

1. Introduction to the Oak Ridge Reservation

The concept of a Secret City is both mystifying and intriguing. It was here, and in supporting locations, that humankind leapt from candlepower to nuclear power in a single generation. In the Secret City an engineering marvel materialized that changed the world, helped bring an end to World War II, and launched the use of diagnostic tools such as magnetic resonance imaging and nuclear medicine that are saving thousands of lives from many types of cancer. Today, the Secret City exists in two parts: the commercial city of Oak Ridge and the Oak Ridge Reservation (ORR), which is a federally owned site in Anderson and Roane Counties in eastern Tennessee.

The ORR site covers 52 square miles of land used for commercial and industrial activities as well as streams, lakes, and woodlands teeming with deer, wild turkey, raccoon, squirrels, and rabbits; birds of prey such as eagles, osprey, great horned owls, and red tail and sparrow hawks; and wildlife predators including coyotes and bobcats. ORR is home to two major US Department of Energy (DOE) operating components: the Oak Ridge National Laboratory (ORNL) and the Y-12 National Security Complex (Y-12 Complex or Y-12). Other facilities on ORR include the East Tennessee Technology Park (ETTP), the site of a former gaseous diffusion plant that has undergone significant environmental cleanup and transitioned to a private sector business and industrial park; the Oak Ridge Institute for Science and Education (ORISE) South Campus, which includes training facilities, laboratories, and support facilities; several smaller, government-owned, contractor-operated facilities involved in environmental cleanup; and the government-owned, government-operated Agent Operations Eastern Command (AOEC) of the National Nuclear Security Administration (NNSA) Office of Secure Transportation (OST). Personnel seeking entrance to ORR must have proper credentials in accordance with current access security requirements.

President Franklin D. Roosevelt received the famous Einstein-Szilard letter in 1939 informing him that German scientists were working on a nuclear weapon. In utmost secrecy, he formed the agencies leading up to the Manhattan Project. Then, on June 28, 1941, the President signed Executive Order 8807 that ultimately funded the Manhattan Project. The super-secret code name Manhattan Project gave no indication of the classified activities it concealed. Originally established in New York City's Manhattan District on the 18th floor of an office building at 270 Broadway in June of 1942, the headquarters of the Manhattan Project moved to Oak Ridge, Tennessee in the late summer of 1943. Here scientists began using the gaseous diffusion process to enrich uranium and pioneered methods for producing and separating plutonium. ORR's mission continues to evolve as it adapts to meet the changing basic and applied research and national security needs of the United States.

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

1.1 Background

The ORR Annual Site Environmental Report (ASER) presents a summary of environmental data that characterizes environmental performance, lists environmental occurrences reported during the year, confirms compliance with environmental standards and requirements, and highlights significant environmental program activities. The ASER meets the requirements of DOE Order 231.1B,

Environment, Safety, and Health Reporting, and its Attachments 1, 2, 3, 4, and 5 (DOE 2012) regarding the preparation of an integrated annual site environmental report.

Summary results presented in this report are based on data collected before and continuing through 2018. Not all results of the environmental monitoring associated with ORR are reported here, and this is not intended as a comprehensive monitoring report. Data collected for other site and regulatory purposes, such as environmental restoration and remedial investigation reports, waste management characterization sampling data, and environmental permit compliance data, are presented in other documents that have been prepared in accordance with applicable laws, regulations, policies, and guidance. These data are referenced herein as appropriate.

Environmental monitoring of ORR activities consists primarily of effluent monitoring and environmental surveillance. Effluent monitoring involves the collection and analysis of samples or measurements of liquid and gaseous effluents at the points of their release to the environment. These measurements allow the quantification and official reporting of contaminant levels, assessment of public exposures to radiation (see Appendix E) and chemicals (see Appendix F), and demonstration of compliance with applicable standards and permit requirements. Environmental surveillance consists of direct measurement, collection, and analysis of samples taken from the site and its environs, exclusive of effluents. These surveillance activities provide information on contaminant concentrations in air, water, groundwater, soil, foods, biota, and other media. Other environmental surveillance data support environmental compliance and, when combined with data from effluent monitoring, also support chemical and radiation dose and exposure assessments of the potential effects of ORR operations, if any, on the local environment.

1.2 History of the Area around the Oak Ridge Reservation

Native Americans first inhabited the ORR area during the Woodland Period (c. 1000 BC to AD 1000). Descendants of these early dwellers, whose ancestors were Neolithic and Stone Age people, still lived in the East Tennessee region when European settlers arrived in the late 1700s. The Cherokee people were dominant in the area following wars with the Shawnee and Creek. The early European settlers of the ORR area lived on farms or in four small communities named Elza, Robertsville, Scarboro, and Wheat. All but Elza were founded shortly after the Revolutionary War. About a thousand families inhabited the area in the early 1940s.

The area that became ORR was selected in 1942 for the Manhattan Project, in part, because the Clinch River provided abundant water, the terrain featured linear and partitioned ridges, nearby Knoxville was a good source of labor, and the Tennessee Valley Authority (TVA) could supply ample amounts of needed electricity. Families that had occupied homes and farms for generations received orders to vacate within just a few weeks. The federal government's acquisition of property immediately affected more than three thousand individuals. According to data from the US Department of Agriculture's National Agricultural Statistics Service, the average farm real estate value in 1942 for the 48 contiguous states was \$34 per acre. Some property owners were paid this amount for their land, and others were paid less. Many felt they were poorly compensated, especially for their homes.

The site's wartime name was Clinton Engineering Works. Although it was not shown on any map, the workers' city on the reservation's northern edge, named Oak Ridge, grew to a population of 75,000, becoming the fifth largest city in Tennessee. To the south of the residential area, an electromagnetic method at the Y-12 Complex separated uranium-235 from natural uranium. The K-25 gaseous diffusion plant was built on the reservation's western edge. Near the reservation's southwest corner, about 16 km (10 mi) from the Y-12 Complex, a third facility—known as X-10 or Clinton Laboratories—housed the experimental graphite reactor. X-10 served as a pilot scale facility for the larger plutonium production facilities built at Hanford, Washington.

Two years after World War II ended, Oak Ridge shifted to civilian control under the authority of the US Atomic Energy Commission. In 1959 the city was incorporated and the community adopted a city manager and city council form of government.

The missions of the three major ORR installations have continued to evolve and operations have adapted to meet America's changing defense, energy, and research needs. Section 1.4 describes their current missions, as well as the missions of several smaller DOE facilities and activities on ORR.

1.3 Site Description

1.3.1 Location and Population

Situated in the Great Valley of East Tennessee between the Cumberland and Great Smoky Mountains, ORR borders the Clinch River (see Figures 1.1 and 1.2). The Cumberland Mountains are 16 km (10 mi) to the northwest and the Great Smoky Mountains are 51 km (31.6 mi) to the southeast. ORR encompasses about 13,055 ha (33,259 acres) of mostly contiguous land in Anderson and Roane Counties owned by the federal government, and ORR is under the management of DOE. According to the US Census Bureau, the estimated population of the 10-county region surrounding ORR is 999,791 and, as reported in *US Department of Energy FY2017 | Economic Impact in Tennessee*, ORR employs about 3 percent of the region's labor force. The 2018 US census population estimate for the official nine-county Knoxville metropolitan statistical area is 883,309. Other municipalities within about 30 km (18.6 mi) of the reservation include Oliver Springs, Clinton, Rocky Top, Lenoir City, Farragut, Kingston, and Harriman.

Knoxville, the major metropolitan area nearest Oak Ridge, is about 40 km (25 mi) to the east and had a population of about 187,500 according to the 2018 US census population estimate. Except for the city of Oak Ridge, the land within 8 km (5 mi) of ORR is semirural and is used primarily for residences, small farms, and cattle pasture. Fishing, hunting, boating, water skiing, and swimming are popular recreational activities in the area.



