed generator systems and 11 portable generator systems. The combined capacity of the emergency and standby power generator system is 2.6 MW (B&W 2002).

4.3.3 Natural Gas

Sigcorp Energy Services supplies natural gas to ORR and Y-12. Natural gas, which is used for furnaces, the Y-12 Steam Plant, and laboratories, is supplied via a pipeline from the East Tennessee Natural Gas Company at "C" Station located south of Bethel Valley Road near the eastern end of Y-12. A 14-inch, 125-pounds per square inch gauge (psig) line is routed from "C" Station to the southwest corner of the Y-12 perimeter fence. From this point, an 8-inch line feeds the steam plant and a 6-inch branch line serves the process buildings and laboratories on the eastern end of Y-12. The western end of Y-12 is served by 4-inch and 2-inch headers that are fed from the steam plant line. Two pressure-reducing stations reduce the gas pressure from 125 pounds per square inch gauge (psig) to 25 psig and 35 psig, respectively. The gas pressure is further reduced and the flow metered at each use point (B&W 2002).

4.3.4 Steam

Steam is vital to the operation of Y-12. It is the primary source of building heat, both for personnel comfort and for freeze protection for critical services such as fire protection systems during the winter months. Steam is also necessary to support the production mission in current facilities. Heating and process steam is supplied from a Y-12 Steam Plant, originally built in 1955 and upgraded and modernized several times since then. The Steam Plant operates 24 hours per day, 365 days per year. It includes four coal-fired boilers, each of which is rated at 200,000 pounds per hour at 500 degrees Fahrenheit (ºF) and 235 psig. Steam is distributed throughout the plant at 235 psig through main headers ranging in size from 2 to 18 inches in diameter. Condensate is collected and returned to the Steam Plant using a similar network of pipes; a majority of the returned condensate is used as feed to the demineralized water system. Gross steam produced at Y-12 is approximately 1.5 billion pounds per year. As part of the Steam Plant Life Extension Project – Steam Plant Replacement, Y-12 prepared an Environmental Assessment (EA) and issued a Finding of No Significant Impact. In 2007, NNSA made a decision to begin design and construction of a new steam plant. The new plant will use natural-gas-fired package

boilers with new burner technology instead of coal, creating much cleaner emissions. Currently, the steam plant is under construction and is scheduled to be completed in September 2010.

Each boiler is capable of firing on either pulverized coal or natural gas and includes two coal pulverizers and four burners. Coal for the Steam Plant is purchased regionally, delivered by truck, and stored in a bermed area near the Steam Plant. Runoff from the coal pile is collected and treated in the Steam Plant Wastewater Treatment Facility prior to discharge to the sanitary sewer system (B&W 2002).

4.3.5 Water

Raw water for ORR is obtained from the Clinch River south of the eastern end of Y-12 and pumped to the water treatment plant located on the ridge northeast of Y-12. Ownership and operation of the treated water system was transferred from DOE to the city of Oak Ridge in April 2000. The water treatment plant can deliver water to two water storage reservoirs at a potential rate of 24 million gallons per day. Water from the reservoirs is distributed to the Y-12 Plant, ORNL, and the city of Oak Ridge. Separate underground piping systems provide distribution of raw and treated water within Y-12. Raw water is routed to Y-12 by two lines: a 16-inch main from the booster station, installed in 1943, and an 18-inch main from the 24-inch filtration plant feed line. The raw water system has approximately five miles of pipes with diameters ranging from 4 inch to 18 inch. The primary use of the raw water is to maintain a minimum flow of 7 million gallons per day in the East Fork Poplar Creek (EFPC). Treated water is routed to Y-12 by three lines: one 24-inch main and two 16-inch mains. The total treated water system contains approximately 19 miles of pipe ranging in size from 1 to 24 inches in diameter. The treated water system supplies water for fire protection, process operations, sanitary sewerage requirements, and boiler feed at the steam plant. Treated water usage at Y-12 averages 4.2 million gallons per day or 1,538 million gallons per year.

NNSA completed an EA for the Y-12 Potable Water System Upgrade (DOE/EA-1548) (DOE 2006a) (see Section 1.7.2). The NNSA proposes to upgrade the Y-12 potable water system by installing two new elevated water tanks, a pumping station, and system supply lines north of Bear Creek Road; inspecting the remaining original cast iron potable water distribution lines and repairing or replacing them if necessary; inspecting the original water (potable, process, and fire) supply lines to individual buildings expected to remain in use past 2010 and replacing them where necessary; replacing approximately 40 obsolete fire hydrants; installing backflow prevention, and converting to dry pipe or isolating approximately 85 existing fire suppression loops in order to prevent cross contamination from propylene glycol sprinkler systems. The proposed action would allow Y-12 to (1) upgrade the fire protection system's backflow protection for known cross connections and maintain proper chlorine residual in the system; (2) control and monitor water coming into the Y-12 distribution system to ensure adequate water flow and pressure to support current and future Y-12 operational needs; and (3) address deferred maintenance and ensure continued system reliability by inspecting, evaluating, and repairing or replacing deteriorated cast iron water mains and building feeds and obsolete fire hydrants.

Demineralized water is used to support various processes at Y-12 that require high-purity water. A central system located in and adjacent to Building 9404-18 serves the entire plant through a

distribution piping system. This system consists of feedwater storage, carbon filters, demineralizers, a deaerator, and demineralized water storage tanks. The primary source of feedwater is condensate return, which is cooled and stored in two storage tanks of 13,000-gallon and 30,000-gallon capacity. The secondary source of feedwater is softened water from the steam plant. Feedwater from the storage tanks is filtered, demineralized, deaerated, and stored until needed.

4.3.6 Sanitary Sewer

The Y-12 Site's sanitary sewer system was first installed in 1943 and expanded as the plant grew. Sewage from most buildings flows to an 18-inch sewer main that leaves the east end of the plant near Lake Reality and connects to the city main near the intersection of Bear Creek Road and Scarboro Road. The current system capacity is approximately 1.5 million gallons per day. The average daily flow has been approximately 750,000 gallons per day (B&W 2002). Y-12 has a sanitary sewer users permit, issued by the City of Oak Ridge, which regulates water discharges.

4.3.7 Chilled Water

The chilled water systems were renovated and upgraded during the mid-1990s. Most chillers that were more than 20 years old were replaced, and the newer chillers were inspected and renovated to eliminate the use of chlorofluorocarbons and to restore the chillers to optimal mechanical condition (B&W 2002).

4.3.8 Industrial Gases

Industrial gases include compressed air, liquid nitrogen, liquid oxygen, liquid argon, helium, and hydrogen.

Compressed air is supplied by three different systems that use compressors and associated air-drying equipment located throughout Y-12. The high-pressure (110 psig) instrument air system serves specific production buildings in the west end of Y-12. The low-pressure (100 psig) system also serves the production facilities in addition to serving the production support buildings. The Y-12 air system (90 psig) serves those areas where air quality is not a concern. All three systems are supplied from the same set of compressors and are different only in the operating pressure and the cleanliness of the piping systems (i.e., the Y-12 air piping system contains legacy oil and moisture from previous operations).

Liquid nitrogen is normally delivered to Y-12 by trailer truck. The Y-12 nitrogen supply system consists of four low-pressure and one high-pressure liquid-nitrogen storage tanks, a bank of atmospheric vaporizers, and a steam vaporizer. Nitrogen is delivered to all production facilities and laboratories at 90 psig through a network of 2-inch, 3-inch, and 4-inch pipes. Y-12 uses approximately 190 million standard cubic feet (scf) of liquid nitrogen annually.

Liquid oxygen is delivered to Y-12 by trailer truck. The oxygen supply system consists of one 914,460-scf vacuum-insulated storage tank for liquid oxygen. Oxygen is generated by passing the liquid oxygen through two banks of atmospheric vaporizers that have a capacity of 5,800 scf per hour, or 4.1 million scf per month. The gas pressure is reduced to 90 psig, metered, and

distributed to production facilities through a 2-inch overhead pipeline. Y-12 uses approximately 3.1 million scf of liquid oxygen annually (B&W 2002).

Liquid argon also is delivered to Y-12 by trailer truck. The Y-12 argon system consists of five vacuum-insulated liquid storage tanks and 12 atmospheric fin-type vaporizers. The storage tanks have a combined capacity of 30,737 gallons equivalent to approximately 3.4 million scf of gas. Gas is distributed to production areas and laboratories through a network of 2-inch and 3-inch pipes. Y-12 uses approximately 30 million scf of liquid argon annually (B&W 2002).

Y-12 receives and stores high-purity helium at 3,000 psig in a jumbo tube trailer. The helium facility includes a jumbo tube trailer with a capacity of 160,000 scf. In addition, 36,000 scf of helium at 1,800 psig is stored in a tube trailer and serves as emergency standby. The cylinder filling facility also houses the high pressure reducing station. Helium gas is distributed throughout Y-12 at 90 psig through a 2-inch overhead pipeline. Y-12 uses approximately 1.6 million scf of helium annually (B&W 2002).

The hydrogen supply at Y-12 consists of multi-cylinder tube trailers in open concrete block stalls. Four trailers are used on a rotating basis: one is in service, one is in ready standby, one is in emergency standby, and one is being refilled. Each trailer has a capacity of approximately 30,000 scf, providing a total capacity of 90,000 scf. Stored gas is pressurized at 2,000 psig. A two-stage pressure-reducing station delivers 50 psig gas through a meter. The hydrogen gas is then distributed through a 2-inch overhead pipeline to Y-12 and laboratory facilities. Y-12 uses approximately 0.3 million scf of hydrogen annually (B&W 2002).

4.3.9 Telecommunications

The four basic telecommunications systems within Y-12 are the Oak Ridge Federal Integrated Communications Network, the Cable Television Network (CATV), the unclassified Y-12 Intrasite Network, and the Y-12 Defense Programs Network (Y-12 DPNet). The Oak Ridge Federal Integrated Communications Network consists of copper cable distributed throughout Y-12 and within all its buildings; this network is used for telephone, FAX, and special data and alarm circuits and is operated by USWest. The CATV network consists of coaxial cable that is run to selected sites within Y-12. This network has the ability to send and/or receive video among the Oak Ridge plants, buildings at a given site, and some off-site locations. The unclassified Y-12 Intrasite Network consists of a fiber-optic backbone network with connectivity to most buildings within Y-12; this network uses routed Ethernet service to separate Internet protocol sub-nets for each building. The Y-12 DPNet is the Classified Services Network and presently consists of a coaxial broadband network and a fiber-optic backbone network with fiber-optic connectivity to most buildings within the protected areas of Y-12.

4.4 TRANSPORTATION AND TRAFFIC

Y-12 is located within 50 miles of three interstate highways: I-40, I-75, and I-81. Interstate 40, an east-west highway, extends from North Carolina to California. Interstate 75 is a north-south highway extending from Michigan to Florida. Interstate 81 is a north-south interstate extending from New York to Tennessee. Interstate 81 connects with I-40 east of Knoxville, and I-40 and

I-75 connect west of Knoxville near the city of Oak Ridge. In addition, TSRs 61, 162, and US25W at Clinton serve Y-12 transportation needs off-site (DOE 2001a). Primary roads on ORR serving Y-12 include TSRs 95, 58, 62, and 170 (Bethel Valley Road). Traffic on Bear Creek Road, north of Y-12, flows in an east-west direction and connects Scarboro Road on the east end of the plant with TSRs 95 and 58. Bear Creek Road has restricted access around Y-12 and is not a public thoroughfare. Bethel Valley Road is also closed to public access. The daily traffic numbers for various public roads at ORR are given in Table 4.4.1–1.

4.4.1 Transportation of Materials and Waste

Various chemicals and other materials being used for Y-12 operations are transported by truck using the above-addressed roads (TSRs 58, 62, 95, and 170; I-40, I-75 and I-81). Low level waste (LLW), hazardous waste, and municipal and solid wastes are generated by Y-12 operations. LLW is stored on-site in temporary storage facilities until eventual disposal off-site at a DOE or commercial site.

Table 4.4.1-1. Existing Average Daily Traffic Counts on ORR Serving Y-12.

Road	To	From	Average Daily Traffic Vehicles/day
TSR 58	TSR 95	I-40	13,970
TSR 95	TSR 62	TSR 58	25,150
TSR 62	TSR 170	N/A	31,620
TSR 170 (Bethel Valley Road)	TSR 62	N/A	9,350

Source: TDOT 2005.

4.5 GEOLOGY AND SOILS

4.5.1 Physiography

ORR lies in the Valley and Ridge Physiographic Province of eastern Tennessee. The topography consists of alternating valleys and ridges that have a northeast-southwest trend, with most ORR facilities occupying the valleys. In general, the ridges consist of resistant siltstone, sandstone, and dolomite units, and the valleys, which resulted from stream erosion along fault traces, consist of less-resistant shales and shale-rich carbonates (DOE 2001a).

The topography within ORR ranges from a low of 750 feet above mean sea level (AMSL) along the Clinch River to a high of 1,260 feet AMSL along Pine Ridge. Within ORR, the topographic relief between the valley floors and ridge crests is generally about 300 to 350 feet (DOE 2001a).

4.5.2 Geology

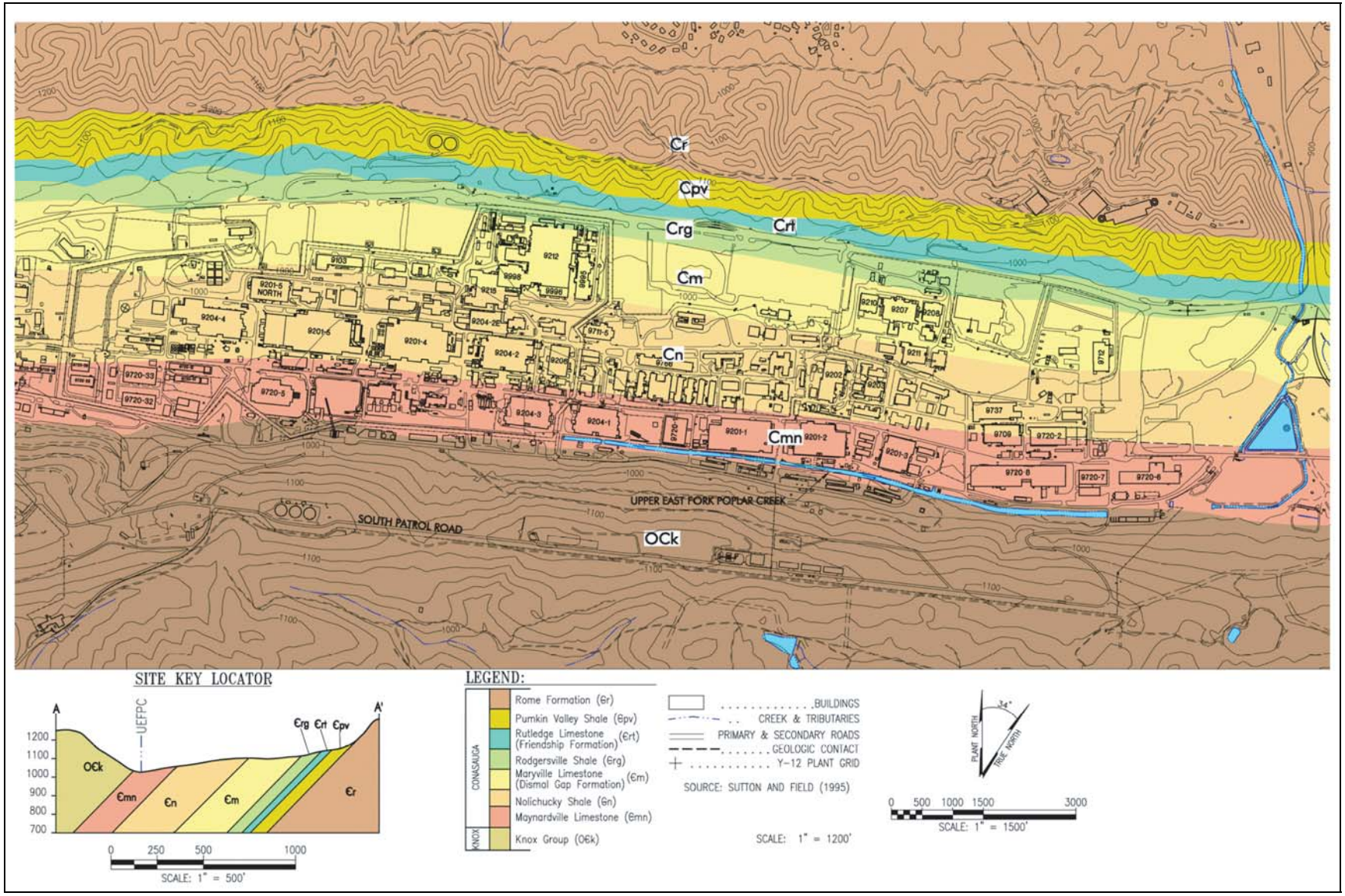
Several geologic formations are present in ORR area. A geologic map and stratigraphic column of the area are shown in Figures 4.5.2-1 and 4.5.2-2, respectively. The Rome Formation, which is present north of Y-12 and forms Pine Ridge, consists of massive to thinly bedded sandstones interbedded with minor amounts of thinly bedded, silty mudstones, shales, and dolomites. In ORR area, the stratigraphic thickness of the Rome Formation is uncertain because of the displacement caused by the White Oak Mountain Thrust Fault. White Oak Mountain

Thrust Fault and other major faults are displayed in Figure 4.5.2-3. The Conasauga Group, which underlies Bear Creek Valley, consists primarily of calcareous shales, siltstone, and limestone. The Knox Group, which is present immediately south of Y-12, can be divided into five formations of dolomite and limestone. All five formations have been identified at ORR. The Knox Group, which underlies Chestnut Ridge, is estimated to be approximately 2,400 feet thick. The Knox Group weathers to a thick, orange-red, clay residuum that consists of abundant chert and contains karst features (DOE 2001a).

Y-12 is located within Bear Creek Valley, which is underlain by Middle to Late Cambrian strata of the Conasauga Group (see Figure 4.5.2-1). The Conasauga Group consists primarily of highly fractured and jointed shale, siltstone, calcareous siltstone, and limestone in the site area. The upper part of the group is mainly limestone, while the lower part consists mostly of shale (LMER 1999a). This group can be divided into six discrete formations, which are, in ascending order, the Pumpkin Valley Shale, the Rutledge Limestone, the Rogersville Shale, the Maryville Limestone, the Nolichucky Shale, and the Maynardville Limestone. The thickness of each of these formations varies throughout the Conasauga Group.

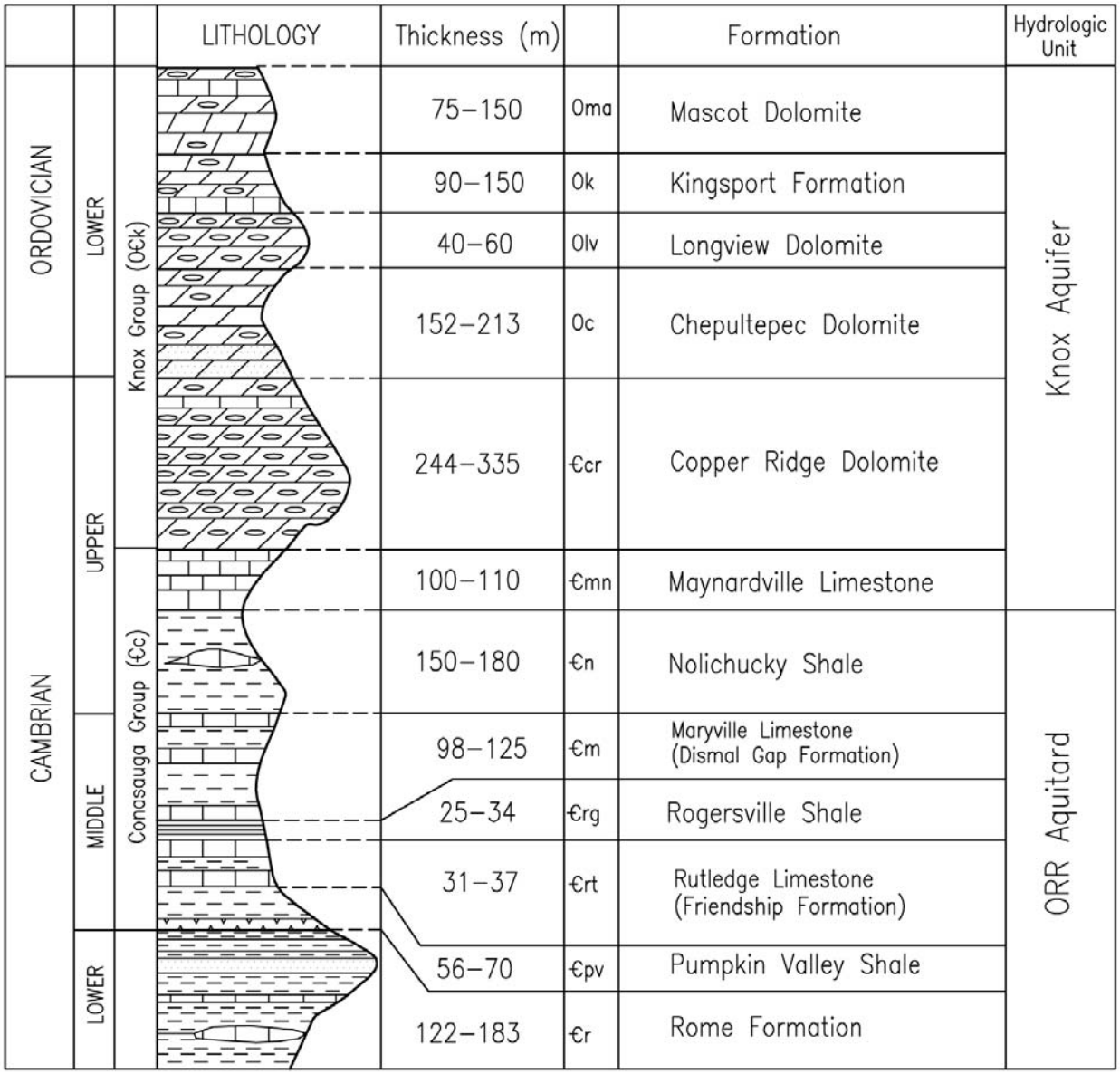
Y-12 is situated on carbonate bedrock such that groundwater flow and contaminant transport are controlled by solution conduits in the bedrock. These karst features, including large fractures, cavities, and conduits, are most widespread in the Maynardville Limestone and the Knox Group. These cavities and conduits are often connected and typically found at depths greater than approximately 1,000 feet (DOE 2001a).

Karst features are dissolutional features occurring in carbonate bedrock. Karst features represent a spectrum ranging from minor solutional enlargement of fractures to conduit flowpaths to caves large enough for a person to walk into. Numerous surface indications of karst development have been identified at ORR (Figure 4.5.2-3). Surface evidence of karst development includes sinking streams (swallets) and overflow swallets, karst and overflow springs, accessible caves, and numerous sinkholes of varying size. In general, karst appears most developed in association with the Knox Group carbonate bedrock, as the highest density of sinkholes occurs in this group (DOE 2001a).



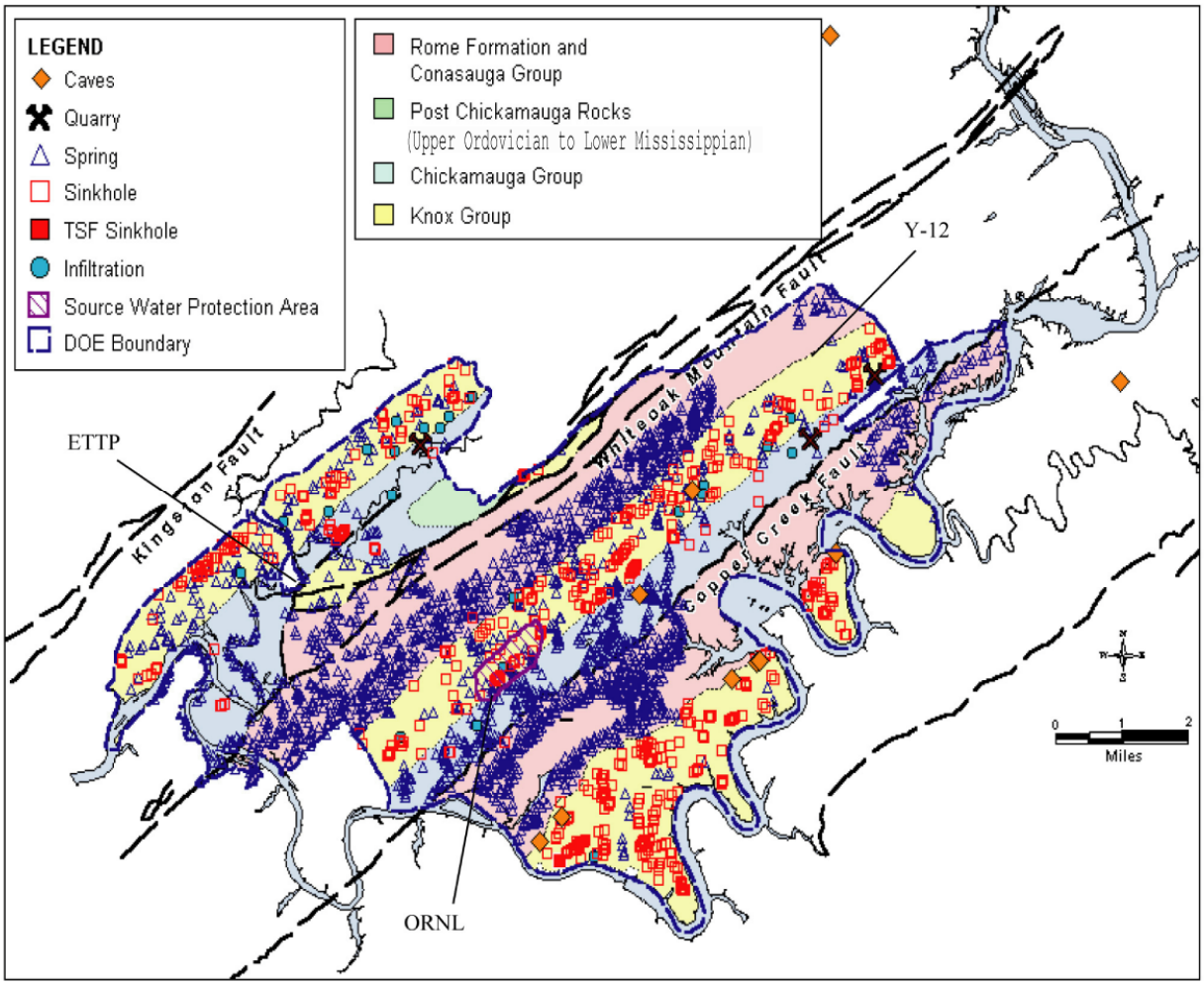
Source: DOE 2001a.

Figure 4.5.2-1. Generalized Bedrock Map for Y-12.



Source: DOE 2001a.

Figure 4.5.2-2. Generalized Stratigraphic Column in the Y-12 Characterization Area.



Source: DOE 2001a.

Figure 4.5.2-3. Geology and Karst Features.

Y-12 is located in the Upper East Fork Poplar Creek (UEFPC) watershed. Unconsolidated materials overlying bedrock in the UEFPC watershed include alluvium (stream-laid deposits), colluvium (material transported downslope), man-made fill, fine-grained residuum from the weathering of the bedrock, saprolite (a transitional mixture of fine-grained residuum and bedrock remains), and weathered bedrock. The overall thickness of these materials in the Y-12 area is typically less than 40 feet. In the undeveloped areas of Y-12, the saprolite retains primary texture features of the unweathered bedrock including fractures.

4.5.3 Seismology

The Oak Ridge area lies in seismic zones 1 and 2 of the Uniform Building Code, indicating that minor to moderate damage could typically be expected from an earthquake. Y-12 is cut by many inactive faults formed during the late Paleozoic Era and there is no evidence of capable faults in the immediate area of Oak Ridge, as defined by 10 CFR Part 100 (surface movement within the past 35,000 years or movement of a recurring nature within the past 500,000 years). The nearest capable faults are approximately 300 miles west of ORR in the New Madrid Fault zone (DOE

2005i). Since the New Madrid earthquakes of 1811 to 1812, at least 26 other earthquakes with a Modified Mercalli intensity (see Table 4.5.3-1), herein referred to as intensity, of III to VI have been felt in the Oak Ridge area, the majority of these having occurred in the Valley and Ridge Province. The Charleston, South Carolina, earthquake of 1886 had an intensity of VI at Oak Ridge, and an earthquake centered in Giles County, Virginia, in 1886 produced an intensity of IV to V at Oak Ridge. One of the closest seismic events to ORR occurred in 1930; its epicenter was 5 miles from ORR (DOE 2001a).

Table 4.5.3-1. The Modified Mercalli Intensity Scale of 1931, With Approximate Correlations to Richter Scale and Maximum Ground Acceleration.[a]

Modified Mercalli Intensity[b]	Observed Effects of Earthquake	Approximate Richter Magnitude[c]	Maximum Ground Acceleration[d]
I	Usually not felt	<2	negligible
II	Felt by persons at rest, on upper floors or favorably placed	2-3	<0.003 g
III	Felt indoors; hanging objects swing; vibration like passing of light truck occurs; might not be recognized as earthquake	3	0.003 to 0.007 g
IV	Felt noticeably by persons indoors, especially in upper floors; vibration occurs like passing of heavy truck; jolting sensation; standing automobiles rock; windows, dishes, and doors rattle; wooden walls and frames may creak	4	0.007 to 0.015 g
V	Felt by nearly everyone; sleepers awaken; liquids disturbed and may spill; some dishes break; small unstable objects are displaced or upset; doors swing; shutters and pictures move; pendulum clocks stop or start	4	0.015 to 0.03 g
VI	Felt by all; many are frightened; persons walk unsteadily; windows and dishes break; objects fall off shelves and pictures fall off walls; furniture moves or overturns; weak masonry cracks; small bells ring; trees and bushes shake	5	0.03 to 0.09 g
VII	Difficult to stand; noticed by car drivers; furniture breaks; damage moderate in well built ordinary structures; poor quality masonry cracks and breaks; chimneys break at roof lines; loose bricks, stones, and tiles fall; waves appear on ponds and water is turbid with mud; small earthslides, large bells ring	6	0.07 to 0.22 g
VIII	Automobile steering affected; some walls fall; twisting and falling of chimneys, stacks, and towers; frame houses shift if on unsecured foundations; damage slight in specially designed structures, considerable in ordinary substantial buildings; changes in flow of wells or springs; cracks appear in wet ground and steep slopes	6	0.15 to 0.3 g
IX	General panic; masonry heavily damaged or destroyed; foundations damaged; serious damage to frame structures, dams and reservoirs; underground pipes break; conspicuous ground cracks	7	0.3 to 0.7g
X	Most masonry and frame structures destroyed; some well built wooden structures and bridges destroyed; serious damage to dams and dikes; large landslides; rails bent	8	0.45 to 1.5 g
XI	Rails bent greatly; underground pipelines completely out of service	9	0.5 to 3 g
XII	Damage nearly total; large rock masses displaced; objects thrown into air; lines of sight distorted	9	0.5 to 7 g

Source: NEIC 2005.
a – This table illustrates the approximate correlation between the Modified Mercalli intensity scale, the Richter scale, and maximum ground acceleration.
b – Intensity is a unit less expression of observed effects.
c – Magnitude is an exponential function of seismic wave amplitude, related to the energy released.
d – Acceleration is expressed in relation to the earth's acceleration due to earth's gravity (g).

