



*Signs such as this were common in the city of Oak Ridge during the Manhattan Project era and for years afterward.*

# 1

## Introduction to the Oak Ridge Reservation

It was not shown on any maps. No visitors were allowed without special approval. US Army guards were posted at the entrances to the city, and all residents were required to wear badges at all times outside their homes. Thus Oak Ridge existed for seven years, from 1942 to 1949, as a truly secret city. It was here and also in supporting locations where humankind made the leap from candlepower to nuclear power in a single generation. The engineering marvel that materialized in the Secret City changed the world, helped end World War II, and launched life-saving diagnostic tools such as magnetic resonance imaging and nuclear medicine. Today the former Secret City exists in two parts: the City of Oak Ridge and the Oak Ridge Reservation (ORR). 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.

ORR covers a little over 50 square miles of land in Anderson and Roane counties and is home to two major US Department of Energy (DOE) operating facilities: the Oak Ridge National Laboratory (ORNL) and the Y-12 National Security Complex (Y-12). Other ORR facilities 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, laboratory, and support facilities; the government-owned, government-operated Agent Operations Eastern Command (AOEC) of the National Nuclear Security Administration (NNSA) Office of Secure Transportation (OST); the Transuranic Waste Processing Center (TWPC); and small government-owned, contractor-operated environmental cleanup entities.

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 xxx and xxxi are included to help readers convert numeric values as needed for specific calculations and comparisons.

## 1.1. Background

The ORR Annual Site Environmental Report (ASER) is 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 Attachment 2 (DOE 2012) regarding the preparation of an integrated annual site environmental report.

Summary results in this report are based on data collected before and continuing through 2021. Not all results of the environmental monitoring associated with ORR are reported here, and this is not intended to be 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 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. 900 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 Nation controlled the region at this time, but the 1791 Treaty of the Holston and the 1798 Treaty of Tellico allowed for European settlement, which forever altered the landscape. As settlements continued to grow in numbers, new counties were formed including Roane County and Anderson County in 1801. Early European settlers of the area lived on farms or in four small communities named Elza, Robertsville, Wheat, and Scarborough. These villages served primarily as gathering centers and usually contained one or two churches and a general store. About one thousand families inhabited the area in the early 1940s (Souza 2001, Hogan 2021).

In 1939 President Franklin D. Roosevelt received the famous Einstein-Szilard letter informing him that German scientists were working on a nuclear weapon. In utmost secrecy, he formed the Advisory Committee on Uranium, a team of scientists and military officials tasked with researching uranium's potential role as a weapon, which later evolved into the Office of Scientific Research and Development. After the United States was thrust into World War II following the Japanese attack on Pearl Harbor, the Manhattan Project emerged in 1942 as a full-scale program to build an atomic bomb. The super-secret code name gave no indication of the classified activities it carried out, and was so named because of the location of its original headquarters at 270 Broadway in New York City's Manhattan district. In the summer of 1943, the project moved to East

Tennessee where construction of America's first full-scale gaseous diffusion plant was underway, to fulfill the mission of isolating uranium-235 for the first atomic bomb.

The selection of the area now known as ORR for the nuclear development site was largely due to the vision of General Leslie Groves. The presence of abundant water from the Clinch River, a good source of labor in nearby Knoxville, railroad accessibility, and a supply of ample amounts of electricity from the Tennessee Valley Authority were viewed as key assets. Moreover, the parallel northeast-to-southwest valleys separated by 200–300 foot ridges were seen as useful to segregate the production areas and to provide protection in case of a catastrophe within any one of them. The federal government's acquisition of property for the uranium enrichment plants and a pilot-scale nuclear reactor took place through eminent domain and immediately affected more than three thousand individuals, many whose families had occupied homes and farms for generations. Although the families were compensated by the federal government, the urgency of the eviction was difficult for the landowners, who were forced to abandon their houses and crops. Many property owners also felt they were underpaid for the value of their homes and land, although many later successfully appealed the initial land valuations offered to them.

The site's wartime name was Clinton Engineer Works, and the area now known as Oak Ridge was the workers' city on the reservation's northern edge. Although Oak Ridge did not appear on any map until 1949, it quickly grew to a population of 75,000, becoming the fifth largest city in Tennessee. To the south of the residential area at the Y-12 Complex, an electromagnetic method 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 (Olwell 1999, Broad 2007, Reed 2014, Johnson 2018).

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 the current missions of these and several smaller ORR facilities and activities.

## 1.3. Location and Description

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 a little over 13,000 hectares (32,258.54 acres) of mostly contiguous, federally owned land in Anderson and Roane Counties, and is under the management of DOE.

### 1.3.1. Population

As reported in *US Department of Energy FY 2020 Economic Impact in Tennessee* (East Tennessee Economic Council), ORR supported nearly 43,000 members of the region's labor force. The US Census Population Estimate which was released on December 21, 2021, and is based on the 2020 Census for the Knoxville Metropolitan Statistical Area, including Oak Ridge, was 893,412. The combined US Census Vintage 2021 Population Estimate for the 10 counties surrounding ORR (Anderson, Blount, Campbell, Cumberland, Knox, Loudon, McMinn, Monroe, Morgan, and Roane) was 1,036,279. Knoxville, the nearest major city, is about 40 km (25 mi) to the east and had a population of 192,648, according to the US Census Vintage 2021 Population Estimate. Other municipalities within about 30 km (18.6 mi) of ORR include Oliver Springs, Clinton, Rocky Top, Lenoir City, Farragut, Kingston, and Harriman. 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.