Figure 1.1. Location of the Oak Ridge Reservation in Tennessee

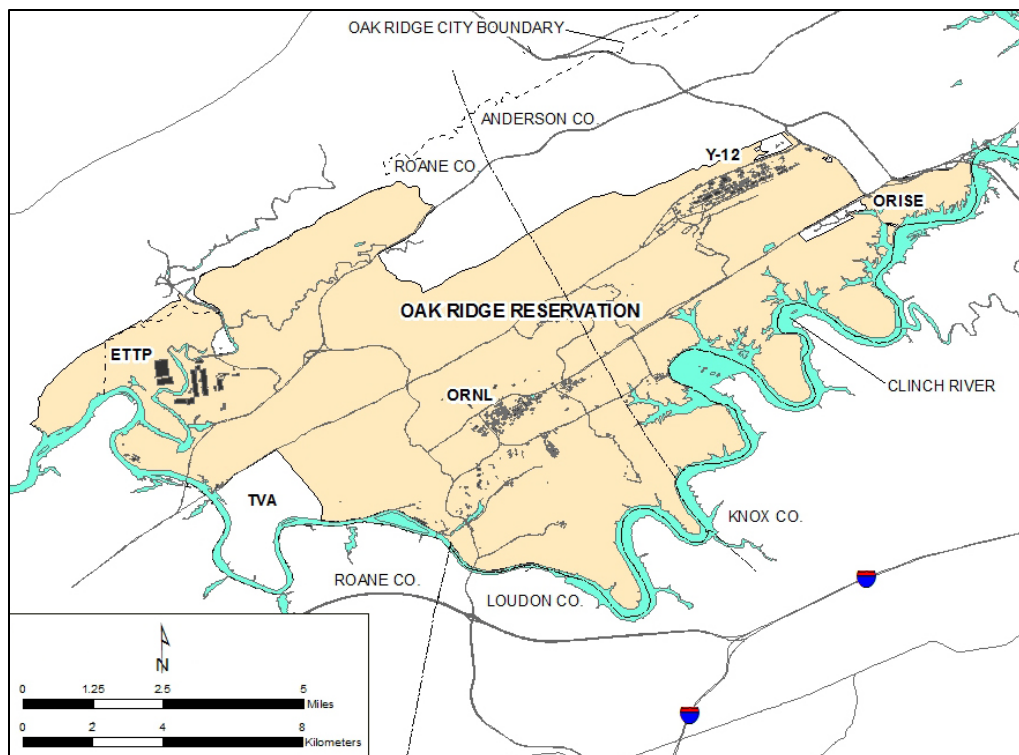


Figure 1.2. Map of the Oak Ridge Reservation

1.3.2 Climate

Although it features significant temperature changes between summer and winter, the climate of the Oak Ridge region qualifies as humid subtropical. The 30-year mean temperature for 1981–2010 was 14.7°C (58.5°F). The average high temperature for the Oak Ridge area in 2018 was 20.6°C (69.1°F). January temperatures were coldest in 2018, averaging 0.4°C (32.8°F). July was the warmest month, with average temperatures of 24.7°C (76.5°F). Monthly summaries of temperature averages, extremes, and 2018 values are provided in Appendix B, Table B.1.

Average annual precipitation in the Oak Ridge area for the 30-year period from 1981 to 2010 was 1,337.5 mm (52.64 in.), including about 21.3 cm (8.4 in.) of snowfall (NOAA 2011). Total precipitation during 2018 as measured at meteorological tower (MT)2 was 1,559.8 mm (61.39 in.), which is 5 percent above the 30-year average. Monthly summaries of precipitation averages, extremes, and 2018 values can also be found in Appendix B, Table B.1.

The average annual wind data recovery rates (a measure of acceptable data) across locations used for modeling during 2018 stood at 99.2 percent for wind sensors at the ORNL sites (towers MT2, MT3, MT4, and MT10). All other MT2, MT3, and MT4 instrument recoveries were well above 90 percent for both quarterly and annual values.

In 2018 wind speeds at ORNL Tower C/D (MT2), measured at 15 m (49 ft) above ground level, averaged 0.94 m/s (2.2 mph). This value remained unchanged for winds at 60 m (198 ft) above ground level. The local ridge-and-valley terrain reduces average wind speeds at valley bottoms, resulting in frequent periods of calm or near calm conditions, particularly during clear early morning hours in weak synoptic weather environments. Wind direction frequencies with respect to precipitation hours for the ORR towers may be reviewed [here](#) under the heading 2018 Annual Precipitation Wind Roses—Oak Ridge Reservation.

Detailed information on the climate of the Oak Ridge area is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (Parr and Hughes 2006) and in Appendix B of this report. An in-depth analysis of wind patterns for ORR conducted from 2009 to 2011 and documented in *Wind Regimes in Complex Terrain in the Great Valley of Eastern Tennessee* (Birdwell 2011) is available online [here](#).

1.3.3 Regional Air Quality

The US Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards set national ambient air quality standards (NAAQS) for key principal pollutants, also known as criteria pollutants. These key pollutants are sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, ozone, particulate matter with an aerodynamic diameter less than or equal to 10 μm (PM_{10}), and fine particulate matter with an aerodynamic diameter less than or equal to 2.5 μm ($\text{PM}_{2.5}$). EPA evaluates NAAQS based on ambient, or outdoor, levels of the criteria pollutants. Areas that satisfy NAAQS are classified as attainment areas, and areas that exceed NAAQS for a particular pollutant are considered non-attainment areas for that pollutant.

ORR is located in Anderson and Roane Counties. As of August 30, 2017, EPA designated Anderson, Knox, Blount, and Roane Counties as attainment areas for the $\text{PM}_{2.5}$ air quality standard. The greater Knoxville and Oak Ridge area is a NAAQS attainment area for all other criteria pollutants for which EPA has made attainment designations.

1.3.4 Surface Water

The ORR area is composed of a series of drainage basins or troughs containing numerous small streams that feed the Clinch River. Surface water on ORR drains into a series of tributaries, streams, or creeks in different watersheds. Each of these watersheds drains into the Clinch River, which in turn flows into the Tennessee River. On December 31, 2018, the Tennessee Valley Authority declared 2018 the wettest year on record for the Tennessee Valley region with 67.1 inches of precipitation, surpassing a previous record of 65.1 inches set in 1973. This conclusion is based on 129 years of collected weather data.

The largest of the ORR drainage basins is Poplar Creek, which receives drainage from a 352 km^2 (136 mi^2) area including the northwestern sector of ORR. Flow is from northeast to southwest, roughly through the center of ETTP, and the creek discharges directly into the Clinch River.

East Fork Poplar Creek, which discharges into Poplar Creek east of ETTP, originates within the Y-12 Complex and flows northeast along the south side of the complex. Bear Creek also originates within the Y-12 Complex and flows southwest. Bear Creek is affected by storm water runoff, groundwater infiltration, and tributaries that drain former waste disposal sites in the Bear Creek Valley Burial Grounds Waste Management Area and the current Environmental Management Waste Management Facility (EMWMF).

Both the Bethel Valley and Melton Valley portions of ORNL are in the White Oak Creek drainage basin, which has an area of 16.5 km^2 (6.4 mi^2). The headwaters of White Oak Creek originate on Chestnut Ridge, north of ORNL and near the Spallation Neutron Source site. The creek flows west along the southern boundary of the developed area of the ORNL site, then flows southwest through a gap in Haw Ridge to the western portion of Melton Valley, forming a confluence with Melton Branch. The headwaters of Melton Branch originate in Melton Valley east of the High Flux Isotope Reactor complex, and the area of the drainage basin is about 3.8 km^2 (1.47 mi^2). The waters of White Oak Creek enter White Oak Lake, 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.

1.3.5 Geological Setting

ORR is in the Tennessee portion of the Valley and Ridge Physiographic Province, which is part of the southern Appalachian fold-and-thrust belt. Thrust faulting, associated fracturing of the rock, and differential erosion rates created a series of parallel valleys and ridges that trend southwest to northeast.