This earthquake in 1930 had an estimated intensity of VII at the epicenter and an approximate intensity of V to VI in the Oak Ridge area. Maximum horizontal ground surface accelerations of 0.06 to 0.30 due to gravity at ORR are estimated to result from an earthquake that could occur once every 500 to 2,000 years.

An earthquake that occurred in 1973 in Maryville, Tennessee, 21 miles southeast of ORR, had an estimated intensity of V to VI in the Oak Ridge area (DOE 2001a). In 1987, a significant earthquake occurred approximately 30 miles from ORR with an intensity of VI. In addition, since 1995, two earthquakes with an intensity of III and two earthquakes with an intensity of V occurred within 100 miles of ORR (NEIC 2005). In 1998, one earthquake that had an intensity of III occurred approximately 1.9 miles from ORR. There have been 13 earthquakes in the last 160 years that, at their epicenter, produced an intensity of VI, and one of intensity VII within 100 miles of ORR (NEIC 2005).

4.5.4 Soils

Y-12 is located in Bear Creek Valley at the eastern boundary of ORR. Bear Creek Valley lies on well- to moderately well-drained soils underlain by shale, siltstone, and silty limestone. Developed portions of the valley are designated as urban land. Soil erosion from past land uses has ranged from slight to severe. Erosion potential is very high in those areas that have been eroded in the past with slopes greater than 25 percent. Erosion potential is lowest in the nearly flat-lying permeable soils that have a loamy texture. Additionally, shrink-swell potential is low to moderate and the soils are generally acceptable for standard construction techniques (DOE 2001a).

Y-12 lies on soils of the Armuchee-Montevallo-Hamblen, the Fullerton-Claiborne-Bodine, and the Lewhew-Armuchee-Muskinghum associations (DOE 2001a). Due to extensive cut-and-fill grading during the construction of Y-12, very few areas within the UEFPC watershed have a sequence of natural soil horizons. Soil erosion due to past land use has ranged from slight to severe. Finer textured soils of the Armuchee-Montevallo-Hamblen association have been designated as prime farmland when drained (DOE 2001a).

Sediment Sampling. Historical data have shown that mercury, polychlorinated biphenyls (PCBs), and isotopes of uranium are present at detectable levels in sediment. Therefore, as a best management practice, Y-12 maintains an annual sampling program to determine whether these constituents are accumulating in the sediments of EFPC and Bear Creek as a result of Y-12 discharges. The monitoring results indicate that the radiological levels, including isotopes of uranium and thorium, have not significantly changed in the past five years (DOE 2008).

In 2004, the Tennessee Department of the Environment and Conservation (TDEC) Environmental Monitoring and Compliance Program sampled sediments at 34 sites, 11 of which were located on the Clinch River and two on the Tennessee River. The other 21 sites were located on tributaries of the Clinch River draining from ORR; these are considered “exit pathways.” None were on a stream, such as White Oak Creek or Poplar Creek that has already been identified as contaminated and currently monitored by DOE. Samples were analyzed for organic, inorganic, and radiological contaminants. The results were compared with standards,

known as Preliminary Remediation Goals, established for ORR based on guidance from the U.S. Environmental Protection Agency (EPA). These standards were used because there are no regulatory guidelines for sediment quality, either at the state or federal level. The sediments met the standards for recreational use, meaning that people can safely engage in activities such as fishing, hiking, and playing at these locations (TDEC 2005a).

4.6 CLIMATE, AIR QUALITY, AND NOISE

4.6.1 Climate

The City of Oak Ridge lies in a valley between the Cumberland and Great Smoky Mountain ranges and is bordered on two sides by the Clinch River. The Cumberland Mountains are located about 10 miles to the northwest; and the Great Smoky Mountains are 32 miles to the southeast (DOE 2005a). The Region of Influence (ROI) specific to air quality is primarily the Bear Creek Valley for Y-12. This valley is bordered by ridges that generally confine facility emissions to the valley between the ridges.

The climate of the region may be broadly classified as humid subtropical and is characterized by significant temperature changes between summer and winter. The average temperature for the Oak Ridge area during 2006 was 59.5° F compared with a 30-year mean temperature (1976–2005) of 57.9° F. The coldest month is usually January, with temperatures averaging about 36.1° F. July tends to be the warmest month, with average temperatures of 77.5° F (DOE 2008).

Average annual precipitation in the Oak Ridge area for the 30 year period from 1976 to 2005 was 54.1 inches, including about 10.8 inches of snowfall. Total rainfall during 2006, measured at the Oak Ridge meteorological tower, was 48.6 inches, and total 2006 snowfall was 3.5 inches. This marks the third consecutive year with below-normal precipitation (DOE 2008).

In 2007 wind speeds at ORNL Tower C (MT2) measured at 32.8 feet above ground level averaged 2.7 miles per hour. This value increased to about 6.5 miles per hour for winds at 328 feet above the ground (about the height of local ridgetops). The local ridge-and-valley terrain reduces average wind speeds at valley bottoms, resulting in frequent periods of nearly calm conditions, particularly during clear, early morning hours (DOE 2008).

Detailed information on the climate of the Oak Ridge area is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (DOE 2008).

4.6.2 Air Quality

Air quality laws and regulations have been established to protect the public from harmful effects of air pollution. These rules take several forms. In some cases, the goal is to designate acceptable levels of pollution in ambient air, as in the establishment of ambient air quality standards (AAQSs). Other regulations establish limits on air pollutant emission sources or activities to reduce their impact. Still others establish jurisdictional authority to regulate air pollutant emission sources and enforce laws and regulations.

The following sections provide a general summary of air protection programs and ambient pollutant levels in the environs of Y-12:

- Section 4.6.2.1 highlights the regional air quality and the regulatory authorities that oversee air protection programs.
- Section 4.6.2.2 details Y-12's nonradiological air pollutant sources and emissions and the programs developed to manage these sources.
- Section 4.6.2.3 discusses radiological air quality, providing information on Y-12's effluent monitoring and ambient air sampling programs, radionuclide emission estimates, as well as dose calculations for maximally exposed receptors and the populace.

4.6.2.1 *Regional Air Quality*

As directed by the *Clean Air Act* (CAA) of 1970 (42 *United States Code* [U.S.C.] §7401), EPA has set the National Ambient Air Quality Standards (NAAQS) for several criteria pollutants to protect human health and welfare (40 CFR Part 50). These pollutants include particulate matter with an aerodynamic diameter less than or equal to 10 microns in diameter (PM_{10}), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), lead (Pb), and ozone. In 1997 the EPA finalized new air quality standards for ozone and $PM_{2.5}$ (particles with an aerodynamic diameter less than or equal to 2.5 microns). Despite a series of legal challenges in the U.S. Court of Appeals, in February 2001 the U.S. Supreme Court upheld the NAAQS for $PM_{2.5}$ and ozone. Based on the ambient (outdoor) levels of the criteria pollutants, EPA evaluates individual Air Quality Control Regions (AQCRs) to establish whether or not they satisfy the NAAQS. Areas that satisfy the NAAQS are classified as attainment areas, and areas that exceed the NAAQS for a particular pollutant are classified as non-attainment areas for that pollutant.

ORR is located in Anderson and Roane Counties in the Eastern Tennessee-Southwestern Virginia AQCR 207 and Y-12 is completely within Anderson County. The EPA has designated Anderson County as a basic non-attainment area for the 8-hour ozone standard, as part of the larger Knoxville basic 8-hour ozone non-attainment area that encompasses several counties; and for $PM_{2.5}$ based on a revision to the standards (EPA 2005a). For all other criteria pollutants for which EPA has made attainment designations, existing air quality in the greater Knoxville and Oak Ridge areas is in attainment with the NAAQS.

Nonradiological air quality is defined by the concentration of various pollutants in the atmosphere expressed in units of parts per million (ppm) or in micrograms per cubic meter ($\mu g/m^3$). The standards and limits set by Federal and state regulations are provided in concentrations averaged over incremental time limits (e.g., 30 minutes, 1 hour, 3 hours). The averaging times shown in the tables in this section correspond to the regulatory averaging times for the individual pollutants. Table 4.6.2.1–1 presents the NAAQS and Tennessee State AAQS.

Table 4.6.2.1-1. National and Tennessee Ambient Air Quality Standards.

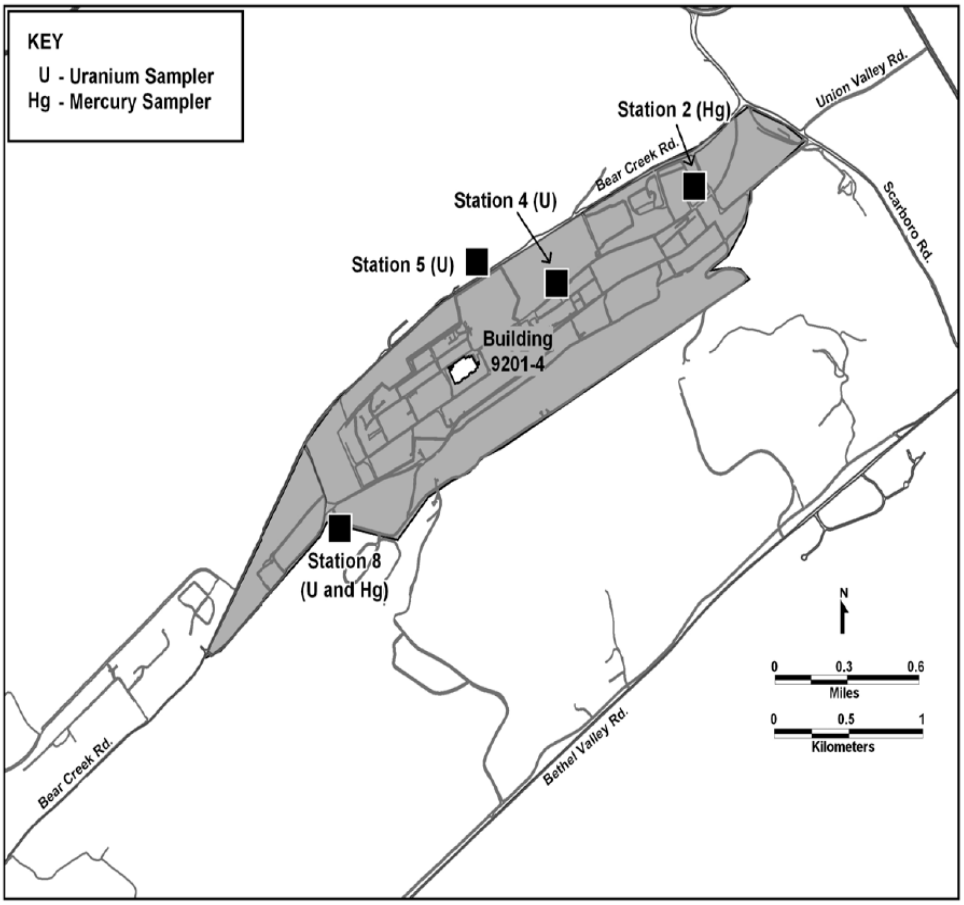
Pollutant	Averaging Time	NAAQS (µg/m^3)	Tennessee Standard (µg/m^3)
SO_2	Annual[1]	80 (0.030 ppm)	80 (0.030 ppm)
	24-Hour[2]	365 (0.14 ppm)[a]	365 (0.14 ppm)[a]
	3-Hour[2]	1,300 (0.5 ppm)[a]	1,300 (0.5 ppm)[a]
PM_{10}	Annual[1]	none	50
	24-Hour[2]	150[b]	150
$PM_{2.5}$	Annual[1]	15[c]	none
	24-Hour[2]	35 [d]	none
Suspended Particulates	Annual[1]	none	none
	24-Hour[2]	none	150
CO	8- Hour[2]	10,000 (9 ppm)[a]	10,000 (9 ppm)[a]
	1- Hour[2]	40,000 (35 ppm)[a]	40,000 (35 ppm)[a]
Ozone	8- Hour[3]	157 (0.08 ppm)[e]	none
	1- Hour[2]	235 (0.12 ppm)[f]	235 (0.12 ppm)[f]
NO_2	Annual[1]	100 (0.053 ppm)	100 (0.05 ppm)
Lead	Rolling 3-Month Average	0.15	none
Lead	Quarter[1]	1.5	1.5
Hydrogen Fluoride	30 days	none	1.2 (1.5 ppm)[a]
	7 days	none	1.6 (2.0 ppm)[a]
	24-Hour	none	2.9 (3.5 ppm)[a]
	12-Hour	none	3.7 (4.5 ppm)[a]
Hydrogen Chloride	24-Hour	none	70

Source: EPA 2007, DOE 2001a.
Note: New NAAQS for lead, 8-hour ozone, and $PM_{2.5}$ have not been implemented. Newer standards have been promulgated.
Key:
a Not to be exceeded more than once per year annual PM_{10} standard in 2006 (effective December 17, 2006).
b – Not to be exceeded more than once per year on average over 3 years.
c – To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.
d – To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).
e – To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
f – (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1. (b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the fourteen 8-hour ozone nonattainment Early Action Compact (EAC) Areas.
1. Arithmetic mean.
2. Block average.
3. Rolling Average.
µg/m^3 = micrograms per cubic meter
ppm = parts per million
ppb = parts per billion
HF = hydrogen fluoride

4.6.2.2 *Air Quality and Emissions on the Oak Ridge Reservation*

Airborne discharges from DOE Oak Ridge facilities, both radioactive and nonradioactive, are subject to regulation by the EPA, the TDEC Division of Air Pollution Control, and DOE Orders. Y-12 has a comprehensive air regulation compliance assurance and monitoring program to ensure that airborne emissions satisfy all regulatory requirements and do not adversely affect ambient air quality. Common air pollution control devices employed on ORR include exhaust gas scrubbers, baghouses, and other exhaust filtration systems designed to remove contaminants from exhaust gases before release to the atmosphere. Process modifications and material substitutions are also made to minimize air emissions. In addition, administrative control plays a role to regulate emissions.

The TDEC performs ambient air monitoring throughout the State of Tennessee and within the vicinity of ORR. The locations of the ambient monitoring stations at Y-12 are shown in Figure 4.6.2.2-1. Concentration of regulated pollutants observed during 1999 at locations near ORR is presented in Table 4.6.2.2-1. As the data indicate, only the 8-hour ozone concentrations exceed the standards, which is typical for all of Anderson County. Sample results show that ORR operations have an insignificant effect on local air quality.



Source: DOE 2008.

Figure 4.6.2.2-1. Locations of Ambient Monitoring Stations at Y-12.

Table 4.6.2.2-1. Tennessee Department of Environment and Conservation Ambient Air Monitoring Data in the Vicinity of Y-12/Oak Ridge Reservation.

Pollutant	Averaging Time	Air Quality standard ($\mu g/m^3$)	Measured Concentration ($\mu g/m^3$)
SO_2	3-hr	1,300	398 [a]
	24-hr	365	47.1 [b]
	Annual	80	10.5 [b]
PM_{10}	Annual [a]	50	25.4 [b]
	24-Hour [b]	150	77 [a]
$PM_{2.5}$	Annual [a]	15	No Data
	24-Hour [b]	150	48.2 [a]
CO	1-hr	40,000	12,712
	8-hr	10,000	4,466 [b]
Ozone	1-hr	235	225 [a]
	8-hr	157	188.4 [a]
NO_2	Annual	100	15.1 [a]
Lead	Calendar quarterly mean	1.5	0.009 [a]
Gaseous Fluorides (as HF)	30-day	1.2	No Data
	7-day	1.6	0.114 [a]
	24-hr	2.9	No Data
	12-hr	3.7	No Data
Hydrogen Chloride	24-hr	70	No Data

a – TDEC 2005c.
b – DOE 2001a.

The release of nonradiological contaminants into the atmosphere at Y-12 occurs as a result of plant production, maintenance, waste management operations, and steam generation. Most process operations are served by ventilation systems (DOE 2008).

In calendar year (CY) 2006, Y-12 implemented complete compliance and reporting activities for its first Major Source (Title V) Operating Air Permit. The permit covers 37 air emission sources and more than 100 air emission points. Other emission sources at Y-12 are categorized as being insignificant and exempt from air permitting. Under the Title V operating permit for the complex, sampling, continuous monitoring, and record keeping of key process parameters are recorded and reported to TDEC in quarterly, semiannual, and annual reports (DOE 2008).

Approximately three-fifths of the permitted air sources release primarily nonradiological contaminants. The remaining two-fifths of the permitted sources process primarily radiological materials. TDEC air permits for the nonradiological sources do not require stack sampling or monitoring except for the opacity and nitrogen oxide (NOx) monitors used at the steam plant to ensure compliance with visible emission standards and ozone season emission limits, respectively. For nonradiological sources where direct monitoring of airborne emissions is not required, or is required infrequently, monitoring of key process parameters is done to ensure compliance with all permitted emission limits (DOE 2008).

The primary source of criteria pollutants at Y-12 is the steam plant, where coal and natural gas are burned (DOE 2008). Actual and allowable emissions from the steam plant are shown in Table 4.6.2.2-2; actual emissions are well below allowable emissions.

Table 4.6.2.2-2. Actual versus Allowable Air Emissions from the Oak Ridge Y-12 Steam Plant, 2007.

Pollutant	Emissions (tons/year)[a]		Percentage of allowable
	Actual	Allowable	
Particulate	28	945	3.0
Sulfur dioxide	2,038	20,803	9.8
Nitrogen oxides [a]	437	5,905	7.4
Nitrogen oxides (ozone season only)	133.5[c]	232	57.5
Volatile organic compounds [b]	2.3	41	5.6
Carbon monoxide [b]	18	543	3.3

Source: DOE 2008.
a – 1 ton = 907.2 kg.
b – When there is no applicable standard or enforceable permit condition for some pollutants, the allowable emissions are based on the maximum actual emissions calculation as defined in Tennessee Department of Environment and Conservation Rule 1200-3-26-.02(2)(d)3 (maximum design capacity for 8760 hr/year). The emissions for both the actual and allowable emissions were calculated based on the latest EPA compilation of air pollutant emission factors. (EPA 1995a and 1998a. *Compilation of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume 1: Stationary Point and Area Sources.* U.S. Environmental Protection Agency, Research Triangle Park, N.C. January 1995 and August 1998.)
c – Monitored emissions

Air Conformity. Submittal of a State Implementation Plan and adherence to the General Conformity Rule are related requirements to ensure the NAAQS are satisfied. The State Implementation Plan identifies strategies such as emissions budgets, emissions limitations, and emission reduction plans to maintain or improve air quality and enforce the NAAQS. The General Conformity Rule, promulgated by the CAA, requires that the federal government may not engage, support, or provide financial assistance for permit or license, or approve any activity that fails to conform to the State Implementation Plan.

Conformity is designed to ensure that federal plans, programs, and projects are consistent with the State Implementation Plan and the local clean air plan, and that they not contribute to air quality degradation that would adversely affect state efforts to attain or maintain the NAAQS. Therefore, rules for conformity are not limited to stationary sources, which require air district permits, but must consider total project emissions (direct and indirect), including emissions from personal and work vehicles, construction equipment, demolition equipment and activities, and non-permitted sources.

The General Conformity evaluation process for a proposed federal action involves two distinct steps: applicability and determination. Applicability is an assessment of whether a proposed action is subject to the Conformity Rule. If the Conformity Rule is applicable for the proposed action, then a Conformity Determination is required.

There are two criteria to assess Applicability. First, do the total direct and indirect emissions for the proposed action in a Non-attainment or maintenance area exceed the 40 CFR Part 51.853 emission thresholds, and second, are the emissions from the proposed action regionally significant (note: 40 CFR Part 51.850 et seq. is adopted by reference in TDEC 1200-3-34-.02). A pollutant emission is considered regionally significant if it represents 10 percent or more of a non-attainment area or maintenance area emission budget for that pollutant (as identified in the State Implementation Plan).

Conformity is assessed on a pollutant-by-pollutant basis. Threshold emission levels are established for each criteria pollutant based on the attainment or maintenance status of the region of interest. The entire state of Tennessee is located within the ozone transport region. For Anderson County, which is a Subpart 1 non-attainment area for ozone, the emission thresholds for NOx and Volatile Organic Compounds (VOCs) are 100 tons per year each. Anderson County is also a Non-attainment area for $PM_{2.5}$, and the emission threshold for $PM_{2.5}$ and its precursors is 100 tons per year.

Conformity requirements do not apply to continued or recurrent activities such as permit renewals where activities conducted will be similar in scope and operation to activities currently in place. In addition, before emissions can be considered in the conformity evaluation, they must satisfy the definition of reasonably foreseeable as cited in Tennessee Code §200-3-34-.02.

> *Reasonably foreseeable emissions are projected future indirect emissions that are identified at the time the conformity determination is made; the location of such emissions is known and the emissions are quantifiable, as described and documented by the Federal agency based on its own information and after reviewing any information presented to the Federal agency.*

EPA's general conformity guidance clarifies that "reasonably foreseeable" should include both direct and indirect projected future emissions, not just indirect future emissions. The Y-12 National Security Complex must comply with the conformity requirements as promulgated in the CAA and TDEC regulation 1200-3-34-.02. Conformity must consider comprehensive emissions estimates associated with the proposed action, including construction, demolition, vehicular emissions, and stationary sources.

Air Monitoring. With respect to hazardous air pollutants (HAPs), the TDEC, Department of Energy Oversight Division's HAPs Monitoring Program was developed to provide continued independent monitoring of hazardous metals in ambient air at Y-12. Monitoring with high volume air samplers was conducted for arsenic, beryllium, cadmium, total chromium, lead, nickel, and uranium as a metal. Although a number of potential sources that have the potential to emit hazardous metals are located on and around Y-12, the results of the 2004 monitoring conducted by TDEC at Y-12 indicate no apparent elevated levels for HAPs metals of concern. Concentrations for all metals of concern were below guidelines, and/or detection limits of laboratory analysis (TDEC 2005b).

Mercury. Y-12's ambient air monitoring program for mercury was established in 1986 as a best management practice. The objectives of the program are to maintain a database of mercury concentration 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 at Y-12 to the atmosphere. Originally, four monitoring stations were operated at Y-12, including two within the former mercury-use area. The two atmospheric mercury monitoring stations currently operating at Y-12, Ambient Air Station No. 2 (AAS2) and Ambient Air Station No. 8 (AAS8), are located near the east and west boundaries of Y-12, respectively. Since their establishment in 1986, AAS2 and AAS8 have monitored mercury in ambient air continuously with the exception of short periods of downtime because of electrical or equipment outages. In

addition to the Y-12 monitoring stations, a control or reference site (Rain Gauge No. 2) was operated on Chestnut Ridge in the Walker Branch Watershed for a 20-month period in 1988 and 1989 to establish a reference concentration at that time (DOE 2008).

At the two current monitoring sites, airborne mercury vapor is collected by pulling ambient air through a sampling train consisting of a Teflon filter, a flow-limiting orifice, and an iodated-charcoal sampling trap. The flowlimiting orifice restricts airflow through the sampling train to approximately 1 liter per minute. Actual flow rates are measured weekly in conjunction with trap changeout with a calibrated Gilmont flowmeter. The charcoal in each trap is analyzed for total mercury using cold vapor atomic fluorescence after acid digestion. Average concentration of mercury vapor in the ambient air for each 7-day sampling period is calculated by dividing the total mercury per trap by the volume of air pulled through the charcoal trap during the corresponding 7-day period (DOE 2008).

As reported in previous annual environmental reports, average ambient mercury concentration at the monitoring sites has declined significantly since the late 1980s, with average mercury vapor concentration at AAS8 declining almost tenfold and at AAS2 approximately threefold. Recent average annual concentration at the two boundary stations are comparable to concentrations measured in 1988 and 1989 at the Chestnut Ridge reference site but slightly elevated above concentrations reported for continental background (approximately 0.002 $\mu g/m^3$). Average mercury concentration measured at the AAS2 site during 2006 was 0.0036 $\mu g/m^3$ (Number of samples (N) =51; Standard Error (S.E.) = ±0.0002) and has remained unchanged since year 2002 when it was slightly higher at 0.0040 $\mu g/m^3$. At monitoring station AAS8, located at the west end of Y-12, the average concentration for CY 2006 was 0.0058 $\mu g/m^3$ (N = 52; S.E. = ±0.0004) and represents a slight, but not significant (Student's *t*-test), increase over the average concentration for 2004 and 2005. Though the difference in the average concentration from 2004 to 2006 is not significant, there has been an upward trend in mercury concentration at AAS8 dating back several years. This upward trend may reflect a temporary increase in ambient concentrations at AAS8 because of increased demolition and excavation in the western end of Y-12 as part of the Y-12 infrastructure reduction program. A very large increase in mercury concentration at AAS8 was observed in the late 1980s and was thought to be related to disturbances of mercury contaminated soils and sediments during the Perimeter Intrusion Detection and Assessment System and utility restoration projects in progress then. Mercury concentrations measured at AAS8 should continue to be tracked closely, especially if demolition and excavation occur in the old mercury-use areas of Y-12 as part of infrastructure reduction. Significant increases may warrant the reestablishment of sites within the old mercury-use areas and a reassessment of reference concentrations at the former reference site on Chestnut Ridge. Table 4.6.2.2-3 summarizes the 2006 mercury results and the results from the 1986 through 1988 period for comparison (DOE 2008).

In conclusion, 2006 average mercury concentrations at the two mercury monitoring sites are comparable to reference levels measured for the Chestnut Ridge reference site in 1988 and 1989. Measured concentrations continue to be well below current environmental and occupational health standards for inhalation exposure to mercury vapor; for example, the National Institute for Occupational Safety and Health recommended exposure limit of 50 $\mu g/m^3$ (time weighted average for up to a 10-hour workday, 40-hour work week), the American Conference of

Governmental Industrial Hygienists workplace threshold limit value of 25 μg/m^3 as a time weighted average for a normal 8-hour workday and 40-hour workweek, and the current EPA reference concentration (0.3 μg/m^3) for elemental mercury for daily inhalation exposure without appreciable risk of harmful effects during a lifetime (DOE 2008). Table 4.6.2.2-3 shows the ambient mercury vapor concentration from the results of the Y-12 Ambient Air Monitoring Program (DOE 2008).

Table 4.6.2.2-3. Results for the Y-12 Mercury in Ambient Air Monitoring Program 2006.

	Mercury Vapor Concentration (μg/m^3)			
Ambient air monitoring stations	2007 Average	2007 Maximum	2007 Minimum	1986–1988[a] Average
AAS2 (east end of Y-12)	0.0036	0.0066	0.0010	0.010
AAS8 (west end of Y-12)	0.0057	0.0143	0.0017	0.033
Reference Site, Rain Gauge No.2 (1988[b])	N/A	N/A	N/A	0.006
Reference Site, Rain Gauge No.2 (1988[c])	N/A	N/A	N/A	0.005

Source: DOE 2008.
a – Period in late-80s with elevated ambient air Hg levels.
b – Data for period from February 9 through December 31, 1988.
c – Data for period from January 1 through October 31, 1989.

Fluorides. The State of Tennessee regulation 1200-3-3-.01 does not define primary standards (affecting public health) for hydrogen fluoride. However, secondary standards (affecting public welfare, i.e., vegetation, aesthetics) are defined in 1200-3-3-.02 for gaseous fluorides expressed as hydrogen fluoride. In anticipation of the startup of the hydrogen fluoride system during CY 2005, arrangements were made to monitor the community adjacent to Y-12 for the presence of fluorides (DOE 2008).

The monitoring methodology chosen for use is in accordance with the American Society for Testing and Materials (ASTM) Standard D3266, which designates the use of a dual-tape sampler. The time period over which the monitoring occurs is 7 days, and results in a total of 56 samples being generated per week (3 hours per sample, 8 samples per day; 7 days per week). The results represent a composite (seven-day average) and serve to provide background information on the presence of fluorides in the surrounding area. The regulatory secondary standard for the seven-day average is 1.6 μg/m^3. Actual monitoring data indicate a maximum of 0.048 μg/m^3, which means concentrations are more than ten times less than the regulatory standard (DOE 2008).

Ozone-Depleting Substances Phase-Out Efforts. Significant progress has been made in eliminating use of Class I and Class II ozone-depleting substances at Y-12, and a number of projects have been identified to further reduce ozone-depleting substance uses. The *Y-12 Complex Ozone Depleting Substances (ODS) Phase-Out and Management Plan* (Y-12 2003), was issued in 2003 and provides a complete discussion of requirements and compliance activities at Y-12. Y-12 personnel continue to investigate and implement actions to reduce the use of regulated ozone-depleting substances, where possible, replacing them with materials that have less ozone-depleting potential. In 2007, a multi-year project was completed that resulted in the elimination of more than 15,000 pounds of yearly chlorofluorocarbon emissions through a recent change in a manufacturing process. For many years, Freon 113 performed well as a solvent for cleaning metal chips but was also an ozone-depleting substance. The Freon was replaced with a new product, Vertrel, manufactured by DuPont. Since the ODS elimination program began in the

early 1990s, Y-12 has eliminated more than 90 percent of its Class I ODSs used in heating, ventilation, and air-conditioning systems (DOE 2008).

Past ODS phase-out and reduction efforts at Y-12 include:

- retrofitting, replacing, or taking out-of-service chillers and air conditioning systems;
- solvent substitutions for uses such as machining, cleaning, and cooling; and
- elimination or conversion of fixed fire protection systems that contained Halon 1301.

Y-12 personnel continue to properly manage refrigerants via programs and actions such as:

- certification of refrigerant recycling and recovery equipment;
- training and EPA certification of refrigerant technicians; and
- procedures for performance of leak checks and for response to equipment leaks.