Figure 1.1. Location of the Oak Ridge Reservation in Tennessee

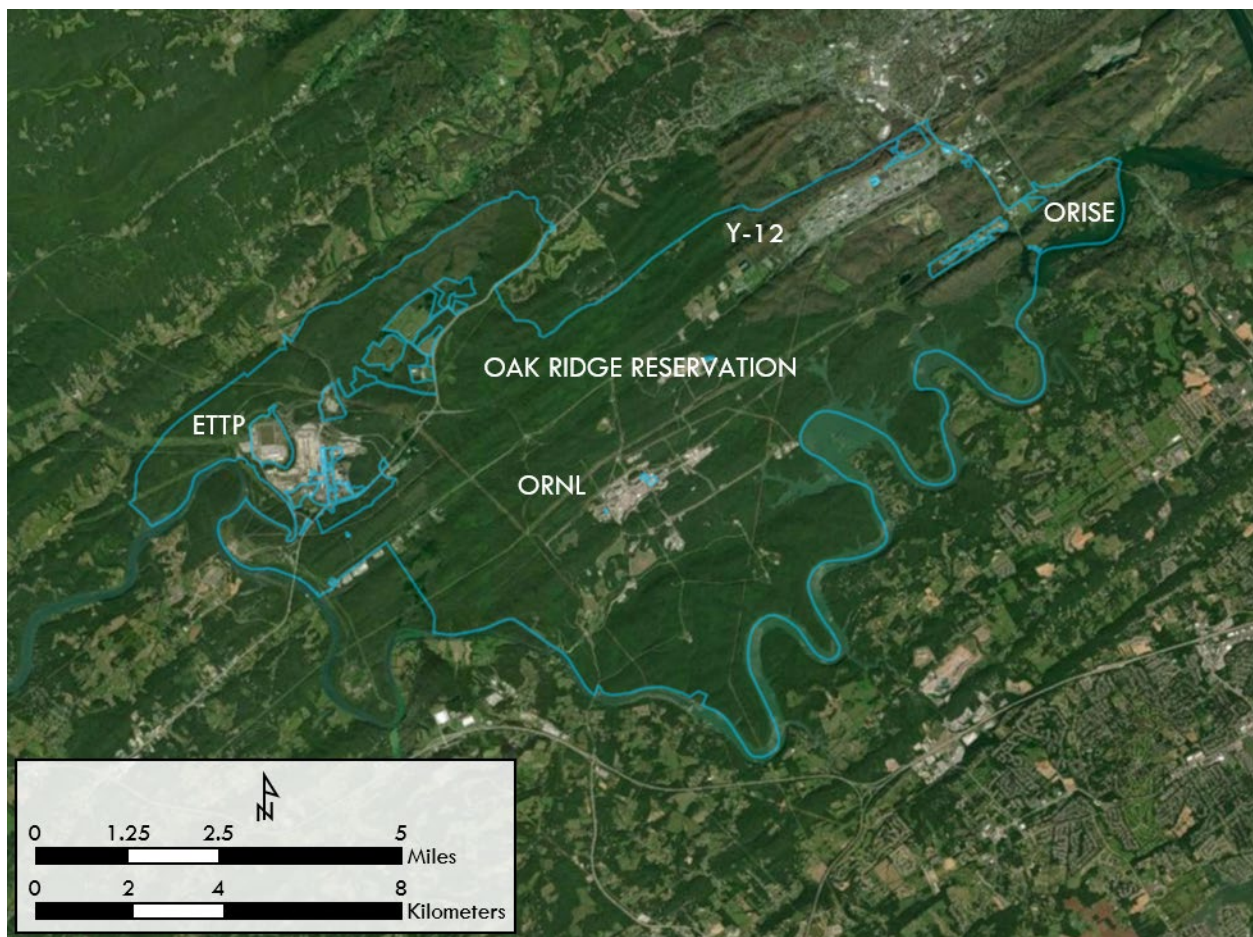


Figure 1.2. Map of the Oak Ridge Reservation

### 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 average temperature for 1992–2021 was 14.9°C (58.8°F). The average temperature for the Oak Ridge area in 2021 was 15.0°C (59.0°F). January temperatures were coldest in 2021, averaging 3.9°C (39.0°F). August was the warmest month, with an average temperature of 25.0°C (77.0°F). Monthly summaries of temperature averages, extremes, and 2021 values are provided in Appendix B, Table B.1.

Average annual precipitation in the Oak Ridge area for the 30-year period from 1992 to 2021 was 1,417.8 mm (55.82 in.), including about 14.5 cm (5.7 in.) of snowfall. Total precipitation during 2021 as measured at meteorological tower (MT)2 was 1,492.2 mm (58.75 in.), which is 5 percent above the 30-year average. Monthly summaries of precipitation averages, extremes, and 2021 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 2021 were greater than 98 percent for wind sensors at the ORNL sites (towers MT2, MT3, MT4, and MT12). All other (MT6, MT9, MT11, and MT13) instrument recoveries were above 69 percent for annual values.

In 2021, wind speeds at ORNL Tower D (MT2) measured at 15 m (49 ft) above ground level averaged 1.3 meters per second (2.9 mph). This value was 2.3 meters per second (5.2 mph) 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 2021 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<sub>10</sub>), and fine particulate matter with an aerodynamic diameter less than or equal to 2.5 µm (PM<sub>2.5</sub>). 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 PM<sub>2.5</sub> 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 (EPA 2021).

### 1.3.4. Surface Water

The ORR area comprises 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. The Tennessee Valley Authority reported 60.91 inches of precipitation in 2021 for the Tennessee River Valley region. Although this amount of rainfall was



about 13 percent less than the record-breaking 70.36 inches of rainfall in 2020, it was still significantly more than a typical year in this region which receives 51 inches. The last time the Tennessee River Valley saw four straight years of over 60 inches of rainfall was 1972–1975; however, the 2018–2021 period saw about 15 more inches of rainfall on average. This conclusion is based on more than 100 years of collected weather data (TVA 2022).

The largest of the ORR drainage basins is Poplar Creek, which receives drainage from a 352 km<sup>2</sup> (136 mi<sup>2</sup>) 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 covers 16.5 km<sup>2</sup> (6.4 mi<sup>2</sup>). 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<sup>2</sup> (1.47 mi<sup>2</sup>). 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 liters per minute (1,000 gallons per minute). 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**

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.

About 243 hectares (600 acres) of potential wetlands (jurisdictional and non-jurisdictional wetland areas) 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 hectares (25 acres) at White Oak Lake. The Tennessee Department of Environment and Conservation's wetland mitigation aquatic resource alteration permits, required by Section 401 of the Clean Water Act (CWA 1972), entail monitoring restored or created wetland mitigation sites for five years. Activities and conditions in and around ORR wetlands are verified by site inspections when appropriate.

