

1. Introduction to the Oak Ridge Reservation

The Oak Ridge Reservation (ORR) is a 13,607-ha (33,624-acre) federally owned site located in the counties of Anderson and Roane in eastern Tennessee. The ORR is home to two major U.S. Department of Energy (DOE) operating components, the Oak Ridge National Laboratory (ORNL) and the Y-12 National Security Complex (Y-12 Complex). Also located on the ORR are the East Tennessee Technology Park (ETTP), site of a former gaseous diffusion plant that is undergoing environmental restoration; the Oak Ridge Institute for Science and Education (ORISE) South Campus, which includes training facilities, laboratories, and support facilities; a variety of smaller government-owned, contractor-operated facilities involved in environmental restoration; and the government-owned, government-operated Agent Operations Eastern Command of the Office of Secure Transportation.

The ORR was established in the early 1940s as part of the Manhattan Project for the purposes of enriching uranium and pioneering methods for producing and separating plutonium. The missions of the ORR have evolved over the years, as it continues to adapt to meet the changing basic and applied research and national security needs of the United States.

The *Oak Ridge Reservation Annual Site Environmental Report* and supporting data are available at http://www.ornl.gov/sci/env_rpt.

1.1 Background

The *Oak Ridge Reservation Annual Site Environmental Report* is prepared annually and presents summary environmental data to (1) characterize environmental performance, (2) summarize environmental occurrences reported during the year, (3) confirm compliance with environmental standards and requirements, and (4) highlight significant program activities. The report fulfills the requirement contained in DOE Order 231.1A, *Environment, Safety and Health Reporting* (DOE 2004) that an integrated annual site environmental report be prepared.

The results summarized in this report are based on data collected prior to and through 2009. This report is not intended to nor does it present the results of all environmental monitoring associated with the ORR. Data collected for other site and regulatory purposes, such as environmental restoration/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 DOE guidance and/or laws and are referenced herein as appropriate. Appendix A to this report identifies corrections to the 2008 report. Appendix B contains a glossary of technical terms that may be useful for understanding the terminology used in this document.

Environmental monitoring on the ORR consists primarily of two major activities: 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 release to the environment; these measurements allow the quantification and official reporting of contaminant levels, assessment of radiation and chemical exposures to the public, and demonstration of compliance with applicable standards and permit requirements. Environmental surveillance consists of direct measurements and collection and analysis of samples taken from the site and its environs exclusive of effluents; these activities provide information on contaminant concentrations in air, water, groundwater, soil, foods, biota, and other media. Environmental surveillance data support determinations regarding environmental compliance and, when combined with data from effluent monitoring, support chemical and radiation dose and exposure assessments regarding the potential effects of ORR operations, if any, on the local environment.

1.2 History of the Oak Ridge Reservation

The ORR area was first occupied by Native Americans more than 10,000 years ago, and members of the Overhill Cherokee tribe still lived in the East Tennessee region when European settlers arrived in the late 1700s. These settlers lived on farms or in four small communities called Elza, Robertsville, Scarboro, and Wheat. All but Elza were founded shortly after the Revolutionary War. In the early 1940s approximately 1,000 families inhabited the area.

In 1942, the area that was to become the ORR was selected for use in the Manhattan Project because the Clinch River provided ample supplies of water, nearby Knoxville was a good source of labor, and the Tennessee Valley Authority (TVA) could supply the huge amounts of electricity needed. About 3,000 residents received court orders to vacate within weeks the homes and farms that their families had occupied for generations. The site's wartime name was "Clinton Engineering Works."

The workers' city, named Oak Ridge, was established on the reservation's northern edge. The city grew to a population of 75,000 and was the fifth largest in Tennessee; however, it was not shown on any map. At the Y-12 Complex, south of the city, the electromagnetic separation method was used to separate ²³⁵U from natural uranium. A gaseous diffusion plant, later known as K-25, was built on the reservation's western edge. Near the reservation's southwest corner, about 16 km (10 miles) from Y-12, was a third facility, known as X-10 (or Clinton Laboratories), where the Graphite Reactor was built. The X-10 facility was a pilot plant for the larger plutonium production facilities built at Hanford, Washington. Two years after World War II ended, Oak Ridge was shifted to civilian control, under the authority of the U.S. Atomic Energy Commission. In 1959, the city was incorporated and a city manager and city council form of government was adopted by the community.

Since that time, the missions of these three major installations have continued to evolve and operations adapted to meet the changing defense, energy, and research needs of the United States. Their current missions, as well as the missions of several smaller DOE facilities/activities on the ORR, are described in Sect. 1.4 of this document.

1.3 Site Description

1.3.1 Location and Population

The ORR lies within the Great Valley of East Tennessee between the Cumberland and Great Smoky Mountains and is bordered on two sides by the Clinch River (Fig. 1.1). The Cumberland Mountains are 16 km (10 miles) to the northwest; the Great Smoky Mountains are 51 km (31.6 miles) to the southeast. The ORR encompasses about 13,607 ha (33,624 acres) of mostly contiguous land owned by the federal government and under the management of the DOE (Fig. 1.2). Most of it lies within the corporate limits of the city of Oak Ridge; some of the area west of ETRP lies outside the city limits. Approximately 4,699 ha (11,611.5 acres) of the ORR is situated in Anderson County, and approximately 8,946 ha (22,106 acres) is in Roane County. The population of the 10-county region surrounding the ORR is about 927,200 with about 1.5% of its labor force employed on ORR (Fig. 1.3). Other municipalities within approximately 30 km (18.6 miles) of the reservation include Oliver Springs, Clinton, Lake City, Lenoir City, Farragut, Kingston, and Harriman (Fig. 1.4).

Knoxville, the major metropolitan area nearest Oak Ridge, is located about 40 km (25 miles) to the east and has a population of about 183,550. Except for the city of Oak Ridge, the land within 8 km (5 miles) of the 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.

1.3.2 Climate

The climate of the Oak Ridge region may be broadly classified as humid subtropical and is characterized by significant temperature changes between summer and winter. The 30-year mean temperature for the period of 1980–2009 is 14.7°C (58.5°F). The average temperature for the Oak Ridge area during 2009 was 14.9°C (58.8°F). The coldest month is usually January, with temperatures averaging