Infrastructure reduction activities also led to the reduction of ODS materials on-site. All refrigerants and solvents must be removed from equipment prior to disposal. If an ODS is no longer going to be used at Y-12 it is managed as follows:

- excessed to other DOE facilities;
- offered to other government agencies such as the Defense Logistics Agency;
- sold to outside vendors for recycle; or
- properly disposed of (DOE 2008).

4.6.2.3 *Radiological Air Emissions*

The release of radiological contaminants, primarily uranium, into the atmosphere at Y-12 occurs almost exclusively as a result of plant production, maintenance, and waste management activities. National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations for radionuclides require continuous emission sampling of major sources (a "major source" is considered to be any emission point that potentially can contribute more than 0.1 milli Roentgen Equivalent Man (mrem) per year effective dose to an off-site individual). As of January 1, 2006, Y-12 had continuous monitoring capability on a total of 53 stacks, 41 of which were active and twelve of which were temporarily shut down. Stacks US-017 and US-127 were permanently taken out of service in 2005. During 2006, 40 of the 53 stacks suitable for continuous monitoring were judged to be major sources. Sixteen of the stacks with the greatest potential to emit significant amounts of uranium are equipped with alarmed breakthrough detectors, which alert operations personnel to process-upset conditions or to a decline in filtration system efficiencies, allowing investigation and correction of the problem before a significant release occurs (DOE 2008).

Emissions from 50 unmonitored processes, categorized as minor emission sources, are estimated according to calculation methods approved by the EPA. In 2006, there were 16 unmonitored processes operated by Y-12. These are included as minor sources in Y-12 source term (DOE 2008).

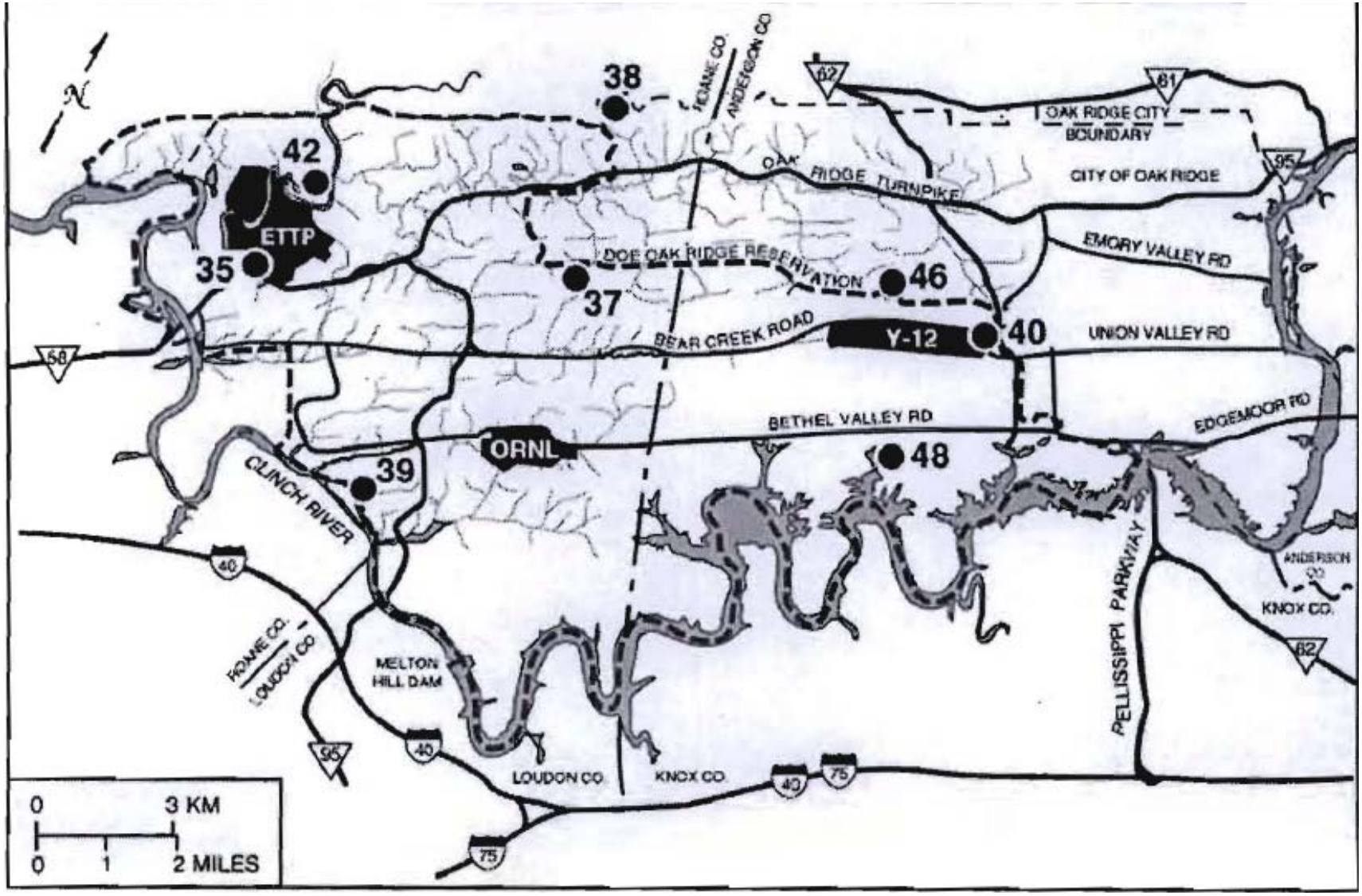
During the year 2006, a change of programmatic responsibility occurred for several facilities located at Y-12 from Bechtel Jacobs Company, LLC, (BJC) to B&W Y-12. The change included four minor sources, specifically the Central Pollution Control Facility Lab Hood, the West End Treatment Facility Degasifier and Lab Hood, and the East End Volatile Organic Compound Air Stripper (DOE 2008).

Uranium and other radionuclides are handled in millicurie quantities at facilities within the boundary of Y-12 as part of Y-12 laboratory activities. Twenty-eight minor emission points were identified from laboratory activities at facilities within the boundary of Y-12 as being operated by B&W Y-12. In addition, the B&W Y-12 Analytical Chemistry Organization laboratory is operated in a leased facility that is not within ORR boundary; it is located approximately a mile east of Y-12 on Union Valley Road. The emissions from the Analytical Chemistry Organization Union Valley laboratory are included in Y-12 source term. Two minor emission points were identified at the laboratory. The releases from those emission points are minimal, however, and have a negligible impact on the total Y-12 dose (DOE 2008).

Emissions from Y-12 room ventilation systems are estimated from radiation control data collected on airborne radioactivity concentrations in the work areas. Areas where the monthly average concentration exceeded 10 percent of the DOE derived air concentration worker-protection guidelines are included in the annual emission estimate. In 2006, one emission specifically identified in the stack emissions point, where room ventilation emissions exceeded 10 percent of the guidelines, was identified in Building 9212. However, because the emissions were vented to stack UB-027, its distributions were not considered in exceedance (DOE 2008).

Uranium stack losses were measured continuously on monitored operating process exhaust stacks in 2006. Particulate matter (including uranium) was filtered from the stack emissions. Filters at each location were changed routinely, from one to two times per week, and were analyzed for total uranium. In addition, the sampling probes and tubing were removed quarterly and were washed with nitric acid; the washing was analyzed for total uranium. At the end of the year, the probe-wash data were included in the final calculations in determining total emissions from each stack (DOE 2008).

The release of radiological contaminants, primarily uranium, into the atmosphere at Y-12 under the No Action Alternative occurs almost exclusively as a result of Y-12 production, maintenance, and waste management activities. An estimated 0.01 Curies of uranium was released into the atmosphere in 2007 as a result of Y-12 activities (DOE 2008). Figure 4.6.2.3-1 shows the approximate locations of monitoring stations.



Source: DOE 2008.

Figure 4.6.2.3-1. Approximate Locations of the ERAMS Air Monitoring Stations.

4.6.3 Noise

Sound level measurements have been recorded at various locations within and near ORR in the process of testing sirens and preparing support documentation for the Atomic Vapor Laser Isotope Separation site. The acoustic environment along the Y-12 site boundary, in rural areas, and at nearby residences away from traffic noise, is typical of a rural location with a Day-Night Average Sound Level (DNL) in the range of 35 to 50 adjusted decibel (dBA). Areas near the Y-12 site within Oak Ridge are typical of a suburban area, with a DNL in the range of 53 to 62 dBA. Traffic is the primary source of noise at the Y-12 site boundary and at residences located near roads. During peak hours, the Y-12 worker traffic is a major contributor to traffic noise levels in the area (DOE 2001a).

Major noise emission sources within Y-12 include various industrial facilities, and equipment and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most Y-12 industrial facilities are at a sufficient distance from the site boundary so that noise levels at the boundary from these sources are not distinguishable from background noise levels. Within the Y-12 site boundary, noise levels from Y-12 mission operations are typical of industrial facilities, ranging from 50 to 70 dBA (DOE 2001a).

The State of Tennessee has not established specific community noise standards applicable to Y-12; however, Anderson County has quantitative noise-limit regulations as shown in Table 4.6.3-1 (DOE 2004).

Table 4.6.3-1. Allowable Noise Level by Zoning District in Anderson County, Tennessee.

Zoning		Allowable Noise Level (dBA)	
District	**Abbreviation**	**7 a.m. – 10 p.m.**	**10 p.m. – 7 a.m.**
Suburban-residential	R-1	60	55
Rural-residential	A-2	65	60
Agricultural-forest	A-1	65	60
General commercial	C-1	70	65
Light industrial	I-1	70	70
Heavy industrial	I-2	80	80
Floodway	F-1	80	80

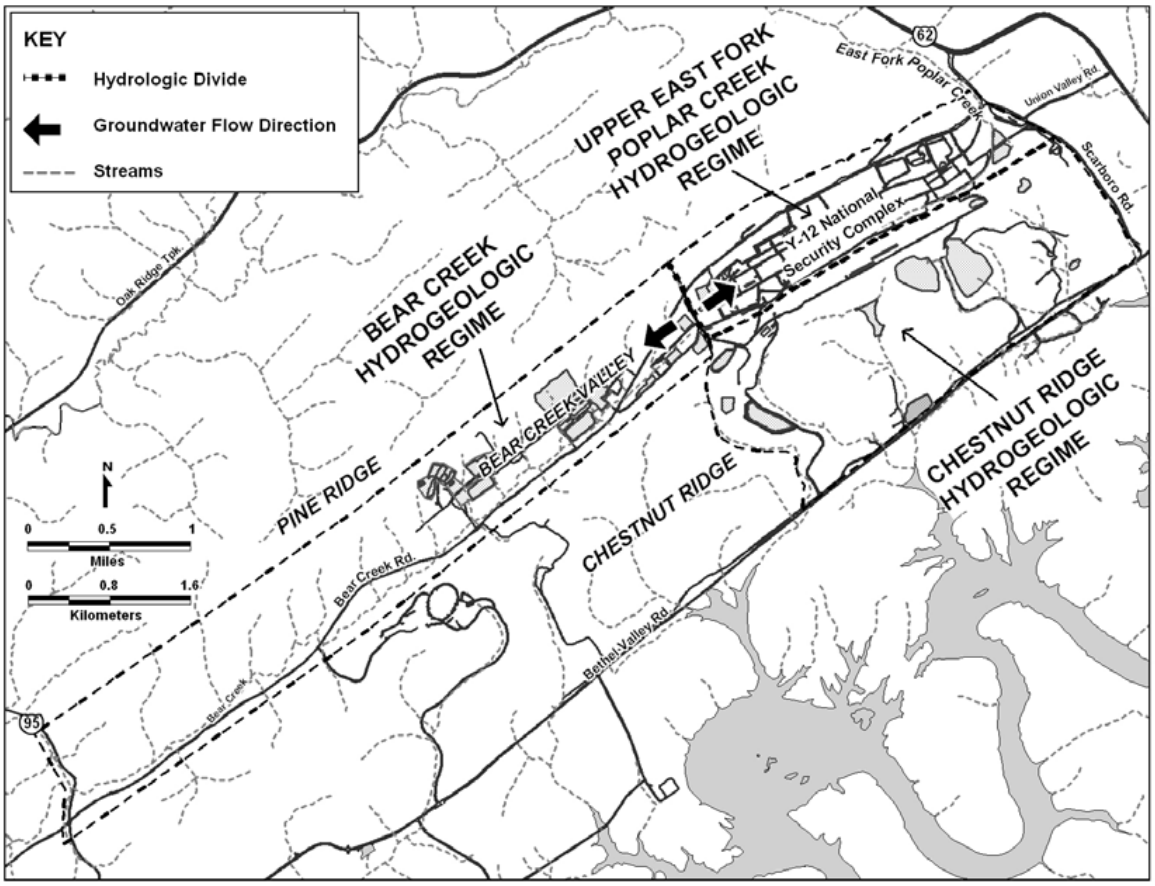
Source: DOE 2004.

4.7 WATER RESOURCES

4.7.1 Groundwater

Y-12 is divided into three hydrogeologic regimes, which are delineated by surface water drainage patterns, topography, and groundwater flow characteristics. The regimes are further defined by the waste sites they contain. These regimes include the Bear Creek Hydrogeologic Regime, the UEFPC Hydrogeologic Regime, and the Chestnut Ridge Hydrogeologic Regime (see Figure 4.7.1-1). Most of the Bear Creek and UEFPC regimes are underlain by geologic formations that are part of ORR aquitard (as shown in Figure 4.5.2-1 and Figure 4.5.2-2). The ORR aquitard is comprised of six geologic formations (Nolichucky Shale, Maryville Limestone, Rogersville Shale, Rutledge Limestone, Pumpkin Valley Shale, and Rome Formation) which

collectively have low permeability and low transmissivity; water is not easily transmitted through these formations. The northern portion of Bear Creek and UEFPC regimes is underlain by aquitard formations including the Nolichucky Shale, Maryville Limestone, and Rogersville Shale. The southern portion of Bear Creek and UEFPC regimes is underlain by the Maynardville Limestone, which is part of the Knox Aquifer. The entire Chestnut Ridge regime, which is adjacent and to the south of the Bear Creek and Upper East Fork Poplar Creek regimes, is underlain by the Knox Aquifer. In general, near surface (shallow) groundwater flow follows topography at Y-12. Shallow groundwater flow in the Bear Creek regime and the Upper East Fork regime is divergent from a topographic and groundwater divide located near the western end of Y-12 that defines the boundary between the two regimes. In addition, flow converges on the primary surface streams (Bear Creek and UEFPC) from Pine Ridge and Chestnut Ridge. In the Chestnut Ridge regime, a groundwater divide exists that approximately coincides with the crest of the ridge. Shallow groundwater flow tends to be toward either flank of the ridge, with discharge primarily to surface streams and springs located in Bethel Valley to the south and Bear Creek Valley to the north (DOE 2008).



Source: DOE 2008.

Figure 4.7.1-1. Hydrogeologic Regimes at the Y-12 Complex.

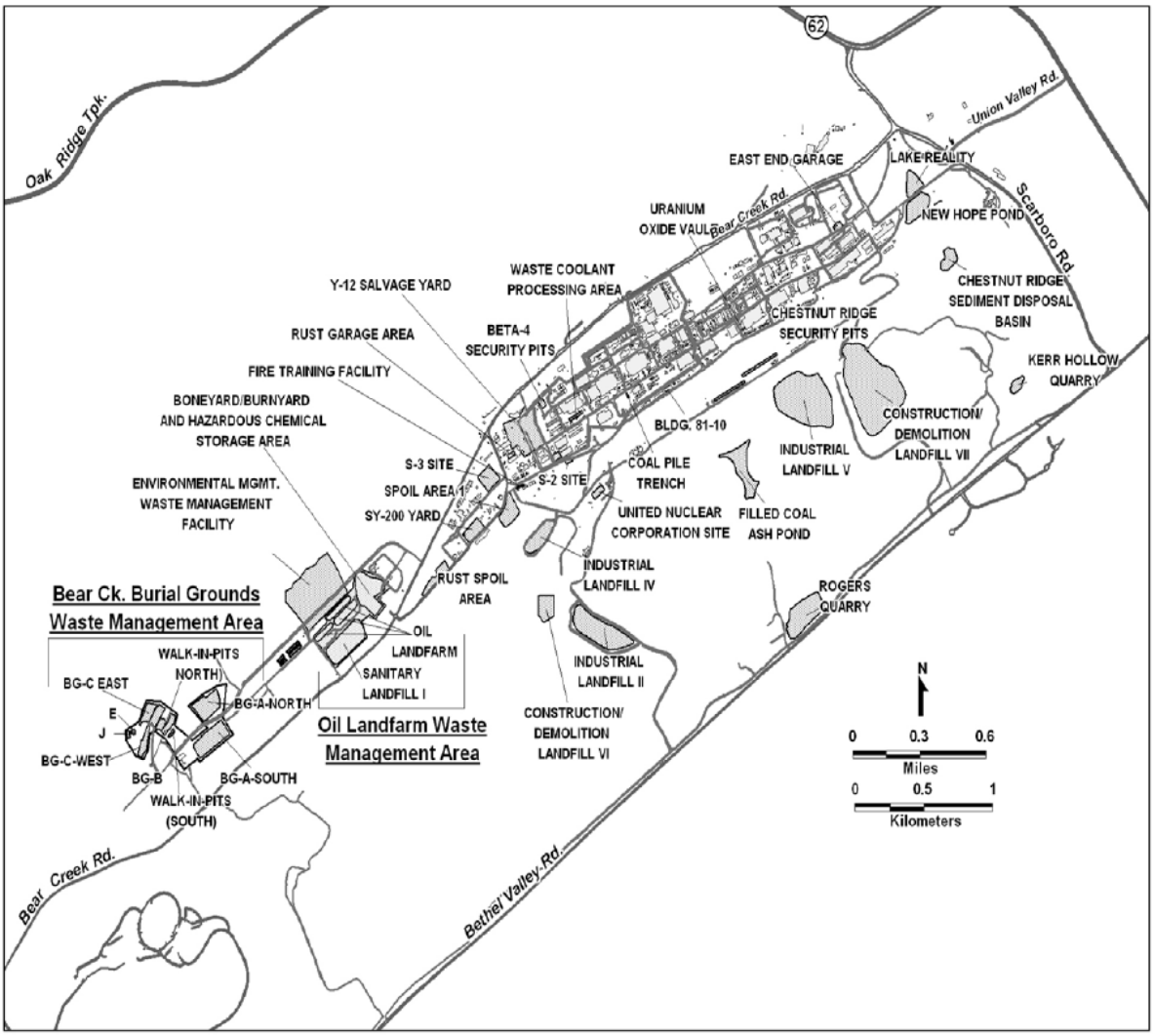
In Bear Creek Valley, groundwater in the intermediate and deep intervals moves predominantly through fractures in ORR aquitards, converging on and then moving through fractures and solution conduits in the Maynardville Limestone. Karst development in the Maynardville

Limestone has a significant impact on groundwater flow paths in the shallow 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 ORR aquitard (< 1 feet per year) but can be quite rapid within solution conduits in the Maynardville Limestone (tens to thousands of feet per day) (DOE 2008). In the UEFPC regime, strike-parallel groundwater flow to the east occurs within the Maynardville Limestone and fractured portions of the ORR aquitard. As shown by groundwater analytical data for VOCs, groundwater and volatile VOCs are moving at depths of almost 500 feet in the Maynardville Limestone. The Maynardville Limestone is the primary groundwater exit pathway on the east end of the Y-12 Complex. The deep fractures and solution channels that constitute flow paths within the Maynardville Limestone appear to be well connected, resulting in contaminant migration for substantial distances off the ORR into Union Valley to the east of the complex (DOE 2008).

The rate of groundwater flow perpendicular to geologic strike from the ORR aquitard to the Maynardville Limestone has been estimated to be very slow below the water table interval (near surface, water-bearing layer consisting of unconsolidated material and shallow bedrock). Most contaminant migration appears to be via surface tributaries to Bear Creek or along below ground utility traces and buried tributaries in the Upper East Fork regime. Extensive volatile organic compound contamination occurs throughout the groundwater system in both the Bear Creek and Upper East Fork regimes. Groundwater flow in the Chestnut Ridge regime is through fractures and solution conduits in the Knox aquifer. 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 (DOE 2008).

Groundwater Quality and Monitoring at Y-12. More than 200 sites have been identified at Y-12 that represent known or potential sources of contamination to the environment as a result of past waste management practices. Figure 4.7.1-2 depicts the major facilities considered as known and/or potential contaminant source areas for which groundwater monitoring was performed during CY 2006. Because of that contamination, extensive groundwater monitoring is performed to comply with regulations and DOE orders (DOE 2008).

During CY 2006, routine groundwater monitoring at Y-12 was conducted primarily by two programs, the Y-12 Groundwater Protection Program, managed by B&W Y-12 LLC, and the Water Resources Restoration Program, managed by BJC. Each program is responsible for monitoring groundwater to meet specific compliance requirements. In CY 2006, the Groundwater Protection Program performed monitoring to comply with DOE orders, while the Water Resources Restoration Program performed groundwater monitoring in compliance with CERCLA and the *Resource Conservation and Recovery Act* (RCRA). In addition to the monitoring performed by the Water Resources Restoration Program, BJC monitors groundwater at the solid waste disposal landfills on Chestnut Ridge and the Environmental Management Waste Management Facility (EMWMF), in Bear Creek Valley (DOE 2008).



Source: DOE 2008.

Figure 4.7.1-2. Known or potential contaminant sources for which groundwater monitoring was performed on Y-12 during CY 2006.

The Upper East Fork Poplar Creek Groundwater Record of Decision (ROD) project will select a final remedy for groundwater in the UEFPC Characterization Area, which includes the Y-12 Complex. The project objective is to reach a final decision for groundwater remediation for the UEFPC Characterization Area and Union Valley. The selected remedy will be implemented under CERCLA. The project will require the preparation of a remedial investigation/feasibility study, Proposed Plan and ROD for regulatory approval and the preparation of a plan for future monitoring and institutional controls of the area. UEFPC Groundwater ROD project is planned for implementation by the Integrated Facility Disposition Program (DOE 2009).

During FY 2007, the approved Phase 2 ROD for UEFPC project was utilized to support remediation decisions at Y-12 National Security Complex locations that were undergoing modernization. Remediation of the UEFPC Watershed is being conducted in stages using a phased approach. Phase 1 addresses interim actions for remediation of mercury-contaminated

soil, sediment, and groundwater discharges that contribute contamination to surface water. The focus of the second phase is remediation of the balance of contaminated soil, scrap, and buried materials within the Y-12 Complex (DOE 2006d). Decisions regarding final land use and final goals for surface water, groundwater, and soils will be addressed in future decision documents. The Phase 2 ROD was approved by all parties in April 2006. Planning to support building demolition and the Infrastructure Facility Disposition Program was also conducted (DOE 2008).

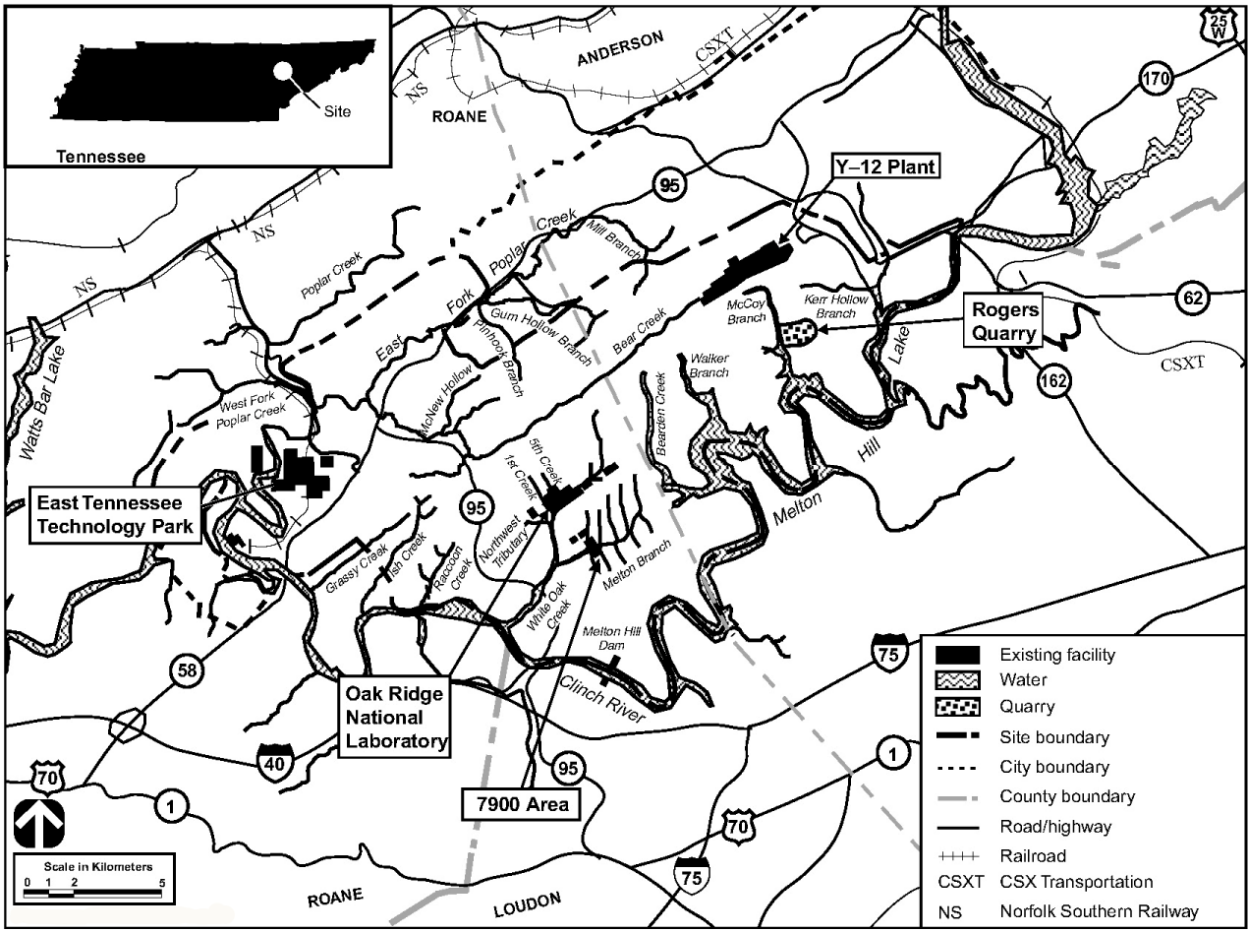
Although the Groundwater Protection Program, the Water Resources Restoration Program, and other projects have differing technical objectives and responsibilities, considerable efforts are made to maintain consistency in groundwater monitoring activities at Y-12. Communication among the programs has been crucial in eliminating any redundancies in monitoring activities. In addition communication and cooperation provides for more consistent and efficient data collection, evaluation, and overall quality. All groundwater monitoring data obtained by all programs are evaluated to provide a comprehensive view of groundwater quality at Y-12 (DOE 2008).

Historical monitoring efforts have shown that four types of contaminants have affected groundwater quality at Y-12: nitrate, volatile organic compounds, metals, and radionuclides. Of those, nitrate and volatile organic compounds are the most widespread. Some radionuclides, particularly uranium and Technetium-99 (99Tc) were found principally in the Bear Creek regime and the western and central portions of the Upper East Fork regime. Trace metals, the least extensive groundwater contaminants, generally occur in a small area of low-pH groundwater at the western end of the complex, near the S-2 and S-3 sites. Historical data have shown that plumes from multiple source units have mixed with one another and that contaminants (other than nitrate and 99Tc) are no longer easily associated with a single source (DOE 2008).

Groundwater Rights and Permits. Because of the abundance of surface water and its proximity to the points of use, very little groundwater is used at Y-12. Industrial and drinking water supplies are taken primarily from surface water sources; however, single-family wells are common in adjacent rural areas not served by the public water supply system. Most of the residential wells in the immediate vicinity of Y-12 are south of the Clinch River (DOE 2000a).

4.7.2 Surface Water

Waters drained from ORR eventually reach the Tennessee River via the Clinch River, which forms the southern and western boundaries of ORR. The ORR lies within the Valley and Ridge Physiographic Province, which is composed of a series of drainage basins or troughs containing many small streams feeding the Clinch River. Surface water at each of the major facilities on ORR drains into a tributary or series of tributaries, streams, or creeks within different watersheds. Each of these watersheds drains into the Clinch River. The largest of the drainage basins is that of Poplar Creek, which receives drainage from a 136-square mile area, including the northwestern sector of ORR. It flows from northeast to south-west, approximately through the center of the ETTP, and discharges directly into the Clinch River (DOE 2008). Figure 4.7.2-1 presents the surface water features in the vicinity of Y-12.



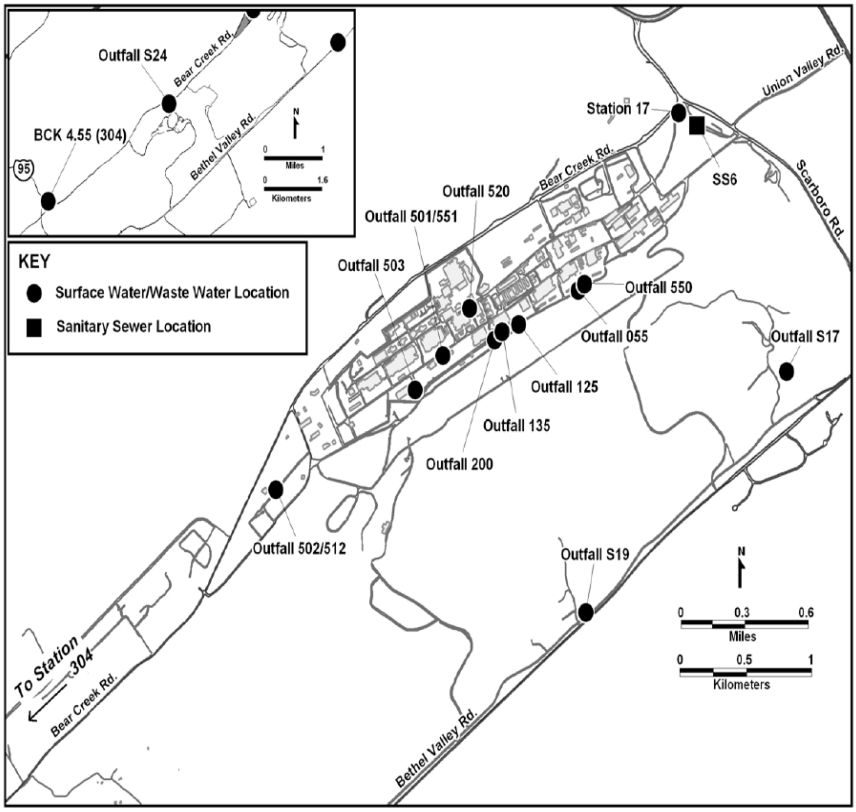
Source: DOE 2005i.