Two geologic units on ORR, the Knox Group and the Maynardville Limestone of the Upper Conasauga Group, consist of dolostone and limestone, respectively, and make up the most significant water-bearing hydrostratigraphic units in the Valley and Ridge Province (Zurawski 1978) and on ORR. Composed of moderately soluble minerals, these bedrock formations are prone to dissolution as slightly acidic rainwater and percolating recharge water come in contact with the mineral surfaces. This dissolution increases fracture apertures and can, under some circumstances, form caverns and extensive solution conduit networks. This hydrostratigraphic unit is locally known as the Knox Aquifer. A combination of fractures and solution conduits in the aquifer control flow over substantial areas and large quantities of water may move long distances. Active groundwater flow can occur at substantial depths (91.5 to 122 m, or 300 to 400 ft) in the Knox Aquifer. The Knox Aquifer is the primary source of groundwater (base flow) for many streams, and most large springs on ORR receive discharge from the Knox Aquifer. Yields of some wells penetrating larger solution conduits exceed 3,785.4 L/min (1,000 gal/min). The high productivity of the Knox Aquifer results from the combination of its abundant and sometimes large solution conduit systems and frequently thick overburden soils that promote recharge and storage of groundwater.

The remaining geologic units on ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) are composed predominantly of shale, siltstones, and sandstones with a subordinate and locally variable amount of carbonate bedrock. These formations are primarily composed of insoluble minerals such as clays and quartz that were derived from ancient continental erosion. Groundwater occurs in and moves through fractures in these bedrock units. Groundwater availability in such settings depends on the abundance and interconnectedness of fractures and the connection of fractures to sources of recharge, such as alluvial soils along streams, which can provide some sustained infiltration. The shale and sandstone formations are the poorest aquifers in the Valley and Ridge Province (Zurawski 1978). Well yields are generally low in the Rome, Conasauga, and Chickamauga bedrock formations except in localized areas where carbonate beds may provide greater groundwater storage than adjacent clastic bedrock. Detailed information on ORR groundwater hydrology and flow is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (Parr and Hughes 2006).

1.3.6 Natural, Cultural, and Historic Resources

The ORR has an exceptional variety of natural, cultural, and historic resources. Ongoing efforts continue to focus on preserving the rich diversity of these resources.

1.3.6.1 Wetlands

Wetlands occur across ORR at low elevations, primarily in riparian zones of headwater streams and receiving streams and in the Clinch River embayments, as shown in Figure 1.3. Surveys of wetland resources presented in *Identification and Characterization of Wetlands in the Bear Creek Watershed* (Rosensteel and Trettin 1993), *Wetland Survey of the X-10 Bethel Valley and Melton Valley Groundwater Operable Units at Oak Ridge National Laboratory, Oak Ridge, Tennessee* (Rosensteel 1996), and *Wetland Survey of Selected Areas in the Oak Ridge Y-12 Plant Area of Responsibility, Oak Ridge, Tennessee* (Rosensteel 1997) serve as references to support wetland assessments for upcoming projects and activities.

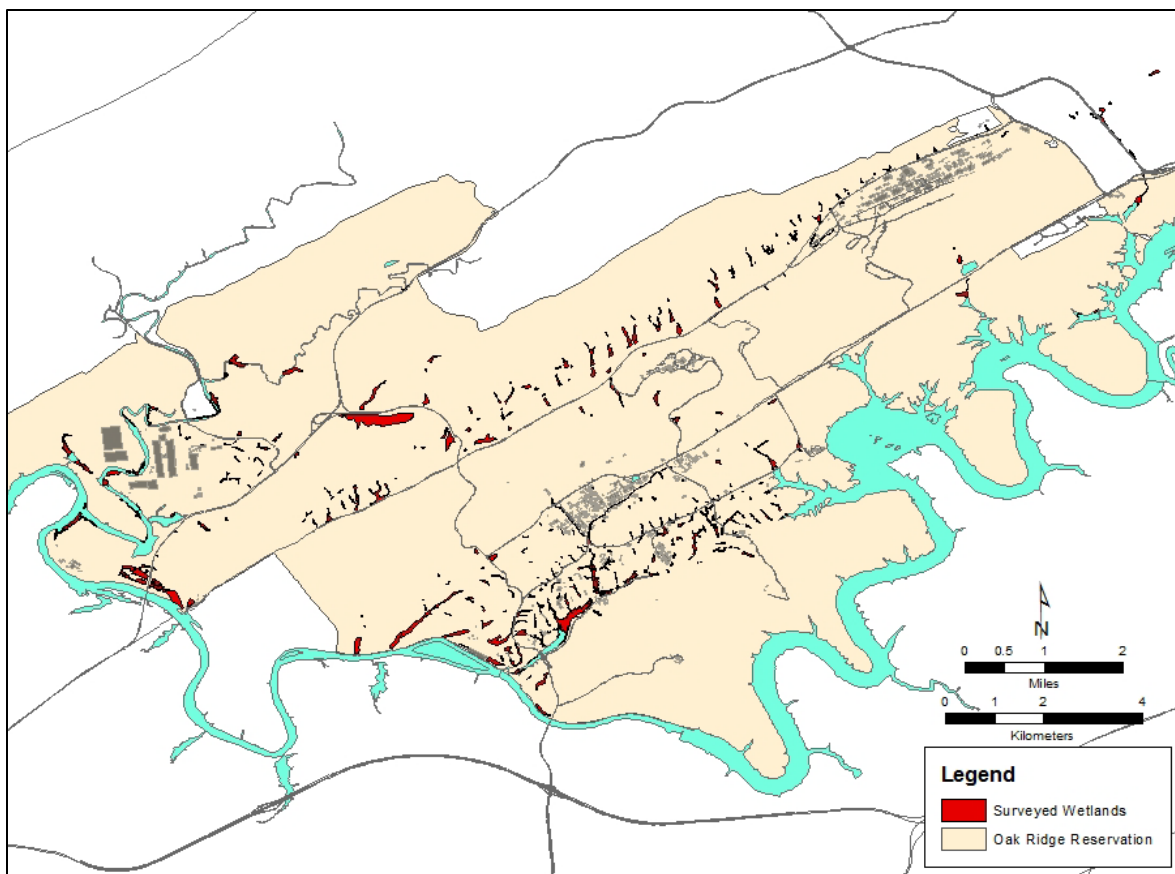


Figure 1.3. Location of Oak Ridge Reservation wetlands

About 243 ha (600 acres) of wetlands have been identified on ORR; most are classified as forested palustrine, scrub/shrub, and emergent wetlands. Wetlands identified to date range from several square meters at small seeps and springs to about 10 ha (25 acres) at White Oak Lake. In 2017, wetlands were delineated in the Copper Ridge Borrow Area and 294 Power Line Area. The Tennessee Department of Environment and Conservation's (TDEC's) wetland mitigation aquatic resource alteration permits (ARAPs), required by Section 401 of the Clean Water Act, entail monitoring restored or created wetland mitigation sites for five years. Activities and conditions in and around ORNL wetlands are verified by site inspections when appropriate (see Chapter 5, Section 5.8.11).

Wetland mitigation efforts that began in 2013 and 2014 as part of the Uranium Processing Facility project at the Y-12 Complex were completed in 2017. Details of this activity are provided in Chapter 4, Section 4.5.8.4. The work was performed under an approved US Army Corps of Engineers Section 404 permit and an ARAP issued by TDEC. Monitoring in accordance with these permits began following the completion of mitigation activities. The wetland mitigation carried out under these permits resulted in a more than 3:1 net increase in total wetland area. Annual monitoring of the remediated wetland sites through 2018 revealed that, in general, the wetlands are responding as intended and have shown remarkable wetland plant coverage over the past few years. The wetland soil bank was undoubtedly key to the restoration effort. Some wetlands have extensive open water areas, and deeper-water species of plants were added at these sites in 2018. Additional actions to lower the water level are to be considered in 2019.

1.3.6.2 Wildlife and Endangered Species

Animals listed as species of concern by state, federal, or international organizations and known to have occurred on the reservation (excluding the Clinch River bordering the reservation) are listed, along with their status, in Table 1.1. Some of these, such as hellbender, have been seen only once or a few times; others, including wood thrush, are comparatively common and widespread on ORR. As of July 2016, Tennessee had 93 species listed under the federal Endangered Species Act (75 endangered and 18 threatened). The complete Tennessee Threatened and Endangered List–New Rules is found [here](#).