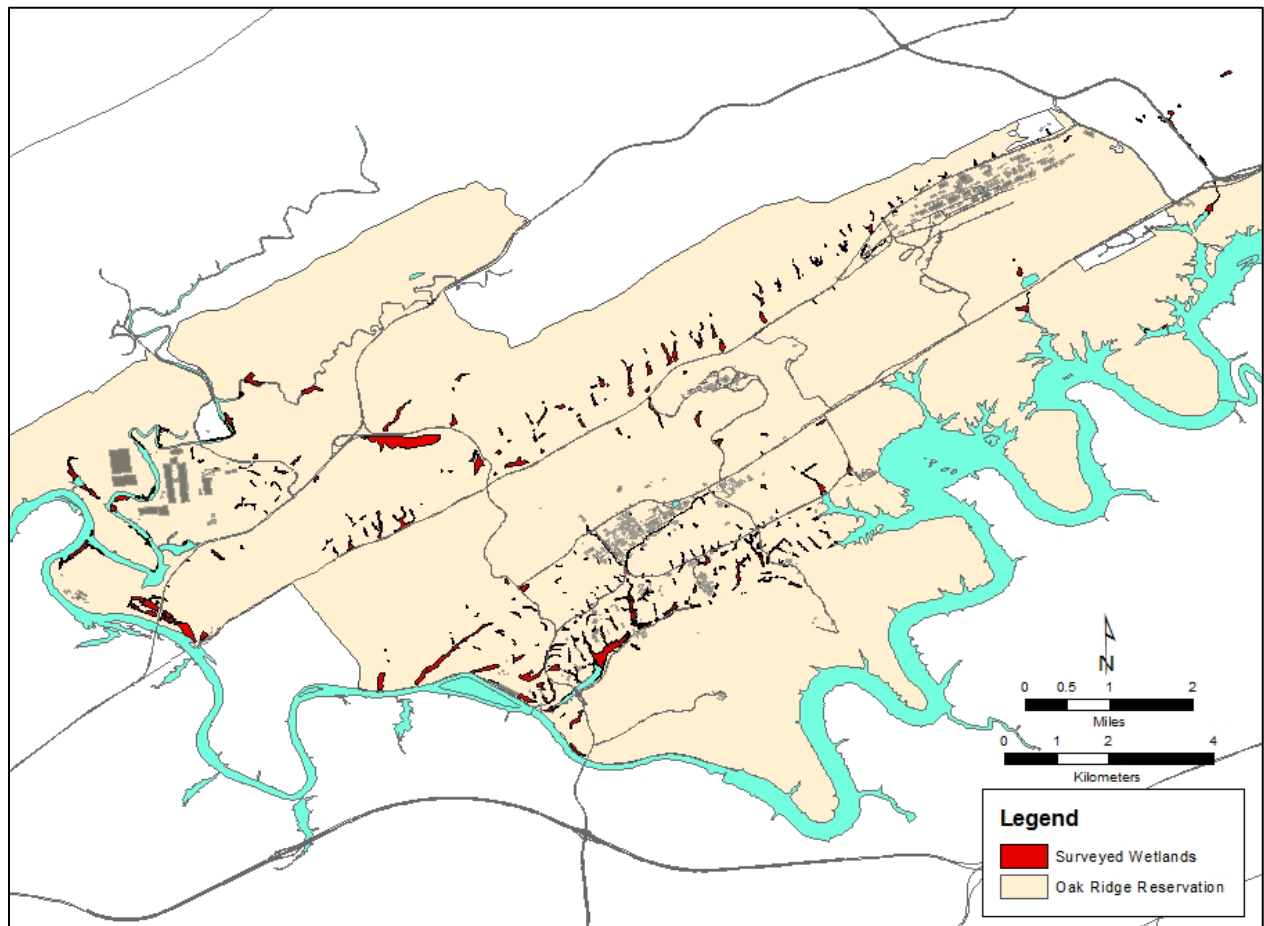


Figure 1.3. Location of Oak Ridge Reservation wetlands

### 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 June 2021, Tennessee had 58 species listed under the federal Endangered Species Act (ESA 1973), including 25 endangered and 33 threatened species. The complete Tennessee Threatened and Endangered List–New Rules is available [here](#) (TDEC 2021a).

Birds, fish, reptiles and amphibians, 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 (listed as endangered) 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 (endangered) 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).



Table 1.1. Animal species of special concern reported on the Oak Ridge Reservation<sup>a</sup>

Scientific name	Common name	Status <sup>b</sup>		
		Federal	State	PIF <sup>c</sup>
<b>FISH</b>				
<i>Phoxinus tennesseensis</i>	Tennessee dace		NM	
<b>AMPHIBIANS AND REPTILES</b>				
<i>Cryptobranchus alleganiensis</i>	Hellbender		E	
<i>Hemidactylum scutatum</i>	Four-toed salamander		NM	
<b>BIRDS</b>				
<b>Swans, Geese, and Ducks</b>				
<i>Branta canadensis</i>	Canada goose	BMC, OB		
<i>Aix sponsa</i>	Wood duck	BMC		
<i>Anas strepera</i>	Gadwall	BMC		
<i>Anas americana</i>	American wigeon	BMC		
<i>Anas rubripes</i>	American black duck	BMC		RC
<i>Anas platyrhynchos</i>	Mallard	BMC		
<i>Anas discors</i>	Blue-winged teal	BMC		
<i>Anas crecca</i>	Green-winged teal	BMC		
<i>Anas clypeata</i>	Northern shovler	BMC		
<i>Anas acuta</i>	Northern pintail	BMC		
<i>Aythya valisineria</i>	Canvasback	BMC		
<i>Aythya americana</i>	Redhead	BMC		
<i>Aythya collaris</i>	Ring-necked duck	BMC		
<i>Aythya affinis</i>	Lesser scaup	BMC		
<b>Grebes</b>				
<i>Podilymbus podiceps</i>	Pied-billed grebe	BMC		
<i>Podiceps auritus</i>	Horned grebe	BMC		
<b>Frigatebirds, Boobies, Cormorants</b>				
<i>Phalacrocorax auritus</i>	Double-crested cormorant	BMC, OB		
<b>Bitterns and Herons</b>				
<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>Butorides virescens</i>	Green heron			CBSD
<i>Mycteria americana</i>	Wood stork	T		
<b>Kites, Hawks, Eagles, and Allies</b>				
<i>Haliaeetus leucocephalus</i>	Bald eagle	BMC <sup>d</sup>		
<i>Chordeiles minor</i>	Common nighthawk	BCC		CBSD
<b>Rails, Gallinules, and Coots</b>				
<i>Rallus limicola</i>	Virginia rail	BMC		
<i>Porzana carolina</i>	Sora	BMC		

Table 1.1. Animal species of special concern reported on the Oak Ridge Reservation<sup>a</sup> (continued)