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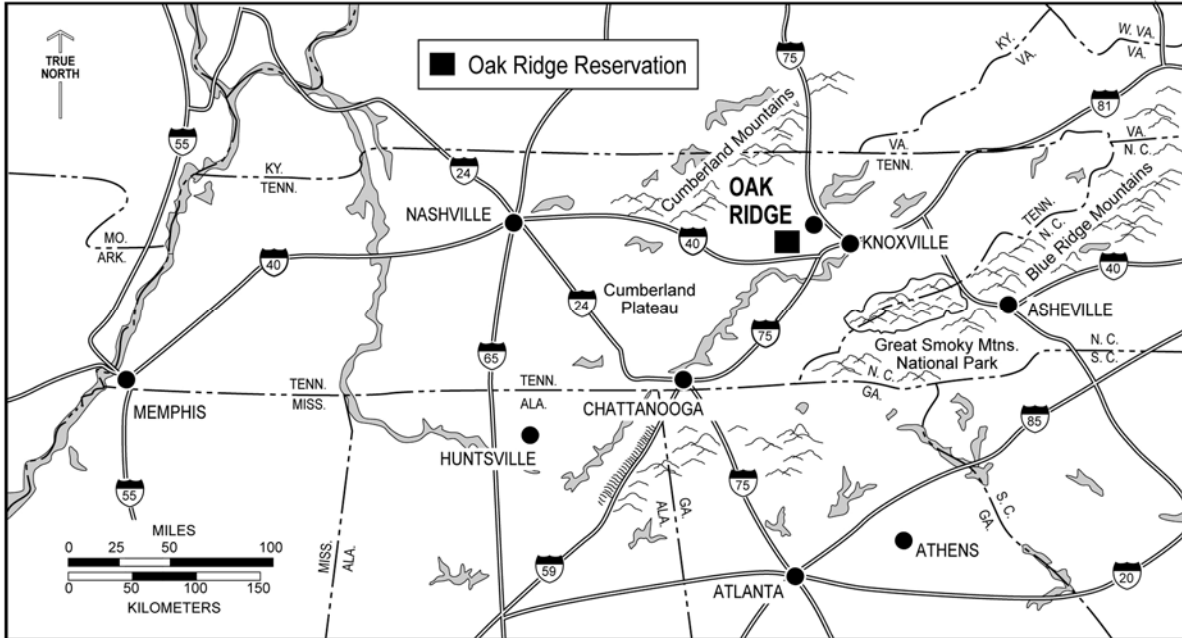


Fig. 1.1. Location of the city of Oak Ridge.

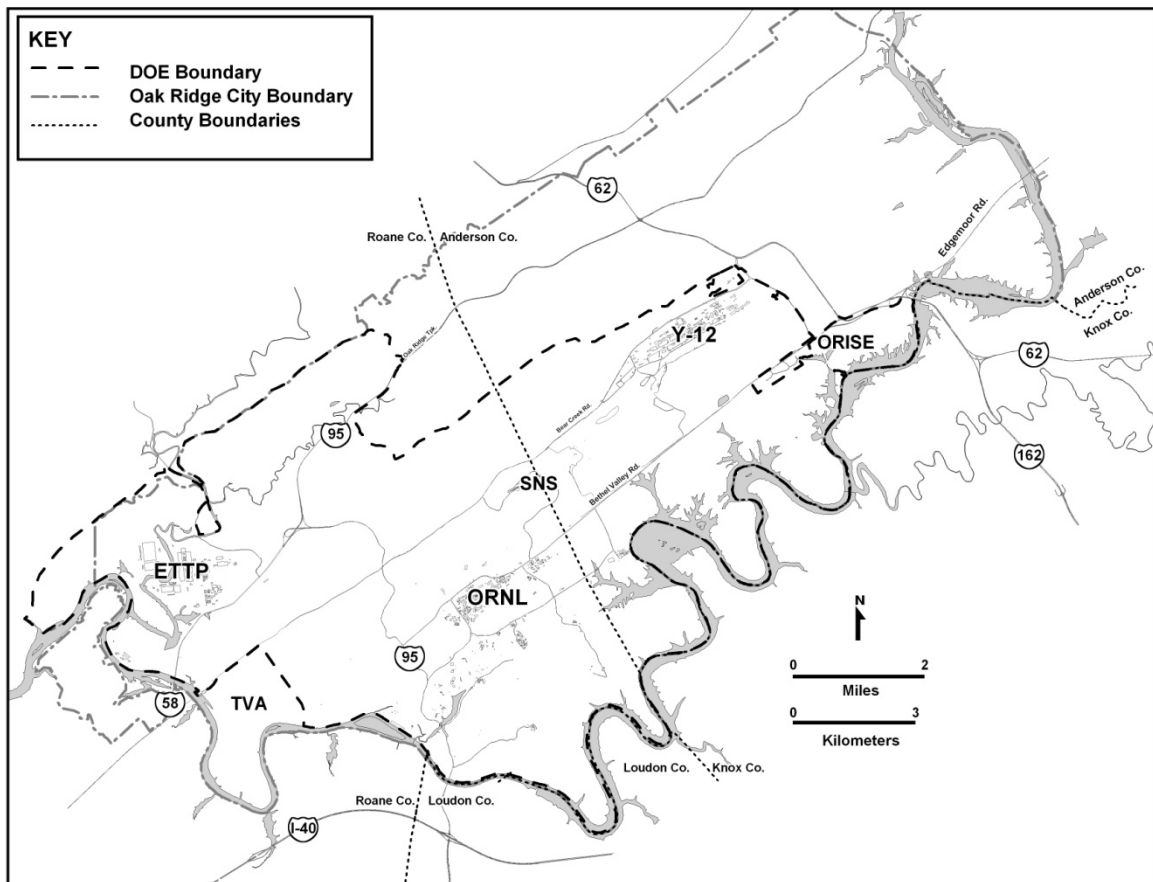


Fig. 1.2. The Oak Ridge Reservation.