Table 1.1. Animal species of special concern reported on the Oak Ridge Reservation^a

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
FISH				
<i>Phoxinus tennesseensis</i>	Tennessee dace		NM	
AMPHIBIANS AND REPTILES				
<i>Cryptobranchus alleganiensis</i>	Hellbender		T	
<i>Hemidactylium scutatum</i>	Four-toed salamander		NM	
BIRDS				
Bitterns and Herons				
<i>Ixobrychus exilis</i>	Least bittern		NM	
<i>Egretta caerulea</i>	Little blue heron		NM	
<i>Nycticorax nycticorax</i>	Black-crowned night heron		NM	
<i>Mycteria americana</i>	Wood stork	T		
Kites, Hawks, Eagles, and Allies				
<i>Haliaeetus leucocephalus</i>	Bald eagle	MC ^d		
Grouse, Turkey, and Quail				
<i>Bonasa umbellus</i>	Ruffed grouse			RC
<i>Colinus virginianus</i>	Northern bobwhite			RC
Goatsuckers				
<i>Caprimulgus carolinensis</i>	Chuck-will's-widow			RC
<i>Caprimulgus vociferus</i>	Eastern whip-poor-will			RC
Swifts				
<i>Chaetura pelagica</i>	Chimney swift			RC
Kingfishers				
<i>Megaceryle alcyon</i>	Belted kingfisher			RC
Woodpeckers				
<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker			RC
<i>Colaptes auratus</i>	Northern flicker			RC
Tyrant Flycatchers				
<i>Contopus virens</i>	Eastern wood-pewee			RC
<i>Empidonax vireescens</i>	Acadian flycatcher			RC
Swallows				
<i>Progne subis</i>	Purple martin			RC
<i>Hirundo rustica</i>	Barn swallow			RC

Table 1.1. Animal species of special concern reported on the Oak Ridge Reservation^a (continued)

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
Kinglets, Gnatcatchers, and Thrushes				
<i>Hylocichla mustelina</i>	Wood thrush		NM	RC
Shrikes				
<i>Lanius ludovicianus</i>	Loggerhead shrike		NM	
Wood Warblers				
<i>Vermivora chrysoptera</i>	Golden-winged warbler		T	RC
<i>Setophaga cerulea</i>	Cerulean warbler		NM	RC
<i>Setophaga discolor</i>	Prairie warbler			RC
<i>Mniotilta varia</i>	Black-and-white warbler			RC
<i>Protonotaria citrea</i>	Prothonotary warbler			RC
<i>Geothlypis formosa</i>	Kentucky warbler			RC
<i>Cardellina canadensis</i>	Canada warbler			RC
<i>Icteria virens</i>	Yellow-breasted chat			RC
Tanagers				
<i>Piranga rubra</i>	Summer tanager			RC
Towhees, Sparrows, and Allies				
<i>Pipilo erythrophthalmus</i>	Eastern towhee			RC
<i>Spizella pusilla</i>	Field sparrow			RC
<i>Ammodramus savannarum</i>	Grasshopper sparrow			RC
<i>Ammodramus henslowii</i>	Henslow's sparrow		T	RC
<i>Melospiza Georgiana</i>	Swamp sparrow			RC
Finches and Allies				
<i>Spinus tristis</i>	American goldfinch			RC
MAMMALS				
<i>Myotis grisescens</i>	Gray bat	E	E	
<i>Myotis lucifugus</i>	Little brown bat		T	
<i>Myotis sodalist</i>	Indiana bat ^e	E	E	
<i>Myotis septentrionalis</i>	Northern long-eared bat	T		
<i>Myotis leibii</i>	Eastern small-footed bat		NM	
<i>Perimyotis subflavus</i>	Tri-colored bat		T	
<i>Corynorhinus rafinesquii</i>	Rafinesque's Big-eared bat		NM	
<i>Sorex dispar</i>	Long-tailed shrew		NM	

^a Land and surface waters of the Oak Ridge Reservation (ORR) exclusive of the Clinch River, which borders ORR.

^b Status codes:

E = endangered

T = threatened

MC = of management concern

NM = in need of management

RC = regional concern

^c Partners in Flight (PIF) is an international organization devoted to conserving bird populations in the Western Hemisphere.

^d The bald eagle was federally delisted effective August 9, 2007.

^e A single specimen was captured in a mist net bordering the Clinch River in June 2013.

Birds, fish, and aquatic invertebrates are the most thoroughly surveyed animal groups on ORR. Nevertheless, the only federally listed animal species observed on ORR in recent years are mammals. Gray bats were seen over the Clinch River bordering ORR in 2003 and over a pond on ORR in 2004. Three gray bats were mist-netted outside a cave on ORR in 2006. Several gray bats and one Indiana bat were caught in mist nets bordering the Clinch River in June and July 2013. Northern long-eared bats, recently federally listed as threatened, are known to be present on ORR; their calls have been identified in various acoustic surveys of the reservation, and in 2013 their presence was confirmed when a number were captured in mist nets (McCracken et al. 2015).

Two-hundred thirty-two species of birds have been recorded on ORR and its boundary waters: the 228 species documented by Roy et al. (2014) plus the cackling goose (*Branta hutchinsii*), purple gallinule (*Porphyrio martinicus*), American bittern (*Botaurus lentiginosus*) and federally threatened wood stork (*Mycteria Americana*). Most of these species are protected under the Migratory Bird Treaty Act and Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. DOE's updated memorandum of understanding on migratory birds with the US Fish and Wildlife Service (FWS) (DOE-FWS 2013) strengthens migratory bird conservation on ORR through enhanced collaboration between DOE and FWS.

Breeding bird surveys conducted at 79 points along nine routes on ORR in 2014 provided data for the Partners in Flight Program. Seven public nature walks on ORR during 2018, which involved a total of 129 participants, included wildlife habitat surveillance, winter tree identification, woodcock and falconry observation, a bird nature walk, frog calls monitoring, a reptiles and amphibians inventory, and a wildflower walk. In past years ORR has been nominated for the Presidential Migratory Bird Federal Stewardship Award. A technical manuscript, *Oak Ridge Reservation Bird Records and Population Trends* (Roy et al. 2014), documents all known ORR bird records since 1950, as well as population trends for 32 species of birds.

Several state-listed bird species such as the golden-winged warbler, cerulean warbler, and little blue heron are uncommon migrants or visitors to the reservation. The cerulean warbler, listed by the state as in need of management, often appears during the breeding season on ORR but is currently listed as a potential breeding bird on the reservation (Roy et al. 2014) as its actual breeding status is still uncertain. The bald eagle (shown in Figure 1.4), which was removed from the federal list of threatened and endangered species on August 9, 2007, is a year-round resident in Tennessee, though it can be difficult to find on the reservation from September through November. One bald eagle nest was confirmed on the reservation in 2018. This nest was first observed in 2011 and has remained active every year since.

More than two dozen eaglets fledged in East Tennessee during 2017, according to bald eagle information published by the East Tennessee State University College of Arts and Sciences Biological Sciences department. More than 50 sightings in Roane and Anderson counties were reported to eBird during calendar year 2018.