Scientific name	Common name	Status <sup>b</sup>		
		Federal	State	PIF <sup>c</sup>
<i>Fulica americana</i>	American coot	BMC		
<i>Tringa solitaria</i>	Solitary sandpiper	BMC, BCC		
<i>Tringa flavipes</i>	Lesser yellowlegs	BMC, BCC		
<i>Scolopax minor</i>	American woodcock	BMC		RC
<b>Grouse, Turkey, and Quail</b>				
<i>Colinus virginianus</i>	Northern bobwhite			CBSD
<b>Pigeons and Doves</b>				
<i>Zenaida macroura</i>	Mourning dove	BMC		
<b>Cuckoos and Roadrunners</b>				
<i>Coccyzus americanus</i>	Yellow-billed cuckoo	T		CBSD
<b>Goatsuckers</b>				
<i>Caprimulgus carolinensis</i>	Chuck-will's widow	BMC, BCC		CBSD
<i>Caprimulgus vociferus</i>	Eastern whip-poor-will	BMC, BCC		RC
<i>Chordeiles minor</i>	Common nighthawk	BCC		CBSD
<b>Swifts</b>				
<i>Chaetura pelagica</i>	Chimney swift	BCC		RC
<b>Kingfishers</b>				
<i>Megaceryle alcyon</i>	Belted kingfisher	BCC		RC
<b>Woodpeckers</b>				
<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker	BMC, BCC		
<i>Colaptes auratus</i>	Northern flicker	BMC		RC
<b>Tyrant Flycatchers</b>				
<i>Contopus virens</i>	Eastern wood-pewee			RC
<i>Empidonax vireescens</i>	Acadian flycatcher			RC
<i>Contopus cooperi</i>	Olive-sided flycatcher	BMC, BCC		
<i>Empidonax trailii</i>	Willow flycatcher	BMC		
<b>Swallows</b>				
<i>Progne subis</i>	Purple martin			RC
<i>Hirundo rustica</i>	Barn swallow			RC
<b>Kinglets, Gnatcatchers, and Thrushes</b>				
<i>Hylocichla mustelina</i>	Wood thrush	BMC, BCC	NM	RC
<b>Shrikes</b>				
<i>Lanius ludovicianus</i>	Loggerhead shrike	BMC, BCC	NM	
<b>Wood Warblers</b>				
<i>Vermivora chrysoptera</i>	Golden-winged warbler	BMC, BCC	T	RC
<i>Setophaga cerulea</i>	Cerulean warbler	BMC, BCC	NM	RC
<i>Setophaga discolor</i>	Prairie warbler	BMC, BCC		RC
<i>Mniotilta varia</i>	Black-and-white warbler			RC

Table 1.1. Animal species of special concern reported on the Oak Ridge Reservation<sup>a</sup> (continued)

Scientific name	Common name	Status <sup>b</sup>		
		Federal	State	PIF <sup>c</sup>
<i>Protonotaria citrea</i>	Prothonotary warbler	BMC, BCC		RC
<i>Geothlypis formosa</i>	Kentucky warbler	BMC, BCC		RC
<i>Cardellina canadensis</i>	Canada warbler	BMC, BCC		RC
<i>Icteria virens</i>	Yellow-breasted chat	BCC		RC
<b>Tanagers</b>				
<i>Piranga rubra</i>	Summer tanager	BMC		RC
<b>Towhees, Sparrows, and Allies</b>				
<i>Pipilo erythrophthalmus</i>	Eastern towhee			RC
<i>Spizella pusilla</i>	Field sparrow	BMC, BCC		CBSD
<i>Ammodramus savannarum</i>	Grasshopper sparrow	BMC, BCC		CBSD
<i>Ammodramus henslowii</i>	Henslow's sparrow	BMC, BCC	T	RC
<b>MAMMALS</b>				
<i>Myotis grisescens</i>	Gray bat	E		
<i>Myotis lucifugus</i>	Little brown bat <sup>e</sup>		T	
<i>Myotis sodalist</i>	Indiana bat <sup>f</sup>		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 <sup>e</sup>		T	
<i>Corynorhinus rafinesquii</i>	Rafinesque's big-eared bat		NM	
<i>Sorex dispar</i>	Long-tailed shrew		NM	

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

<sup>b</sup> Status codes:

E = endangered (TDEC 2021a, TDEC 2021b, FWS 2021)

T = threatened (TDEC 2021a, TDEC 2021b, FWS 2021)

BMC = Birds of management concern (FWS 2011)

BCC = Birds of conservation concern (FWS 2021)

NM = in need of management (TDEC 2021a, TDEC 2021b)

OB = overly abundant (FWS 2011)

RC = regional concern (PIF 2021)

CBSD = common bird in steep decline (PIF 2021)

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

<sup>d</sup> The bald eagle was federally delisted effective August 9, 2007.

<sup>e</sup> Under review for federal listing.

<sup>f</sup> A single specimen was captured in a mist net bordering the Clinch River in June 2013.

Birds recorded on ORR and its boundary waters include 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*) for a total of 232 species. Most of these species are protected under the Migratory Bird Treaty Act (MBTA 1918) and Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds* (EO 2001). 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 along varying numbers of up to 10 routes on ORR provide data for the Partners in Flight Program. Public nature walks normally organized by ORNL did not take place in 2021 due to the COVID-19 pandemic. In previous years, these walks began in the late winter and carried through mid-summer, and covered topics such as the American woodcock (shown in Figure 1.4), birds of prey, frog calls, inventories of reptiles and amphibians, and the history of ORR. 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 known ORR bird records since 1950 and 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.



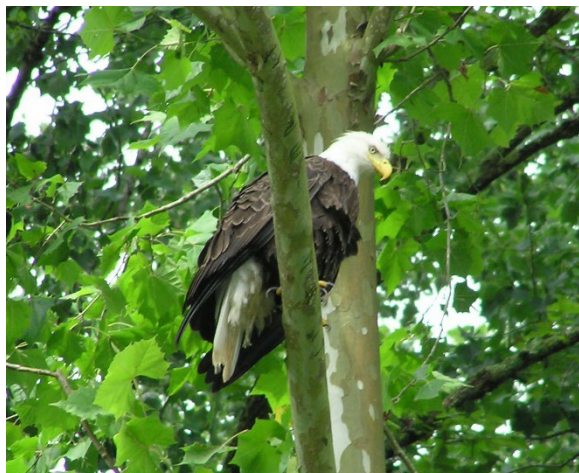
Source: Sarah Darling, ORNL

**Figure 1.4. American woodcock fledgling on ORR**

The bald eagle (Figure 1.5), 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. At least three bald eagle nests were confirmed on the reservation in 2021, all located along the Clinch River/Melton Hill Lake, between Gallaher Bend and Melton Hill Dam. One nest was first observed in 2011 near the mouth of Walker Branch and has remained active every year since, and another nest near Melton Hill Dam has been documented by an area nature photographer for several years. 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.

Other bird species of interest include the migratory wood thrush and barn swallow which have been observed nesting 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 lincolnii*) (no listed status) in May 2014. Barn owls were documented nesting on the reservation in 2019.





Source: Kelly Roy, ORNL

**Figure 1.5. Bald eagle photographed on ORR**

Uncommon birds for ORR recorded in recent years include several species associated with wetland habitats. 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. The sora, least bittern, and Virginia rail were observed at the K1007 P1 pond at ETTP in 2013 and were likely attracted to the high-quality wildlife habitat established through recent restoration efforts. The sora, seen as recently as December 2016, is a fairly common migrant throughout Tennessee that is seldom seen on ORR. The least bittern, an uncommon migrant and summer resident in Tennessee, was documented calling on an acoustic recorder in 2018 at P-1 Pond on ETTP. 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). While collaborating on detection methodologies for secretive marsh birds, researchers from ORNL and Charles Sturt University in New South Wales, Australia, photographed a purple gallinule on a trail camera at the Heritage Center Greenway Powerhouse Trail in 2017 (Figure 1.6). This was the first documented appearance of a purple gallinule on ORR.