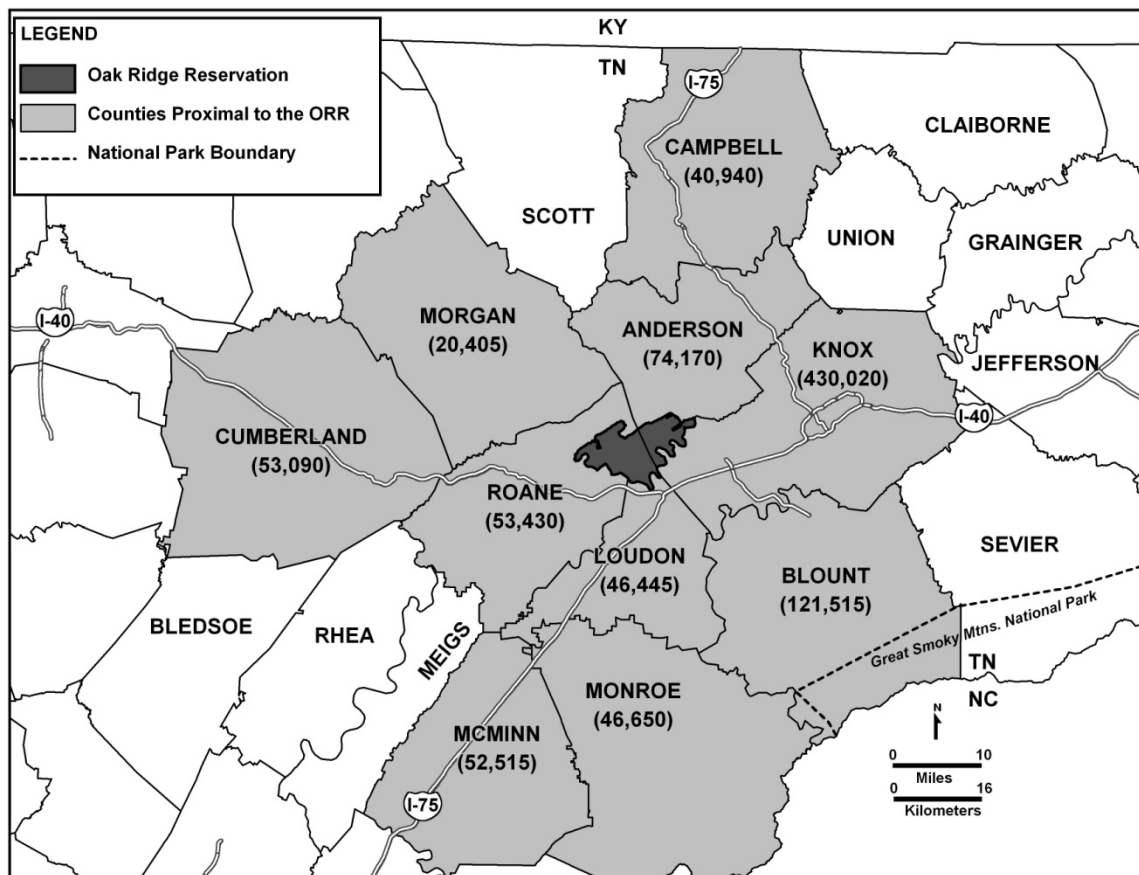


Fig. 1.3. Population by county in the ten-county region surrounding the Oak Ridge Reservation.

about 3.1°C (37.6°F). During 2009, January temperatures averaged near normal at 2.9°C (37.2°F). July tends to be the warmest month, with average temperatures of 25.6°C (78°F). July 2009 temperatures averaged 23.9°C (75°F), significantly below the 30 year mean for July.

Average annual precipitation in the Oak Ridge area for the 30-year period from 1980 to 2009 was 1,312.6 mm (51.68 in.), including about 21.4 cm (8.4 in.) of snowfall annually (NOAA 2010). Total rainfall during 2009 (measured at the Oak Ridge National Weather Service meteorological tower) was 1,544.0 mm (60.8 in.), and total 2009 snowfall was 10.2 cm (4 in.). Precipitation during 2009 was 17.6% above the 30 year average. Monthly summaries of precipitation averages, extremes, and 2009 values are provided in Appendix C, Table C.1.

In 2009, wind speeds at ORNL Tower C (MT2) measured at 10 m (32.8 ft) above ground level averaged 1.2 m/s (3.9 ft/s). This value increased to about 2.9 m/s (9.5 ft/s) for winds at 100 m (328 ft) above the ground (about the height of local ridgetops). The local ridge-and-valley terrain reduces average wind speeds at valley bottoms, resulting in frequent periods of nearly calm conditions, particularly during clear, early morning hours. Wind direction and speed frequencies for the ORR towers during 2009 and during precipitation events over the 10 year representative period from 1998–2007 are presented in Appendix C.

More 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 C of this document.

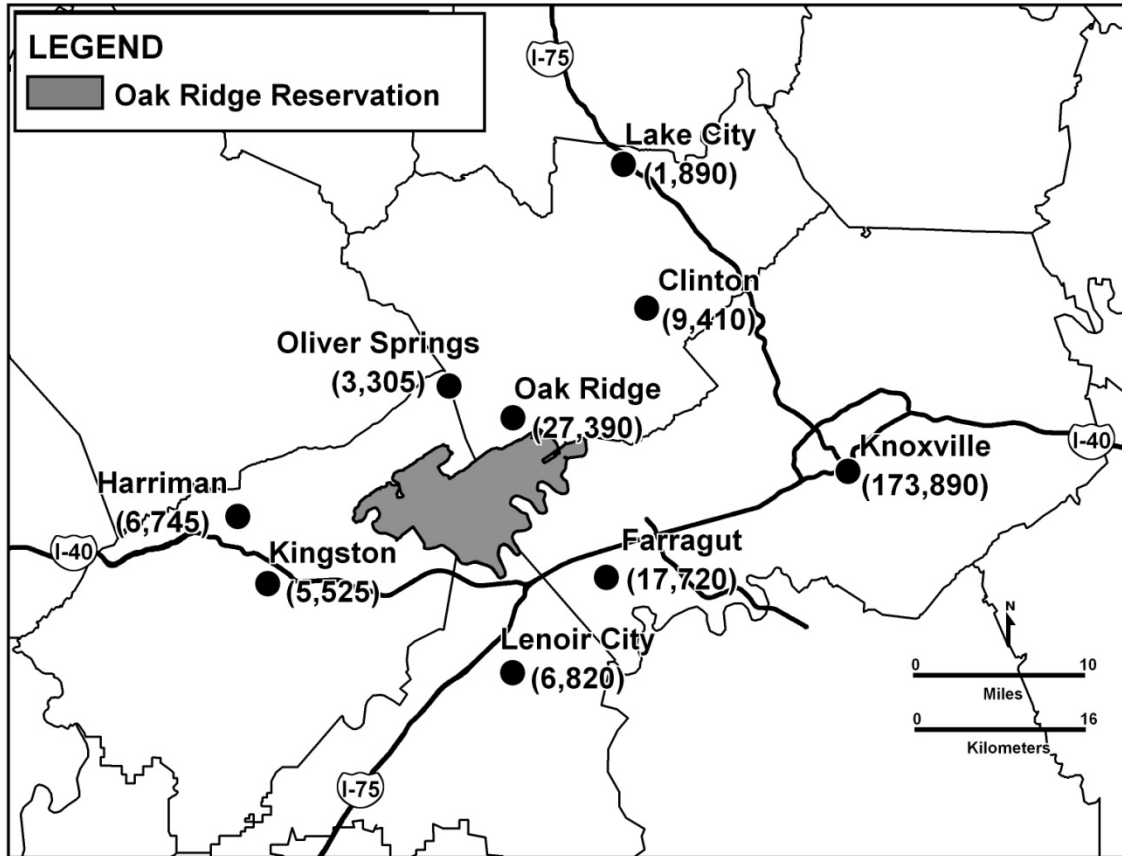


Fig. 1.4. Locations and populations of towns nearest to the Oak Ridge Reservation.

1.3.3 Regional Air Quality

The Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards has set National Ambient Air Quality Standards (NAAQS) for key principal pollutants, which are called “criteria” pollutants. These pollutants are sulfur dioxide (SO₂), carbon monoxide (CO), carbon dioxide (CO₂), nitrogen dioxide (NO₂), lead (Pb), ozone (O₃), particles with an aerodynamic diameter less than or equal to 10 μm (PM₁₀), and fine particulate matter with an aerodynamic diameter less than or equal to 2.5 μm (PM_{2.5}). EPA evaluates NAAQS based on ambient (outdoor) levels of the criteria pollutants. Areas that satisfy NAAQS are classified as attainment areas, whereas areas that exceed the NAAQS for a particular pollutant are classified as nonattainment areas for that pollutant.