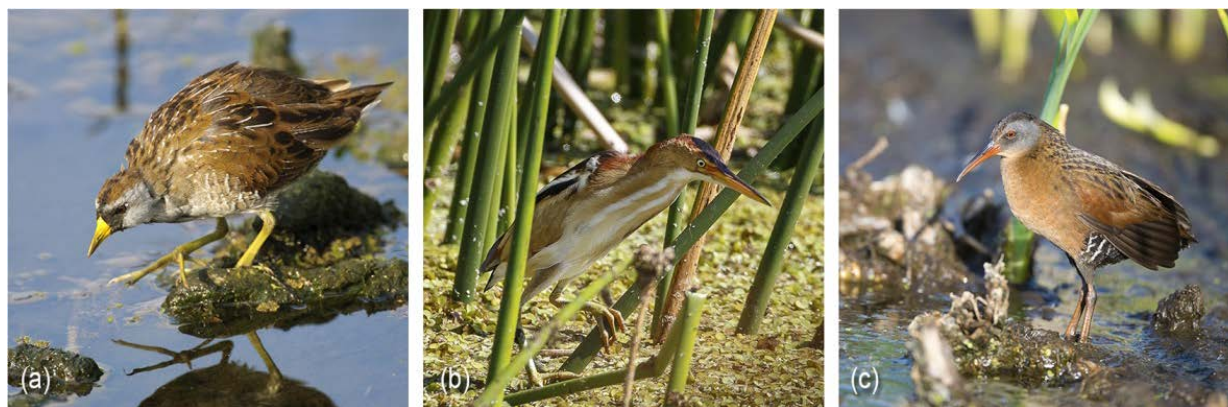
Other species such as the wood thrush and barn swallow are migrants and are known to nest on the reservation. The golden-winged warbler (*Vermivora chrysoptera*), listed by the state as threatened, was sighted once (in May 1998) on the reservation, as was the Lincoln's sparrow (*Melospiza lincolni*) (no listed status) in May 2014. Barn owls were documented nesting on the reservation in 2018.



Source: Jason Richards, ORNL photographer

Figure 1.4. Bald eagle nest on the Oak Ridge Reservation

With many northern lakes freezing solid during the winter of 2013–2014, white-winged scoters (*Melanitta fusca*) and red-necked grebes (*Podiceps grisegena*) made rare appearances in East Tennessee in February and March of 2014, though they were recorded locally only on boundary waters of the reservation. Other uncommon birds for ORR recorded in recent years include several species associated with wetland habitats. The sora, least bittern, and Virginia rail, shown in Figure 1.5, were observed at the K1007 P1 pond at ETP in 2013 and were likely attracted to high quality wildlife habitat established through recent restoration efforts. The sora, seen as recently as December 2016, is a fairly common migrant throughout Tennessee but is seldom seen on ORR. The least bittern is an uncommon migrant and summer resident in Tennessee. The Virginia rail, most recently observed in October 2013, was previously known on ORR only through historic records from the early 1950s (Roy et al. 2014). FWS lists all three of these species as of management concern. The least bittern is also deemed in need of management by the State of Tennessee, as shown in Table 1.1.



Source: Stock images courtesy of iStock.

Figure 1.5. Interesting bird species sighted on the Oak Ridge Reservation in recent years: (a) sora, (b) least bittern, and (c) Virginia rail

One fish species, the spotfin chub (*Erimonax monachus*), which is listed as threatened by both the state and the federal government, has been sighted and collected in the city of Oak Ridge and may be present on ORR. The tangerine darter (*Percina aurantiaca*), a species listed by the state as in need of

management, has also been recorded in close proximity to ORR. The lake sturgeon (*Acipenser fulvescens*), state-listed as endangered, is known to inhabit the adjacent Clinch River. The Tennessee dace, listed by the state as in need of management, appears in the Bear Creek watershed, tributaries to the lower East Fork watershed, and Ish Creek. The Tennessee dace also occurs in some sections of Grassy Creek upstream of Scientific Ecology Group, Inc. and International Technology Corporation at Clinch River kilometer 23, south of west Bear Creek Road near Grassy Creek sampling point 1.9.

1.3.6.3 Threatened and Endangered Plants

Four plant species known to be on ORR (spreading false foxglove, Appalachian bugbane, tall larkspur, and butternut) have been under review for listing at the federal level and were previously listed under the C2 candidate designation. FWS now informally refers to these as special concern species.

The State of Tennessee lists 17 plant species occurring on ORR as endangered, threatened, or of special concern; these are included in Table 1.2. Appalachian bugbane is no longer listed by Tennessee and does not have official federal status; therefore, it does not appear in Table 1.2. An additional 10 threatened, endangered, or special concern species occur in the area and, although currently unconfirmed on ORR, may be present. These are also included in Table 1.2. Other plant populations currently under study on ORR may be added to the table in future years.

The latest Tennessee Rare Plant List was published in October 2016. The 2012 Tennessee Rare Plant List reduced the number of state-protected species on ORR by six, and the 2016 Tennessee Rare Plant List reduced this number by an additional two species: the Tennessee coneflower (*Echinacea tennesseensis*) and Egget's sunflower (*Helianthus eggertii*).

Table 1.2. Vascular plant species listed by state or federal agencies and sighted/reported on or near the Oak Ridge Reservation, 2017

Species	Common name	Habitat on ORR	Status code ^a
<i>Currently known to be or previously reported on ORR</i>			
<i>Aureolaria patula</i>	Spreading false foxglove	River bluff	FSC, S
<i>Berberis canadensis</i>	American barberry	Rocky bluff	S
<i>Bolboschoenus fluviatilis</i>	River bulrush	Wetland	S
<i>Delphinium exaltatum</i>	Tall larkspur	Barrens and woodlands	FSC, E
<i>Diervilla lonicera</i>	Northern bush-honeysuckle	Rocky river bluff	T
<i>Draba ramosissima</i>	Branching whitlow-grass	Limestone cliff	S
<i>Elodea nuttallii</i>	Nuttall waterweed	Pond, embayment	S
<i>Eupatorium godfreyanum</i>	Godfrey's thoroughwort	Dry woods edge	S
<i>Fothergilla major</i>	Mountain witch-alder	Woods	T
<i>Helianthus occidentalis</i>	Naked-stem sunflower	Barrens	S
<i>Juglans cinerea</i>	Butternut	Lake shore	FSC, T
<i>Juncus brachycephalus</i>	Small-head rush	Open wetland	S
<i>Liparis loeselii</i>	Fen orchid	Forested wetland	T
<i>Panax quinquefolius</i>	American ginseng	Rich woods	S, CE
<i>Platanthera flava var. herbiola</i>	Tuberculed rein-orchid	Forested wetland	T
<i>Spiranthes lucida</i>	Shining ladies'-tresses	Boggy wetland	T
<i>Thuja occidentalis</i>	Northern white cedar	Rocky river bluffs	S

Table 1.2. Vascular plant species listed by state or federal agencies and sighted/reported on or near the Oak Ridge Reservation, 2018 (continued)

Species	Common name	Habitat on ORR	Status code ^a
<i>Rare plants that occur near and could be present on ORR</i>			
<i>Agalinis auriculata</i>	Earleaf false foxglove	Calcareous barren	FSC, E
<i>Allium burdickii</i> or <i>A. tricoccom</i> ^b	Ramps	Moist woods	S, CE
<i>Lathyrus palustris</i>	Marsh pea	Moist meadows	S
<i>Liatrix cylindracea</i>	Slender blazing star	Calcareous barren	T
<i>Lonicera dioica</i>	Mountain honeysuckle	Rocky river bluff	S
<i>Meehania cordata</i>	Heartleaf meehania	Moist calcareous woods	T
<i>Pedicularis lanceolata</i>	Swamp lousewort	Calcareous wet meadow	S
<i>Pseudognaphalium helleri</i>	Heller's catfoot	Dry woodland edge	S
<i>Pycnanthemum torrei</i>	Torrey's mountain-mint	Calcareous barren edge	S
<i>Solidago ptarmicoides</i>	Prairie goldenrod	Calcareous barren	E

^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 Ramps have been reported near ORR, but there is not sufficient information to determine which of the two species is present or whether the occurrence may have been the result of planting. Both species of ramps have the same state status.

Acronyms: ORR = Oak Ridge Reservation

1.3.6.4 Historical and Cultural Resources

Efforts continue to preserve ORR's rich prehistoric and historic cultural resources. Compliance with the National Historic Preservation Act is maintained in conjunction with National Environmental Policy Act (NEPA) compliance. The scope of proposed actions is reviewed in accordance with the *Cultural Resource Management Plan, DOE Oak Ridge Reservation, Anderson and Roane Counties, Tennessee* (DOE 2001). ORR has 168 facilities that were eligible for inclusion on the National Register of Historic Places (NRHP), a National Park Service program to identify, evaluate, and protect historic and archeological resources in the US, as well as numerous facilities that were not eligible for NHRP inclusion. Artifacts of historical or cultural significance are identified prior to demolition and catalogued in a database to aid in the historic interpretation. The reservation contains more than 45 known prehistoric sites (primarily burial mounds and archeological evidence of former structures), more than 250 historic pre-World War II structures, 32 cemeteries, and several historically significant structures from the Manhattan Project era.