Figure 4.7.2-1. Surface Water Features in the Vicinity of Y-12.

EFPC, which discharges into Poplar Creek east of the ETTP, originates within Y-12 just south of Building 9204-1 and flows northeast along the south side of Y-12. Various Y-12 wastewater discharges to the upper reaches of EFPC from the late 1940s to the early 1980s left a legacy of contamination (e.g., mercury, PCBs, uranium) that has been the subject of water quality improvement initiatives over the past two decades. Bear Creek also originates within Y-12 with headwaters near the former S-3 ponds, where the creek flows southwest. Bear Creek is mostly affected by stormwater runoff, groundwater infiltration, and tributaries that drain former waste disposal sites in the Bear Creek Valley Burial Grounds Waste Management Area and the current EMWMF (DOE 2008).

Both the Bethel Valley and Melton Valley portions of ORNL are in the White Oak Creek drainage basin, which has an area of 6.37 square miles. White Oak Creek headwaters originate on Chestnut Ridge, north of ORNL, near the Spallation Neutron Source (SNS) site. At ORNL, the creek flows west along the southern boundary of the developed area and then flows southwesterly through a gap in Haw Ridge to the western portion of Melton Valley, where it forms a confluence with Melton Branch. The waters of White Oak Creek enter White Oak Lake, which is an impoundment formed by White Oak Dam. Water flowing over White Oak Dam enters the Clinch River after passing through the White Oak Creek embayment area (DOE 2008).

Y-12 Liquid Discharges. The current Y-12 National Pollutant Discharge Elimination System (NPDES) permit, issued on March 13, 2006, and effective on May 1, 2006, requires sampling, analysis, and reporting for approximately 65 outfalls. Figure 4.7.2-2 displays major Y-12 NPDES outfalls. The number is subject to change as outfalls are eliminated, consolidated, or added. Currently, Y-12 has outfalls and monitoring points in the following water drainage areas: East Fork Poplar Creek, Bear Creek, and several unnamed tributaries on the south side of Chestnut Ridge. These creeks and tributaries eventually drain to the Clinch River (DOE 2008).



Source: DOE 2008.

Figure 4.7.2-2. Major Y-12 NPDES Outfalls.

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 if a limit exists for each parameter. Some parameters, defined as "monitor only," have no specified limits (DOE 2008).

The water quality of surface streams in the vicinity of Y-12 is affected by current and historical legacy operations. Discharges from Y-12 processes flow into EFPC before the water exits Y-12. 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. The effluent limitations contained in the permit are based on the protection of water quality in the receiving streams. The permit emphasizes storm water runoff and biological, toxicological, and radiological monitoring. Some of the requirements in the new permit and the status of compliance are as follows:

- chlorine limitations based on water quality criteria at three outfalls located near the headwaters of EFPC (monitoring ongoing); new dechlorination facilities are being constructed;
- reduction of the measurement frequency for pH and chlorine at EFPC outfalls with addition of requirement for measurements in stream at the Station 17 location;
- implementation of a storm water pollution prevention plan requiring sampling and characterization of storm water, and sampling of stream baseload sediment at four instream EFPC locations;
- requirement for an annual storm water monitoring report, an annual report of the Biological Monitoring and Abatement Program (BMAP) data, and twice annual letter report to update BMAP progress; all submitted to TDEC;
- a requirement to manage the flow of EFPC such that a minimum flow of 7 million gallons per day is guaranteed by adding raw water from the Clinch River to the headwaters of EFPC; and
- whole effluent toxicity testing limitation for the three outfalls headwaters of EFPC.

Radiological data for surface waters were well below the allowable derived concentration guidelines. The total mass of uranium and associated Curies released from Y-12 at the easternmost monitoring station, Station 17 on UEFPC was 0.073 Curies in 2003 and 0.036 Curies in 2007 (Table 4.7.2-1) (DOE 2008).

Table 4.7.2-1. Release of Uranium from Y-12 to the Offsite Environment as a Liquid Effluent, 2003 to 2007.

Year	Quantity released	
	Ci[a]	kg
	Station 17	
2003	0.073	167
2004	0.067	161
2005	0.043	93
2006	0.050	131
2007	0.036	70

Source: DOE 2008.
Bq = Becquerel
a – 1 Ci = 3.7E + 10 Bq

A notice of appeal of certain permit limits was filed by NNSA in April 2006. The permit limits for mercury at several outfalls, PCBs at outfall 200, and toxicity limits at three outfalls were appealed because legacy contamination is addressed under CERCLA. Chlorine limits at headwaters of the creek were appealed, and a compliance schedule was requested so that a dechlorination unit could be put in place to handle a more stringent chlorine limit at outfall 109 (DOE 2008).

Surface Water Quality. The streams and creeks of Tennessee are classified by TDEC and defined in the State of Tennessee Water Quality Standards. Classifications are based on water quality, designated uses, and resident aquatic biota. The Clinch River is the only surface water body on ORR classified for domestic water supply. Most of the streams at ORR are classified for fish and aquatic life, livestock watering, wildlife, and recreation. White Oak Creek and Melton Branch are the only streams not classified for irrigation, while portions of Poplar Creek and Melton Branch are not classified for recreation.

There are seven wastewater treatment facilities which operate under NPDES permits at Y-12. Another facility known as Big Spring Water Treatment Facility began operation in 2005 as an interim remedial action to remove mercury under a CERCLA ROD. Sanitary and certain industrial wastewaters are permitted for discharge to the city of Oak Ridge wastewater collection and treatment systems.

The water quality of surface streams in the vicinity of Y-12 is affected by current and past operations. While stormwater, groundwater, and wastewater flows may contribute contaminants to UEFPC, the water quality and ecological health of this stream has greatly improved over the last 20 years. This is primarily due to rerouting of discharge pipes, construction and operation of wastewater treatment facilities, dechlorination of process waters, and other ongoing environmental protection activities at Y-12.

EFPC, which discharges into Poplar Creek east of the ETTP, originates within Y-12 near the former S-3 ponds and flows northeast along the south side of the Y-12. Various Y-12 wastewater discharges to the upper reaches of EFPC from the late 1940s to the early 1980s left a legacy of contamination (e.g., mercury, PCBs, uranium) that has been the subject of water quality improvement initiatives over the past two decades. Bear Creek also originates within Y-12 with headwaters near the former S-3 Ponds, where the creek flows southwest. Bear Creek is mostly affected by stormwater runoff, groundwater infiltration, and tributaries that drain former waste disposal sites in the Bear Creek Valley Burial Grounds Waste Management Area and the current EMWMF (DOE 2008).

Routine surface water surveillance monitoring, above and beyond that required by the NPDES permit, is performed as a best management practice. The Y-12 Environmental Compliance Department staff monitor the surface water as it exits from each of the three hydrogeologic regimes (DOE 2008).

Monitoring is conducted in EFPC at Station 17 (9422-1), near the junction of Scarboro Road and Bear Creek Road. During the first quarter of 2006 the best management practices sampling program consisted of one 7-day composite each week. These samples are analyzed for mercury, ammonia-N, inductively coupled plasma (ICP) metals, and total suspended solids. The NPDES permit which became effective on May 1, 2006, includes most of these parameters plus dissolved oxygen, temperature, nitrate/nitrite and phosphorus as a requirement for monitoring and sets limits at Station 17 for pH within range of 6.0 to 9.0 units. Monitoring at Station 17 continued for the remainder of the year by a 7-day composite sampling conducted weekly to satisfy the NPDES permit conditions. For years monitoring has been conducted in Bear Creek at BCK 4.55 (former NPDES Station 304), which is at the western boundary of the Y-12 Complex area of

responsibility. Surveillance sampling at this location was suspended in June 2006, and instream sampling is conducted upstream at S24 or BCK 9.4. in accordance with the permit issued in 2006. This sampling is quarterly and includes pH, total suspended solids, PCBs, phosphorus, nitrate/nitrite, total nitrogen and metals (DOE 2008).

The exit pathway from the Chestnut Ridge Hydrogeologic Regime is monitored via NPDES location S19 (the former NPDES Station 302) at Rogers Quarry. S19 is an instream location of McCoy Branch and is sampled annually for suspended and dissolved solids, metals, and pH (DOE 2008).

As shown in Table 4.7.2-2, comparisons with the Tennessee water quality criteria indicate that only mercury and zinc from samples collected at Station 17 were detected above the criteria maximum (DOE 2008). Of all the parameters measured in the surface water as a best management practice, mercury is the only demonstrated contaminant of concern (DOE 2008).

Table 4.7.2-2. Surface Water Surveillance Measurements Exceeding Tennessee Water Quality Criteria at Y-12, 2006.

Parameter Detected	Location	Number of Samples	Detection limit	Maximum	Average	Water quality Criteria (mg/L)	Number exceeding Criteria
Mercury	Station 17	99	0.0002	0.004	<0.0002	0.000051	75
Zinc	Station 17	17	0.05	0.344	<0.06	0.12	3

Source: DOE 2008.

The NPDES permit issued for Y-12 in 2006 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 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 Y-12 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 (DOE 2008).

Monitoring is presently being conducted at five primary EFPC sites, although sites may be excluded or added, depending upon the specific objectives of the various tasks. The primary sampling sites include upper EFPC at East Fork Poplar Creek kilometer (EFK) 24.4 and 23.4 (upstream and downstream of Lake Reality, respectively); EFK 18.7 (also EFK 18.2), located off ORR and below an area of intensive commercial and light industrial development; EFK 13.8, located upstream from the Oak Ridge Wastewater Treatment Facility; and EFK 6.3, located approximately 1.4 kilometers below ORR boundary. Brushy Fork at Brushy Fork kilometer (BFK) 7.6 is used as a reference stream in two tasks of the BMAP. Additional sites off ORR are also occasionally used for reference, including Beaver Creek, Bull Run, Cox Creek, Hinds Creek, Paint Rock Creek, and the Emory River in Watts Bar Reservoir (DOE 2008).

Drinking Water Quality. The Tennessee Regulations for Public Water Systems and Drinking Water Quality, Chap. 1200-5-1, set limits for biological contaminants and for chemical activities and chemical contaminants. Sampling for the following is conducted:

- total coliform
- chlorine residuals
- lead
- copper
- disinfectant byproduct
- propylene glycol

The city of Oak Ridge supplies potable water to Y-12 that meets all federal, state and local standards for drinking water. The water treatment plant, located north of Y-12, is owned and operated by the city of Oak Ridge. In 2007, TDEC completed a sanitary survey on the potable water system at Y-12 and gave it a grade of 98 out of a possible 100. This grade returned the Y-12 potable water system to an "approved" status from the previous status of "provisional." In response to TDEC comments, Y-12 has completed revisions to the site cross connection control program (DOE 2008).

Y-12 began sampling the site potable water system for propylene glycol in 2007 per TDEC requirements due to unapproved cross connections between the site potable water system and antifreeze fire sprinkler systems containing propylene glycol. A total of 92 samples were collected and analyzed, with one showing a slight trace of propylene glycol. Additional samples were collected; results were below the detection limits. A potable water system upgrade project is scheduled for the installation of approved backflow prevention devices, conversion to dry pipe, and/or disconnection of the antifreeze fire sprinkler systems by 2010 (DOE 2008).

All total coliform samples collected during 2007 were returned negative. Analytical results were satisfactory for disinfectant by-products (total trihalomethanes and haloacetic acids) for the Y-12 and ORNL water systems. The Y-12 potable water system is currently sampled triennially for lead and copper. The last scheduled sample period took place from June to September 2008 (DOE 2008).

Surface Water Rights and Permits. In Tennessee, the state's water rights are codified in the *Water Quality Control Act*. In effect, the water rights are similar to riparian rights in that the designated uses of a body of water cannot be impaired. The only requirement to withdraw from surface water would be a TDEC Chapter 1200-5-8 Water Registration Requirement, and the U.S. Army Corps of Engineers (USACE) and TVA permits to construct intake structures.

4.8 ECOLOGICAL RESOURCES

This section describes ecological resources at ORR including terrestrial and aquatic resources, threatened and endangered (T&E) species, and floodplains and wetlands. Information for Y-12 is also included.

4.8.1 Terrestrial and Aquatic Resources

4.8.1.1 *Terrestrial Resources*

The ORR is mostly contiguous native eastern deciduous forest. Forested areas are found throughout the reservation. Local plant life is characteristic of the intermountain regions of central and southern Appalachia; pine and pine-hardwood forest and oak-hickory forest are the most extensive plant communities found at ORR (DOE 2001a). The forests are mostly oak-hickory, pine-hardwood, or pine. Minor areas of other hardwood forest cover types are found throughout ORR, including northern hardwoods, a few small natural stands of hemlock or white pine, and floodplain forests. Over 1,100 vascular plant species are found on ORR (ORNL 2002). Animal species found on ORR include approximately 59 species of amphibians and reptiles; up to 260 species of migratory, transient, and resident birds; and 38 species of mammals (DOE 2001a). White-tailed deer, wild turkey, and geese populations are controlled on ORR through managed hunts. Canada Geese hunting is only allowed on ORR in the Three Bends Area. Less than 2 percent of ORR remains as open agricultural fields (ORNL 2002).

Within the fenced, developed portion of Y-12, grassy and unvegetated areas surround the entire facility. Building and parking lots dominate the landscape at Y-12, with limited vegetation present. Fauna within the Y-12 area is limited due to the lack of large areas of natural habitat.

At ORR, DOE has set aside large tracts of land for conservation, including approximately 3,000 acres set aside in April 2005. This conservation land is located on the western end of ORR and features mature forests, wetlands, river bluffs, cliffs and caves and is home to several rare species. Another conservation easement is Parcel G which contains a palustrine emergent/scrub-shrub wetland system totaling approximately 3.4 acres.

4.8.1.2 *Aquatic Resources*

Aquatic habitat on or adjacent to ORR ranges from small, free-flowing streams in undisturbed watersheds to larger streams with altered flow patterns due to dam construction. These aquatic habitats include tailwaters, impoundments, reservoir embayments, and large and small perennial streams. Aquatic areas within ORR also include seasonal and intermittent streams (DOE 2001a).

Sixty-three fish species have been collected on or adjacent to ORR (ORNL 2002). The minnow family has the largest number of species and is numerically dominant in most streams (DOE 2001a). Fish species representative of the Clinch River in the vicinity of ORR include shad and herring (Clupeidae), common carp (*Cyprinus carpio*), catfish and bullheads (Ictaluridae), bluegill (*Lepomis macrochirus*), crappie (*Pomoxis spp.*), and freshwater drum (*Aplodinotus grunniens*) (ORNL 1981a). The most important fish species taken commercially in ORR area are common carp and catfish. According to the most recent regulations, commercial fishing is no longer permitted on the Clinch River below Melton Hill Reservoir (TWRA 2010). Recreational species consist of crappie, largemouth bass (*Micropterus salmoides*), sauger (*Stizostedion canadense*), sunfish (*Lepomis* spp.), and catfish. The redbreast sunfish (*Lepomis auritus*) and rock bass (*Ambloplites rupestris*) are used in bioaccumulation studies for mercury and PCB concentrations as part of Y-12's BMAP (DOE 2008). Sport fishing is not permitted within ORR.

In 2006 the Agency for Toxic Substances and Disease Registry (ATSDR) released a fish consumption recommendation based on the level of PCBs found in the muscle and fatty tissues of several local fish species inhabiting waterways on or near the vicinity of Y-12 (Clinch River, EFPC, and Poplar Creek). Based on the levels of PCBs detected in fish, geese, and turtles, the ATSDR determined it is safe to eat up to one meal of any type of fish per month. However, the ATSDR suggests limiting the consumption of largemouth bass, catfish, striped bass, and white bass to one fish meal per week (ATSDR 2006). In addition the ATSDR advises against eating turtle fat from turtle species that occur concomitantly with the aforementioned fish species (ATSDR 2006). The PCBs in local waterways came from plant operations and former waste disposal practices at ORR's Y-12, K-25, X-10, and S-50 sites (ATSDR 2006).

4.8.2 Threatened and Endangered Species

There are three special status species known to occur on ORR, the gray bat (*Myotis grisescens*) is a federally and state-listed endangered species, the state-listed threatened northern saw-whet owl (*Aegolius acadicus*) and the state-listed endangered peregrine falcon (*Falco peregrinus*) (the peregrine falcon was federally delisted on August 25, 1999). These species, along with 17 other species of animals listed as species of concern known to be present on ORR (excluding the Clinch River bordering the reservation) are shown along with their status in Table 4.8.2-1. Table 4.8.2-1 illustrates the diversity of birds on ORR, which is also habitat for many species, some of which are in decline nationally or regionally. Other federally and/or state-listed species may also be present on ORR, although they have not been observed recently. These include several species of mollusks (such as the spiny river snail [*Io fluvialis*]), amphibians (such as the hellbender [*Cryptobranchus alleganiensis*]), birds (such as Bachman's sparrow [*Aimophila aestivalis*]), and mammals (such as the smoky shrew [*Sorex fumeus*]). Birds, fish, and aquatic invertebrates are the most thoroughly surveyed animal groups on ORR. The only federally listed animal species that has recently been observed on ORR is the gray bat, which was observed over water bordering ORR (the Clinch River) in 2003 and over a pond on ORR in 2004. A gray bat was mist-netted outside a cave on ORR in 2006 (DOE 2008).

Table 4.8.2-1. Animal Species of Concern Reported from the Oak Ridge Reservation[a].

		Status[b]		
Scientific name	**Common name**	**Federal**	**State**	**PIF[c]**
	Fish			
Phoxinus tennesseensis	Tennessee dace		NM	
	Amphibians and Reptiles			
Hemidactylium scutatum	Four-toed salamander		NM	
	Birds			
Anhinga anhinga	Anhinga		NM	
Egretta caerulea	Little blue heron		NM	
Egretta thula	Snowy egret		NM	
Ardea alba	Great egret		NM	
Accipiter striatus	Sharp-shinned hawk		NM	
Buteo platypterus	Broad-winged hawk			RI
Falco peregrinus	Peregrine falcon	d	E	
Circus cyaneus	Northern harrier		NM	
Haliaeetus leucocephalus	Bald eagle	e	NM	
Bonasa umbellus	Ruffed grouse			RI

Table 4.8.2-1. Animal Species of Concern Reported from the Oak Ridge Reservation[a] *(continued)*.

Scientific name	Common name	Status[b] Federal	State	PIF[c]
	Birds *(continued)*			
Colinus virginianus	Northern bobwhite			RI
Aegolius acadicus	Northern saw-whet owl	MC	T	RI
Tyto alba	Barn owl		NM	
Caprimulgus carolinensis	Chuck-will's-widow			RI
Caprimulgus vociferous	Whip-poor-will			RI
Ceryle alcyon	Belted kingfisher			RI
Melanerpes erythrocephalus	Red-headed woodpecker			RI
Picoides pubescens	Downy woodpecker			RI
Colaptes auratus	Northern flicker			RI
Sphyrapicus varius	Yellow-bellied sapsucker	MC	NM	
Contopus cooperi	Olive-sided flycatcher		NM	RI
Contopus virens	Eastern wood-pewee			RI
Empidonax virescens	Acadian flycatcher			RI
Empidonax trailii	Willow flycatcher			RI
Progne subis	Purple martin			RI
Sitta pusilla	Brown-headed nuthatch			RI
Hylocichla mustelina	Wood thrush			RI
Toxostoma rufum	Brown thrasher			RI
Lanius ludovicianus	Loggerhead shrike	MC	NM	RI
Viero flavifrons	Yellow-throated vireo			RI
Dendroica cerulea	Cerulean warbler		NM	RI
Dendroica discolor	Prairie warbler			RI
Dendroica fusca	Blackburnian warbler			RI
Mniotilta varia	Black-and-white warbler			RI
Wilsonia citrina	Hooded warbler			RI
Wilsonia canadensis	Canada warbler			RI
Icteria virens	Yellow-breasted chat			RI
Helmitheros vermivorus	Worm-eating warbler			RI
Oporonis formosus	Kentucky warbler			RI
Seiurus motacilla	Louisiana waterthrush			RI
Vermivora chrysoptera	Golden-winged warbler	MC	NM	RI
Vermivora pinus	Blue-winged warbler			RI
Piranga rubra	Scarlet tanager			RI
Piranga olivacea	Summer tanager			RI
Pooecetes gramineus	Vesper sparrow		NM	
Passerina cyanea	Indigo bunting			RI
Pipilo erythrophthalmus	Eastern towhee			RI
Ammodramus savannarum	Grasshopper sparrow			RI
Spizella pusilla	Field sparrow			RI
Sturnella magna	Eastern meadowlark			RI
	Mammals			
Myotis grisescens	Gray bat	E	E	
Myotis sodalis	Indiana bat	E	E	
Sorex longirostris	Southeastern shrew		NM	

Source: DOE 2008.
a – Land and surface waters of ORR exclusive of the Clinch River, which borders ORR.
b – Abbreviations:
E = endangered, RI = species of regional importance, T= threatened, NM = in need of management, MC = management concern.
c – Partners in Flight
d – The peregrine falcon was federally delisted on August 25, 1999.
e – The bald eagle was federally delisted on August 8, 2007.

U.S. Fish and Wildlife Service (USFWS) records indicate that the Federal listed endangered Indiana bat (*Myotis sodalis*) may also be present in the vicinity of Y-12, however, this bat has not been observed at Y-12 or other parts of ORR (DOE 2001a). The peregrine falcon and northern saw-whet owl are only very rare transients on the site. Similarly, several state-listed bird species, such as the anhinga (*Anhinga anhinga*), olive-sided flycatcher (*Contopus cooperi*), and little blue heron (*Egretta caerulea*), are currently uncommon migrants or visitors to ORR; however, the little blue heron is probably increasing in numbers. The cerulean warbler (*Dendroica cerulea*), listed by the state as in need of management, has been recorded during the breeding season; however, this species is not actually known to breed at ORR. The bald eagle (*Haliaeetus leucocephalus*), also listed by the state as in need of management, is increasingly seen in winter and may well begin nesting at ORR within a few years. Others, such as the northern harrier (*Circus cyaneus*), great egret (*Ardea alba*), and yellow-bellied sapsucker (*Sphyrapicus varius*), are migrants or winter residents that do not nest on the reservation. The golden-winged warbler (*Vermivora chrysoptera*), listed by the state as in need of management, has been sighted once on the reservation. Barn owls (*Tyto alba*) have been known to nest on the reservation in the past. One Federal and state threatened species, the spotfin chub (*Cyprinella monnacha*), has been sighted and collected in the EFPC. The Tennessee dace has been found in some sections of Grassy Creek (DOE 2008).

There are no Federal-listed threatened or endangered plant species on ORR. Twenty-four plant species listed as threatened or endangered species by the State of Tennessee have been observed on ORR in the last 10 years (DOE 2008). Table 4.8.2-2 presents vascular plant species known or previously reported from ORR and rare plants that occur near and could be present on ORR. No critical habitat for threatened or endangered species, as defined in the *Endangered Species Act*, exists on ORR (DOE 2001a).

Table 4.8.2-2. Vascular Plant Species Listed by Federal or State Agencies, 2007.

Common name	Species	Habitat on ORR	Status code[a]
Currently known or previously reported from ORR			
Spreading false-foxglove	*Aureolaria patula*	River bluff	FSC, S
Heavy sedge	*Carex gravida*	Varied	S
Hairy sharp-scaled sedge	*Carex oxylepis var. pubescens*[b]	Shaded wetlands	S
Appalachian bugbane	*Cimicifuga rubifolia*	River slope	FSC, T
Pink lady's-slipper	*Cypripedium acaule*	Dry to rich woods	E, CE
Tall larkspur	*Delphinium exaltatum*	Barrens and woods	FSC, E
Northern bush-honeysuckle	*Diervilla lonicera*	River bluff	T
Branching whitlow-grass	*Draba ramosissima*	Limestone cliff	S
Nuttall waterweed	*Elodea nuttallii*	Pond, embayment	S
Mountain witch-alder	*Fothergilla major*	Woods	T
Golden seal	*Hydrastis canadensis*	Rich woods	S, CE
Butternut	*Juglans cinerea*	Slope near stream	FSC, T
Small-head rush	*Juncus brachycephalus*	Open wetland	S
Canada lily	*Lilium canadense*	Moist woods	T
Michigan lily	*Lilium michiganense*	Moist woods	T
Fen orchid	*Liparis loeselii*	Forested wetland	E
Ginseng	*Panax quinquifolius*	Rich woods	S, CE
Tuberculed rein-orchid	*Platanthera flava var. herbiola*	Forested wetland	T

Table 4.8.2-2. Vascular Plant Species Listed by Federal or State Agencies, 2007 *(continued)*.

Common name	Species	Habitat on ORR	Status code[a]
Currently known or previously reported from ORR (continued)			
Pursh's wild-petunia	*Ruellia purshiana*	Dry, open woods	S
River bulrush	*Scirpus fluviatilis*	Wetland	S
Shining ladies-tresses	*Spiranthes lucida*	Boggy wetland	T
Northern white cedar	*Thuja occidentalis*	Rocky river bluffs	S
Naked-stem sunflower	*Helianthus occidentalis*	Barrens	S
Three-parted violet	*Viola tripartite var. tripartite*	Rocky woods	S
Rare plants that occur near and could be present on ORR			
Earleaf false foxglove	*Agalinis auriculata*	Calcareous barren	FSC, E
Ramps	*Allium burdickii or A. tricoccom*[d]	Moist woods	S, CE
Heller's catfoot	*Gnaphalium helleri*	Dry woodland edge	S
A vetch	*Vicia caroliniana*	Moist meadows	S
Slender blazing star	*Liatris cylindracea*	Calcareous barren	E
Mountain honeysuckle	*Lonicera dioica*	Rocky river bluff	S
Heartleaf meehania	*Meehania cordata*	Moist calcareous woods	T
Swamp lousewort	*Pedicularis lanceolata*	Calcareous wet meadow	T
Torrey's mountain-mint	*Pycnanthemum torrei*	Calcareous barren edge	S
Prairie goldenrod	*Solidago ptarmicoides*	Calcareous barren	E

Source: ORNL 2009.
a – Status codes:
CE - Status due to commercial exploitation.
E - Endangered in Tennessee.
FSC - Federal Special Concern; formerly designated as C2. See *Federal Register*, February 28, 1996.
S - Special concern in Tennessee.
T - Threatened in Tennessee.
b – *Carex oxylepis var. pubescens* has not been observed during recent surveys.
c – *Lilium michiganense* is believed to have been extirpated from ORR by the impoundment at Melton Hill.
d – Ramps have been reported near ORR, but there is not sufficient information to determine which of the two species is present or if the occurrence may have been introduced by planting. Both species of ramps have the same state status.

4.8.3 Floodplains and Wetlands

Floodplains. A floodplain is defined as the valley floor adjacent to a streambed or arroyo channel that may be inundated during high water. The TVA conducted floodplain studies along the Clinch River, Bear Creek, and EFPC. Eastern Portions of Y-12 lie within the 100- and 500-year floodplains of EFPC; however, facilities associated with the alternatives in this SWEIS are located outside of the 100- and 500-year floodplains (see Figure 4.8.3-1).

Wetlands. Approximately 600 acres of wetlands exist on ORR, with most classified as forested palustrine, scrub/shrub, and emergent wetlands (DOE 2008). Wetlands occur across ORR at lower elevations, primarily in the riparian zones of headwater streams and their receiving streams, as well as in the Clinch River embayments. Wetlands identified to date range in size from several square yards at small seeps and springs to approximately 24.7 acres at White Oak Lake (DOE 2008).

Wetlands are protected under Executive Order (EO) 11990 (42 Federal Register (FR) 26961, May 24, 1977). A wetlands survey of the Y-12 area found palustrine, scrub/shrub, and emergent wetlands. An emergent wetland was found at the eastern end of Y-12, at a seep by a small

tributary of EFPC, between New Hope Cemetery and Bear Creek Road. Eleven small wetlands have been identified north of Bear Creek Road in remnants of the UEFPC. A relatively undisturbed, forested wetland was identified in the stream bottomland of Bear Creek Tributary 1, between Bear Creek Road and the powerline right-of-way (LMES 1997). Headwater areas of small unnamed tributaries to Bear Creek, some of which contain wetlands, were identified near the Haul Road extension (see Appendix G for details regarding these wetlands).

4.8.4 Biological Monitoring and Abatement Programs

The NPDES permit issued to Y-12 in 2006 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 BMAP, which has been monitoring the ecological health of EFPC since 1985, consists of three major tasks that reflect complementary approaches to evaluating the effects of Y-12 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 (DOE 2008).

Monitoring is currently being conducted at five primary EFPC sites, although sites may be excluded or added, depending upon the specific objectives of the various tasks. The primary sampling sites include upper EFPC at EFK 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 approximately 1.4 kilometers below ORR boundary (Figure 4.8.4-1). Trends of increases in species richness and diversity at upstream locations over the last decade, along with similar but more subtle trends in a number of other BMAP indicators, demonstrate that the overall ecological health of EFPC continues to improve. However, the pace of improvement in the health of EFPC near Y-12 has slowed in recent years, and fish and invertebrate communities continue to be degraded when compared to similar communities in reference streams (DOE 2008).