**Figure 1.6. Purple gallinule caught on a trail surveillance camera at ETTP in 2017**

ORNL increased monitoring of amphibians and reptiles over the past two years. The ORR contains some of the highest densities of state-listed four-toed salamanders (*Hemidactylum scutatum*) in eastern Tennessee, which are considered by the state as in need of management. Several of their largest subpopulations on the ORR occur in areas that are slated for development. ORNL has also documented what appear to be state-listed black mountain salamanders (*Desmognathus welteri*, considered by the state as in need of management) on the ORR, just south of the Horizon Center. Two state-listed reptiles have inhabited the ORR: the northern pinesnake (*Pituophis melanoleucus melanoleucus*, state-listed as threatened) and the eastern slender glass lizard (*Ophisaurus attenuatus longicaudus*, state-listed as in need of management). However, there is limited evidence to suggest either species still occurs at low densities on the ORR.

Several fish species that are listed and noted for management concern are known to inhabit areas in and around the ORR. 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 federal listing and were previously listed under the C2 candidate designation. FWS now informally refers to these as special concern species.

The state of Tennessee lists 16 plant species occurring on ORR as endangered, threatened, or of special concern; these are included in Table 1.2. An additional 10 threatened, endangered, or special concern species occur in the area and may be present on ORR, although currently unconfirmed. 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 (TDEC 2021b, TDEC 2021c).

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

Species	Common name	Habitat on ORR	Status/rank code <sup>a,b</sup>
<b>Currently known to be or previously reported on ORR</b>			
<i>Aureolaria patula</i>	Spreading false foxglove	River bluff	S, G3
<i>Berberis canadensis</i>	American barberry	Rocky bluff	S, G3
<i>Bolboschoenus fluviatilis</i>	River bulrush	Wetland	S, G5
<i>Delphinium exaltatum</i>	Tall larkspur	Barrens and woodlands	E, G3
<i>Diervilla lonicera</i>	Northern bush-honeysuckle	Rocky river bluff	T, G5
<i>Draba ramosissima</i>	Branching whitlow-grass	Limestone cliff	S, G4
<i>Elodea nuttallii</i>	Nuttall waterweed	Pond, embayment	S, G5
<i>Eupatorium godfreyanum</i>	Godfrey's thoroughwort	Dry woods edge	S, G4
<i>Fothergilla major</i>	Mountain witch-alder	Woods	T, G3
<i>Helianthus occidentalis</i>	Naked-stem sunflower	Barrens	S, G5
<i>Juglans cinerea</i>	Butternut	Lake shore	T, G3
<i>Juncus brachycephalus</i>	Small-head rush	Open wetland	S, G5
<i>Liparis loeselii</i>	Fen orchid	Forested wetland	T, G5
<i>Panax quinquefolius</i>	American ginseng	Rich woods	S, CE
<i>Platanthera flava</i> var. <i>herbiola</i>	Tuberculed rein-orchid	Forested wetland	T, G4
<i>Spiranthes lucida</i>	Shining ladies'-tresses	Boggy wetland	T, G4
<b>Rare plants that occur near and could be present on ORR</b>			
<i>Agalinis auriculata</i>	Earleaf false foxglove	Calcareous barren	E, G3
<i>Allium burdickii</i> <sup>c</sup>	Narrow-leaf Ramps	Moist woods	T, CE, G4
<i>Allium tricoccom</i> <sup>c</sup>	Ramps	Moist woods	S, CE, G5
<i>Lathyrus palustris</i>	Marsh pea	Moist meadows	S, G5
<i>Liatris cylindracea</i>	Slender blazing star	Calcareous barren	T, G5

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

Species	Common name	Habitat on ORR	Status/rank code <sup>a,b</sup>
<i>Lonicera dioica</i>	Mountain honeysuckle	Rocky river bluff	S, G5
<i>Meehania cordata</i>	Heartleaf meehania	Moist calcareous woods	T, G5
<i>Pedicularis lanceolata</i>	Swamp lousewort	Calcareous wet meadow	S, G5
<i>Pseudognaphalium helleri</i>	Heller's catfoot	Dry woodland edge	S, G4
<i>Pycnanthemum torrei</i>	Torrey's mountain-mint	Calcareous barren edge	E, G2

<sup>a</sup> State status codes (TDEC 2021 c):

CE = Status due to commercial exploitation

E = Endangered in Tennessee

S = Special concern in Tennessee

T = Threatened in Tennessee

<sup>b</sup> Global rank codes (NatureServe 2022):

G2 = Very rare and imperiled, generally with six to twenty occurrences and less than 3,000 individuals, or because of some factor(s), vulnerable to extinction.

G3 = Very rare and local throughout its range or found locally in a restricted range, or, because of other factors, vulnerable to extinction throughout its range. Generally between 21 and 100 occurrences and fewer than 10,000 individuals.

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery. Thus, the plant is of long-term concern

G5 = Demonstrably secure globally, though it might be quite rare in parts of its range, especially at the periphery

<sup>c</sup> 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.

**Acronym:** 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 (NHPA 1966) is maintained in conjunction with National Environmental Policy Act (NEPA 1969) 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 several 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 historic interpretation. The reservation contains

more than 44 known prehistoric sites (primarily archeological evidence of former structures), 254 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 (NDAA 2014), 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 (DOE-DOI 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 ETTP.

The X-10 Graphite Reactor building has been a National Historic Landmark 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 Complex are eligible for listing on the NRHP, at present neither is available for regular public access. Occasional public access to both facilities last occurred on November 12, 2015, when DOE facilitated public tours of both buildings to celebrate the establishment of the National Park. By helping to develop the National Park, DOE aims to enhance safe access to these buildings while protecting the agency's mission capabilities.

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 the National Historic Preservation (NHP) project to develop the K-25 History Center that opened to the public in early 2020, and serves to highlight the historic aspects of ETTP and of the communities that were displaced during the construction of the site. In December 2021, preliminary design documents for the K-25 Viewing Platform and other site improvements on the K-25 Preservation Footprint were completed, which will further build on the NHP project.

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](#).

In addition to the X-10 Graphite Reactor, six additional historic ORR properties are listed individually in the planning for a History Center:

- Freels Bend Cabin
- 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.

Three 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 on ORR, at ORNL, and at Y-12 are being implemented since their respective approvals.