The ORR is located in Anderson and Roane counties in Air Quality Control Region 207 (East Tennessee–Southeastern Virginia). The EPA has designated Anderson County as a basic nonattainment area for the 8-hour (h) O₃ standard as part of the larger Knoxville 8 h basic O₃ nonattainment area, which encompasses several counties. In addition, the EPA has designated Anderson, Knox, and Blount counties as a nonattainment area for the PM_{2.5} air quality standard. EPA designated the portion of Roane County surrounding the Kingston Steam Plant as a nonattainment area for PM_{2.5} as well. Air quality in the greater Knoxville and Oak Ridge area is classified as an attainment area with the NAAQS for all other criteria pollutants for which EPA has made attainment designations.

1.3.4 Surface Water

The ORR lies within the Valley and Ridge Physiographic Province, which is composed of a series of drainage basins or troughs containing many small streams feeding the Clinch River. Surface water on the

ORR drains into a tributary or series of tributaries, streams, or creeks within different watersheds. Each of these watersheds drains into the Clinch River that, in turn, flows into the Tennessee River.

The largest of the drainage basins is Poplar Creek, which receives drainage from a 352 km² (136 mile²) area, including the northwestern sector of the ORR. It flows from northeast to southwest, approximately through the center of the ETTP, and discharges directly into the Clinch River.

East Fork Poplar Creek, which discharges into Poplar Creek east of the ETTP, originates within the Y-12 Complex and flows northeast along the south side of the Y-12 Complex. Bear Creek also originates within the Y-12 Complex and flows southwest. Bear Creek is mostly 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 km² (6.4 mile²). White Oak Creek headwaters originate on Chestnut Ridge, north of ORNL, near the Spallation Neutron Source (SNS) site. At the ORNL site, the creek flows west along the southern boundary of the developed area and then flows southwesterly through a gap in Haw Ridge to the western portion of Melton Valley, where it forms a confluence with Melton Branch. The waters of White Oak Creek enter White Oak Lake, which is an impoundment formed by White Oak Dam. Water flowing over White Oak Dam enters the Clinch River after passing through the White Oak Creek embayment area.

1.3.5 Geological Setting

The ORR is located in the Tennessee portion of the Valley and Ridge Physiographic Province, which is part of the southern Appalachian fold-and-thrust belt. As a result of thrust faulting and differential erosion rates, a series of parallel valleys and ridges have formed that trend southwest–northeast.

Two geologic units on the ORR, designated as the Knox Group and the Maynardville Limestone of the Upper Conasauga Group, consisting of dolostone and limestone, respectively, comprise the most significant water-bearing hydrostratigraphic unit in the Valley and Ridge Province (Zurawski 1978) as well as on the ORR. Being composed of the fairly soluble minerals, these bedrock formations are prone to dissolution as slightly acidic rainwater and percolating recharge water come in contact with mineral surfaces. This dissolution increases fracture apertures and can form caverns and extensive solution conduit networks under some circumstances. This hydrostratigraphic unit is referred to locally 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 in the Knox Aquifer [91.5 to 122 m (300 to 400 ft) deep]. The Knox Aquifer is the primary source of groundwater to many streams (base flow), and most large springs on the ORR receive discharge from the Knox Aquifer. Yields of some wells penetrating larger solution conduits are reported to exceed 3,784 L/min (1,000 gal/min). The high productivity of the Knox Aquifer is attributed to 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 the ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) are composed predominantly of shales, siltstones, and sandstones with a subordinate and locally variable amount of carbonate bedrock. These formations are predominantly composed of insoluble minerals such as clays and quartz that were derived from ancient continental erosion. Groundwater occurs and moves through fractures in those bedrock units. Groundwater availability in such settings is dependent on the abundance and interconnectedness of fractures as well as connection of fractures to sources of recharge, such as alluvial soils along streams that 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 very localized areas, where carbonate beds may provide greater groundwater storage than adjacent clastic bedrock (Fig. 1.5). Detailed information on ORR groundwater hydrology and flow is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (Parr and Hughes 2006).

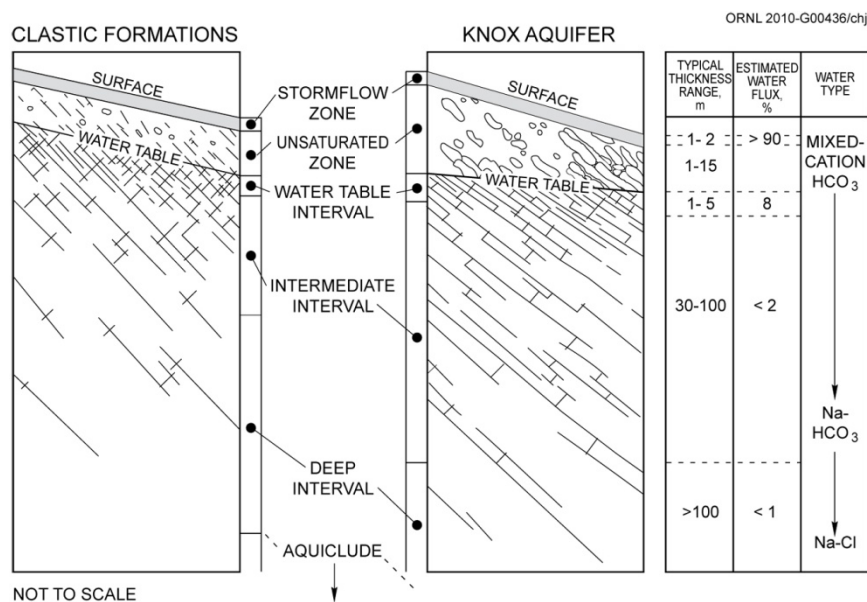


Fig. 1.5. Vertical relationships of flow zones of the Oak Ridge Reservation: estimated thicknesses, water flux, and water types.

1.3.6 Natural, Cultural, and Historic Resources

The ORR contains a unique 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

About 243 ha (600 acres) of wetlands have been identified on the ORR, most are classified as forested palustrine, scrub/shrub, and emergent wetlands. Wetlands occur across the ORR at low elevations, primarily in riparian zones of headwater streams and receiving streams as well as in the Clinch River embayments (Fig. 1.6). Wetlands identified to date range in size from several square meters at small seeps and springs to approximately 10 ha (25 acres) at White Oak Lake. Surveys of wetlands resources presented in *Identification and Characterization of Wetlands in the Bear Creek Watershed* (MMES 1993), *Wetland Survey of Selected Areas in the Oak Ridge Y-12 Plant Area of Responsibility, Oak Ridge, Tennessee* (LMES 1997), and *Wetland Survey of the X-10 Bethel Valley and Melton Valley Groundwater Operable Units at Oak Ridge National Laboratory* (Rosensteel 1996) serve as references to support wetlands assessments for upcoming projects and activities.

Two sites in the Bear Creek watershed were monitored in 2009 as part of wetland and stream mitigation requirements: north tributary 3 (NT-3) and the “Bear Creek Weir” site near Route 95. Both mitigation sites were established as a consequence of wetland and stream disturbances resulting from the implementation of waste disposal requirements in the watershed. In 2009, both mitigation sites were monitored for the growth and survival of planted trees and shrubs, and the general condition of the wetlands relative to jurisdictional wetland criteria.