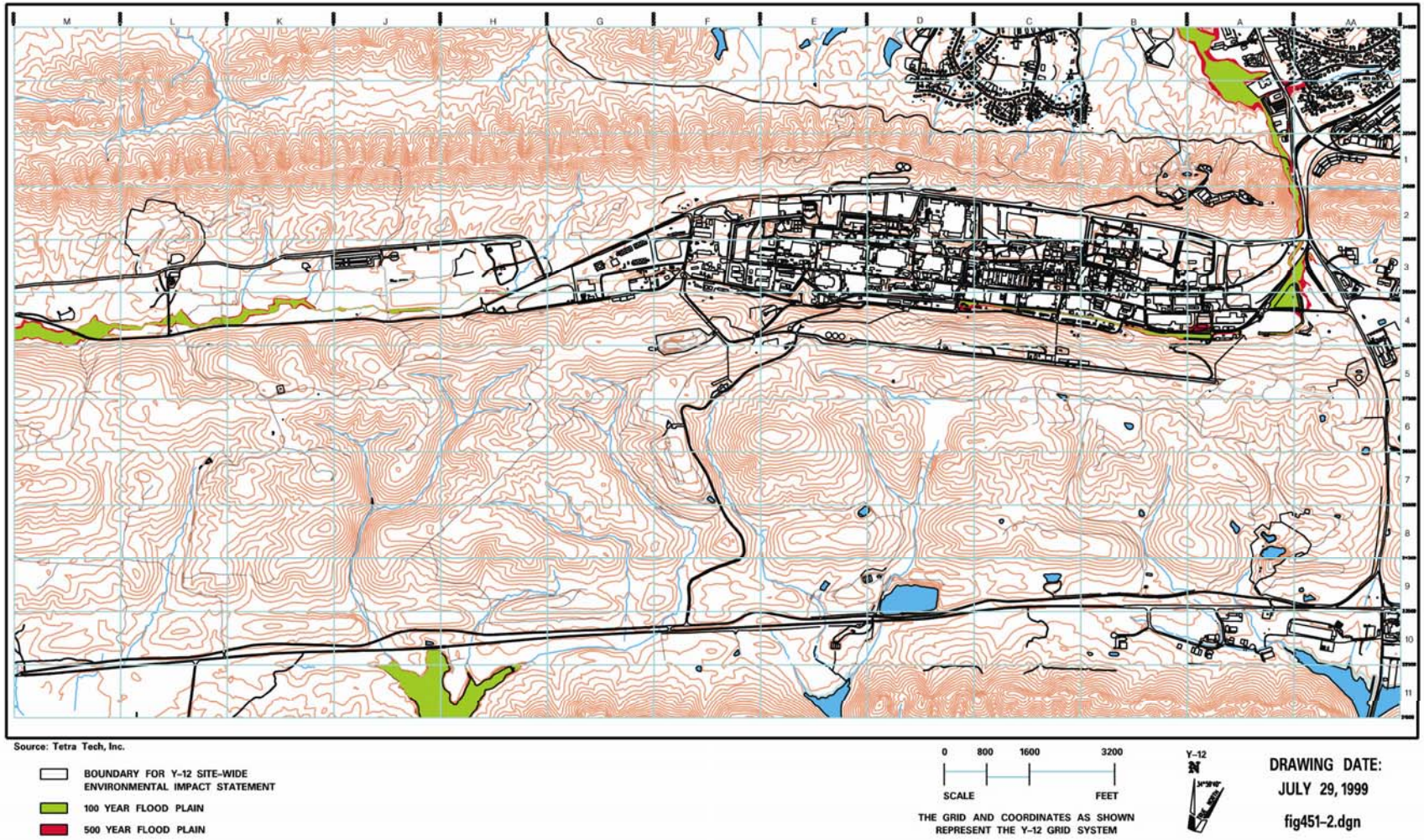
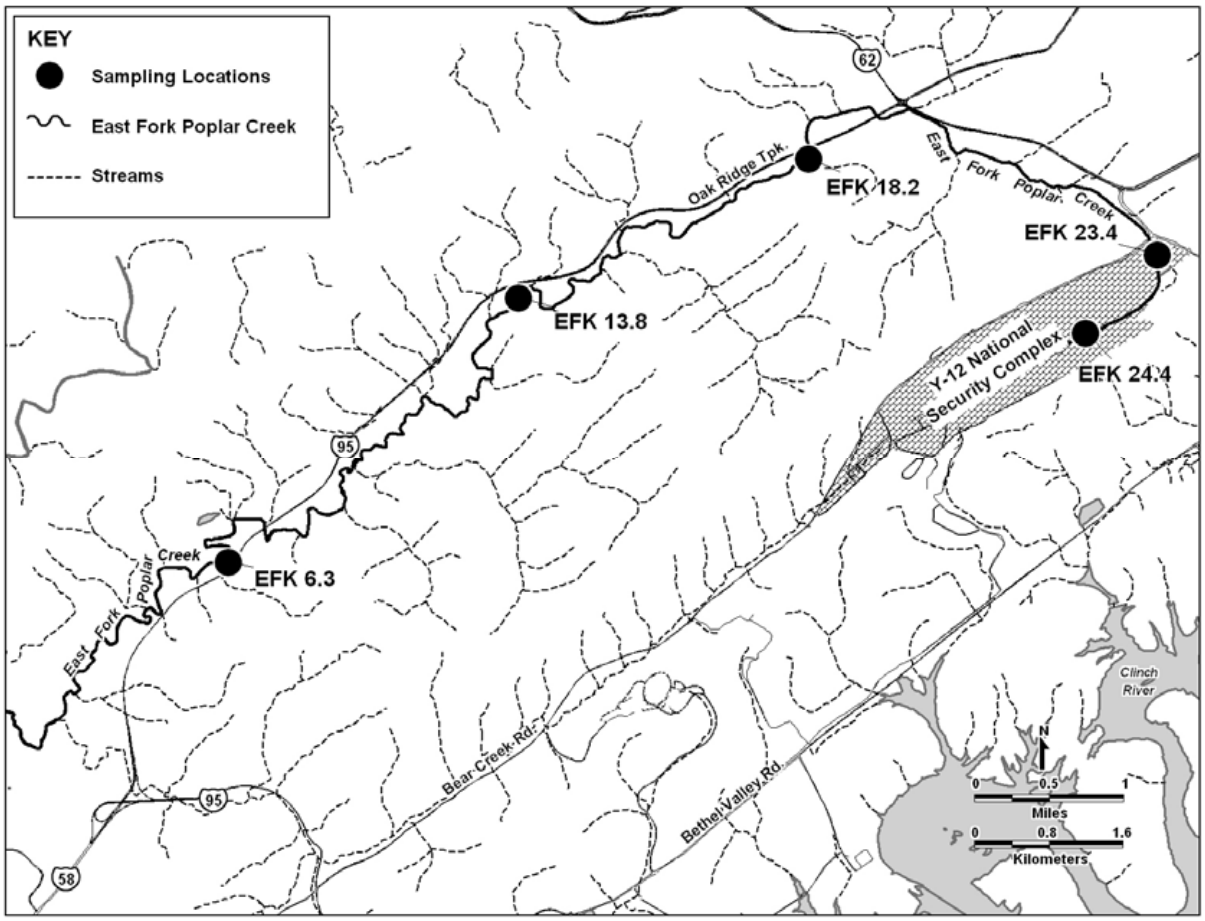


Figure 4.8.3-1. 100 and 500-year Floodplains for Y-12.



Source: DOE 2008.

Figure 4.8.4-1. Locations of Biological Monitoring Sites on East Fork Poplar Creek in Relation to Y-12.

Mercury and PCB levels in EFPC fish have historically been elevated relative to fish in uncontaminated reference streams. Fish are monitored regularly in EFPC for mercury and PCBs to assess spatial and temporal trends in bioaccumulation associated with ongoing remedial activities and plant operations. Mercury concentrations remained much higher during 2007 in fish from EFPC than in fish from reference streams. Elevated mercury concentrations in fish from the upper reaches of EFPC indicate that Y-12 remains a continuing source of mercury to fish in the stream. Although waterborne mercury concentrations in the upper reaches of EFPC decreased substantially following the 2005 start-up of a treatment system on a mercury-contaminated spring, mercury concentrations in fish have not decreased in response. Lead and PCB concentrations in fish were much lower in 2007 than peak concentrations observed in the mid-1990s (DOE 2008).

The biological indicator task is designed to evaluate the effects of water quality and other environmental variables on the health and reproductive condition of individual fish and fish populations in EFPC. The health and reproductive condition of fish from sites upstream in EFPC remain lower in several respects than in fish from reference sites or downstream EFPC.

4.9 CULTURAL RESOURCES

4.9.1 Introduction

Cultural resources are those aspects of the physical environment that relate to human culture and society, and those cultural institutions that hold communities together and link them to their surroundings. The cultural resources present within ORR region are complex because of the long prehistoric use of the area; the relocation of the Cherokee from villages during historic times; the presence of well-established settlements prior to acquisition by the Federal government; the continuity of traditional American folklife traditions; and the importance of ORR facilities in the history of nuclear research and production activities for World War II and the Cold War era. An extensive discussion of cultural resources of ORR region can be found in the DOE-Oak Ridge Office (ORO) Cultural Resource Management Plan (Souza et al.1997).

A short history of the human use of the area surrounding ORR and Y-12 is presented to provide a background for the discussion of cultural resources. The region of influence (ROI) for cultural resources is ORR. The ROI defines the general resource base and relevant cultural and historical contexts for addressing impacts in the area of potential effects. An area of potential effects is the geographic area within which an action may cause changes in the character or use of an historic property (36 CFR 800.3[a]). The resources of the ROI provide a comparative basis for establishing the relative importance of resources in the area of potential effects and considering the intensity of potential impacts. The area of potential effects for this SWEIS is the Y-12 site and land adjacent to the Y-12 site boundary.

4.9.2 Significance of Cultural Resources

The long history of legal jurisdiction over cultural resources, dating back to 1906 with the passage of the *Antiquities Act* (16 U.S.C. 431-433), demonstrates a continuing concern on the part of Americans for their cultural resources. Foremost among these statutes are the *National Historic Preservation Act* (NHPA) of 1966, as amended (16 U.S.C. 470), and its revised implementing regulations (36 CFR Part 800). This statute describes the process for identification and evaluation of cultural resources, assessment of effects of Federal actions on historic resources, and consultation to avoid, reduce, or mitigate adverse effects. The NHPA does not require preservation of cultural resources, but does ensure that Federal agency decisions concerning the treatment of these resources result from meaningful consideration of cultural and historic values, and identification of options available to protect the resources.

Identified cultural resources are fully recorded and evaluated to determine if they are eligible for listing on the National Register of Historic Places (NRHP). To be eligible, a resource will always possess several, and usually most, of the aspects of integrity. Eligible resources are afforded consideration under the NHPA. If a Federal action will adversely affect an eligible resource, then measures must be taken to avoid, reduce, or mitigate the effect.

4.9.3 Regional Cultural History

Archaeologists and historians have developed a basic framework to describe changes observed in the cultural traditions of the region. Human occupation and use of the East Tennessee Valley between the Cumberland Mountains and the southern Appalachians is believed to date back to the Late Pleistocene, at least 14,000 years ago. Archaeologists have traditionally believed that these Paleo-Indian bands subsisted primarily by hunting the large game of that era and collecting wild plant foods. More recent research indicates that a generalized subsistence strategy was probably practiced. In response to warmer and drier climatic conditions and the subsequent loss of Pleistocene megafauna, hunter-gatherers practiced a more diverse subsistence strategy by targeting smaller game and increasing their plant-gathering activities. More sedentary adaptations on river terraces, floodplains, and labor specialization concurred with the development and refinement of fishing gear and the exploitation of additional plant materials. Between 3000 and 900 B.C., larger, multifamily communities evolved and primitive horticulture first appeared. Trade goods such as marine shells, copper goods and soapstone bowls were first found on sites dating to this period. The introduction of pottery, a continued pattern of multiseasonal settlement along river terraces, refinement of agricultural practices, and the use of a broader scope of food resources characterized the next 1,800 years.

During the Mississippian cultural periods (900 A.D. to historic times), larger scale, permanent communities developed, first along the alluvial terraces, and later on the second river terraces in rich bottomlands suitable for intensive agriculture. These expanding villages included multiple structures, storage pits, hearths, mounds, stockades, plazas, and semisubterranean earth lodges. Archaeological evidence reflects an increasingly complex and specialized society with a high degree of organization, which included the development of elite social classes. Just prior to Euro-American contact in the late 17th century, however, there appears to have been a breakdown in the hierarchies and a scaling-back of both village size and elaborate public structures. The first Euro-Americans to visit the region were French and English traders and trappers, soon followed by permanent settlers. These newcomers introduced a variety of domesticated animals, fruit trees, food crops, beads, metal, glass, and other raw materials and derived products to the native inhabitants, now known as the Overhill Cherokee. After a series of conflicts, most of the Cherokee were forcibly relocated to the Oklahoma Territory in 1838. Small, close-knit, agricultural communities developed and continued until 1942, when 58,575 acres were purchased by the U.S. government as a military reservation. To contribute to the development of nuclear weapons for the World War II effort, three production facilities (including Y-12) and a residential townsite were built inside the reservation. New facilities were constructed on ORR after the War and new missions continued through the Cold War period to the present (NNSA 2008).

4.9.4 Cultural Resources of ORR and Y-12

Section 106 of the NHPA (16 U.S.C. 470) requires federal agencies take into account the effects of their undertakings on properties included in, or eligible for, inclusion in the NRHP. To comply with Section 106 of the NHPA and its implementing regulations at 36 CFR Part 800, DOE-ORO was instrumental in the ratification of a programmatic agreement among DOE-ORO, the Tennessee State Historic Preservation Officer (SHPO), and the Advisory Council on Historic

Preservation (ACHP) concerning management of historical and cultural properties on ORR. The programmatic agreement was approved on August 25, 2003, and has been incorporated into the approved *Cultural Resource Management Plan, DOE Oak Ridge Reservation* (DOE 2004b). The plan was completed in accordance with stipulations in the programmatic agreement, including historical surveys to identify significant historical properties on ORR. Because of plans to demolish a significant number of buildings at ORNL and at Y-12, a second programmatic agreement was drafted for each site. It was approved by DOE-ORO, the SHPO, and the ACHP on February 23, 2005 (DOE 2005a).

Compliance with NHPA at ORNL, Y-12, and ETTP is achieved and maintained in conjunction with NEPA compliance. The scope of proposed actions is reviewed in accordance with the *Cultural Resource Management Plan* and Programmatic Agreement and the appropriate level of documentation is prepared and submitted. If warranted, consultation is initiated with the SHPO and the ACHP. Y-12 developed an Interpretive Plan on Historic Preservation for Y-12, which was reviewed by NNSA, DOE-ORO, the SHPO, and the ACHP. It was approved by the SHPO January 28, 2005. The Interpretative Plan examined Y-12's purpose and significant resources in order to establish interpretative themes, goals and objectives for conveying the site's history. The plan identified interpretive themes, analyzed the interpretive needs of Y-12, and outlined recommended actions. The actions recommended in the plan are those that can reasonably be expected to be accomplished in 7 to 10 years, the projected life span of the plan. The plan was driven by the site's historic significance and historic resources, as well as the site's operational objectives and security requirements (DOE 2008).

Methods used to identify the presence of cultural resources and to determine eligibility vary according to the resource types. Pedestrian surveys are used to locate archaeological resources, and a separate excavation phase is often required to evaluate archaeological resources for NRHP eligibility. Approximately 90 percent of ORR has been surveyed, on a reconnaissance level, for prehistoric and historic archaeological resources. Less than five percent has been intensely surveyed. To date, over 44 prehistoric sites and 254 historic sites, including 32 cemeteries, have been recorded within the current boundaries of ORR. Fifteen prehistoric sites and 35 historic archaeological resources are considered eligible for listing on the NRHP (Souza et al. 1997).

Architectural and archaeological studies have been conducted for Y-12 (Thomason and Associates 2003). In 1995, with a final version in 1999, Thomason and Associates completed a comprehensive architectural and historical evaluation of Y-12. A total of 248 properties were individually recorded and evaluated, and the remaining 325 facilities were identified and categorized by use. At least 10 major archaeological reconnaissance-level surveys have been conducted on ORR. A survey conducted of Y-12 in the early 1990s identified one archeological site (40AN68) which is located on a flat rise overlooking the EFPC within the boundaries of Y-12. This site is of an ephemeral nature and is not eligible for inclusion in the NRHP pursuant to 36 CFR Part 60.4 (DuVall and Associates 1999). It was concluded that the potential is low for identifying significant archeological sites within Y-12 proper that meet the criteria for inclusion in the NRHP. All buildings and structures in Y-12 have been surveyed and evaluated.

Y-12 currently has a proposed National Register Historic District of historic buildings associated with the Manhattan Project that are eligible for listing in the NRHP (Figure 4.9.4-1)

(NNSA 2005c). The Tennessee SHPO has concurred with this determination (Thomason and Associates 2003). The district and its contributing properties are eligible under Criterion A for its historical associations with the Manhattan Project, development as a nuclear weapons component plant within the post-World War II scientific movement, and early nuclear activities. The historic district is also eligible under Criterion C for the engineering merits of many of the properties and their contributions to science.

Within the proposed historic district, two buildings have been recommended for the National Historic Landmark status as individual properties (see Figure 4.9.4-1) Building 9731 is the oldest facility completed at Y-12 and played a major part in the Manhattan Project. The prototype calutron was housed and operated in this building and the building was also the location of the original production of stabilized metallic isotopes used in nuclear medicine. Building 9204-3 (Beta-3) functioned as a uranium enrichment facility during World War II and is significant for its pioneering role in the nuclear research in enriched uranium and the separation of stabilized isotopes (NNSA 2005c).

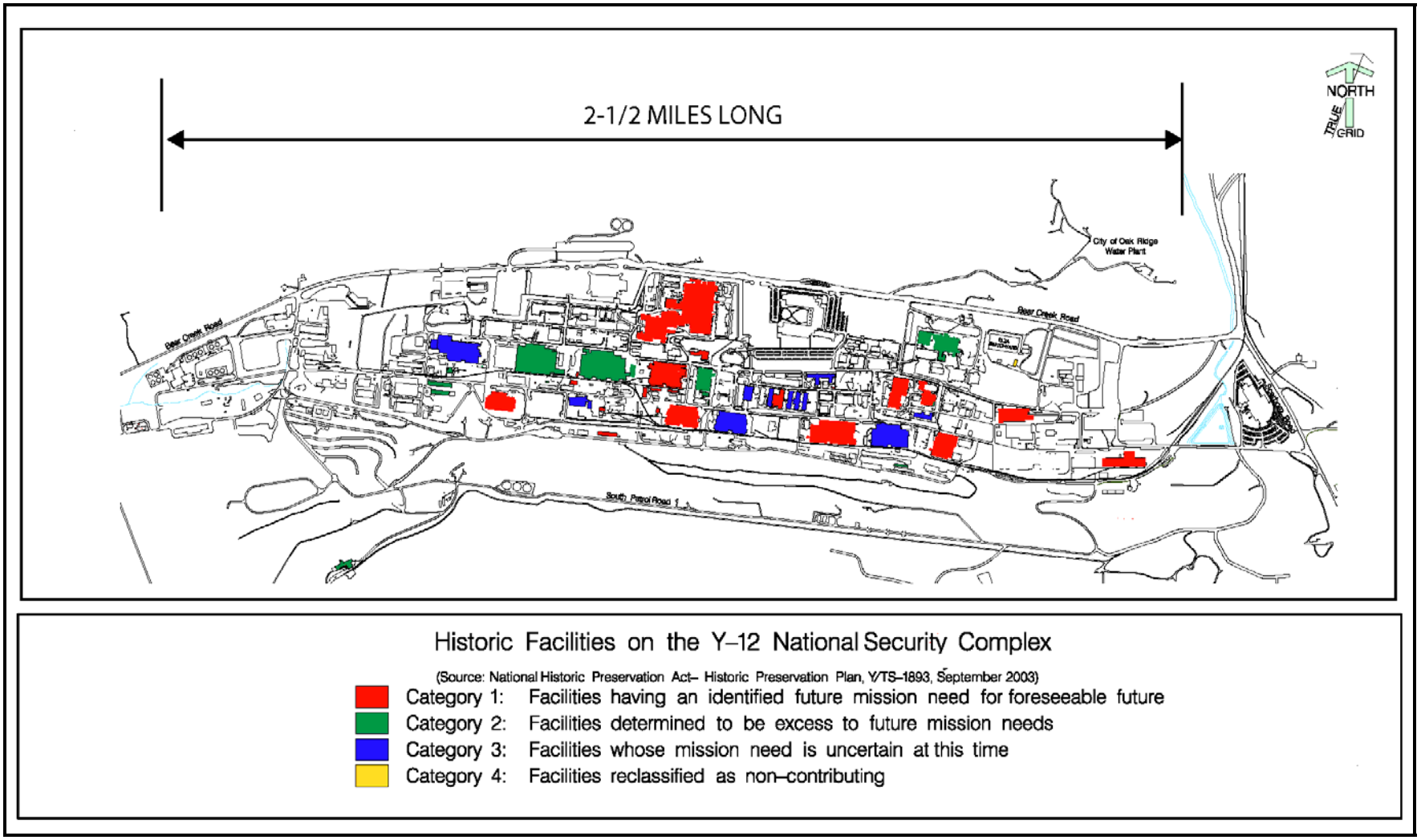
To better fulfill the requirements of the NHPA, in September, 2003, DOE NNSA developed the *National Historic Preservation Act Historic Preservation Plan* (HPP) for Y-12 (Thomason and Associates 2003). The HPP provides an effective approach to preserving the historically significant features of the Y-12 site, while facilitating continued use of the site for ongoing and future missions. The preservation strategy outlined in the HPP ensures historic preservation is an integral part of the comprehensive planning process. As a part of this strategy and based on the dynamics of Y-12's planning efforts, the existing historic properties were categorized into four groups. These groups and their respective facilities are shown in Figure 4.9.4-1 and described as follows:

- **Category 1—Facilities having an identified future mission need for foreseeable future.** This category is subject to change since long-range planning to consolidate operations continues to take place.

- **Category 2—Facilities determined to be excess to future mission needs.** This category includes facilities that have been declared excess and those projected to become excess.

- **Category 3—Facilities whose mission need is uncertain at this time.** This category continues to evolve as short-term planning on key consolidation projects matures. For example, many of the facilities in this category are linked to the construction of new administrative and technical facilities.

- **Category 4—Facilities reclassified as non-contributing.** This category includes facilities discontiguous to the historic district that were identified and recommended for re-evaluation. They were re-evaluated and reclassified as non-contributing properties to the historic district. Implementation of the Y-12 historic preservation strategy is being accomplished through the combined application of interpretive initiatives and physical preservation of historic properties. Physical preservation will be evaluated in the context of, but not limited to, continuing mission need, functional use, security considerations, and economics. This strategy recognizes that historic preservation goes beyond the



Source: NNSA 2007.

Figure 4.9.4-1. Location of the Historic Facilities at Y-12.

retention of physical structures, principally due to the fact that much of Y-12's historical significance goes beyond physical structures (NNSA 2005c).

Ancestors of the Eastern Band of the Cherokee Indians and the Cherokee Nation of Oklahoma may be culturally affiliated with the prehistoric use of the Y-12 area. No Native American traditional use areas or religious sites are known to be present on the Y-12 site. Also, no artifacts of Native American religious significance are known to exist or to have been removed from the Y-12 site (DOE 2001a).

There are at least 32 cemeteries located within the boundaries of ORR, 7 of which are located on the Y-12 site. These cemeteries are associated with Euro-American use of the area prior to World War II and are likely to have religious or cultural importance to descendants and the local community (DOE 2001a). All are currently maintained and protected. No other traditional, ethnic, or religious resources have been identified on the Y-12 site.

4.9.5 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geologic age. Paleontological resources are important mainly for their potential to provide scientific information on paleoenvironments and the evolutionary history of plants and animals. Impact assessments for paleontological resources are based on the research potential of the resource, the quality of the fossil preservation in the deposit, and on the numbers and kind of resources that could be affected. Resources with high research potential include well-preserved terrestrial vertebrates, unusual depositional contexts or concentrations, assemblages containing a variety of different fossil forms, and deposits with poorly understood fossil forms that originate from areas that are not well studied.

Paleontological Resources of ORR and Y-12. The ORR is underlain by bedrock formations predominated by calcareous siltstones, limestones, sandstones, siliceous shales, and siliceous dolostones. The majority of geologic units with surface exposures on ORR contain paleontological materials. All of these paleontological materials consist of common invertebrate remains which are unlikely to be unique from those available throughout the East Tennessee region.

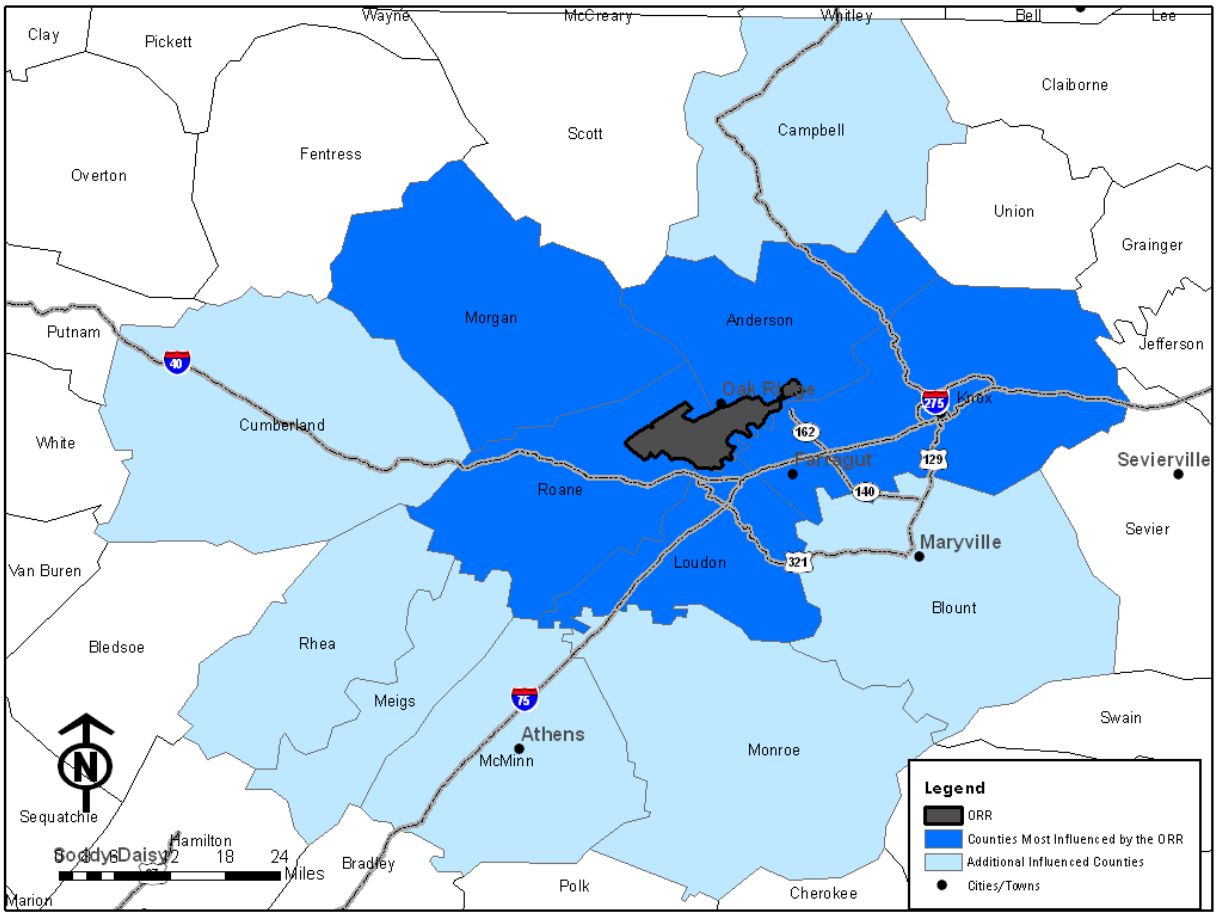
4.10 SOCIOECONOMICS

This section describes current socioeconomic conditions within an ROI where more than 90 percent of ORR workforce resides. The ROI is a four-county area in Tennessee comprised of Anderson, Knox, Loudon, and Roane Counties. Figure 4.10–1 shows the surrounding counties influenced by ORR. Approximately 40 percent of the current ORR labor force, which includes employed and unemployed individuals, resides in Knox County, 29 percent in Anderson County, 16 percent in Roane County, and 6 percent in Loudon County. The remaining 9 percent of the labor force resides in other counties across Tennessee, none of which are home to more than 3 percent of the labor force.

4.10.1 Employment and Income

The ORR ROI has historically been dependent on manufacturing and government employment. More recent trends show growth in the service sector and a decline in manufacturing and government employment. Table 4.10.1–1 presents current and historical employment for the major sectors of the ROI economy. Although there have been fluctuations in these estimates, the ROI labor force grew by approximately 11 percent from 280,986 in 2000 to 312,211 in 2007 (BLS 2007).

The 2010 unemployment rate in the ROI varies from a low of approximately 7.0 percent in Knox County to a high of approximately 8.8 percent in Anderson County (Table 4.10.1–2). The unemployment rate in Tennessee is approximately 10.6 percent.



Source: derived from DOE 2001a.

Figure 4.10-1. Location of Oak Ridge Reservation and Surrounding Counties.

Table 4.10.1-1. Employment by Sector (Percent).

Sector	1980	1990	2000	2005
Services	19.1	27.3[a]	32.2	39.0
Wholesale	5.5	5.5	5.0	7.9
Retail	15.6	19.3[a]	18.3	12.3
Government (including Federal, State, local, and military)	20.3	15.4	13.7	13.1
Manufacturing	21.9	15.8	10.7	8.6
Farm	2.0	1.5	1.2	1.0
Construction	4.9	5.4	6.3	6.1
Finance, Insurance, and Real Estate	6.0	5.1	6.3	5.8
Transportation and Public Utilities	3.7	4.0	5.1	ND
Agricultural Service, Forestry, and Other	0.3	0.6	1.1[b]	0.1[c]
Mining	0.7	0.4	0.2[b]	0.2[c]

Source: BEA 2003, BEA 2007.
a – Percentage only includes Knox and Loudon Counties. Data for Roane and Anderson Counties not available.
b – Percentage only includes Knox and Roane Counties. Data for Loudon and Anderson Counties not available.
c – Percentage only includes Knox County. Data for Anderson, Loudon, and Roane Counties not available.
ND – No Data available.

Table 4.10.1-2. 2010 Unemployment Rates.

County or State	% Unemployment
Anderson	8.8
Knox	7.0
Loudon	8.1
Roane	8.5
Tennessee	10.6

Source: BLS 2010.

Per capita income statistics for 2001 to 2006 are shown in Table 4.10.1-3. The average per capita income in the ROI was $31,493 in 2006, a 21.7 percent increase from the 2001 level of $25,880. Per capita income in 2006 in the ROI ranged from a low of $29,074 in Roane County to a high of $33,963 in Knox County. The per capita income in Tennessee was $32,172 in 2006 (BEA 2007).

Table 4.10.1-3. Per Capita Income Statistics, 2001-2006.