## 1.4. Oak Ridge Sites

ORR includes a number of sites critical to the mission of DOE. Eight of these sites are described in this section: ORNL, the Y-12 Complex, ETTP, EMWMF, the Oak Ridge National Environmental Research Park, ORISE, NNSA OST AOEC, and the TWPC.

UCOR is the lead DOE ORR cleanup contractor. The scope of UCOR activities includes characterization and cleanup of former production facilities, building pads, and impacted environmental media; management and maintenance of active ORR facilities; long-term management of inactive waste disposal sites; and water quality monitoring. The *2021 Cleanup Progress: Annual Report on Oak Ridge Reservation Cleanup* (UCOR 2021) provides detailed information on UCOR activities at the ORR and is available [here](#).



### 1.4.1. Oak Ridge National Laboratory

ORNL (shown in Figure 1.7) 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 Frontier 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 ITER project (formerly the 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 5,500 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.

During fiscal year (FY) 2021, 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. Isotek is slated to begin its next phase of the disposition campaign in early 2022 that involves processing canisters with the high-dose uranium-233 material.



Figure 1.7. Aerial view of the Oak Ridge National Laboratory

UCOR continued to carry out characterization and deactivation of former reactors and isotope production facilities in 2021. These activities included demolition of the Tritium Target Preparation Facility and the former Radiological Development Lab's West Cell Bank. Deactivation activities took place at multiple facilities, including the Low Intensity Test Reactor, the Oak Ridge Research Reactor, and a group of buildings called "Isotope Row" that were constructed in the 1950s and early 1960s to process radioisotopes. This work focuses on asbestos, lead, and universal waste removal to eliminate high-risk contaminated structures and to open up space for future research missions at ORNL.

Demonstrating environmental excellence through high-level policies that clearly state expectations for continual improvement, pollution prevention, and compliance with regulations and other requirements is a priority at ORNL. Implementing an environmental management system (EMS) allows environmental impacts to be systematically measured, managed, and controlled. UT-Battelle's EMS is a fully integrated set of environmental management services for UT-Battelle activities and facilities. Services include pollution prevention, waste management, effluent management, regulatory review, reporting, permitting, and other environmental management programs.

Examples of environmental performance optimization during FY 2021 include the following:

- The calculated energy use intensity was 240,885 Btu/gross square foot. This is a 4.5 percent increase from 2020, but there has been a cumulative reduction of 33.8 percent since the DOE baseline target year of FY 2003.
- The diversion rate for municipal solid waste at ORNL was 54 percent in FY 2021; the DOE sustainability goal remained at 50 percent. Sustainable Campus Initiative staff plan to work with Procurement staff to continue to employ terms and conditions within construction contracts to manage construction waste and recycling.

- UT-Battelle implemented 24 new and ongoing reuse and recycle projects at ORNL during 2021, which eliminated more than 2.3 million kg of waste.
- ORNL is replacing less fuel-efficient vehicles with new alternative fuel vehicles. As of the end of FY 2021, ORNL has replaced 308 vehicles in the 467-vehicle fleet with newer models. The new vehicles are more fuel efficient; 90 percent are alternative fuel vehicles or gas hybrids. Furthermore, 100 percent of the light-duty vehicles operate on alternative fuels, exceeding DOE fleet management goals.

See Section 5.2.1.4 for additional details on ORNL environmental sustainability performance data for FY 2021.

#### 1.4.2. Y-12 National Security Complex

The Y-12 Complex (shown in Figure 1.8) 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 a leader in materials science and precision manufacturing. As the main storage facility for the nation's supply of enriched uranium, Y-12 serves as the nation's only source of enriched uranium nuclear weapons components and provides enriched uranium for the US Navy. 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 issued the *Construction Execution/Management Plan, Outfall 200 Mercury Treatment Facility at the Y-12 Nuclear Security Complex, Oak Ridge, Tennessee* (UCOR 2017). The Outfall 200 Mercury Treatment Facility is a vital piece of infrastructure that will open the door for demolition of Y-12's large, deteriorated, mercury-contaminated facilities and subsequent soil remediation by providing a mechanism to limit



potential mercury releases into Upper East Fork Poplar Creek. The west end Y-12 storm drain system discharges to Upper East Fork Poplar Creek at Outfall 200, and mercury from historic operations is present at Outfall 200 where storm water enters Poplar Creek.

In FY 2021, progress continued on construction of the Outfall 200 Mercury Treatment Facility. Excavation activities took place at both the Treatment Plant and Headworks sites, and shoring walls were installed at the Headworks site. Crews also poured concrete pads and installed rebar for the walls of the treatment plant. The new facility is slated for completion in the mid-2020s.

In FY 2021, UCOR completed demolition of the final two buildings in the Biology Complex, the 255,000-square-foot Building 9207 and the 65,000-square-foot Building 9210. Originally consisting of 11 buildings, the 1940s-era complex was constructed for recovering uranium from process streams and later used for research that

led to strides in understanding genetics and the effects of radiation. Once cleared of the remaining building slabs, the 18-acre site is the planned location for Y-12's future Lithium Processing Facility (UCOR 2021).

Y-12's environmental policy reflects a commitment to providing sound environmental stewardship practices through the implementation of its EMS. At the end of FY 2021, the Y-12 Complex had achieved seven of eleven established environmental targets driven by the EMS, and the remaining targets were carried into future years. Highlights of achievements include the following (further details and additional successes are presented in Chapter 4 of this report):

- **Clean air:** Y-12 upgraded software, training, and procedures to improve control of ozone-depleting substances that are managed on site.



Figure 1.8. Aerial view of the Y-12 National Security Complex

- **Energy efficiency:** Y-12 completed phase one of a project to upgrade power lines to 13.8kV service. Additional power line upgrade work will continue into 2022. Progress on several energy-saving improvements for water chillers; heating, ventilation, and air conditioning systems; and cooling towers and a Kathabar unit were made and completed by the end of the 2021 calendar year.
- **Hazardous materials:** A project to disposition and ship legacy mixed waste according to the Site Treatment Plan continued, and the FY 2021 milestone was completed. The 2021 priorities to disposition unneeded materials and equipment in four buildings were completed. Y-12 completed a project to reduce risks associated with inactive west end fuel tanks.
- **Land, water, and natural resources:** Y-12 completed re-roofing projects on two buildings to improve stormwater quality, and also completed work on upgrading and relining approximately 88 feet of sanitary sewer line as part of a larger project to protect the sanitary sewer lines from infill and infiltration.