The construction of a parking structure north of building 4500N at ORNL resulted in impacts to wetland and stream areas. A jurisdictional wetland delineation was conducted on August 4, 2009, prior to major construction activities, and an Aquatic Resources Alteration Permit application was submitted to the Tennessee Department of Environment and Conservation (TDEC) on November 2, 2009. The construction will result in 0.03 ha (0.08 acre) of wetland loss and 67 m (220 ft) of stream loss, which will be mitigated by expanding an existing wetland by 0.02 ha (0.04 acre) and enhancement of 366 m (1,200 ft) of riparian area along White Oak Creek and First Creek. TDEC issued a permit that certified the proposed activity including approval of the mitigation plan on January 15, 2010.

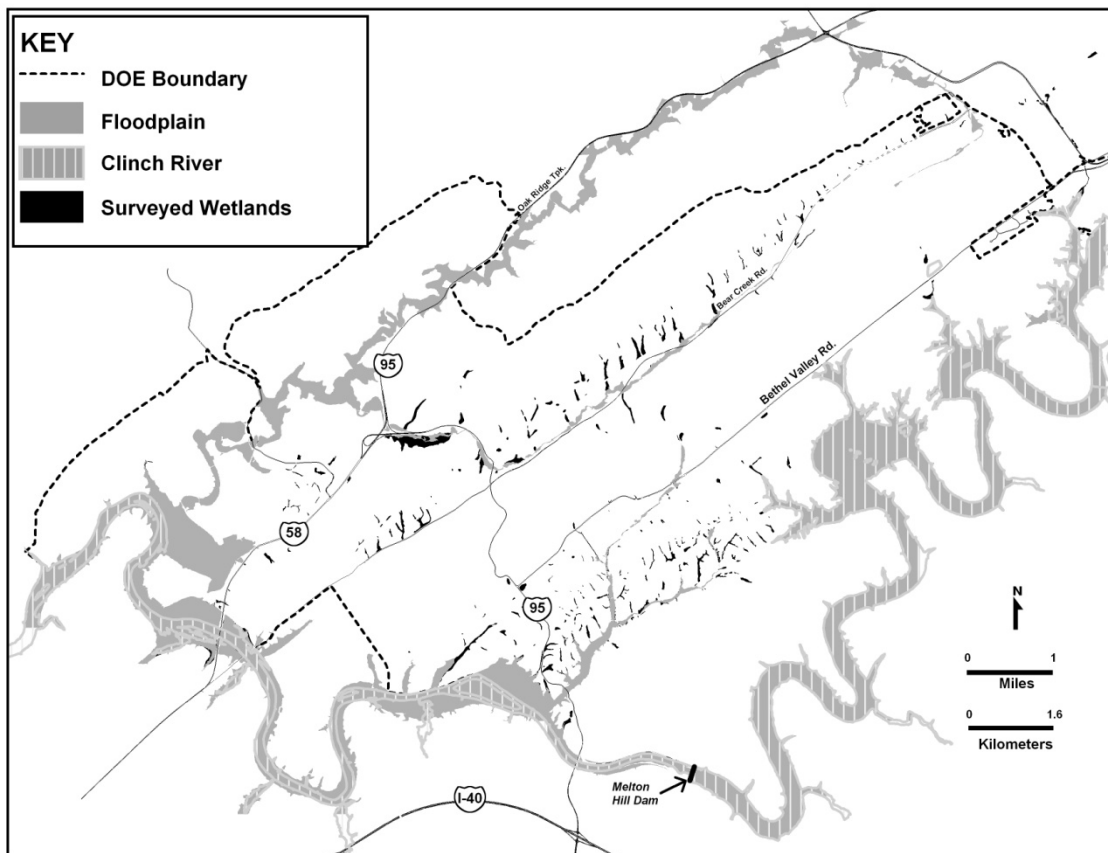


Fig. 1.6. Oak Ridge Reservation wetlands.

1.3.6.2 Wildlife/Endangered Species

Animals listed as species of concern known to be present on the reservation (excluding the Clinch River bordering the reservation) are listed along with their status in Table 1.1. The list illustrates the diversity of avian species on the ORR, which is also habitat for many unlisted species, some of which are in decline nationally or regionally. Some of these (e.g., anhinga) have been seen only once or a few times; others (e.g., sharp-shinned hawk, southeastern shrew) are comparatively common and widespread on the reservation. Other listed species may also be present, although they have not been observed recently. These include several species of mollusks (such as the spiny river snail), amphibians (such as the hellbender), birds (such as Bachman’s sparrow), and mammals (such as the smoky shrew).

Birds, fish, and aquatic invertebrates are the most thoroughly surveyed animal groups on the ORR. The only federally listed animal species that has been observed on the ORR in recent years is the gray bat, which was observed over water bordering the ORR (the Clinch River) in 2003 and over a pond on the ORR in 2004. Three gray bats were mist-netted outside a cave on the ORR in 2006. The peregrine falcon, listed by the state of Tennessee as endangered, and the northern saw-whet owl, listed by the state as threatened, are only very rare transients on the site. Similarly, several state-listed bird species, such as the anhinga, olive-sided flycatcher, and little blue heron, are uncommon migrants or visitors to the reservation; however, the little blue heron is believed to be increasing in numbers. The cerulean warbler, listed by the state as in need of management, has been recorded during the breeding season; however, this species is not actually known to breed on the reservation. The bald eagle, also listed by the state as in need of management, is increasingly seen in winter and may begin nesting here within a few years. Others, such as the northern harrier, great egret, and yellow-bellied sapsucker, are migrants or winter

Table 1.1. Animal species of concern reported from and sensitive wildlife species recently found on the Oak Ridge Reservation^a

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
MAMMALS				
<i>Myotis grisescens</i>	Gray bat	E	E	
<i>Sorex longirostris</i>	Southeastern shrew		NM	
<i>Zapus hudsonius</i>	Meadow jumping mouse		NM	
FISH				
<i>Phoxinus tennesseensis</i>	Tennessee dace		NM	
AMPHIBIANS AND REPTILES				
<i>Cryptobranchus alleganiensis</i>	Hellbender	MC	NM	
<i>Hemidactylium scutatum</i>	Four-toed salamander		NM	
BIRDS				
Darters				
<i>Anhinga anhinga</i>	Anhinga		NM	
Bitterns and Herons				
<i>Ardea alba</i>	Great egret		NM	
<i>Egretta caerulea</i>	Little blue heron		NM	
<i>Egretta thula</i>	Snowy egret		NM	
Kites, Hawks, Eagles, and Allies				
<i>Haliaeetus leucocephalus</i>	Bald eagle ^d		NM	
<i>Circus cyaneus</i>	Northern harrier		NM	
<i>Accipiter striatus</i>	Sharp-shinned hawk		NM	
<i>Buteo platypterus</i>	Broad-winged hawk			RI
Falcons				
<i>Falco peregrinus</i>	Peregrine falcon ^e		E	RI
Grouse, Turkey, and Quail				
<i>Bonasa umbellus</i>	Ruffed grouse			RI
<i>Colinus virginianus</i>	Northern bobwhite			RI
Rails, Gallinules, and Coots				
<i>Gallinula chloropus</i>	Common moorhen		NM	
Owls				
<i>Aegolius acadicus</i>	Northern saw-whet owl	MC	T	RI
<i>Tyto alba</i>	Barn owl		NM	