The National Defense Authorization Act of 2015, passed by Congress and signed into law on December 19, 2014, included provisions authorizing the Manhattan Project National Historical Park. An agreement by the Secretaries of Energy and Interior established the Manhattan Project National Historical Park on November 10, 2015. The Park includes facilities and lands in Los Alamos, New Mexico and Hanford, Washington, as well as Oak Ridge. On ORR, the National Park includes the X-10 Graphite Reactor, Buildings 9731 and 9204-3 at the Y-12 Complex, and the K-25 Building Site at ETPP.

The X-10 Graphite Reactor building has been on the NRHP since 1966, and has been open for public access in various ways since that time. Enhancing access and improving the visitor experience are important DOE objectives as it moves forward in implementing the National Park.

Although Buildings 9731 and 9204-3 at the Y-12 National Security Complex are eligible for listing on the NRHP, at present neither is available for regular public access. Occasional public access to both facilities occurred as recently as Nov. 12, 2015, when DOE facilitated public tours of both buildings to celebrate the establishment of the National Park. By developing the National Park, DOE aims to enhance safe access to these buildings while protecting the agency's mission capabilities.

DOE will fulfill the objective of enabling safe access to the former site of the K-25 Building. The National Park Service will aid in historic interpretation of the site, although the K-25 Building site is already undergoing extensive historic interpretation activities separate and independent from the National Park. DOE launched the K-25 Virtual Museum as part of the activities to establish the Park. The online exhibit, which details the history of the K-25 Gaseous Diffusion Plant through narrative and photographs, can be viewed [here](#).

Seven historic ORR properties are listed individually in the NRHP:

- Freels Bend Cabin
- Graphite Reactor
- New Bethel Baptist Church and Cemetery
- Oak Ridge Turnpike Checking Station
- George Jones Memorial Baptist Church and Cemetery
- Bear Creek (Scarboro) Road Checking Station
- Bethel Valley Road Checking Station

Although not yet included on the NRHP, an area known as the Wheat Community African Burial Grounds was dedicated in June 2000, and a memorial monument was erected.

A memorandum of agreement signed in 2012 between DOE Oak Ridge Office, the State Historic Preservation Officer, the Advisory Council on Historic Preservation, the City of Oak Ridge, and the East Tennessee Preservation Alliance ensures consistent interpretation of site historic properties at ETTP. The memorandum of agreement is being implemented through planning for a History Center that will highlight the historic aspects of ETTP and of the communities that were displaced during the construction of the site.

Two site-wide programmatic agreements among the DOE Oak Ridge Office, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation concerning management of historical and cultural properties at ORNL and at Y-12 have been enforced since their respective approvals.

1.4 Oak Ridge Sites

The Oak Ridge Reservation includes a number of sites critical to the mission of DOE. Eight of these sites are described in the following pages: the Oak Ridge National Laboratory, the Y-12 National Security Complex, the East Tennessee Technology Park, the Environmental Management Waste Management Facility, the Oak Ridge Environmental Research Park, the Oak Ridge Institute for Science and Education, the National Nuclear Security Administration Office of Secure Transportation Agent Operations Eastern Command, and the Transuranic Waste Processing Center Sludge Buildout Facility.

1.4.1 Oak Ridge National Laboratory

ORNL (shown in Figure 1.6) is managed for DOE by UT-Battelle, LLC, a partnership between the University of Tennessee and Battelle Memorial Institute. The largest science and energy national laboratory in the DOE system, ORNL conducts basic and applied research to deliver transformative solutions to compelling problems in energy and security. The laboratory is home to several of the world's top supercomputers and is a leading neutron science and nuclear energy research facility that includes the Spallation Neutron Source and the High Flux Isotope Reactor. ORNL hosts a DOE leadership computing facility, home of the Summit supercomputer; one of DOE's nanoscience centers, the Center for Nanophase Materials Sciences; one of DOE's energy research centers; and the Bio-Energy Science Center. UT-Battelle, LLC also manages the US International Thermonuclear Experimental Reactor project for DOE.

Formerly known as X-10, ORNL was established in 1943 to support the Manhattan Project. From an early focus on chemical technology and reactor development, ORNL's research and development portfolio broadened to include programs supporting DOE missions in scientific discovery and innovation, clean energy, and nuclear security. Today ORNL employs about 4,400 workers, and the laboratory's extensive capabilities in scientific discovery and innovation are applied to the delivery of mission outcomes for DOE and other sponsors.



Figure 1.6. Aerial view of the Oak Ridge National Laboratory

During fiscal year (FY) 2018, DOE remained focused on disposing of a significant inventory of uranium-233 stored in Building 3019 at ORNL. This special nuclear material requires strict safeguards and security controls to protect against access. The objectives of the Uranium-233 Project are to address safeguards and security requirements, eliminate safety and nuclear criticality concerns, and safely dispose

of the material. DOE has successfully resolved the concerns associated with the disposition of the Consolidated Edison Uranium Solidification Project material, which originated from a 1960s research and development test of thorium and uranium fuel at Consolidated Edison's Indian Point 1 Nuclear Plant in New York. Isotek Systems, LLC manages activities at the Building 3019 complex for DOE and is responsible for activities associated with processing, down-blending, and packaging the DOE inventory of uranium-233 stored in the complex.

UCOR is the DOE ORR cleanup contractor. The scope of UCOR activities at ORNL includes long-term surveillance, maintenance, and management of inactive waste disposal sites, structures, and buildings such as former reactors and isotope production facilities. Other UCOR activities include groundwater monitoring, transuranic waste storage, and operation of the liquid low-level and process waste systems and the off-gas collection and treatment system.

Seventy-four waste items added to the Molten Salt Reactor Experiment Facility waste handling plan in 2014 were characterized and disposed of during 2018. Workers completed the pumpdown of the Reactive Gas Removal System fuel drain and fuel flush tanks.

The ORNL Liquid and Gaseous Waste Operations lifecycle was extended during FY 2018 through building and infrastructure upgrades.

1.4.2 Y-12 National Security Complex

The Y-12 Complex (shown in Figure 1.7) was originally constructed as part of the World War II Manhattan Project and began operations in November 1943. The first site mission was the separation of uranium-235 from natural uranium by an electromagnetic separation process. At its peak in 1945, more than 22,000 workers were employed at the Y-12 site.

Today, as part of the NNSA Nuclear Security Enterprise, the Y-12 Complex is the nation's only source of enriched uranium nuclear weapons components and provides enriched uranium for the US Navy. The Y-12 Complex is a leader in materials science and precision manufacturing and serves as the main storage facility for the nation's supply of enriched uranium. The Y-12 Complex also supports efforts to reduce the risk of nuclear proliferation and performs complementary work for other government agencies.

In December 2017, UCOR (the cleanup contractor for ORR) issued the *Construction Execution/Management Plan, Outfall 200 Mercury Treatment Facility at the Y-12 Nuclear Security Complex, Oak Ridge, Tennessee* (UCOR 2017). The goal of the Mercury Treatment Facility is to reduce the mercury concentration in water exiting the Y-12 Complex. The west end Y-12 storm drain system discharges to Upper East Fork Poplar Creek at Outfall 200. Mercury from historic operations is present at Outfall 200 where storm water enters Poplar Creek.

Three lines of investigation were developed for East Fork Poplar Creek: to examine potential downstream sources such as bank soil and sediment control, to study the ecology and investigate how differences in food chain processes may influence the uptake of mercury in fish, and to investigate the water chemistry and flow characteristics of the creek and their influence. In support of mercury cleanup efforts, research and technology development activities focused on the major factors influencing the accumulation of mercury in fish, which are the major route of both human and wildlife exposure.