Y-12 continues to strive to reduce impacts on the environment through increased use of environmentally friendly products and processes and reductions in waste and emissions. In FY 2021, the Y-12 Complex implemented 109 pollution prevention initiatives that resulted in a reduction of more than 120 million lb of waste and projected cost efficiencies of more than \$2.8 million. Also in 2021, Y-12 diverted 50 percent of municipal and 65 percent of construction and demolition waste from landfill disposal through reuse and recycle. In FY 2021, Y-12 diverted more than 2.9 million lb of municipal materials from landfill disposal through source reduction, reuse, and recycle. More than 116.7 million lb of construction and demolition materials were diverted from landfill disposal.

Compared to the FY 2003 baseline year, Y-12 has seen an energy intensity reduction of 51.47 percent as of FY 2021. During FY 2021, energy

intensity was 203,085 Btu/gross square foot, a full 5.4 percent above the prior year (192,119 Btu/gross square foot). The upward trend is largely attributed to the height of the pandemic occurring during FY 2020 and the effect of the plant population returning to the site, which increased the use of infrastructure to support the work force and project requirements. Sustainability goals and performance status for the Y-12 Complex are listed in Chapter 4, Table 4.1.

### 1.4.3. East Tennessee Technology Park

ETTP (see Figure 1.9), 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.

In 2021, the Centrifuge Complex concrete slab removal was completed, which formed the footprint of the 235,000-square-foot facility. The facilities that made up the complex were designed to develop and test technologies associated with the use of centrifuges for uranium enrichment. The last of these facilities was demolished in 2020.

In addition to the Centrifuge Complex slab, other major environmental remediation and building slab demolition projects were completed at ETTP during 2021. The site is divided into two cleanup regions: Zone 1, a 1,400-acre area outside the main plant area, and Zone 2, the 800-acre area that comprises the main plant area. In Zone 1, UCOR completed backfilling and contouring a 30-acre section of the area that that previously had housed oil tanks associated with the Old



Powerhouse and stored scrap metal from ETTP, Y-12, and ORNL. A two-foot clean soil cover was placed on the site and GPS was used to shape the topography to direct water to wetlands and the nearby Clinch River. The area was then revegetated, leaving behind a swath of land that has been proposed for future recreational development. In Zone 2, UCOR removed building slabs and excavated soil contaminated with radiological and chemical contaminants in various exposure units (EUs) to help protect the groundwater and a future industrial workforce, along with land use controls. These areas included EU-19, which lies immediately west of the former K-25 Building, the site of the former K-1303 facility in EU-30, the site of the former K-1423 facility in EU-25, the site of the former Central Neutralization Facility in EU-35, the site of the former K-1413 in EU-25, and EU-21 inside the “U” shape of the former K-25 facility.

The UCOR EMS environmental sustainability principles incorporate the procurement of environmentally preferable products, recycling, and pollution prevention and waste minimization practices in work processes and activities at ETTP. UCOR recycles much of its universal waste, municipal solid waste, and scrap metal; reuses large amounts of construction and demolition debris; and encourages the reduction of waste wherever possible. In 2021, more than 58 metric tons of greenhouse gas emissions, 8,600 cubic yards of waste, 24,870,000 gallons of wastewater, and more than 33,000 miles of travel were avoided as a result of ETTP projects implementing pollution prevention measures. In addition to lessening the impact on the environment, these pollution prevention measures also saved more than \$5,000,000. UCOR’s pollution prevention and waste minimization practices at ETTP are detailed further in Section 3.2.1.

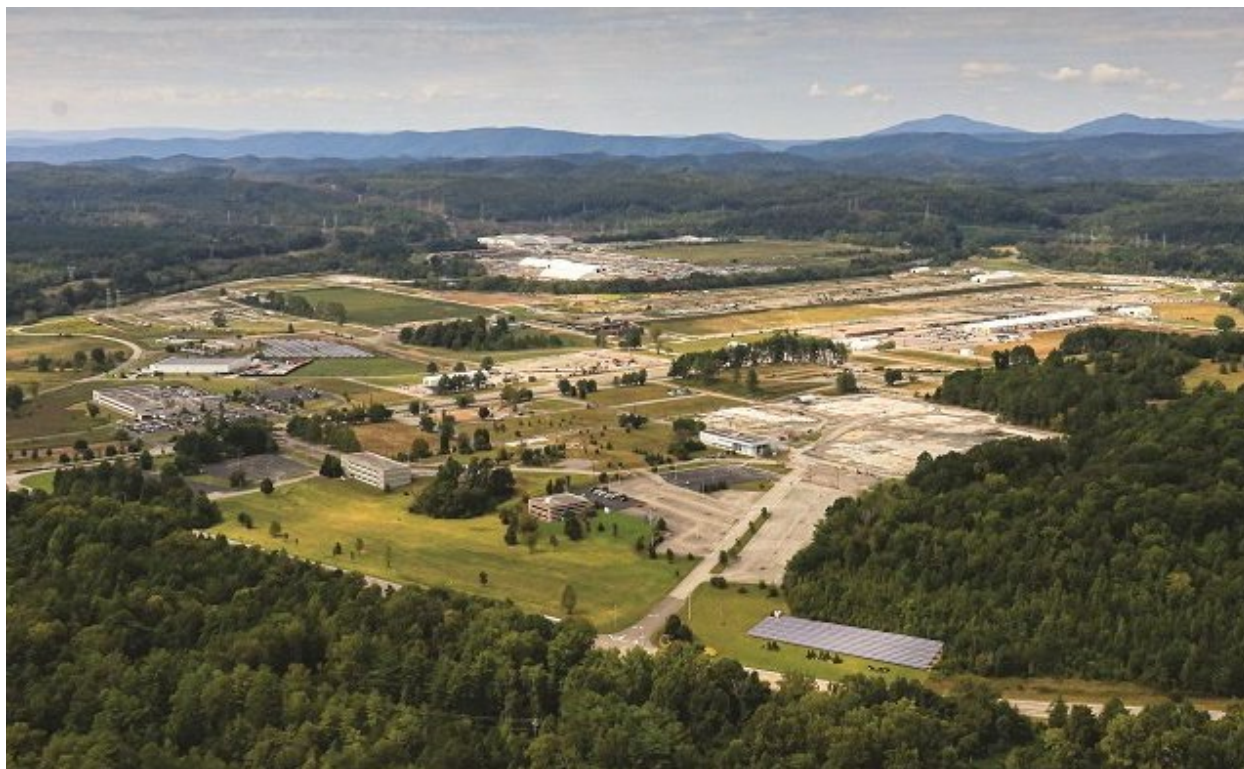


Figure 1.9. Aerial view of East Tennessee Technology Park

In 2021, DOE completed transfer of Access Portals 4 and 11. Portal 4 and one-block sections of both 9th and 10th Streets were transferred to the Community Reuse Organization of East Tennessee (CROET) comprising 0.84 acres of land. Portal 11 (0.52 acres) was transferred to the city of Oak Ridge as a complement to their existing Fire Station. Work continued on the transfer of additional areas of ETTP to CROET for economic development opportunities, including a former switchyard, the former K-1037 area, and the former TSCA Incinerator area (27.9 acres). All transfers are in the review process and pending approval. DOE also continued to support the proposed general aviation airport project, which is in the planning stage.