Table 1.1 (continued)

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
Goatsuckers				
<i>Caprimulgus carolinensis</i>	Chuck-will's-widow			RI
<i>Caprimulgus vociferus</i>	Whip-poor-will			RI
Swifts				
<i>Chaetura pelagica</i>	Chimney swift			RI
Kingfishers				
<i>Megaceryle alcyon</i>	Belted kingfisher			RI
Woodpeckers				
<i>Melanerpes erythrocephalus</i>	Red-headed woodpecker			RI
<i>Sphyrapicus varius</i>	Yellow-bellied sapsucker	MC	NM	
<i>Picoides pubescens</i>	Downy woodpecker			RI
<i>Colaptes auratus</i>	Northern flicker			RI
Tyrant Flycatchers				
<i>Contopus cooperi</i>	Olive-sided flycatcher		NM	RI
<i>Contopus virens</i>	Eastern wood-pewee			RI
<i>Empidonax traillii</i>	Willow flycatcher			RI
<i>Empidonax vireescens</i>	Acadian flycatcher			RI
Swallows				
<i>Progne subis</i>	Purple martin			RI
Titmice and Chickadees				
<i>Poecile carolinensis</i>	Carolina chickadee			RI
Nuthatches				
<i>Sitta pusilla</i>	Brown-headed nuthatch			RI
Kinglets, Gnatcatchers, and Thrushes				
<i>Hylocichla mustelina</i>	Wood thrush			RI
Thrashers and Mockingbirds				
<i>Toxostoma rufum</i>	Brown thrasher			RI
Shrikes				
<i>Lanius ludovicianus</i>	Loggerhead shrike	MC	NM	RI
Vireos				
<i>Vireo flavifrons</i>	Yellow-throated vireo			RI

Table 1.1 (continued)

Scientific name	Common name	Status ^b		
		Federal	State	PIF ^c
Wood Warblers				
<i>Vermivora chrysoptera</i>	Golden-winged warbler	MC	NM	RI
<i>Vermivora pinus</i>	Blue-winged warbler			RI
<i>Dendroica cerulea</i>	Cerulean warbler		NM	RI
<i>Dendroica discolor</i>	Prairie warbler			RI
<i>Dendroica fusca</i>	Blackburnian warbler			RI
<i>Mniotilta varia</i>	Black-and-white warbler			RI
<i>Helmitheros vermivorum</i>	Worm-eating warbler			RI
<i>Seiurus motacilla</i>	Louisiana waterthrush			RI
<i>Oporornis formosus</i>	Kentucky warbler			RI
<i>Wilsonia canadensis</i>	Canada warbler			RI
<i>Wilsonia citrina</i>	Hooded warbler			RI
<i>Icteria virens</i>	Yellow-breasted chat			RI
Tanagers				
<i>Piranga olivacea</i>	Scarlet tanager			RI
<i>Piranga rubra</i>	Summer tanager			RI
Cardinals, Grosbeaks, and Allies				
<i>Passerina cyanea</i>	Indigo bunting			RI
Towhees, Sparrows, and Allies				
<i>Pipilo erythrophthalmus</i>	Eastern towhee			RI
<i>Spizella pusilla</i>	Field sparrow			RI
<i>Ammodramus savannarum</i>	Grasshopper sparrow			RI
<i>Pooecetes gramineus</i>	Vesper sparrow		NM	
Blackbirds and Allies				
<i>Sturnella magna</i>	Eastern meadowlark			RI

^aLand and surface waters of the ORR exclusive of the Clinch River, which borders the ORR

^bStatus codes

E = endangered

T = threatened

MC = species of management concern

NM = in need of management

RI = regional importance

^cPartners in Flight was launched in 1990 in response to growing concerns about declines in the populations of many land bird species, and to emphasize the conservation of birds not covered by existing conservation initiatives.

^dThe bald eagle was federally delisted effective August 8, 2007.

^eThe peregrine falcon was federally delisted effective August 25, 1999.

residents that do not nest on the reservation. The golden-winged warbler, listed by the state as in need of management, has been sighted once on the reservation. Barn owls have been known to nest on the reservation in the past.

One species of fish, the spotfin chub (*Cyprinella monnacha*), 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 the ORR. The Tennessee dace, listed by the state as being in need of management, has been found in Bear Creek watershed, tributaries to lower East Fork watershed, and Ish Creek, and may occur in some sections of Grassy Creek (upstream of Scientific Ecology Group, Inc., and International Technology Corporation at Clinch River Kilometer 23).

1.3.6.3 Threatened and Endangered Plants

There are 23 state-listed plant species that have been observed in the last 10 years on the ORR; among them are the pink lady's-slipper and Canada lily (Table 1.2). Two species occurring on the ORR, Carey's saxifrage and the purple fringeless orchid, were removed from the state list November 17, 1999. The big-tooth aspen was found on the ORR; it was removed from the state list at the January 2007 meeting of the Tennessee Heritage Program Scientific Advisory Committee. Four species (spreading false-foxglove, Appalachian bugbane, tall larkspur, and butternut) have been under review for listing at the federal level and were listed under the formerly used "C2" candidate designation. These species are now informally referred to as "special concern" species by the U.S. Fish and Wildlife Service.

Two additional species listed by the state, the Michigan lily and the hairy sharp-scaled sedge, were identified in the past on the ORR; however, they have not been found in recent years. Several state-listed plant species currently found on adjacent lands may be present on the ORR, although they have not been observed (Table 1.2).

During botanical surveys in 2009, an addition to the ORR list of state-protected plants (Table 1.2) was found. This plant, American barberry, is listed as a species of special concern by the state. The Tennessee Heritage Program scientific advisory committee met in 2009 to revise the state list, but its changes to the state list are not yet official. These changes are expected to add one species to the ORR list while deleting two. In addition, the ORR list (Table 1.2) reflects changes made by the state to the scientific names used for plants.

1.3.6.4 Historical and Cultural Resources

Efforts continue to preserve the rich prehistoric and historic cultural resources of the ORR. 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, 31 cemeteries, and several historically significant Manhattan Project-era structures. Six historic ORR properties are individually listed in the *National Register of Historic Places*:

- Freels Bend Cabin,
- Graphite Reactor,
- New Bethel Baptist Church and Cemetery,
- Oak Ridge Turnpike Checking Station,
- George Jones Memorial Baptist Church and Cemetery, and
- Scarboro Road Checking Station.

Although not yet listed in the *National Register*, an area known as the Wheat Community African Burial Grounds was dedicated in June 2000, and a memorial monument was erected.

The DOE Oak Ridge Office (ORO) *Cultural Resource Management Plan* (DOE 2001) was developed to identify, assess, and document historic and cultural resources on the ORR and establish a management strategy.