The Mercury Treatment Facility is designed to treat up to 3,000 gallons of storm water per minute. It includes a 2-million-gallon storage tank to collect storm water during peak flow conditions of up to 40,000 gallons per minute. The stored water can then be treated after storm flow subsides. Captured storm water will be piped to a treatment facility located on an available site east of Outfall 200. Mercury

treatment will be accomplished using chemical precipitation, clarification, and media filtration. Treated water will be discharged back into Upper East Fork Poplar Creek. The *Mercury Remediation Technology Development for Lower East Fork Poplar Creek—2017 Progress Report* (ORNL 2018) provided details of each study area and findings. DOE's Oak Ridge Office of Environmental Management (OREM) began site preparation on the Mercury Treatment Facility in 2018. Construction of the facility is expected to begin in 2019.



Figure 1.7. Aerial view of the Y-12 National Security Complex

At the end of FY 2018, the Y-12 Complex had achieved five of its 10 established environmental targets, and the remaining targets were carried into future years. Highlights include the following; further details and additional successes are presented in other sections of this report.

- **Clean Air:** The Y-12 Complex finalized implementation of a new Title V air operating permit.
- **Energy Efficiency:** Implementation of five Energy Savings Performance Contract energy conservation measures began in FY 2014 for projects to improve lighting, chilled water, air compressors, and the Y-12 Complex steam system. Significant progress was made on the effort to obtain Leadership in Energy and Environmental Design (LEED) certification on the Uranium Processing Facility Construction Support Building. A Silver Certification was awarded, with the additional credit points required for obtaining a Gold Certification pending occupancy.
- **Hazardous Materials:** A project to disposition and ship more than 60 items of legacy mixed waste per Site Treatment Plan milestones was completed in 2018, and FY 2018 priorities for unneeded materials and chemicals were completed to disposition them in the Development High Head Area.

- **Reduce, Reuse, Recycle, and Buy Green:** The Y-12 Complex completed a project to improve the Destruction and Recycling Facility and to install a drum crusher in one facility to reduce the quantity of empty drum waste.
- **Mercury Removal:** More than 3 tons of mercury were removed from column exchange equipment at Alpha-4. Approximately 9,477 feet of piping, 22 tanks, and four heat exchangers were tapped, drained, and deactivated during 2018. Twenty-one of the 22 tanks were demolished and removed from the site.

In FY 2018, the Y-12 Complex implemented 96 pollution prevention initiatives resulting in a reduction of more than 62.7 million lb of waste and cost efficiencies of more than \$5 million. Also in 2018, the Y-12 Complex diverted 51.6 percent of municipal and 91.5 percent of construction and demolition waste from landfill disposal through reuse and recycle. The Y-12 Complex diverted more than 2.3 million lb of municipal materials from landfill disposal through source reduction, reuse, and recycling in FY 2018. In addition, more than 60.1 million lbs of construction and demolition materials were diverted from landfill disposal in FY 2018. Also in FY 2018, more than 3,200 lbs of waste generation prevention was realized by transferring materials for on-site reuse, and more than 2.78 million lbs of materials were diverted from landfills into viable recycle processes.

The Y-12 Complex achieved a 9 percent reduction in energy intensity during 2018. Specific initiatives that helped reduce energy consumption at the Y-12 Complex include:

- Completing a new, more-efficient Air Compressor Plant at the end of FY 2016
- Continuing to upgrade light fixtures
- Replacing steam with natural gas
- Upgrading chillers with new high-efficiency variable speed modes; retrofitting existing chillers with efficient controls; replacing constant-speed chilled water pumps with a variable-speed type; and replacing tower pumps, steam controls, and control valves
- Replacing Cooling Towers

Sustainability goals and performance status for the Y-12 Complex are listed in Chapter 4, Table 4.1.

Buildings 9743-2 and 9770-2 of the Biology Complex were demolished in 2018.

1.4.3 East Tennessee Technology Park

ETTP (see Figure 1.8), originally named K-25, is the site of the nation's first gaseous diffusion uranium enrichment plant. It was established as part of the World War II Manhattan Project. Additional uranium enrichment facilities K-29, K-31, and K-33 were built adjacent to K-25 during the Cold War, and these facilities formed a complex officially known as the Oak Ridge Gaseous Diffusion Plant. Uranium enrichment operations at the site ceased in 1986, and restoration and decontamination and decommissioning activities began soon after in preparation for ultimate conversion of the site to a private-sector industrial park, to be called the Heritage Center. Reindustrialization of the site began in 1996, when it was renamed the East Tennessee Technology Park. Today restoration of the environment, decontamination and decommissioning of facilities, disposition of wastes, and reindustrialization are the major activities at the site.

In 2018, ETTP landlord contractor functions and the majority of the ETTP cleanup program actions were managed by UCOR. During that year ETTP had no National Pollutant Discharge Elimination System permit noncompliances, no Clean Air Act noncompliances, and no reportable releases of hazardous

substances or extremely hazardous substances, as defined by the Emergency Planning and Community Right-to-Know Act of 1986. The annualized levels of chromium and lead during 2018 were below the indicated annual standards. Demolition of the K-633 Test Loop Facility began in February and concluded in June 2018. Decontamination and demolition of the K-1314 UF₆ cylinder sandblast and repaint facility was completed in April 2018. Demolition of the Toxic Substances Control Act (TSCA) Incinerator began in June 2018 and concluded in September 2018. Samples collected during rainfall events at these demolition sites did not exhibit any screening level exceedances. Final sampling conducted on December 31, 2018 resulted in no exceedances.



Figure 1.8. Aerial view of East Tennessee Technology Park

In 2017, a proposed plan to build an airport on the ETTP site reached a major milestone with the completion of a master plan, which was submitted to the Federal Aviation Administration for approval. Metropolitan Knoxville Airport Authority is leading the project. During 2018, officials have continued to work on locating the proposed airport near the former K-25 site at ETTP, and the master plan was reviewed by the Federal Aviation Administration. The corporate planes most likely to use the airport include the Beechcraft King Air 350, Cessna 500, and Cirrus SF-50 Vision Jet.

1.4.4 Environmental Management Waste Management Facility

The Environmental Waste Management Facility, or EMWMF (shown in Figure 1.9), is located in eastern Bear Creek Valley near the Y-12 Complex and is managed by UCOR. EMWMF was built for the disposal of waste resulting from CERCLA cleanup actions on ORR. The original design was for the construction, operation, and closure of a projected 1.3 million m³ (1.7 million yd³) disposal facility. The approved capacity was subsequently increased to 1.8 million m³ (2.4 million yd³) to maximize use of the footprint designated in a 1999 record of decision. The facility currently consists of six disposal cells.



Figure 1.9. Aerial view of the Environmental Management Waste Management Facility

EMWMF is an engineered landfill that accepts low-level, mixed low-level, and hazardous wastes from CERCLA cleanup activities on ORR that meet specific waste acceptance criteria developed in accordance with agreements with state and federal regulators. Waste types that qualify for disposal include soil, dried sludge and sediment, solidified waste, stabilized waste, building debris, scrap equipment, and secondary waste such as personal protective equipment, all of which must meet land disposal restrictions. In addition to the solid waste disposal facility, EMWMF operates a leachate collection system. In FY 2018 the facility collected, analyzed, and disposed of approximately 3.9 million gallons of leachate. The leachate is treated at the ORNL Liquids and Gaseous Treatment Facility, which is also operated by UCOR. The Oak Ridge Reservation landfills disposed of 39,990 yd³ of waste during 2018.

During FY 2018 the EMWMF received 6,305 waste shipments, accounting for 73,510 tons, from cleanup projects at ETTP, ORNL, and Y-12. EMWMF will reach its capacity before OREM completes its cleanup at Y-12 and ORNL. Planning continued throughout FY 2018 for a new facility, the Environmental Management Disposal Facility, which will provide the additional disposal capacity needed to complete the cleanup at Oak Ridge. The public comment period for this new facility closed on December 10, 2018.