County or State	2001	2002	2003	2004	2005	2006
Anderson	$25,985	$26,798	$27,566	$28,055	$29,007	$30,218
Knox	$29,179	$29,583	$30,059	$31,417	$32,815	$33,963
Loudon	$25,717	$26,377	$27,528	$29,554	$30,538	$32,715
Roane	$22,638	$23,942	$24,863	$26,447	$27,584	$29,074
ROI Average	$25,880	$26,675	$27,504	$28,868	$29,986	$31,493
Tennessee	$26,871	$27,499	$28,350	$29,641	$30,969	$32,172

Source: BLS 2007.

Y-12 employs approximately 6,500 workers, including DOE employees and multiple contractors and subcontractors (NNSA 2005c). This represents approximately 3.1 percent of the ROI employment. DOE has a significant impact on the economies both of the ROI and of Tennessee. As a whole, DOE employees and contractors number more than 13,700 individuals in Tennessee, primarily in the ROI. These DOE jobs have an average salary of $54,800 in comparison to the statewide average of $32,919 (UTenn 2005).

DOE employment and spending generate additional benefits to the ROI and state economies through the creation of additional jobs in sectors providing support to DOE and its workers. An analysis of the economic impacts of DOE operations conducted by the Center for Business and Economic Research at the University of Tennessee revealed the following:

- Spending by DOE and its contractors led to an increase of nearly $3.7 billion in the state of Tennessee gross state product in 2004.
- Total personal income generated in the state of Tennessee by DOE-related activities was roughly $1.9 billion in 2004. Each dollar of income directly paid by DOE in the state translates into a total of $2.26 in personal income for Tennessee residents.
- DOE-related spending generated $74.7 million in state and local sales tax revenue in Tennessee in 2004 (UTenn 2005).

4.10.2 Population and Housing

U.S. Census Bureau data from the 2000 Census was used in the discussion of population and housing. From 2000 to 2007, the population of the ROI increased 3 percent from 544,358 to 596,192 in 2007. Loudon County experienced the largest population growth within the ROI between 2000 and 2007 with an increase of 16 percent. Roane County experienced the lowest growth rate with an increase of 2.9 percent (USCB 2007). Populations in all counties in the ROI are projected to continue to grow at a slower rate between 2000 and 2020, as shown in Table 4.10.2–1.

Table 4.10.2-1. Historic and Projected Population Levels in the Region of Influence.

County or State	1990	2000	2010	2020
Anderson	68,250	71,330	75,163	77,226
Knox	335,749	382,032	427,593	481,842
Loudon	31,255	39,086	48,362	58,729
Roane	47,227	51,910	57,042	61,836
ROI	482,481	544,358	608,160	679,633
Tennessee	4,877,203	5,689,283	6,425,969	7,195,375

Source: USCB 2007, State of Tennessee 2003.

Knox County is the largest county in the ROI with a 2007 population of 423,874. Knox County includes the city of Knoxville, the largest city in the ROI. Loudon County is the smallest county in the ROI with a total population of 45,448 in 2007. The city of Oak Ridge and ORR are located in both Roane and Anderson Counties which had 2003 populations of 53,399 and 73,471, respectively (USCB 2007).

Table 4.10.2-2 lists the total number of housing units and vacancy rates in the ROI. In 2000, the total number of housing units in the ROI was 244,537 with 224,796 occupied (91.9 percent). There were 156,219 owner-occupied housing units and 68,577 rental units. The median value of owner-occupied units in Loudon County was the greatest of the counties in the Y-12 ROI ($97,300). The vacancy rate was the lowest in Loudon County (7.7 percent) and the highest in Roane County (9.3 percent) (USCB 2007).

Table 4.10.2-2. Region of Influence Housing Characteristics (2000).

County or ROI	Total Units	Occupied housing Units	Owner Occupied Units	Renter Occupied Units	Vacant units	Vacancy Rate (percent)	Median value of Owner Occupied Units (dollars)
Anderson	32,452	29,780	21,592	8,188	2,671	8.2	87,500
Knox	171,439	157,872	105,562	52,310	13,567	7.9	98,500
Loudon	17,277	15,944	12,612	3,332	1,333	7.7	97,300
Roane	23,369	21,200	16,453	4,747	2,169	9.3	86,500
ROI	244,537	224,796	156,219	68,577	19,740	8.1	95,619

Source: USCB 2007.
NA – Not applicable.

4.10.3 Community Services

Community services analyzed in the ROI include public schools, law enforcement, fire suppression and medical services. There are 7 school districts with 145 schools serving the Y-12 ROI. Educational services are provided for approximately 81,729 students by an estimated 5,216 teachers for the 2005 to 2006 school year (IES 2007). The student-to-teacher ratio in these school districts ranges from a high of 18:1 in the Lenoir City School District in Loudon County to a low of 14:1 in the Oak Ridge School District. The student-to-teacher ratio in the ROI was 16:1 (IES 2007).

The counties within the ROI employ approximately 46,000 firefighters and law enforcement officers. Security at Y-12 is provided by Wackenhut Services, Inc. (DOE 2001a). There are eleven hospitals that serve residents of the ROI with the majority located in Knox County. These hospitals have a total bed capacity of 2,195 (ESRI 2007).

4.11 ENVIRONMENTAL JUSTICE

Environmental justice has been defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (EPA 2005b). Concern that minority and/or low-income populations might be bearing a disproportionate share of adverse health and environmental impacts led President Clinton to issue an EO in 1994 to address these issues. That Order, EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," directs Federal agencies to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. When conducting NEPA evaluations, DOE incorporates environmental justice considerations into both technical analyses and public involvement programs in accordance with EPA and the Council on Environmental Quality (CEQ) regulations (CEQ 1997).

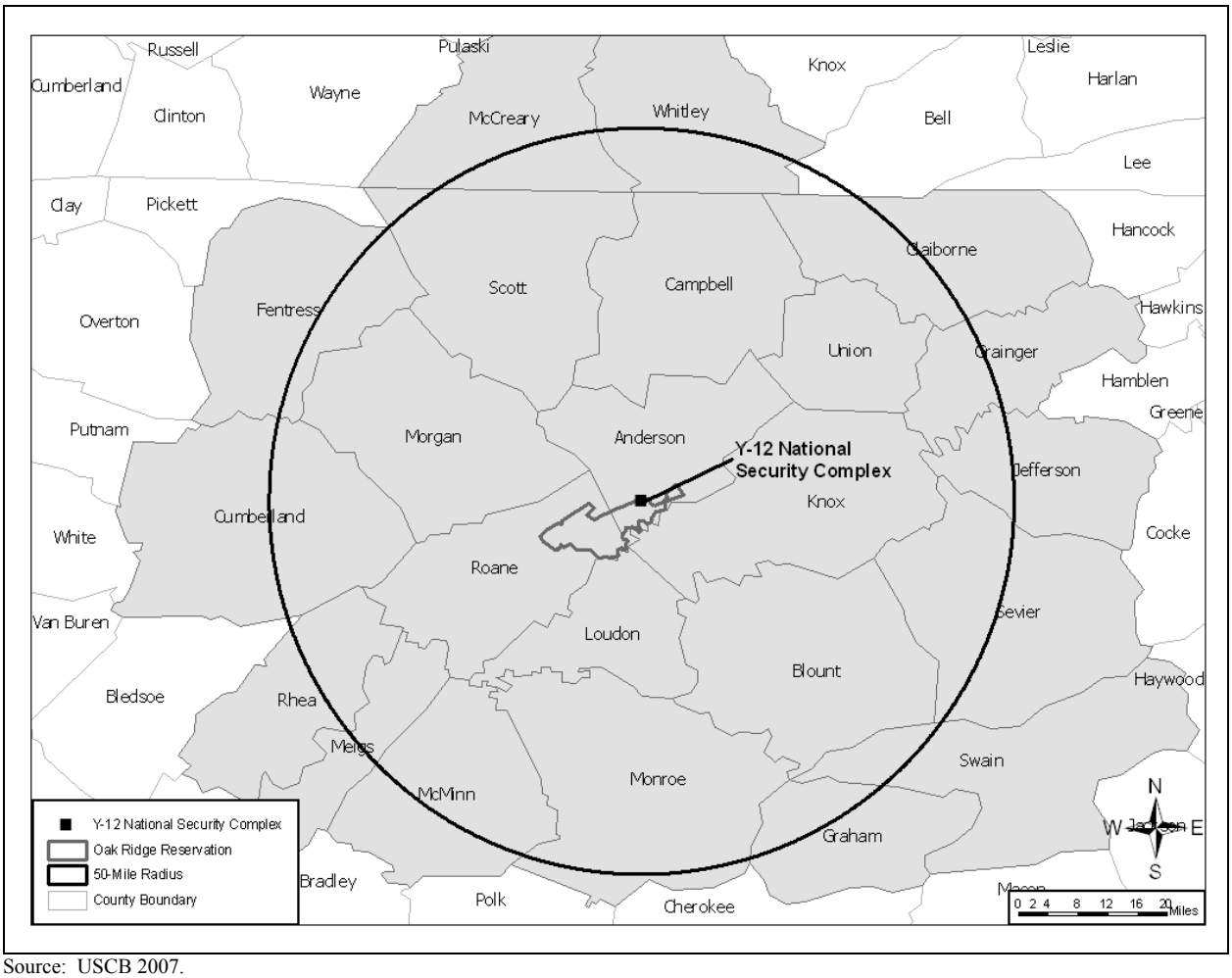
Demographic information from the U.S. Census Bureau was used to identify minority and low-income populations in the ROI. Information on locations and numbers of minority and low-

income populations was obtained from the 2000 U.S. Census. Census data are reported on the level of census tracts, a geographical area that varies with size depending largely on population density, with low-population density census tracts generally covering larger geographical areas.

Minority refers to people who classified themselves in the 2000 U.S. Census as Black or African American, Asian or Pacific Islander, American Indian or Alaskan Native, Hispanic of any race or origin, or other non-White races (CEQ 1997). Environmental Justice guidance defines "low-income" using statistical poverty thresholds used by the U.S. Census Bureau. Information on low-income populations was developed from 1999 incomes reported in the 2000 U.S. Census. In 1999, the poverty weighted average threshold for an individual was $8,501 annually (USCB 2002).

The CEQ identifies minority and low-income populations when either (1) the minority or low-income population of the affected area exceeds 50 percent or (2) the minority or low-income population percentage in the affected area is meaningfully greater (i.e., 20 percentage points greater) than the minority population percentage in the general population or appropriate unit of geographical analysis. The potentially affected area considered for environmental justice analysis is the area within a 50-mile radius of Y-12. Figure 4.11-1 shows counties potentially at risk from the current missions performed at Y-12. There are 19 counties that are included in the potentially affected area. Table 4.11-1 provides the demographic profile of the potentially affected area using data obtained from the 2000 Census.

Any disproportionately high and adverse human health or environmental effects on minority populations and/or low-income populations that could result from the alternatives being considered for Y-12 are assessed for the census tract which contains the site. Health effects resulting from discharge to water pathways would also be assessed for this area.



Source: USCB 2007.

Figure 4.11-1. Potentially Affected Counties Surrounding Y-12 Environmental Justice.

Table 4.11-1. Demographic Profile of the Potentially Affected Area Surrounding Y-12, 2000.

Population Group	Population	Percent
Minority	**81,942**	**7.4**
Hispanic alone	7,115	0.6
Black or African American	46,871	4.2
American Indian and Alaska Native	3,058	0.3
Asian	8,053	0.7
Native Hawaiian and Other Pacific Islander	267	0.02
Some other race	5,185	0.5
Two or more races	11,393	1.0
White alone	**1,023,659**	**92.6**
Total Population	**1,105,601**	**100.0**

Source: USCB 2007.

In 2000, persons self-designated as minority individuals in the potentially affected area comprised 7.4 percent of the total population. This minority population is composed largely of Black or African American residents. As a percentage of the total resident population in 2000, Tennessee had a minority population of 20.8 percent and the U.S. had a minority population of 30.9 percent (USCB 2007).

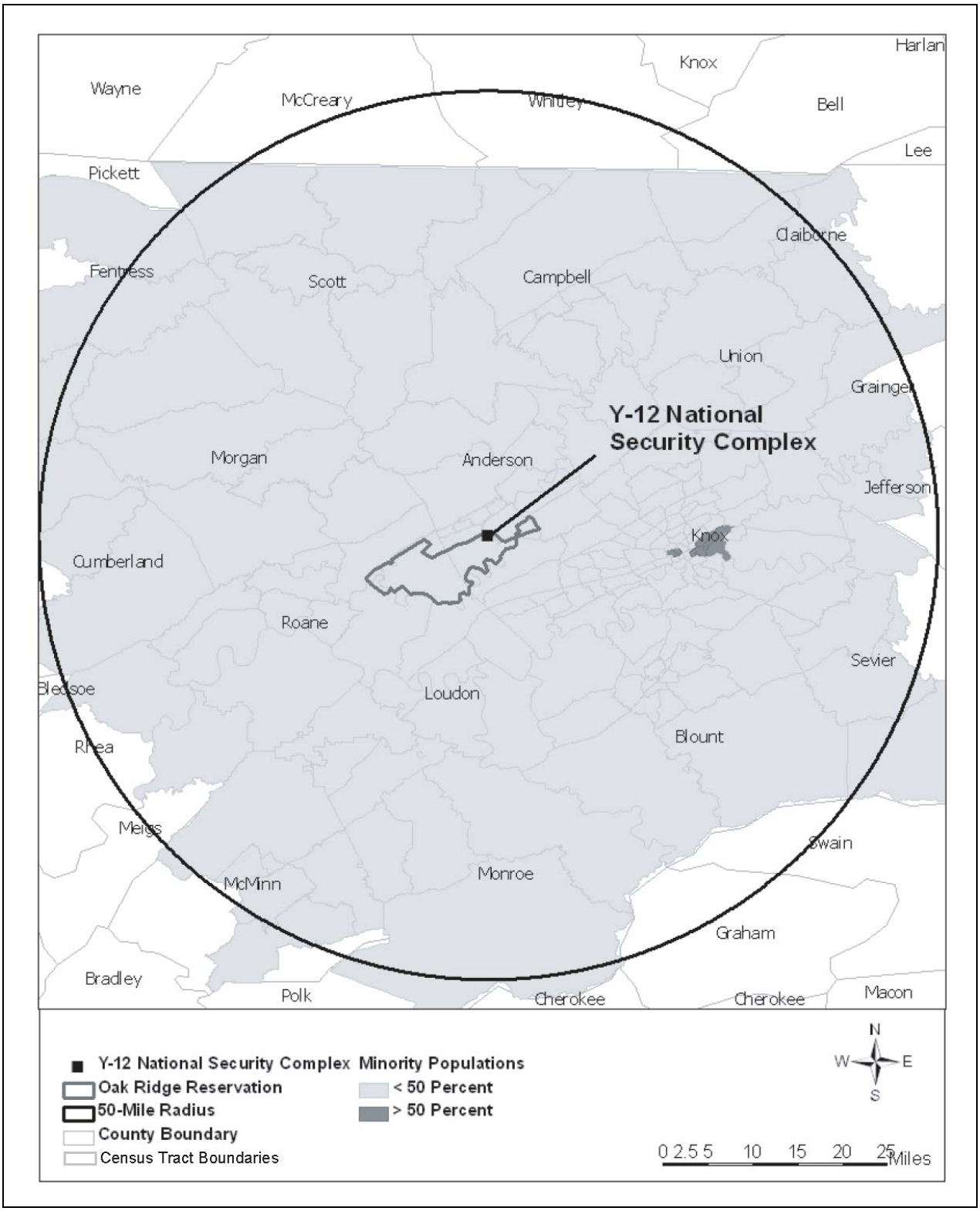
Census tracts with minority populations exceeding 50 percent were considered minority census tracts. Based on 2000 census data, Figure 4.11-2 shows minority census tracts within the 50-mile radius where more than 50 percent of the census tract population is minority.

Census tracts were considered low-income census tracts if the percentage of the populations living below the poverty threshold exceeded 50 percent. Based on 2000 Census data, Figure 4.11-3 shows low-income census tracts within the 50-mile radius where more than 50 percent of the census tracts population is living below the Federal poverty threshold.

According to 2000 census data, approximately 122,216 individuals residing within census tracts in the 50-mile radius of Y-12 were identified as living below the Federal poverty threshold, which represents approximately 13 percent of the census tracts population within the 50-mile radius. There were five census tracts located in Knox County with populations greater than 50 percent identified as living below the Federal poverty threshold. In 2000, 13.5 percent of individuals for whom poverty status was determined were below the poverty level in Tennessee and 12.4 percent in the U.S. (USCB 2007).

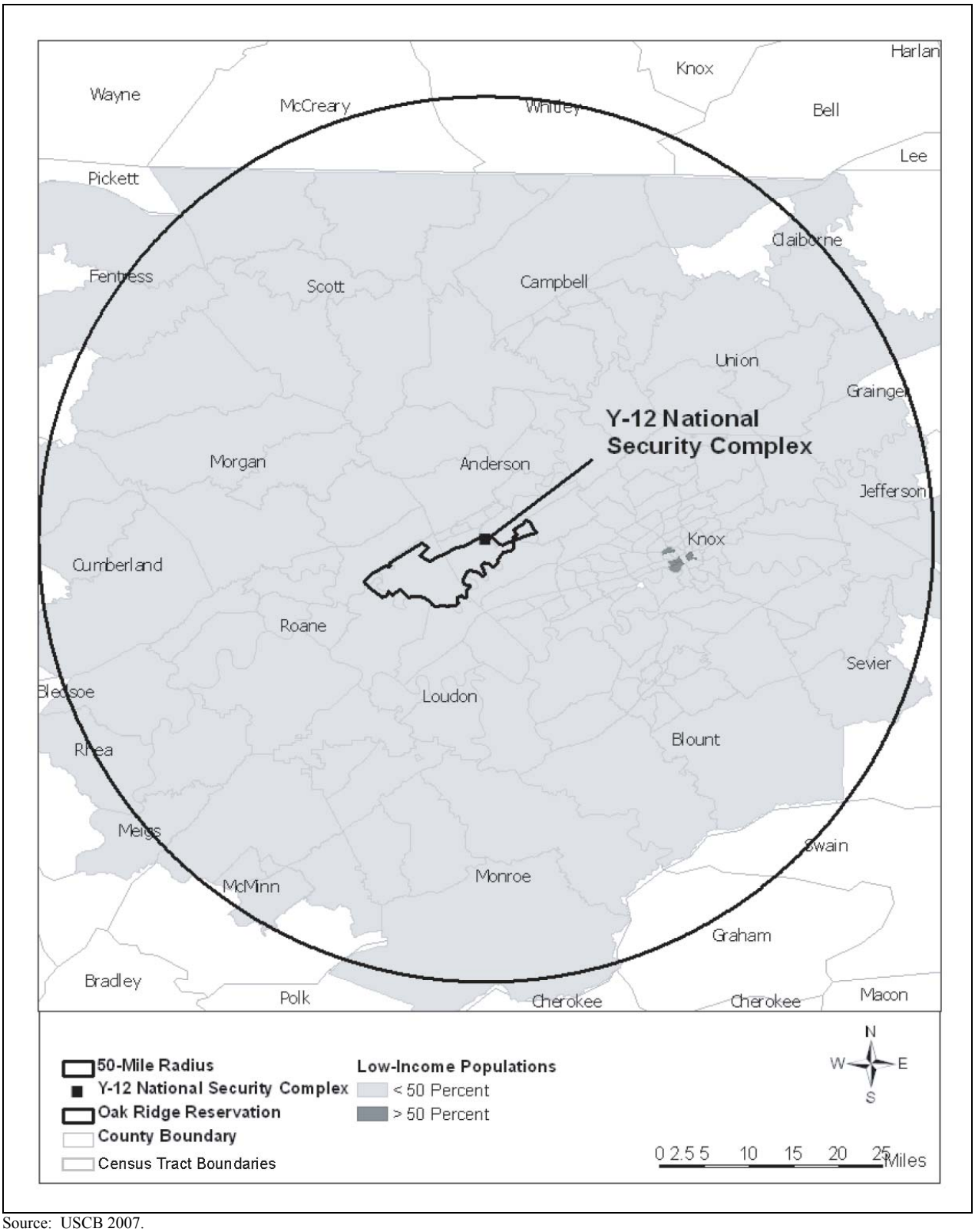
In April 2003, the EPA completed a study of soil and water quality in the Scarboro community (EPA 2003). Scarboro Community is an urban minority community located closer to the boundary of ORR than any other residential community. EPA's study looked for hazardous substances and radionuclides associated with the operations of nearby Y-12, several of which had not been included in sample analysis from other studies. None of the EPA radionuclide analytical values exceeded normal background levels, Maximum Concentration Levels (MCLs) or Preliminary Remediation Goals (PRGs) that may indicate a health concern. None of the mercury samples were above the MCL or PRG. The National Secondary Drinking Water Standard (NSDWS) and PRG levels were exceeded for aluminum, iron and manganese in a few water, sediment and soil samples. However, aluminum, iron and manganese are naturally occurring in the geographic area of Oak Ridge, indicating that these are not related to releases from DOE operations and do not in any case present a health risk. All other metals were undetected or below the MCLs, NSDWSs, or PRGs. EPA's work gives a completed representation of any contamination that might have been encountered.

The EPA study concludes that the residents of Scarboro are not currently being exposed to substances that pose an unreasonable risk to health or the environment. The soil, sediment and water quality in this community does not pose a risk to human health and the environment. The EPA does not propose to conduct any further environmental sampling in the Scarboro community unless such work is needed as part of future studies within the entire Oak Ridge community. These results confirm that existing soil and water quality pose no risk to human health within the Scarboro community.



Source: USCB 2007.

Figure 4.11-2. Minority Population – Census Tracts with More than 50 Percent Minority Population in a 50-Mile Radius of Y-12.

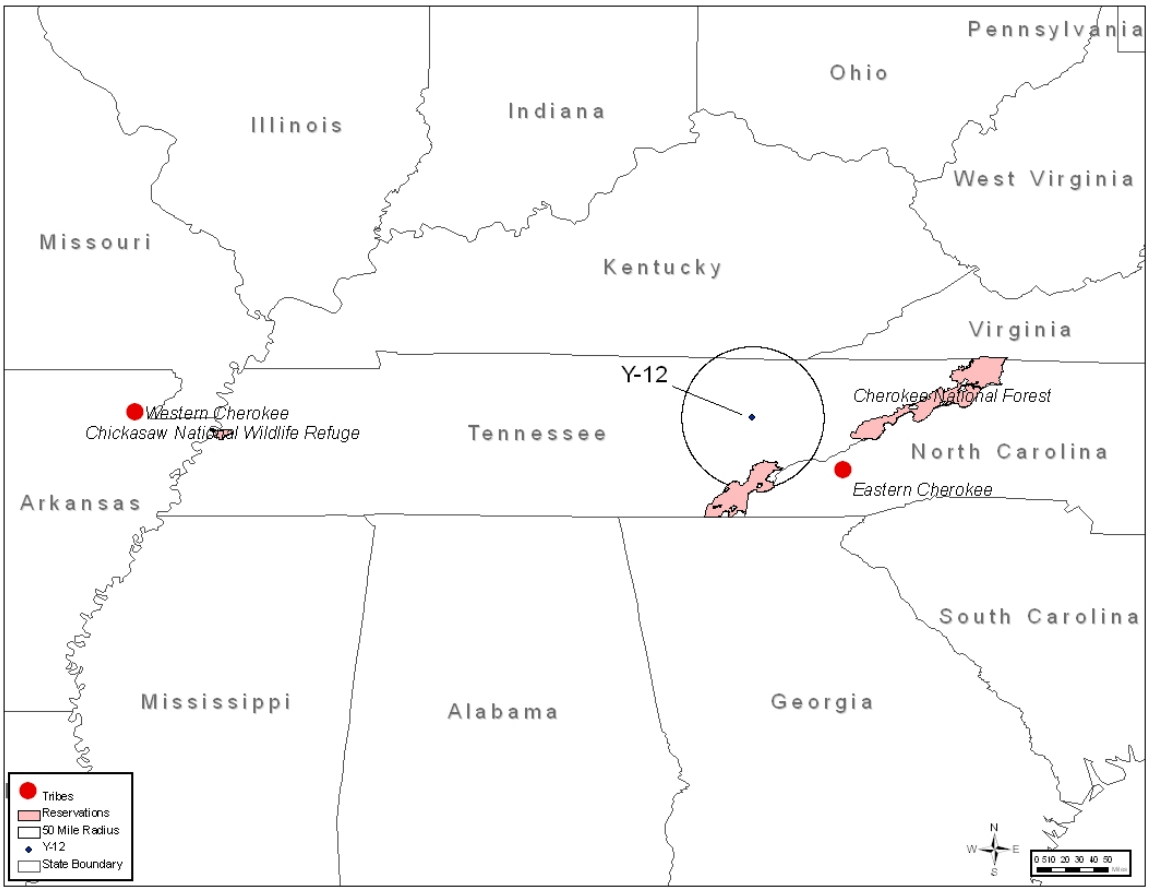


Source: USCB 2007.

Figure 4.11-3. Low-Income Population – Census Tracts with More than 50 Percent Low-Income Population in a 50-Mile Radius of Y-12.

4.11.1 Characteristics of Native American Populations within the Vicinity of or with Interest in Y-12 Activities/Operations

Native American groups which are known to have used the lands surrounding Y-12 are the Ancestors of the Eastern Band of the Cherokee Indians and the Cherokee Nation of Oklahoma. The 2000 U.S. Census Bureau was used to obtain characteristics, including population, employment, educational attainment, income, poverty level, average family size, and housing characteristics for all population subcategories associated with the ones mentioned above. The locations of various tribes in relation to Y-12 are shown in Figure 4.11.1-1. The results of this analysis are provided in the following section.



Source: ESRI 2007.

Figure 4.11.1-1. Location of Tribes within Vicinity of or with Interest in Y-12.

As shown in Table 4.11.1-1, the Eastern Cherokee had a population of 8,451, which was larger than the Western Cherokee population of 6,693 in 2000. The Eastern Cherokee also have a larger percentage of their population as members of the civilian labor force with 65.9 percent and the Western Cherokee with a smaller percentage of their population as members of the civilian labor force with 64.3 percent. The Eastern Cherokee had a higher unemployment rate at 4.8 percent and the Western Cherokee had a lower unemployment rate of 4.1 percent (USCB 2007).

Table 4.11.1-1. Population and Employment Estimates for Native American Populations within the Vicinity of or with Interest in Y-12, 2000.

Y-12	Population	Civilian Labor Force	Civilian Labor Force (percent)	Employed	Employed (percent)	Unemployed	Unemployed (percent)
Eastern Cherokee	8,451	4,033	65.9	3,740	61.1	293	4.8
Western Cherokee	6,693	3,255	64.3	3,048	60.2	207	4.1

Source: USCB 2007.

Of those individuals over 25 with some form of education, the largest constituency of the two Native American populations had received a high school diploma as shown in Table 4.11.1-2. A slightly lesser percentage of individuals had attended some college and lesser percentages of these populations had received degrees from institutions of higher learning (Associate, Bachelor, or Graduate/Professional) (USCB 2007).

The Western Cherokee population had the higher mean household earnings and per capita income with $45,538 and $17,616, respectively, in 2000 as shown in Table 4.11.1-3. The Eastern Cherokee population had the lower mean household earnings with $41,727 and the lower per capita income with $14,955 (USCB 2007).

Of the two Native American populations with ties to Y-12, the Eastern Cherokee had the larger percentage of individuals below the poverty level in 2000 with 18.5 percent as compared to the Western Cherokee population which had 13.6 percent of the total population living below the poverty level as shown in Table 4.11.1-3 (USCB 2007).

In 2000, the Eastern Cherokee had the larger average family size with 3.17 persons per family as compared to the Western Cherokees who had an average family size of 3.06 persons per family. The Eastern Cherokee had the greater number of occupied housing units which is consistent with their larger population as shown in Table 4.11.1-4 (USCB 2007).

Table 4.11.1-2. Level of Educational Attainment by Native American Populations within the Vicinity of or with Interest in Y-12, 2000.

Y-12	High School Graduate	High School Graduate (percent)	Some College	Some College (percent)	Associate Degree	Associate Degree (percent)	Bachelor Degree	Bachelor Degree (percent)	Graduate/ Professional Degree	Graduate/ Professional Degree (percent)
Eastern Cherokee	1,392	28.1	1,206	24.4	484	9.8	406	8.2	320	6.5
Western Cherokee	1,113	25.8	1,219	28.2	362	8.4	589	13.6	334	7.7

Source: USCB 2007.

Table 4.11.1-3. Income and Poverty Level Estimates for Native American Populations within the Vicinity of or with Interest in Y-12, 2000.

Y-12	Mean Household Earnings	Per Capita Income	Individuals Below the Poverty Level	Individuals Below the Poverty Level (percent)
Eastern Cherokee	$41,727	$14,955	1,517	18.5
Western Cherokee	$45,538	$17,611	883	13.6

Source: USCB 2007.

Table 4.11.1-4. Housing Characteristics for Native American Populations within the Vicinity of or with Interest in Y-12, 2000.

Y-12	Average Family Size	Housing Units	Occupied Housing Units	Owner Occupied Housing Units	Owner Occupied Housing Units (percent)	Renter Occupied Housing Units	Renter Occupied Housing Units (percent)
Eastern Cherokee	3.17	3,008	3,020	2,274	75.3	746	24.7
Western Cherokee	3.06	2,610	2,543	1,692	66.5	851	33.5

Source: USCB 2007.

4.12 HEALTH AND SAFETY

Current activities associated with routine operations at Y-12 have the potential to affect worker and public health. Air emissions at Y-12 can lead to exposure to radioactive and non-radioactive materials. Liquid effluents discharged into nearby waterbodies may affect downstream populations using the water for drinking or recreation. Additionally, workers are exposed to occupational hazards similar to those experienced at most industrial work sites. Monitoring of materials released from the reservation and environmental monitoring and surveillance on and around the reservation are discussed in Sections 4.6 and 4.7.

The following discussion characterizes the human health impacts from current releases of radioactive and nonradioactive materials at Y-12. It is against this baseline that the potential incremental and cumulative impacts associated with the alternatives are compared and evaluated.

4.12.1 Public Health

Radiological. This section presents estimates of potential radiation doses to the public from releases of radiological materials at Y-12. The dose estimates are performed using monitored and estimated release data, environmental monitoring and surveillance data, estimated exposure conditions that tend to maximize the calculated doses, and environmental transport and dosimetry codes that also tend to overestimate the calculated doses. Thus, the presented dose estimates do not necessarily reflect doses received by typical people in the vicinity of ORR; they are likely to be overestimates.