Table 1.2. Vascular plant species listed by state or federal agencies, 2009

Species	Common name	Habitat on ORR	Status code ^a
Currently known or previously reported from the ORR			
<i>Aureolaria patula</i>	Spreading false-foxglove	River bluff	FSC, S
<i>Berberis canadensis</i>	American barberry	Rocky bluff, creek bank	S
<i>Bolboschoenus fluviatilis</i>	River bulrush	Wetland	S
<i>Carex gravida</i>	Heavy sedge	Varied	S
<i>Carex oxylepis var. pubescens^b</i>	Hairy sharp-scaled sedge	Shaded wetlands	S
<i>Cimicifuga rubifolia</i>	Appalachian bugbane	River slope	FSC, T
<i>Cypripedium acaule</i>	Pink lady's-slipper	Dry to rich woods	E, CE
<i>Delphinium exaltatum</i>	Tall larkspur	Barrens and woods	FSC, E
<i>Diervilla lonicera</i>	Northern bush-honeysuckle	River bluff	T
<i>Draba ramosissima</i>	Branching whitlow-grass	Limestone cliff	S
<i>Elodea nuttallii</i>	Nuttall waterweed	Pond, embayment	S
<i>Fothergilla major</i>	Mountain witch-alder	Woods	T
<i>Helianthus occidentalis</i>	Naked-stem sunflower	Barrens	S
<i>Hydrastis canadensis</i>	Golden seal	Rich woods	S, CE
<i>Juglans cinerea</i>	Butternut	Slope near stream	FSC, T
<i>Juncus brachycephalus</i>	Small-head rush	Open wetland	S
<i>Lilium canadense</i>	Canada lily	Moist woods	T
<i>Lilium michiganense^c</i>	Michigan lily	Moist woods	T
<i>Liparis loeselii</i>	Fen orchid	Forested wetland	E
<i>Panax quinquefolius</i>	Ginseng	Rich woods	S, CE
<i>Platanthera flava var. herbiola</i>	Tuberculed rein-orchid	Forested wetland	T
<i>Ruellia purshiana</i>	Pursh's wild-petunia	Dry, open woods	S
<i>Spiranthes lucida</i>	Shining ladies-tresses	Boggy wetland	T
<i>Thuja occidentalis</i>	Northern white cedar	Rocky river bluffs	S
<i>Viola tripartite var. tripartita</i>	Three-parted violet	Rocky woods	S
Rare plants that occur near and could be present on the ORR			
<i>Agalinis auriculata</i>	Earleaf false foxglove	Calcareous barren	FSC, E
<i>Allium burdickii</i> or <i>A. tricoccom^d</i>	Ramps	Moist woods	S, CE
<i>Pseudognaphalium helleri</i>	Heller's catfoot	Dry woodland edge	S
<i>Lathyrus palustris</i>	A vetch	Moist meadows	S
<i>Liatris cylindracea</i>	Slender blazing star	Calcareous barren	E
<i>Lonicera dioica</i>	Mountain honeysuckle	Rocky river bluff	S
<i>Meehanian cordata</i>	Heartleaf meehania	Moist calcareous woods	T
<i>Pedicularis lanceolata</i>	Swamp lousewort	Calcareous wet meadow	T
<i>Pycnanthemum torrei</i>	Torrey's mountain-mint	Calcareous barren edge	S
<i>Solidago ptarmicoides</i>	Prairie goldenrod	Calcareous barren	E

^aStatus codes:

CE = Status due to commercial exploitation.

E = Endangered in Tennessee.

FSC = Federal Special Concern; formerly designated as C2. See *Federal Register*, February 28, 1996.

S = Special concern in Tennessee.

T = Threatened in Tennessee.

^b*Carex oxylepis var. pubescens* has not been observed during recent surveys.

^c*Lilium michiganense* is believed to have been extirpated from the ORR by the impoundment at Melton Hill.

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

1.4 DOE Offices and Sites

1.4.1 The DOE Oak Ridge Office

The DOE Oak Ridge Office (ORO) is rich in history, dating back to World War II, when the organization played a major role in the production of enriched uranium and development of processes for production and separation of plutonium for the Manhattan Project. Since then, the ORO has expanded far beyond those first missions and today is responsible for managing major DOE programs in science, environmental management, energy efficiency, nuclear fuel supply, reindustrialization, and national security and for providing support to science laboratories and facilities operated by DOE throughout the United States. ORO also provides support to national security activities managed by the National Nuclear Security Administration (NNSA). The FY 2009 budget for all DOE programs in Oak Ridge was \$4.063 billion (\$1.180 billion, American Recovery and Reinvestment Act–related Energy and Water appropriations; \$2.253 billion, FY 2009 Energy and Water appropriations).

1.4.2 The National Nuclear Security Administration Y-12 Site Office

The National Nuclear Security Administration (NNSA) is a semiautonomous agency within DOE that works in partnership with the U.S. Department of Defense and the other components of the national security enterprise to perform routine maintenance and repair of nuclear weapons components, dismantlement of retired nuclear weapons, and refurbishment of nuclear warheads and to maintain the capability to design, manufacture, and certify new nuclear warheads.

The NNSA Y-12 Site Office (YSO), located on the Y-12 Complex, is responsible for operation of the Y-12 Complex. YSO employees perform contract and program management oversight, contract and administrative management, and technical evaluation and assessment.

1.4.3 Oak Ridge National Laboratory

Oak Ridge National Laboratory is DOE's largest science and energy laboratory (Fig. 1.7). Managed since April 2000 by a partnership of the University of Tennessee and Battelle, ORNL was established in 1943 as a part of the Manhattan Project to pioneer a method for producing and separating plutonium. During the 1950s and 1960s, ORNL became an international center for the study of nuclear energy and related research in the physical and life sciences. With the creation of DOE in the 1970s, ORNL's mission broadened to include a variety of energy technologies and strategies. Today the laboratory supports the nation with a peacetime science and technology mission.



Fig. 1.7. The Oak Ridge National Laboratory.

As an international leader in a range of scientific areas that support DOE's mission, ORNL has six major mission roles: neutron science, energy, high-performance computing, systems biology, materials science at the nanoscale, and national security. ORNL's leadership role in the nation's energy future includes hosting the U.S. project office for the ITER fusion experiment and the BioEnergy Science Center, which is sponsored by the DOE Office of Science.

The Transuranic (TRU) Waste Processing Center (TWPC) is managed by Wastren Advantage, Inc. (WAI) for DOE. In late 2009, WAI was awarded the contract to operate the TWPC. Until that contract was awarded, the TWPC was operated by EnergX TN LLC. The mission of TWPC is to receive TRU wastes from ORNL for processing, treatment, repackaging, and shipment to designated facilities for final disposal. Processed TRU waste is shipped to the Waste Isolation Pilot Plant (WIPP) for disposal. Waste that is determined to be non-TRU (e.g., low-level radioactive waste, mixed low-level waste) is shipped to the Nevada Test Site or other approved facility.

Isotek Systems LLC (Isotek) manages activities at ORNL's Building 3019 Complex for DOE and is responsible for activities associated with processing, down-blending, and packaging the DOE inventory of ^{233}U stored in the Building 3019 Complex.