1.4.5 Oak Ridge Environmental Research Park

DOE established the Oak Ridge Environmental Research Park (see Figure 1.10) in 1980. Managed for DOE by UT-Battelle, LLC, the research park serves as an outdoor laboratory to evaluate the environmental consequences of energy use and development and the strategies to mitigate those effects. Its large blocks of forest and diverse communities of vegetation offer unparalleled resources for ecosystem-level and large-scale research. Major national and international collaborative research initiatives use it to address issues such as multiple stress interactions, biodiversity, sustainable development, tropospheric air quality, global climate change, innovative power conductors, solar radiation monitoring, ecological recovery, and monitoring and remediation.

Field sites at the research park provide maintenance and support facilities that permit sophisticated and well-instrumented environmental experiments. These facilities include elaborate monitoring systems that enable users to precisely and accurately measure environmental factors for extended periods. Because the

park is under the jurisdiction of the federal government, public access is restricted and experimental sites and associated equipment are therefore not disturbed.

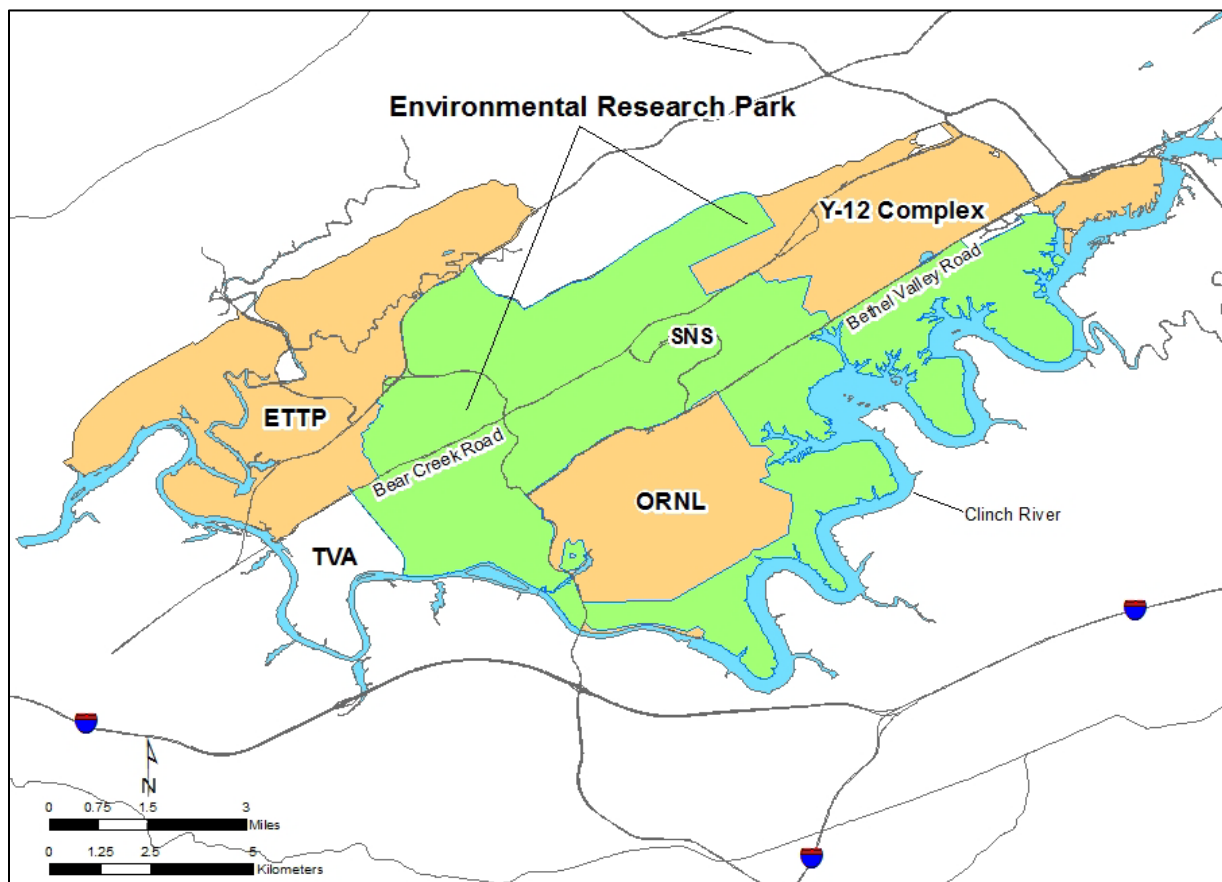


Figure 1.10. Location of the Oak Ridge Environmental Research Park

National recognition of the research park's value has led to its use in both regional- and continental-scale research projects. Research park sites offer opportunities for aquatic and terrestrial ecosystem analyses of topics such as biogeochemical cycling of pollutants resulting from energy production, landscape alterations, ecosystem restoration, wetland mitigation, and forest and wildlife management.

1.4.6 Oak Ridge Institute for Science and Education

ORISE is managed for DOE by Oak Ridge Associated Universities. The ORISE mission is to develop people and solutions to strengthen our nation's competitive advantage in science. ORISE accomplishes its mission by recruiting and preparing the next generation of our nation's scientific workforce; promoting sound scientific and technical investment decisions through independent peer reviews; facilitating and preparing for the medical management of radiation incidents in the US and abroad; evaluating health outcomes in workers exposed to chemical and radiological hazards on the job; and ensuring public confidence in environmental cleanup through independent environmental assessments. ORISE creates opportunities for collaboration through partnerships with other DOE facilities, federal agencies, academia, and industry consistent with DOE objectives and the ORISE mission.

ORISE is in an area on the southeastern border of ORR that was part of an agricultural experiment station owned by the federal government from the late 1940s to the mid-1980s and, until 1981, was operated by the University of Tennessee. The site houses offices, laboratories, and storage areas for ORISE program offices and support departments.

1.4.7 National Nuclear Security Administration Office of Secure Transportation, Agent Operations Eastern Command

Beginning in 1947, DOE and its predecessor agencies moved nuclear weapons, weapons components, special nuclear materials, and other important national security assets by commercial and government modes of transportation. In the late 1960s, worldwide terrorism and acts of violence prompted a review of procedures for safeguarding these materials. As a result, a comprehensive new series of regulations and equipment was developed to enhance the safety and security of these materials in transit. Modified and redesigned transport equipment was created to incorporate features that more effectively enhance self-protection and deny unauthorized access to the materials. Also during this time, the use of commercial transportation systems was abandoned and a totally federal operation was implemented. The organization responsible for this mission within DOE NNSA is the Office of Secure Transportation (OST).

The NNSA OST AOEC Secure Transportation Center and Training Facility is located on ORR. Situated on about 723 ha (1,786 acres), it operates under a user permit agreement with DOE Oak Ridge Office. NNSA OST AOEC implements its assigned mission transportation operations, maintains applicable fleet and escort vehicles, and continues extensive training activities for its federal agents.

1.4.8 TWPC Sludge Buildout Facility

The Transuranic Waste Processing Center (TWPC) is located on an approximately 10.5-ha (26-acre) tract of land in the Melton Valley area of ORNL about 120 feet west of the existing Melton Valley Storage Tanks. North Wind Solutions, LLC manages the TWPC for DOE. TWPC's mission is to receive transuranic waste for processing, treatment, repackaging, and shipment to DOE's Waste Isolation Pilot Plant near Carlsbad, New Mexico.

Transuranic waste consists of materials and debris that are contaminated with elements that have a higher atomic mass and are listed after uranium on the periodic table. The majority of Oak Ridge's inventory of transuranic materials originated from previous research and isotope production missions at ORNL. Waste determined to be non-transuranic (e.g., low-level radioactive waste or mixed low-level waste) is shipped to the Nevada National Security Site or other approved facilities.

Key progress for the project during FY 2018 included the following actions:

- Received vendor proposals for the sludge mobilization system, the Slurry Mixing and Characterization Tank, and the Sludge Test Area Construction
- Awarded the contract for testing of the Mobilization Measurement Instrumentation
- Completed development of documents pertaining to the Integrated System Test Plan, Simulant Strategy, Slurry Mixing and Characterization Tank/Mobilization Measurement Instrumentation, Flowsheet and Material Balance, Project Management Plan, Risk Management Plan, and Code of Record
- Conducted quarterly Safety Design Integration Team meetings

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