Calculated radiation doses to maximally exposed individuals (MEI) from airborne releases from ORR are listed in Table 4.12.1-1. The hypothetical MEI for ORR was located about 3.6 miles south of the main Y-12 Complex release point, about 2.6 miles east northeast of the 7911 stack at ORNL, and about 6.8 miles east of the *Toxic Substances Control Act* (TSCA) Incinerator (stack K-1435) at the ETTP. This individual could have received an effective dose (ED) of about 0.3 mrem, which is well below the NESHAP standard of 10 mrem and is 0.1 percent of the 360 mrem that the average individual receives from natural sources of radiation (EPA 2009). The calculated collective ED to the entire population within 50 miles of ORR (about 1,040,041 persons) was about 19.5 person-rem, which is approximately 0.005 percent of the 374,415 person-rem that this population received from natural sources of radiation (based on an individual dose of 360 mrem per year) (DOE 2008). For liquid effluents, the MEI dose to a member of the public would be approximately 0.006 mrem per year (DOE 2008).

Table 4.12.1-1. Calculated Radiation Doses to Maximally Exposed Offsite Individuals from Airborne Releases during 2007.

Plant	Effective dose, mrem (mSv)	
	At plant max	At ORR max
Oak Ridge National Laboratory	0.26 (0.0026)[a]	0.26 (0.0026)
East Tennessee Technology Park	0.02 (0.0002)[b]	0.009 (0.00009)
Y-12	0.15 (0.0015)[c]	0.009 (0.00009)
Entire ORR	[d]	0.3 (0.003)[e]

Source: DOE 2008.
a – The maximally exposed individual was located 5,060 meters east of X-3039 and 4,259 meters east-northeast of X-7911.
b – The maximally exposed individual was located 685 meters west of K-1435.
c – The maximally exposed individual is located 2,307 meters northeast of Y-12 release point.
d – Not Applicable.
e – The maximally exposed individual for the entire ORR is ORNL maximally exposed individual.

The maximally exposed individual for Y-12 was located at about 1.43 miles northeast of the main Y-12 site release point. This individual could have received an ED of about 0.15 mrem from Y-12 emissions. Inhalation and ingestion of uranium radioisotopes (i.e., 232U, 233U, 234U, 235U, 236U, and 238U) accounted for essentially all (about 99 percent) of the dose. The contribution of Y-12 emissions to the 50-year committed collective ED to the population residing within 50 miles of ORR was calculated to be about 1.5 person-rem, which is approximately 8 percent of the collective ED for ORR (DOE 2008).

The maximally exposed individual for ORNL was located at a residence about 3.1 miles east of the 3039 stack and 2.6 miles east-northeast of the 7911 stack. This individual could have received an ED of about 0.26 mrem from ORNL emissions. Radionuclides contributing 1 percent or more to the dose include 41Ar (54.2 percent), 138Cs (22.9 percent), 212Pb (12.2 percent), and 88Kr (4.2 percent). The contribution of ORNL emissions to the collective ED to the population residing within 50 miles of ORR was calculated to be about 17.2 person rem, approximately 88 percent of the collective ED for ORR (DOE 2008). Calculated effective doses from airborne releases are listed in Table 4.12.1-2.

The maximally exposed individual for the ETTP was located at a business about 0.42 miles west of the TSCA Incinerator stack (K-1435). The ED received by this individual was calculated to be about 0.02 mrem. About 79 percent of the dose is from ingestion and inhalation of uranium radioisotopes, about 16 percent is from 3H, and 4 percent is from 99Tc. The contribution of ETTP emissions to the collective ED to the population residing within 50 miles of ORR was calculated to be about 0.8 person-rem; approximately 4 percent of the collective ED for the reservation (DOE 2008).

Table 4.12.1-2. Calculated Collective Effective Doses from Airborne Releases during 2007.

Plant	Collective dose[a]	
	Person-rem	Person-Sv
Oak Ridge National Laboratory	17.2	0.172
East Tennessee Technology Park	0.8	0.008
Y-12	1.5	0.015
Entire ORR	19.5	0.195

Source: DOE 2008.
a – Collective effective dose to the 1,040,041 persons residing within 50 miles of ORR.

Radionuclides discharged to surface waters from ORR enter the Tennessee River system by way of the Clinch River. Discharges from Y-12 enter the Clinch River via Bear Creek and EFPC, both of which enter Poplar Creek before it enters the Clinch River, and by discharges from Rogers Quarry into McCoy Branch and then into Melton Hill Lake. Discharges from ORNL enter the Clinch River via White Oak Creek and enter Melton Hill Lake via some small drainage creeks. Discharges from the ETTP enter the Clinch River either directly or via Poplar Creek (DOE 2008).

Table 4.12.1-3 is a summary of potential EDs from identified waterborne radionuclides around ORR. Adding worst-case EDs for all pathways in a water-body segment gives a maximum individual ED of about 0.9 mrem to a person obtaining his or her full annual complement of fish from and participating in other water uses on Lower EFPC. The maximum collective ED to the 50-mile population could be as high as approximately 6.3 person-rem. These are small percentages of individual and collective doses attributable to natural background radiation, about 0.3 percent and 0.002 percent, respectively (DOE 2008).

Table 4.12.1-3. Summary of annual maximum individual (mrem) and collective (person-rem) effective doses (EDs) from waterborne radionuclides[ab].

	Drinking water	Eating fish	Other uses	Total[c]
Upstream of all ORR discharge locations (CRK 70 and CRK 66, City of Oak Ridge Water Plant)				
Individual ED	0.0	0.03	0.0	0.03
Collective ED	0.0	0.001	0.0	0.001
Melton Hill Lake (CRK 58, Knox County Water Plant)				
Individual ED	0.0007	0.001	0.00005	0.002
Collective ED	0.02	0.00005	0.0003	0.02
Upper Clinch River (CRK 23, Gallaher Water Plant, CRK 32)				
Individual ED	0.2	.01	0.02	0.3
Collective ED	0.08	0.03	0.005	0.1
Lower Clinch River (CRK 16)				
Individual ED	NA[d]	0.08	0.1	0.2
Collective ED	NA[d]	0.04	0.03	0.08
Upper Watts Bar Lake, Kingston Municipal Water Plant				
Individual ED	0.04	0.03	0.03	0.09
Collective ED	0.5	0.04	0.05	0.6
Lower System (Lower Watts Bar Lake and Chickamauga Lake)				
Individual ED	0.04	0.03	0.005	0.07
Collective ED	4	0.3	0.4	5
Poplar Creek (near Lower East Fork Poplar Creek)				
Individual ED	0.0	0.03	0.0	0.03
Collective ED	0.0	0.001	0.0	0.001
Upstream of all ORR discharge locations (CRK 70 and CRK 66, City of Oak Ridge Water Plant)				
Individual ED	NA[d]	0.9	0.01	0.9
Collective ED	NA[d]	0.03	0.0005	0.03

Source: DOE 2008.
a – 1 mrem = 0.01 mSv.
b – Doses based on measured radionuclide concentrations in water or estimated from measured discharges and known or estimated steam flows.
c – Rounded difference between individual pathway doses and total.
d – Not at drinking water supply locations.

2007 Summary. A summary of the maximum EDs to individuals by pathway of exposure is given in Table 4.12.1-4. In the unlikely event that any person was irradiated by all of those sources and pathways for the duration of 2007, that person could have received a total ED of about 4 mrem. Of that total, 0.3 mrem would have come from airborne emissions, 1.2 mrem from waterborne emissions, (0.2 mrem from drinking water from the Watts Bar Lake, 0.9 mrem from consuming fish from Lower EFPC near its confluence with Poplar Creek, and 0.1 mrem from other water uses along the Lower Clinch River), and 0.4 mrem from direct radiation while fishing on Clinch River. This dose is about 1.3 percent of the annual dose (300 mrem) from background radiation. The ED of 4 mrem includes the person who received the highest EDs from eating wildlife harvested on ORR. A total of about 2.2 mrem are attributed to the consumption of wildlife from ORR, with 2.0 mrem associated with eating deer and 0.2 mrem associated with eating geese and turkey (0.1 mrem from each). If the maximally exposed individual did not consume wildlife harvested from ORR, the estimated dose would be about 2 mrem (DOE 2008).

DOE Order 5400.5 limits the ED that an individual may receive from all exposure pathways from all radionuclides released from ORR during 1 year to no more than 100 mrem. The 2007 maximum ED should not have exceeded about 4 mrem, or about 4 percent of the limit given in DOE Order 5400.5 (DOE 2008).

The total collective ED to the population living within a 50-mile radius of ORR was estimated to be about 26 person-rem. This dose is about 0.008 percent of the 312,012 person-rem that this population received from natural sources during 2007 (DOE 2008). Table 4.12.1-4 presents the potential radiological impacts to the public, from all sources, resulting from normal operations at ORR including Y-12.

Table 4.12.1-4. Potential Radiological Impacts to the Public Resulting from Normal Operations at ORR (including Y-12).

Pathway	Dose to maximally exposed individual		Percentage of DOE mrem/year limit (%)	Estimated population dose		Population within 50 miles	Estimated background radiation population dose (person-rem)[a]
	mrem	mSv		Person-rem	Person-Sv		
Airborne effluents:							
All pathways	0.3	0.003	0.3	19.5	0.195	1,040,041[b]	
Liquid effluents:							
Drinking water	0.2	0.002	0.2	5	0.05	367,438[c]	
Eating fish	0.9	0.009	0.9	0.5	0.005	49,455[d]	
Other activities	0.1	0.001	0.1	0.5	0.005	489,023[d]	
Eating deer	2[e]	0.02	2	0.3	0.003	358	
Eating geese	0.1[f]	0.001	0.1	g	g		
Eating turkey	0.1[h]	0.001	0.1	0.0007	0.000007	31	
Direct radiation	0.4[i]	0.004	0.4				
All pathways	4	0.04	4	26	0.26	1,040,041	312,012

Source: DOE 2008.
a – Estimated background population dose is based on 300 mrem/year individual dose and the population with 50 miles of ORR.
b – Population based on 2000 census data.
c – Population estimates based on community and non-community drinking water supply data from the Tennessee Department of Environment and Conservation, Division of Water.
d – Population estimates based on population within 50 miles and fraction of fish harvested from Melton Hill, Watts Bar, and Chickamauga reservoirs. Melton Hill and Chickamauga recreational use information were obtained from the Tennessee Valley Authority.
e – From consuming one hypothetical worst-case deer, each a combination of the heaviest deer harvested and the highest measured concentrations of ^{137}Cs in released deer on ORR in 2007 and the population dose is based on number of hunters that harvested deer.
f – From consuming two hypothetical worst-case geese, each a combination of the heaviest goose harvested and the highest measured concentrations of ^{137}Cs in released geese.
g – Population doses were not estimated for the consumption of geese since no geese were brought to checking station during the goose hunt.
h – From consuming two hypothetical worst-case turkey, a combination of the heaviest turkey harvested and the highest measured concentrations of ^{137}Cs in released turkey. The population dose is based on number of hunters that harvested turkey.
i – Direct radiation dose estimate based on exposure to a fisherman on the Clinch River.

Five-Year Trends. Doses associated with selected exposure pathways for the years from 2003 to 2007 are given in Table 4.12.1-5. The variations in values over the 5-year period likely are not statistically significant. The dose estimates for direct irradiation along the Clinch River have been corrected for background.

Table 4.12.1-5. Trends in Total Effective Dose (mrem)[a] for Selected Pathways.

Pathway	2003	2004	2005	2006	2007
All air	0.2	0.4	0.9	0.8	0.3
Fish consumption (Clinch River)	1	0.2	0.3	0.7	0.9
Drinking water (Kingston)	0.1[b]	0.04	0.03	0.02	0.04
Direct radiation (Clinch River)	0.4[c]	0.4	0.4	0.5 [d,e]	0.4 [f]
Direct radiation (Poplar Creek)	2[d]	3[d]	1 [d]	0.8 [d]	NA

Source: DOE 2008.
a – 1 mrem = 0.01 mSv.
b – Based on water samples from the Clinch River System.
c – These values have been corrected by removing the contribution of natural background radiation and by using International Commission on Radiological Protection recommendations for converting external exposure to effective dose.
d – Included gamma and neutron radiation measurement data. In 2006, the Poplar Creek location was near the K-1066E Cylinder Yard.
e – This location is along the bank of the Clinch River near the K-770 Scrap Yard.
f – From 2003 to 2005 and 2007, the direct radiation measurements are from an area near Jones Island.

Nonradiological. Each ORR facility evaluates their respective operations to determine applicability for submittal of annual toxic release inventory reports to EPA and TDEC on or before July 1 of each year. The reports cover the previous calendar year and address releases of certain toxic chemicals to air, water, and land as well as waste management, recycling, and pollution prevention activities. Threshold determinations and reports for each of ORR facilities are made separately. Operations involving toxic release inventory chemicals are compared with regulatory thresholds to determine which chemicals exceed the reporting thresholds based on amounts manufactured, processed, or otherwise used at each facility. After threshold determinations are made, releases and offsite transfers are calculated for each chemical that exceeded one or more of the thresholds (DOE 2008).

Total 2007 reportable toxic releases to air, water, and land and waste transferred offsite for treatment, disposal, and recycling were less than the amounts reported for Y-12 in 2006. This was the result of a return to pre-2006 methanol use in the methanol brine system. The following list describes the reported chemicals for Y-12. Table 4.12.1-6 summarizes releases and offsite transfers for those chemicals exceeding reporting thresholds (DOE 2008).

Table 4.12.1-6. EPCRA Section 313 Toxic Chemical Release and Offsite Transfer Summary for Y-12, 2007[a].

Chemical	Year	Quantity (lb)[b]
Chromium	2006	c
	2007	c
Cobalt	2006	d
	2007	c
Copper	2006	c
	2007	c
Lead/lead compounds	2006	10,049
	2007	6,729
Manganese	2006	d
	2007	c
Mercury/mercury compounds	2006	39
	2007	32
Methanol	2006	140,840
	2007	48,478
Nickel	2006	c
	2007	c
Nitrate compounds	2006	0
	2007	c
Nitric Acid	2006	c
	2007	2,060
Ozone	2006	d
	2007	c
Silver	2006	d
	2007	c

Table 4.12.1-6. EPCRA Section 313 Toxic Chemical Release and Offsite Transfer Summary for Y-12, 2007[a] (*continued*).

Chemical		Year	Quantity (lb)
Sulfuric acid (aerosol)		2006	52,000
		2007	41,000
	Total	2006	202,928

Source: DOE 2008.
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 = 0.45 kg.
c – Not applicable because releases were less than 5,000 lb, and hence a Form A was submitted.
d – No reportable releases because the site did not exceed the applicable Toxic Release Inventory reporting thresholds.

Chromium, cobalt, copper, manganese, nickel, and silver. The processing threshold for each of these metals was exceeded as a result of offsite metal recycling and metal machining and welding operations.

Sulfuric acid (aerosol form). Sulfuric acid aerosols were coincidentally manufactured in excess of the reporting threshold as a combustion by-product from burning coal at the steam plant.

Lead and lead compounds. The "otherwise-use" threshold for lead was exceeded at the steam plant and at the Central Training Facility firing range. The processing threshold for lead was exceeded as a result of metal being sent offsite for recycling.

Mercury and mercury compounds. Mercury compounds were otherwise used and coincidently manufactured as a combustion by-product from burning coal in excess of the 10 pound reporting threshold at the steam plant.

Methanol. Most of the methanol at Y-12 is otherwise used in the chiller buildings for the brine-methanol system.

Nitrate compounds. Nitrate compounds were coincidentally manufactured in excess of the reporting threshold as by-products of neutralizing nitric acid wastes and in the sanitary sewer. Various mixtures used throughout the complex contain the compounds.

Nitric acid. Nitric acid was used in excess of the otherwise-use threshold as a chemical-processing aid.

Ozone. Ozone was produced in excess of the manufacture threshold.

4.12.2 Worker Health

One of the major goals of DOE is to keep worker exposures to radiation and radioactive material as low as reasonably achievable (ALARA). The purpose of an ALARA program is to minimize doses from both external and internal exposures. Y-12 worker doses have typically been well below DOE worker exposure limits. The Radiation Exposure and Monitoring System 2009 Annual Report indicates that Y-12 personnel received a total internal dose of 49 person-rem. The Y-12 internal dose is spread across approximately 2,450 workers. About 10 percent of those

workers account for about half the total exposure, mainly hands-on production and maintenance workers. None of the internal exposures exceeded the site's 1.0 rem administrative limit The exposures ranged from 0 to 0.823 rem (Oliver 2010).

4.13 WASTE MANAGEMENT

There are many waste management facilities at Y-12. The disposal facilities and landfills are operated by the Environmental Management Program. The majority of the waste management, treatment and storage facilities are operated by NNSA. Waste management facilities are located in buildings or on the sites where they are needed, or are collocated with other waste management facilities or operations.

The TDEC Division of Solid Waste Management (DSWM) regulates the management of waste streams under the *Tennessee Solid Waste Management Act* (TSWMA). Onsite waste disposal facilities in operation at Y-12 include industrial, construction/demolition landfills, and a CERCLA waste landfill.

Waste Management PEIS RODs affecting ORR and ORNL are shown in Table 4.13.1-1 for the waste types analyzed in this SWEIS. Decisions on the various waste types were announced in a series of RODs that were issued under the *Waste Management PEIS* (DOE 1997). The initial transuranic (TRU) waste ROD was issued on January 20, 1998 (63 FR 3629) with several subsequent amendments; the hazardous waste ROD was issued on August 5, 1998 (63 FR 41810); the high-level radioactive waste ROD was issued on August 12, 1999 (64 FR 46661), and the low-level radioactive waste and mixed low-level radioactive waste ROD was issued on February 18, 2000 (65 FR 10061). The TRU waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare TRU waste for disposal at Waste Isolation Pilot Plant (WIPP). Y-12 does not generate TRU waste. Each DOE site that has or will generate TRU waste will, as needed, prepare and store its TRU waste onsite until the waste is shipped to WIPP. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the non-wastewater hazardous waste, with ORR and the Savannah River Site (SRS) continuing to treat some of their own non-wastewater hazardous waste onsite in existing facilities where it is economically feasible.

The high-level radioactive waste ROD states that immobilized high-level radioactive waste will be stored at the site of generation until transferred to a geologic repository. The ROD for LLW and mixed-LLW (MLLW) states that, for the management of LLW, minimal treatment will be performed at all sites and disposal will continue, to the extent practicable, onsite at Idaho National Environmental Laboratory (INL), Los Alamos National Laboratory (LANL), ORR, and SRS. In addition, the Hanford Site and Nevada Test Site (NTS) will be available to all DOE sites for LLW disposal. MLLW will be treated at the Hanford Site, INL, ORR, and SRS and disposed of at the Hanford Site and the NTS. More detailed information concerning DOE's preferred alternatives for the future configuration of waste management facilities at ORR is presented in the *Waste Management PEIS* as well as the high-level radioactive waste, TRU waste, hazardous waste, and LLW and mixed-LLW waste RODs.

4.13.1 Waste Generation from Routine Operations

The major waste types generated at Y-12 from routine operations include LLW, MLLW, hazardous waste, and nonhazardous waste. Table 4.13.1-1 presents the types of wastes generated by Y-12 and the way these wastes are managed. Table 4.13.1–2 presents a summary of waste generation totals for routine operations at Y-12 for FY 2007. Other waste includes sanitary and industrial wastewater, PCBs, asbestos, construction debris, general refuse, and medical wastes. Y-12 does not generate or manage high-level radiological waste or TRU waste.

Table 4.13.1-1. Waste Management PEIS Records of Decision Affecting Y-12.

Waste Type	Preferred Action
Low-level radioactive	DOE decided to treat ORR liquid low-level radioactive waste on-site.[a] Separate from the Waste Management PEIS, DOE prefers offsite management of ORR solid low-level radioactive waste after temporary onsite storage.
Mixed low-level radioactive	DOE decided to regionalize treatment of mixed low-level radioactive waste at ORR. This includes the onsite treatment of ORR waste and could include treatment of some mixed low-level radioactive waste generated at other sites.[b]
Hazardous	DOE decided to use commercial and onsite ORR facilities for treatment of ORR nonwastewater hazardous waste. DOE will also continue to use onsite facilities for wastewater hazardous waste.[e]

a – From the ROD for low-level waste (65 FR 10061).
b – From the ROD for mixed low-level waste (65 FR 10061).
c – From the ROD for hazardous waste (63 FR 41810).

Low-Level Waste. Solid LLW, consisting primarily of radioactively contaminated scrap metal, construction debris, wood, paper, asbestos, filters containing solids, and process equipment is generated at Y-12. In FY 2007, Y-12 generated approximately 9,405 cubic yards of solid LLW. Liquid LLW is treated in several facilities, including the West End Treatment Facility (WETF). Y-12 is the largest generator of routine LLW at Oak Ridge. In FY 2007, Y-12 generated 713 gallons of liquid LLW.

Mixed Low-Level Waste. Mixed waste subject to treatment requirements to meet Land Disposal Restrictions (LDRs) under RCRA are generated and stored at Y-12. DOE is under a State Commissioner's Order (October 1, 1995) to treat and dispose of these wastes in accordance with milestones established in the *Site Treatment Plan for Mixed Waste on the Oak Ridge Reservation* and to comply with a *Federal Facilities Compliance Act* (FFCA) that went into effect on January 1992. TSCA-regulated waste (containing PCBs) that is also radioactive waste is managed under a separate FFCA agreement, first effective August, 1997 (ORR 1997). In FY 2007, Y-12 generated 126 cubic yards of solid mixed low-level waste and 1,096 gallons of liquid MLLW.

Hazardous Waste. RCRA-hazardous waste is generated through a wide variety of production and maintenance operations. The majority of RCRA-hazardous waste is in solid form. In FY 2007, Y-12 generated 11.62 short tons of RCRA waste. The hazardous waste is shipped offsite for treatment and disposal at either DOE or commercially-permitted facilities.

Other Waste Types. During 2004, the sanitary wastewater flow averaged about 663,000 gallons per day. Treated sanitary wastewater is discharged to the sanitary system in accordance with the

Industrial and Commercial User Wastewater Discharge Permit No. 1-91. PCBs are transported to permitted facilities for treatment and disposal. Medical wastes are autoclaved to render them noninfectious and are then sent to a Y-12 sanitary industrial landfill, as are asbestos wastes and general refuse. Construction, demolition, and nonhazardous industrial materials are disposed of in a construction/demolition landfill at Y-12.

Capacities. Excess treatment and disposal capacity for hazardous waste exist both onsite and offsite at Y-12. Storage capacities at Y-12 are currently adequate for hazardous, MLLW, and LLW.

Table 4.13.1–2. Waste Generation Totals by Waste Type for Routine Operations at Y-12.

Waste Type	Waste Volume (FY-2007)
Low-level waste (liquid)	713 gallons
Low-level waste (solid)	9,405 cubic yards
Mixed low level waste (liquid)	1,096 gallons
Mixed low level waste (solid)	126 cubic yards
RCRA waste	11.62 tons
TSCA waste	0.73 tons
Mixed TSCA	15.89 tons
Sanitary waste	10,373.88 tons

Source: Jackson 2008.

4.13.2 Waste Management Facilities

The majority of waste management facilities at Y-12 are operated by NNSA. Waste management facilities are located in buildings, or on sites, dedicated to their individual functions, or are collocated with other waste management facilities or operations. Active facilities for the storage and treatment of LLW, MLLW, RCRA-hazardous and TSCA-regulated waste as well as disposal facilities for non-hazardous waste are summarized in this section. Many of the facilities are used for more than one waste stream.

The TDEC DSWM regulates the management of both hazardous and non-hazardous waste streams under the TSWMA. Facilities used to store or treat RCRA-hazardous waste at Y-12 are regulated by the DSWM as authorized by the EPA. These facilities may also be used to manage mixed waste (waste that is both RCRA-hazardous and radioactive). There are no facilities for the disposal of solid hazardous waste currently in operation at Y-12. Storage and physical treatment (e.g., shredding, compaction) of non-hazardous waste does not generally require a permit under RCRA. There are three landfills in operation for disposal of non-hazardous waste at Y-12. These disposal facilities are regulated by the TDEC DSWM as well.

TSCA-regulated waste that contains PCBs is managed at Y-12 in accordance with EPA regulations (40 CFR Part 761) and with the FFCA for managing PCBs on ORR (EPA 1997). Many requirements for the safe storage and handling of PCB waste are similar to requirements for RCRA-hazardous waste. Therefore, PCB wastes and TSCA mixed waste (waste containing both PCBs and radioactivity) are often stored in facilities approved for RCRA-hazardous and mixed waste storage. Some Y-12 databases and reports group TSCA regulated and RCRA-hazardous wastes together and refer to this grouping as hazardous waste.

DOE is authorized to manage radioactive waste that it generates under the *Atomic Energy Act* of 1954. LLW is generated during machining and other operations at Y-12. DOE stores, treats, and repackages, but does not dispose of LLW at Y-12. The majority of the LLW generated at Y-12 is dry active waste, construction debris, and scrap metal. LLW at Y-12 is managed in accordance with DOE Orders, policies, and guidance related to management of radioactive waste. Management of this waste is not directly regulated by EPA or TDEC.

The following description of waste management facilities at Y-12 focuses on the facilities currently available for managing waste at Y-12. The facilities are grouped by functional program area: storage, treatment, or disposal.

4.13.3 Waste Storage at Y-12

Storage for Mixed Waste Residues/Ash. The enriched uranium (EU) Building along with Building 9206 provide container storage areas for mixed waste residues or ash. A RCRA operating permit was issued in 2005. The ash results from the burning of solvent- and uranium-contaminated solid wastes. The ash does not contain free liquids. Uranium-bearing solutions generated during the uranium recovery process and laboratory analyses are also stored in these buildings. These solutions, as well as the residues, are mixed (hazardous and radioactive) wastes and are being stored prior to further uranium recovery. Occasionally, uranium-bearing materials generated offsite may be stored in the EU and EU storage buildings, prior to uranium recovery at the EU Building. Although a Phaseout/Deactivation Program Management Plan has been approved by DOE for the EU Storage Building, and the recovery operations within this facility will no longer be operated, this building will continue to store hazardous and mixed waste for several years.

Production Tank Farm. The Production Tank Farm, a RCRA permit-by-rule facility, consists of three dikes containing four 10,000-gallon stainless-steel tanks that are used to collect nitrate waste from operations before being transferred to the WETF.

Liquid Storage Facility. The Liquid Storage Facility is a hazardous and mixed waste storage and pretreatment facility built during the Bear Creek Burial Ground closure activities. It is located in Bear Creek Valley approximately two miles west of Y-12, and operates under RCRA permit-by-rule as materials from the facility are subsequently transferred to an NPDES-permitted facility. It collects, stores, and pre-treats groundwater and other wastewater received from the seep collection lift station, the Disposal Area Remedial Action (DARA) Solid Storage Facility, tankers, polytanks, and a water collection/storage tank which accommodates rainfall accumulation in the diked area. Feed streams may contain oil contaminated with PCBs, VOCs, non-VOCs, and heavy metals. Most equipment is in an outdoor containment area which includes two 75,000-gallon bulk water storage tanks, a 6,000-gallon oil storage tank; a gravity separator, two filtering units, a composite monitoring station, and a tanker transfer station. Collected liquids are pretreated by traveling through the gravity separator, filters, and composite monitoring station prior to entering bulk storage tanks. The wastewater is then transferred by tanker to the Groundwater Treatment Facility for further treatment.

PCB and RCRA Hazardous Drum Storage Facility. This building is a 12,500-square foot, single-story, prefabricated metal building with slab on grade built in 1955. The facility provides a drum storage area for mixed and PCB waste, including an area for flammable waste. The building is used to store both RCRA and PCB mixed waste.

Container Storage Facility. The Container Storage Facility, also called the LLW Storage Areas, provides storage for mixed (hazardous and radioactive) waste residues, ash, and combustibles. It also contains some classified waste. A RCRA operating permit was issued in 2005. The ash is a product of burning solvent- and uranium-contaminated wastes. Unburned solvent- and uranium-contaminated solid wastes are also here. The waste at this building contains no free liquids and is typically generated during the uranium recovery process. Some of this waste is also stored in the buildings that store mixed waste residues/ash, as described above.

Waste Storage Facility. The Waste Storage Facility is a 17,600-square foot, single-story building with masonry-bearing walls and a precast concrete roof system built in 1962. It provides storage for PCB waste, LLW and MLLW, which is classified for national security purposes under provisions of the *Atomic Energy Act.* A new RCRA operating permit was issued in 2005.

PCB Storage Facility. The PCB Storage Facility provides storage capability for PCB waste, primarily PCB-containing ballasts. This building is a 3,600-square foot, single-story building with masonry-bearing walls and a structural steel roof built in 1984.

RCRA and Mixed Waste Staging and Storage Facility. The RCRA Staging and Storage Facility is a 6,571-square foot, single-story building with masonry-bearing walls and a precast concrete roof system built in 1986. A new RCRA permit was issued in 2005. Solid, liquid, and sludge wastes are prepared for offsite shipment at this facility. The facility consists of seven storage rooms and seven staging rooms, each with a separate ventilation system. The staging rooms house small containers that are packed with compatible materials and shipped. The storage rooms hold larger containers, such as 55-gallon drums.

West Tank Farm. The West Tank Farm provides storage for mixed and LLW sludge and is associated with the WETF. It operates under RCRA permit-by-rule (see also Section 4.13.4, WETF). The West Tank Farm includes thirteen 500,000-gallon tanks. Six are utilized as process bioreactors, and three serve as holding tanks for an effluent polishing system. The remaining four tanks hold sludges that are RCRA-hazardous due either to listing or characteristics. Currently, one tank is empty and one is being emptied. In addition, three, 100,000-gallon tanks provide storage for radioactively contaminated calcium carbonate sludge generated as a result of WETF processes.

Old Salvage Yard. The Old Salvage Yard, located at the west end of Y-12, contains both low-level uranium-contaminated and non-radioactive scrap metal. The Contaminated Scrap Metal Storage is an area within the Old Salvage Yard that is used to store uranium-contaminated scrap metal. Contaminated scrap is placed in approved containers and shipped offsite to NTS for disposal. This facility is closed and all scrap metal is currently being removed and properly disposed. As discussed in Section 2.2.2.4, this site is expected to be remediated under the American Recovery and Reinvestment Act in accordance with CERCLA requirements.

New Salvage Yard. Contaminated waste is sent to the New Salvage Yard for staging. Likewise, new waste containers are staged here as well. It consists of 8 enclosed acres; 1 acre is paved. The New Salvage Yard provides accumulation and sorting space for the scrap metal. This facility is located west of Y-12 on the north side of Bear Creek Road, near the Bear Creek Burial Grounds.