#### 1.4.4. Environmental Management Waste Management Facility

The EMWMF (shown in Figure 1.10) 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 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA 1980) cleanup actions on ORR. The original design was for the construction, operation, and closure of a projected 1.3 million cubic meter (1.7 million cubic yard) disposal facility. The approved capacity was subsequently increased to 1.8 million cubic meters (2.4 million cubic yards) to maximize use of the footprint designated in a 1999 record of decision. The facility currently consists of six disposal cells.



Figure 1.10. 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 2021, the facility collected, analyzed, and disposed of approximately 3.52 million gallons of leachate. The leachate is treated at the ORNL Liquids and Gaseous Treatment Facility, which is also operated by UCOR. ORR landfills disposed of 145,292 cubic yards of waste during 2021 (UCOR 2021).



During FY 2021, the EMWMF received 9,546 waste shipments from cleanup projects at ETPP, ORNL, and Y-12. However, EMWMF will reach its capacity before OREM completes its cleanup at Y-12 and ORNL. Planning continued in FY 2021 for another disposal facility that is needed to provide the capacity required to complete Oak Ridge’s cleanup. DOE O 435.1, *Preliminary Disposal Statement*, was issued by DOE Headquarters following successful review of the project and DOE O 413.3, *Project Peer Review*, was successfully completed. Also, OREM continues to work with EPA and the Tennessee Department of Environment and Conservation to move forward on regulatory documents related to the project. The Record of Decision was prepared and submitted for regulatory review in July 2021. Planning for the groundwater field demonstration that will augment the existing site characterization is in progress, including the demonstration design (UCOR 2021).

#### 1.4.5. Oak Ridge Environmental Research Park

DOE established the Oak Ridge National Environmental Research Park (see Figure 1.11) 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 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.

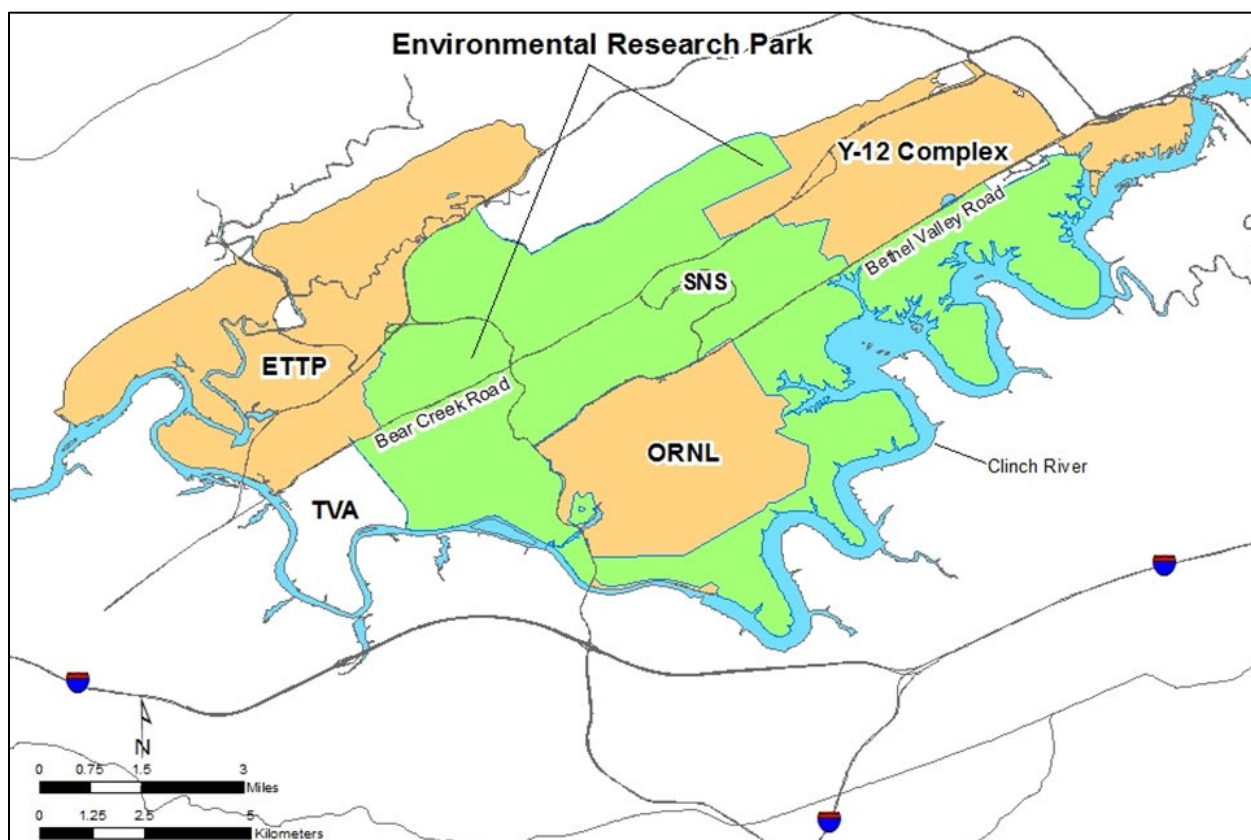


Figure 1.11. Location of the Oak Ridge National Environmental Research Park

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 therefore experimental sites and associated equipment are not disturbed. 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 located 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, or OST.

The NNSA OST AOEC Secure Transportation Center and Training Facility is located on ORR. Situated on about 723 hectares (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. Transuranic Waste Processing Center**

TWPC is located on an approximately 10.5-hectare (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 TWPC for DOE. TWPC's mission is to receive transuranic waste for processing, treatment, repackaging, and shipment to designated facilities for final disposal.



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. TWPC has processed approximately 98 percent of the contact-handled transuranic waste and 98 percent of the remote-handled transuranic waste, and has also completed key regulatory milestones in the *Site Treatment Plan for Mixed Wastes on the US Department of Energy Oak Ridge Reservation* (TDEC 2020) on schedule.

Key progress for the project during FY 2021 included the following actions (UCOR 2021):

- 159 cubic meters accounting for 756 containers of contact-handled transuranic waste were sent to the Waste Isolation Pilot Plant.
- Construction continued on the Sludge Processing Mock Test Facility, which will play a vital role in maturing technologies needed to begin processing Oak Ridge's 500,000-gallon inventory of transuranic sludge waste.

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