DARA Solid Storage Facility. The DARA Solid Storage Facility provides 17,500 square feet of storage space for PCB-, RCRA-, and uranium-contaminated soil. The facility has a synthetic liner for leachate collection and a leak detection system. Collected leachate is transferred to the Liquid Storage Facility for pretreatment. The DARA Solid Storage Facility is an interim-status facility under RCRA, but is now being managed through the CERCLA process. No additional wastes are being added to the facility.

Containerized Waste Storage Area. The Containerized Waste Storage Area consists of three concrete pads covering approximately 24,800 square feet. An impermeable dike for spill containment surrounds each pad. No wastes are currently stored at the Containerized Waste Storage Area, which has been turned over to the DOE-EM surveillance and maintenance program.

Production Waste Storage Facility. The Production Waste Storage Facility (also a Container Storage Area) has not yet been used for storage, but future use is planned. The building is separated into two areas, a smaller one for ignitable RCRA waste, and a larger area for non-ignitable waste. Both areas have curbing and may be used for containerized liquids if stored on self-containing pallets. The facility houses the non-destructive assay equipment for Y-12 and has a design capacity for storage of 616,968 gallons. The permitted area was closed in 2004.

LLW Storage Pad. The LLW Storage Pad, is located in the Sludge Handling Facility that originally provided water filtration and sludge dewatering to support a storm sewer cleaning and relining project. The facility is empty currently and transitioning to the DOE-EM surveillance and maintenance program.

Liquid Organic Solvent Storage Facility. The Liquid Organic Waste Storage Facility is a 2,250-square foot single-story pavilion with metal posts and roof panels, built in 1987. It contains four 6,500-gallon and 3,000-gallon stainless-steel tanks for storage of ignitable nonreactive liquids, including those contaminated with PCBs and uranium. In addition, a diked and covered storage area provides space for 10,600 gallons of containerized waste. The facility is set up to segregate various spent solvents for collection and storage. Major solvent waste streams are transferred to tanks until final disposal. This facility is currently empty, RCRA-closed, and managed under the DOE-EM surveillance and maintenance program.

RCRA and PCB Container Storage Area. The RCRA and PCB Container Storage Area is a 4,200-square foot single-story, prefabricated metal building with metal wall panels built in 1987. It is a warehouse facility used for staging prior to treatment or disposal of PCB- and RCRA-contaminated equipment (e.g., transformers, capacitors, and electrical switchgear) and non-reactive, non-ignitable RCRA, mixed and PCB waste. The facility was emptied and the permitted area was closed in 2002. It is currently used as a vehicle maintenance garage.

Classified Container Storage Facility. The Classified Container Storage Facility (also a Production Waste Storage Facility) is a 15,105-square foot, single-story, prefabricated metal building with metal wall panels. The permitted area was closed in 2003, and the facility is currently used for material storage.

Depleted Uranium Oxide Storage Vaults I and II. The Depleted Uranium Oxide Storage Vaults I and II are located on Chestnut Ridge. The vaults are constructed of reinforced concrete and provide a retrievable storage repository for uranium oxide, uranium metal, and a blended mixture of uranium sawfines and oxide. The vaults contain a negative pressure exhaust system that operates during material entry. The exhaust is filtered and monitored prior to its release to the atmosphere. Waste is no longer accepted in the vaults. One vault is empty and was never used. One building was formerly used as storage for drummed, depleted uranium oxide materials; it is a 1,200-square foot single-story building built in 1990 with masonry-bearing walls and a structural steel roof system. The third building is currently empty. This building and the vaults are inactive and currently managed by the DOE-EM surveillance and maintenance program.

OD7 Waste Oil Storage Tank Area. This building houses three areas for storage of RCRA liquids (OD7, OD8, and OD9), and is an 874-square foot, single-story, prefabricated metal building with metal wall panels, built in 1986. OD7 contains a diked storage area for tanks (permitted in 2005). The OD7 contains four 30,000-gallon tanks, two 10,000-gallon tanks, and associated piping and pumps. The OD7 facility was emptied, RCRA-closed in 2002, and is now managed by the DOE-EM surveillance and maintenance program.

OD8 Waste Oil Solvent Drum Storage Facility. The Waste Oil Solvent Drum Storage Facility (OD8) has a capacity for 55-gallon drums and a smaller number of Tuff tanks. RCRA waste oil/solvent mixtures containing various concentrations of chlorinated and nonchlorinated hydrocarbon solvents, uranium, trace PCBs, and water for specific chemical constituents are stored at OD8 in 55 gallon drums and 300 gallon Tuff tanks. The facility was emptied and the permitted area was closed in 2002. The facility is currently used for material storage.

OD9 Waste Oil/Solvent Storage Facility. The Waste Oil/Solvent Storage Facility (OD9) houses LLW, MLLW, and hazardous waste, including PCBs. It consists of a diked area supporting five 40,000-gallon tanks, a tanker transfer station with five centrifugal transfer pumps, and a drum storage area. A diked and covered pad furnishes space for 1,165 cubic feet of containerized waste. The diked area contains additional space for a sixth 40,000-gallon tank. All tanks were emptied and the facility was RCRA-closed in 2002. The facility is now managed by the DOE-EM surveillance and maintenance program.

Oil Landfarm Soil Storage Facility. The Oil Landfarm Soil Storage Facility is a RCRA-interim-status facility containing 14,832 cubic feet of soil contaminated with PCBs and volatile organics. The soil was excavated from the Oil Landfarm and Tributary 7 in 1989. The soil is contained in a covered, double-lined concrete dike with a leak-detection system. This facility is now closed.

4.13.4 Treatment of Waste at Y-12

Central Pollution Control Facility. The Central Pollution Control Facility, a 20,000-square foot multistory structural steel building with masonry walls, began operation in 1985. The Central Pollution Control Facility operates under RCRA permit-by-rule and an NPDES permit issued in April 28, 1995. It is the primary facility for treatment of non-nitrated waste. It receives wastes that are acidic or caustic, oily mop water containing beryllium, thorium, uranium, emulsifiers, and cleansers. The facility can also destroy diluted quantities of cyanide in wastewater using ultraviolet oxidation. The Central Pollution Control Facility provides both physical and chemical processing, including oil/water separation, neutralization, precipitation, coagulation, flocculation, carbon adsorption, decanting, and filtration. Treated water is discharged to EFPC through an NPDES monitoring station or sent to the WETF for further processing. Sludge from the treatment processes is transferred to the West End Tank Farm. Spent carbon cartridges and filters are disposed of in commercial treatment, storage, and disposal (TSD) facilities.

Plating Rinsewater Treatment Facility. The Plating Rinsewater Treatment Facility treats dilute, non-nitrate bearing, plating rinsewater contaminated primarily with chromium, copper, nickel, and zinc. In addition, the facility can remove chlorinated hydrocarbons. It is currently not maintained in operable status because the Plating Shop that formerly produced most of Y-12's rinsewater has been deactivated. The facility's neutralization and equalization equipment are located outdoors in a diked basin. The remainder of the facility process is located within the Central Pollution Control Facility.

Central Mercury Treatment System. The Central Mercury Treatment System (CMTS) is designed to treat mercury-contaminated sump water from former mercury use buildings. The CMTS was installed as part of the Y-12 Integrated Mercury Strategy Program to achieve compliance with regulations and guidance addressing mercury contamination in EFPC. Sump water from several buildings is treated at the CMTS. The CMTS is located in the Central Pollution Control Facility. Outfall 551 is the discharge point where treated wastewater is discharged in conformance with NPDES monitoring guidelines.

West End Treatment Facility. The WETF treats MLLW- and LLW-contaminated wastewater generated by Y-12 production operations and other DOE-ORO activities meeting the facility waste acceptance criteria under a RCRA permit-by-rule. Treatment methods include hydroxide precipitation of metals, sludge settling and decanting, bio-denitrification, bio-oxidation, pH adjustment, degasification, coagulation, flocculation, clarification, filtration, and carbon adsorption. Wastewaters are primarily nitrate bearing and include the following: nitric acid wastes, mixed acid wastes, waste coolant solutions, mop water, and caustic wastes. Wastes are received at the WETF in 5,000-gallon tankers, 300-gallon polytanks, drums, carboys, and small bottles. Detailed waste characterization documentation and jar tests are used to determine the treatment scheme for wastewater shipments. Treatment at WETF is performed in three processes: Head End Treatment, West Tank Farm biological treatment, and Effluent Polishing. The Head End Treatment System consists of waste receiving, hydroxide precipitation of heavy metals, sludge settling, and decanting. Biological treatment in the West Tank Farm consists of bio-denitrification, then bio-oxidation. The Effluent Polishing System consists of pH adjustment,

degasification, coagulation, flocculation, clarification, filtration, carbon adsorption, and effluent discharge to the EFPC through an NPDES monitoring station.

Legacy MLLW treatment sludges are presently being removed from sludge storage tanks at the West Tank Farm for offsite disposal. Currently generated MLLW and LLW treatment sludges are being accumulated and concentrated for final characterization and disposal. Other treatment residuals, such as spent carbon and personal protective equipment, are being sent for immediate offsite disposal where feasible or otherwise characterized for onsite treatment or disposal.

Organic Handling Unit for Mixed Waste. The Organic Handling Unit provides storage and treatment of organic solutions containing EU. The uranium level in the waste material arriving at the Organic Handling Unit is typically less than 400 parts per million. These wastes are characterized as mixed hazardous and radioactive wastes. Occasionally, EU-contaminated wastes generated offsite may be treated at the Organic Handling Unit. An assay reduction process is used to dilute the U-235 isotope with U-238 isotope in such a manner that they cannot be easily separated chemically or physically. This is accomplished by first mixing depleted uranyl nitrate with the organic solution and then neutralizing the organic solution by adding sodium hydroxide or other acceptable material. Since uranyl nitrate solution is not readily soluble in most organic solutions, "extractant" may be added to the organic solution.

Biodenitrification Unit. The Biodenitrification Unit has been in stand-down, but restart is anticipated. It is capable of treating nitrate-bearing, liquid MLLW generated by enriched uranium recovery operations in EU Building. The denitrification unit removes nitrates from the waste and also separates liquids and solids. The wastewater is then transferred to the WETF for further treatment, and the sludge is transferred to the West Tank Farm.

Uranium Recovery Operations. Uranium Recovery Operations are a recovery process to increase production efficiency at Y-12. Liquid waste from the operation is transferred to the Biodenitrification Unit. The system is exempt from permitting requirements under RCRA.

Groundwater Treatment Facility. The Groundwater Treatment Facility treats wastewater to remove VOCs, non-VOCs, iron, and other contaminants. It is part of the DARA program to treat groundwater contaminated with LLW and MLLW that is collected from the Bear Creek Burial Grounds. The Groundwater Treatment Facility is located at the far west end of Y-12, in the same building as the WETF. This facility uses an air stripping operation to remove VOCs. In addition, carbon adsorption eliminates nonvolatile organics and PCBs. Precipitation and filtration are used to remove iron. After treatment, wastewater is sampled and recycled if additional processing is required. Wastewater that meets discharge specifications is pumped into the EFPC through a NPDES monitoring station.

Big Spring Wastewater Treatment System. Y-12 Big Spring Wastewater Treatment System (BSWTS) is a full-scale treatment system that removes mercury contamination from a spring (outfall 51) that discharges directly to UEFPC. The BSWTS can reduce the mercury concentration to less than 50 nanograms per liter at a flow rate of 300 gallons per minute. Unit processes in the facility include (1) a water collection wetwell, (2) a 92,000-gallon equalization tank, (3) pre and post filters, (4) carbon adsorption columns, (5) a backwash feed and collection

system, and (6) a caustic feed pH adjustment system. The process system is housed in a pre-engineered, ventilated, steam-heated metal building. The 1.5-story building is about 40 feet wide and 75 feet long. The instrumentation and control system allows the process to operate automatically and unattended.

Steam Plant Wastewater Treatment Facility. The Steam Plant Wastewater Treatment Facility treats wastewater from Steam Plant operations, demineralizers, and coal pile runoff. Treatment processes include wastewater collection/sedimentation, neutralization, clarification, pH adjustment, and dewatering. The treatment facility uses automated processes for continuous operation. All solids generated during treatment are nonhazardous and are disposed of in the sanitary landfill. The treated effluent is monitored prior to discharge to the Oak Ridge public sewage system.

Uranium Chip Oxidation Facility. The Uranium Chip Oxidation Facility is a 3,750-square foot, single-story, prefabricated building with metal wall panels built in 1987. The facility thermally oxidizes depleted and natural uranium machine chips under controlled conditions to a stable uranium oxide. Upon arrival, chips are weighed, drained of machine coolant, placed into an oxidation chamber, and ignited. The oxide is transferred into drums and disposed of in an offsite commercial facility. The Uranium Chip Oxidation Facility is not designed to treat uranium sawfines. Hence, sawfines are currently blended with uranium oxide and placed in storage as a short-term treatment method.

Waste Feed Preparation Facility. The Waste Feed Preparation Facility is a 3,600-square foot, single-story, prefabricated building with metal wall panels built in 1984. It was previously used to process and prepare solid LLW for volume reduction (compaction and repackaging) by an outside contractor or storage facility. Although the compactor/baler is inactive, the facility has been used in recent years as a waste sorting/segregation facility to prepare containers for offsite shipment.

Steam Plant Ash Disposal Facility. The Steam Plant Ash Disposal Facility is used to collect, dewater, and dispose of sluiced bottom ash generated during operation of the coal-fired Y-12 Steam Plant. To comply with environmental regulations for landfill operations, it includes a leachate collection system and a transfer system to discharge the collected leachate into the Oak Ridge public sewage system. The dewatered ash is disposed of in Landfill VI.

Cyanide Treatment Unit. The Y-12 Cyanide Treatment Unit provides storage and treatment of LLW and MLLW solutions containing metallic cyanide compounds from spent plating baths and precious metal recovery operations or other areas; the unit's RCRA permit was issued on September 28, 1995. Treatment is by chemical oxidation and pH adjustment. The cyanide reduction process performed within the unit is currently performed in 55-gallon containers. After waste is treated at the Cyanide Treatment Unit, it is transferred to the WETF for further treatment, then discharged to the EFPC. The Cyanide Treatment Unit was closed in 2004 (DOE 2005a).

4.13.5 Disposal of Waste at Y-12

DOE operates solid waste disposal facilities located near Y-12, called ORR Sanitary Landfills. In 2004, industrial, construction/demolition, classified, and spoil material waste were disposed of at these landfills. The wastes must be non-hazardous, non-radioactive, and non-RCRA-regulated. DOE must use approved operations in receiving, compacting, and covering waste.

TDEC performs a monthly audit of DOE's landfills on ORR. It also reviews DOE practices to ensure that radioactive waste is not disposed of in these landfills. Waste that contains residual radioactive materials at levels below authorized limits established in accordance with DOE Order 5400.5 may be accepted for disposal. All DOE facilities may receive materials containing residual radioactivity of any radionuclide on material surfaces provided that they are below limits specified in DOE Order 5400.5. Current waste acceptance criteria (WAC) for the landfills include a ceiling for residual radioactivity of 35 picocuries per gram for total uranium on a volumetric basis. Materials containing uranium and other radioisotopes with residual levels of radioactivity below DOE authorized limits on a volumetric basis are accepted for disposal on a case-by-case basis. The landfills are summarized below, based on information in the TDEC Status Report to the Public for FY 2004 (TDEC 2005a).

Industrial Landfill IV. Industrial Landfill IV is used for disposal of classified, non-hazardous industrial waste, for construction/demolition waste, and for approved special waste. It has a footprint of about four acres. This industrial waste landfill operates as an approved Class II landfill in accordance with TDEC permit No. IDL-01-103-0075. Because it was opened prior to implementation of the current Class II requirement established in the TDEC solid waste processing and disposal regulation, the eastern area does not require a leachate collection system or gas monitoring capabilities. However, it has a leachate collection system in place in the western area and a gas monitoring system. Landfill IV is a classified industrial landfill.

Industrial Landfill V. Industrial Landfill V is a Class II landfill permitted under TDEC permit No. IDL 01-103-0083. The landfill receives mostly sanitary and industrial waste generated at the plants. It does accept special waste approved by TDEC. Industrial Landfill V is used for disposal of unclassified, non-hazardous sanitary/industrial waste and for approved special waste. Approved special wastes have included asbestos materials, empty aerosol cans, materials contaminated with beryllium, glass, fly ash, coal pile runoff sludge, empty pesticide containers, and Steam Plant Wastewater Treatment Facility sludge. The landfill area is located on Chestnut Ridge near the eastern end of Y-12 and serves Y-12, ORNL, ETTP, and other DOE prime contractors at Oak Ridge. The landfill is equipped with a liner and leachate collection system. Disposal of special waste is approved on a case-by-case basis by the State of Tennessee. Requests are filed with the state to provide disposal for additional materials as needed. The landfill is approximately 15 percent filled. The landfill has a footprint of almost 26 acres and is being constructed in phases as disposal capacity is needed.

Construction/Demolition Landfill VI. Construction/Demolition Landfill VI accepts unclassified, non-hazardous construction/demolition debris and approved special waste. Dewatered ash from the Y-12 Steam Plant is currently disposed of in Landfill VI. The facility has been constructed to 100 percent design capacity and has been in operation since 1993.

Landfill VI was certified closed during FY 2004 and, therefore, no waste was disposed at the landfill during the year.

Construction/Demolition Landfill VII. Landfill VII is a Class IV landfill permitted under TDEC permit No. DML-01-103-0045. This landfill is used for the disposal of demolition/construction waste and certain other TDEC-approved waste having similar characteristics. It was placed in service when Landfill VI filled to capacity in 2004. It has a footprint of slightly more than 30 acres. The Construction/Demolition Landfill VII was expanded in 2004 to add 175,000 cubic yards of capacity. Construction/Demolition Landfill VII is the repository for much of the uncontaminated debris generated by demolition of buildings at ETTP. Future expansion will add another 336,000 cubic yards of capacity to Construction Demolition Landfill-VII.

Onsite Low-Level Waste Disposal Capability. Y-12 has no active disposal facility onsite for LLW or hazardous waste. All disposal activities at the Bear Creek Burial Grounds were terminated in 1993. These burial grounds were used to dispose of radiologically contaminated waste. Similar waste streams generated today are containerized and stored at Y-12 or are shipped offsite for disposal.

However, the EMWMF was constructed to provide a new disposal capability at ORR for various types of hazardous and radioactively-contaminated waste under certain conditions. This facility has only been approved to accept waste generated as a result of response actions to expedite cleanup of contamination that resulted from previous DOE and *Atomic Energy Act* operations on ORR and that are conducted under CERCLA authorization (or in a few cases, under the Inactive Hazardous Substances Site Remedial Action Program [State Superfund] of the State of Tennessee). The EMWMF was constructed in Bear Creek Valley (near Y-12) to dispose of wastes generated by CERCLA activities on ORR. The facility relies on waste profiles provided by the waste-generating organizations to characterize waste disposed in the facility. This profile is based on an average of contaminants in a waste lot. Since the size of waste lots can vary from a single package to many truckloads of waste, the averages reported are not necessarily representative of each load of waste transported to the facility. That is, some loads may have highly contaminated wastes, while other loads may contain very little contamination. The EMWMF has a design capacity of 1,300,000 cubic yards. The construction of cell 5 of the EMWMF (currently occurring) would expand the capacity to 1,700,000 cubic yards. Cell 6, which is currently under design, would expand the capacity to approximately 2,200,000 cubic yards.

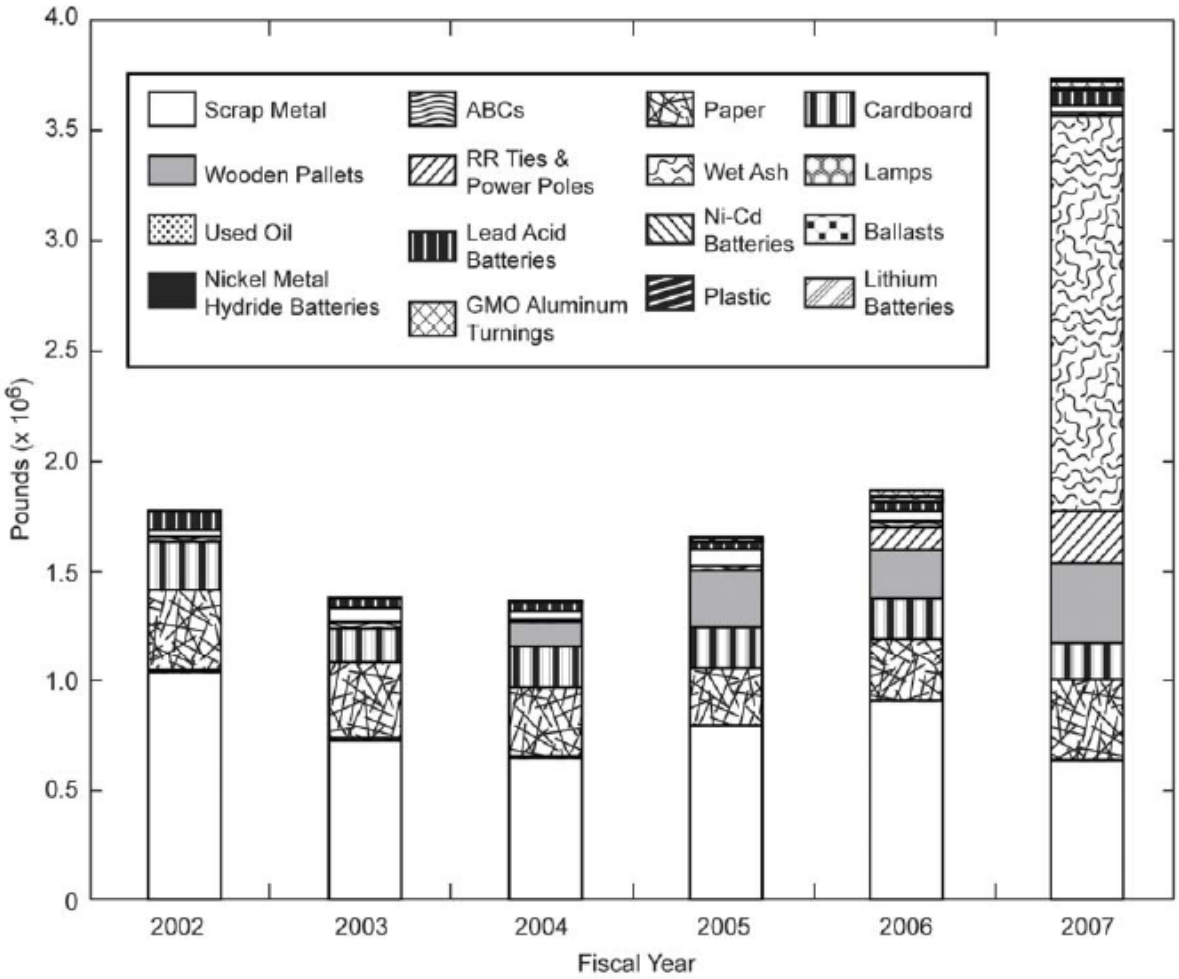
4.13.6 Pollution Prevention

The *Pollution Prevention Act* of 1990 (42 U.S.C. § 13101) and the *Hazardous and Solid Waste Amendments* of 1984 (P.L. 98-616, 98 Stat. 3221) enabled Federal agencies to implement the pollution prevention program. NEPA's original purpose, which was to promote efforts that would prevent or eliminate damage to the environment, was complemented by both acts. This relationship was further strengthened by a 1993 memorandum from the CEQ, which recommended that Federal agencies incorporate pollution prevention principles, techniques, and

mechanisms throughout their NEPA planning and decisionmaking processes. This section provides detailed information regarding pollution prevention and waste minimization at Y-12.

EPA has published strategies and guidelines to help facilities meet regulatory requirements. The *Pollution Prevention Act* establishes an environmental protection hierarchy, with source reduction as the most desirable environmental management option. If pollution cannot be prevented at the source, then the following waste management options should be explored in order of preference: reuse, recycling, treatment, and disposal. Waste avoidance is accomplished by source reduction or the recycling of solid wastes regulated under the RCRA. Pollution prevention complements the concept of waste avoidance by focusing on source reduction and other practices that reduce or eliminate pollutants through increased efficiency in the use of raw materials, energy, water, or other resources, or protection of natural resources by conservation. Waste avoidance is an applied element of the pollution prevention process.

The Y-12 Pollution Prevention Program is consistent with DOE and other legal requirements and designed to eliminate or minimize pollutant releases to all media and incorporate a pollution prevention ethic into the facility. Y-12 has a well-established recycling program and continues to identify new material streams and expand the types of materials that can be recycled by finding new markets and outlets for the materials. As shown in Figure 4.13.6-1, Y-12 has diverted thousands of metric tons of materials from the landfill and into viable recycle processes. Currently, materials recycled by Y-12 range from office-oriented materials such as paper (including phone books), aluminum cans, and toner cartridges to operations-oriented materials such as scrap metal, tires, and batteries. Many Y-12 recycling activities have been implemented, including the 2007 activities highlighted in this section (DOE 2008).



Source: DOE 2008.

Figure 4.13.6-1. Y-12 Recycling Program Results.

In FY 2007, Y-12 established a comprehensive program for recycling transformers through an offsite vendor. This recycling initiative began in FY 2006, when more than 80 transformers were identified and earmarked for disposition. Recycling provides an environmentally friendly way to disposition transformers and greatly minimizes the environmental liability related to storing old transformers onsite. In FY 2007, this initiative resulted in 118 transformers, totaling 62,100 pounds being sent offsite for recycle, saving more than 1,670 cubic feet of landfill space, generating $8,000 in revenue, and avoiding more than $3,660 in landfill disposal cost. The total estimated cost avoidance for this initiative was more than $11,660 (DOE 2008).

Y-12 teamed with ORNL and an offsite smelting operation to avoid the generation of mixed-hazardous waste at Y-12 and to reduce the need for procurement of a hazardous material at ORNL and across the DOE Complex. ORNL had identified the need for lead for use as shielding in onsite operations but did not have enough onsite to meet its needs. Additionally, an offsite smelting operation needed lead for use across the DOE Complex. In contrast, Y-12 had excess lead onsite that if not reused would ultimately be deemed a mixed RCRA hazardous waste. Through these joint efforts, approximately 53,323 pounds of excess lead located at Y-12 was

transferred to contractors at ORNL for reuse as shielding and to the offsite smelting operation for use across the DOE Complex. While the transfer of the lead resulted in more than $113,300 in costs for Y-12, the disposal costs alone for Y-12 would have been more than $213,290, resulting in an overall cost avoidance of almost $100,000 (DOE 2008).

Y-12 expanded the battery recycling initiative to include the recycling of silver, lithium, and mercury batteries to an offsite recycling vendor. This initiative was fully-implemented during September 2007. This recycling initiative is expected to contribute to waste-reduction amounts and cost avoidances in the future (DOE 2008).

Energy management is an ongoing and comprehensive effort that contains a key strategy of implementing guidelines to reduce the consumption of energy, water, and fuel (including gasoline, diesel fuel, electricity, and natural gas). Energy savings performance contracts (ESPCs) have been used at Y-12 and are integral to the future of Y-12 as a means of funding modernization of the complex with energy-saving equipment. With the advent of requirements of Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," ESPCs have been reinvigorated as a method for recapitalizing energy saving investments at Y-12. Johnson-Controls, Inc., has been selected as Y-12's Energy savings contractor (ESCO). The ESPC kick-off meeting was conducted in January 2008, initiating the project development phase (DOE 2008).

Energy consumption over the past several years has continued a steady downward trend. By FY 2006, Y-12 achieved an overall energy usage reduction of 44.5 percent from the previously existing FY 1985 baseline. In FY 2007, EO 13423 reset the baseline for comparison to FY 2003. Energy consumption in FY 2007 continued its downward trend, achieving a 6.8 percent reduction in energy intensity relative to the new FY 2003 baseline.

4.14 ENVIRONMENTAL RESTORATION ACTIVITIES AT ORR

For over half a century, one of the primary missions of DOE and its predecessor agencies was the production of nuclear weapons for the nation's defense. Production of materials for nuclear weapons, which began in 1943, produced hazardous and radioactive waste and resulted in contamination of facilities, structures, and environmental media. Two laws passed by Congress included requirements to address these problems. These two laws are the FFCA and the CERCLA. The FFCA requires that all DOE facilities manage and dispose of waste in accordance with their respective site treatment plans. The Waste Disposition and Waste Operations projects address waste stored, treated, disposed of, or recycled on ORR in accordance with the Site Treatment Plan.

CERCLA, also known as Superfund, was passed in 1980 and was amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA). Under CERCLA, a site is investigated and remediated if it poses significant risk to health or the environment. The EPA National Priorities List (NPL) is a comprehensive list of sites and facilities that have been found to pose a sufficient threat to human health and/or the environment to warrant cleanup under CERCLA. In 1989, ORR was placed on EPA's NPL.

In 1992, ORR Federal Facility Agreement among EPA, TDEC, and DOE became effective and established the framework and schedule for developing, implementing, and monitoring remedial actions on ORR. The onsite CERCLA Waste Facility, located in Bear Creek Valley, is used for disposal of waste resulting from CERCLA cleanup actions on ORR, including ORNL (DOE 2008).

The CERCLA Waste Facility is an engineered landfill that accepts low-level radioactive and hazardous wastes in accordance with specific waste acceptance criteria under an agreement with state and federal regulators. The ORR Federal Facility Agreement is intended to coordinate the corrective action processes of RCRA required under the Hazardous and Solid Waste Amendments permit with CERCLA response actions. Three RCRA postclosure permits, one for each of the three hydrogeologic regimes at Y-12, have been issued to address the eight major closed waste disposal areas at Y-12. Because it falls under the jurisdiction of two postclosure permits, the S-3 Pond Site is described as having two parts (eastern and former S-3). Postclosure care and monitoring of East Chestnut Ridge Waste Pile was incorporated into permit TNHW-128. Groundwater corrective actions required under the postclosure permits have been deferred to CERCLA. RCRA groundwater monitoring data will be reported yearly to TDEC and EPA in the annual CERCLA *Remediation Effectiveness Report* for ORR (DOE 2008).

Periodic updates of proposed construction and demolition activities at Y-12 (including alternative financing projects) have been provided to managers and project personnel from the TDEC DOE Oversight Division, and EPA Region 4. A CERCLA screening process is used to identify proposed construction and demolition projects that warrant CERCLA oversight. The goal is to ensure that modernization efforts do not impact the effectiveness of previously completed CERCLA environmental remedial actions and that they do not adversely impact future CERCLA environmental remedial actions (DOE 2008).