1.4.4 The Y-12 National Security Complex

The original Y-12 Complex (Fig. 1.8) was constructed as part of the World War II Manhattan Project and began operations in November 1943. The first site mission was the separation of ^{235}U from natural uranium by the electromagnetic separation process. At its peak in 1945, more than 22,000 workers were employed at the site.



Fig. 1.8. Y-12 National Security Complex.

Today, as part of the NNSA Nuclear Security Enterprise, Y-12 performs critical roles in strengthening national security and reducing the global threat from weapons of mass destruction through work in support of the nation's nuclear weapons stockpile, nuclear nonproliferation, and naval reactors. Y-12 also provides unique and highly specialized manufacturing and software technologies to other federal agencies through the DOE Work for Others program.

1.4.5 East Tennessee Technology Park

What is now known as the ETPP site was originally named the K-25 site, on which was located the nation's first gaseous diffusion plant for enriching uranium (Fig. 1.9), as part of the Manhattan Project.

In the postwar years, additional uranium enrichment facilities were built adjacent to K-25, forming a complex officially known as the Oak Ridge Gaseous Diffusion Plant. Uranium enrichment operations at the site ceased in 1987. The site was renamed the East Tennessee Technology Park in 1996 and began undergoing cleanup for ultimate conversion to a private-sector industrial park called the Heritage Center. Restoration of the environment, decontamination and decommissioning of facilities, disposition of wastes, and reindustrialization are the major activities at the site.

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Fig. 1.9. East Tennessee Technology Park.

1.4.6. Environmental Management Waste Management Facility

The EMWMF is located in eastern Bear Creek Valley near the Y-12 Complex and is operated by Bechtel Jacobs, Inc., LLC. The EMWMF was built for disposal of waste resulting from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup actions on the 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 utilization of the footprint designated in a 1999 record of decision. The facility currently consists of four disposal cells. A fifth cell under construction will be completed in 2010.

EMWMF is an engineered landfill that accepts low-level, mixed low-level, and hazardous wastes from DOE sites on the ORR that meet specific waste acceptance criteria developed in accordance with the agreements with state and federal regulators. Waste types that qualify for disposal include soil, dried sludge and sediment, solidified wastes, stabilized waste, building debris, scrap equipment, and secondary waste such as personal protective equipment, all of which must meet the land disposal restrictions. In addition to the solid waste disposal facility, EMWMF operates a leachate collection system. The leachate is treated at the ORNL Liquids and Gaseous Treatment Facility (LGTF), which is operated by UT-Battelle.

1.4.7 Oak Ridge National Environmental Research Park

In 1980, DOE established the Oak Ridge National Environmental Research Park (Fig. 1.10), which by congressional action was designated a protected outdoor research reserve in 1990. Consisting of about 8,000 ha (19,760 acres), the Research Park serves as an outdoor laboratory to evaluate the environmental consequences of energy use and development as well as the strategies to mitigate those effects. It contains large blocks of forest and diverse communities of vegetation that 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.

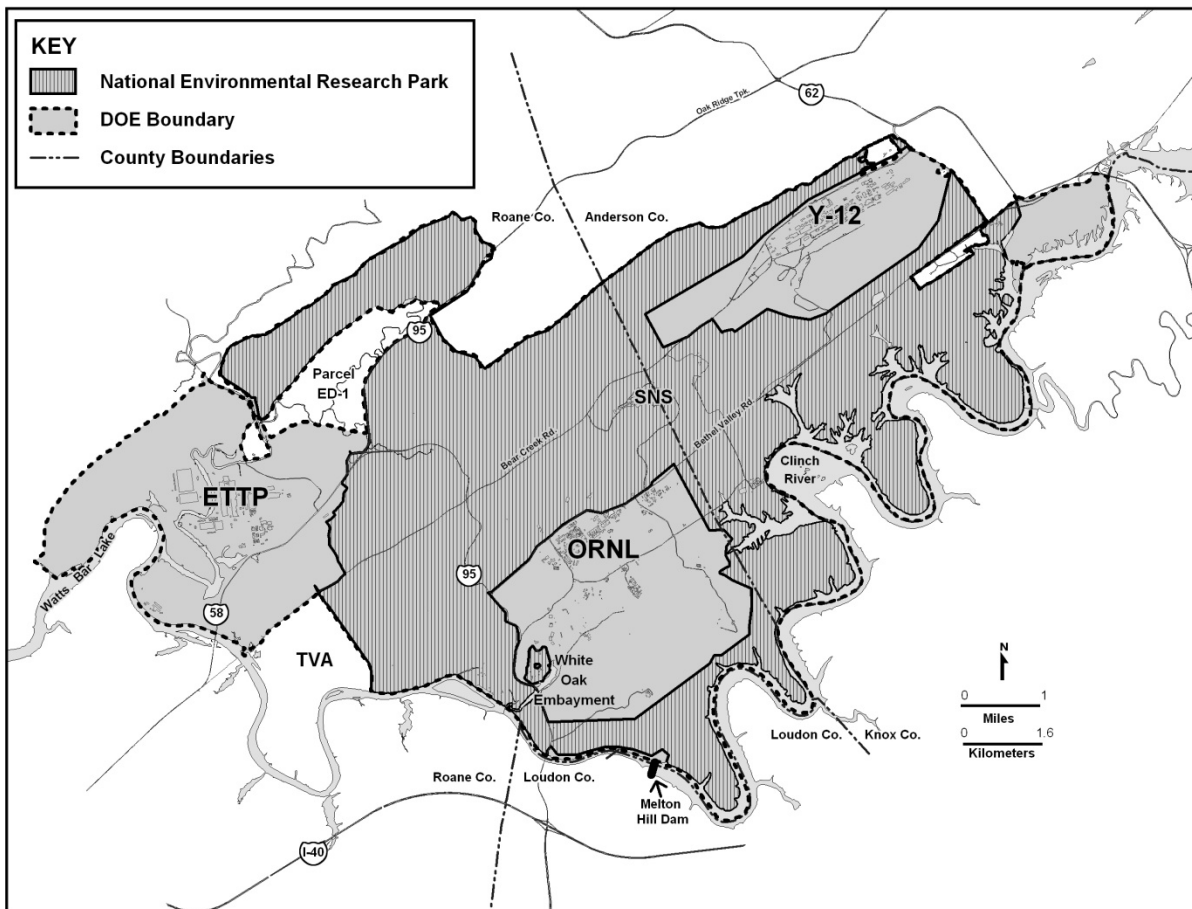


Fig. 1.10. The Oak Ridge National Environmental Research Park covers about 8000 hectares (19,760 acres) on the reservation.

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 of time. 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.

National recognition of the value of the Research Park has led to its use as a component of both regional- and continental-scale research projects. Various 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, wetlands mitigation, and forest and wildlife management.

1.4.8 Oak Ridge Institute for Science and Education

The Oak Ridge Institute for Science and Education (ORISE) is a DOE institute, which is managed by Oak Ridge Associated Universities (ORAU). ORISE addresses national needs in assessing and analyzing environmental and health effects of radiation, beryllium, and other hazardous materials; developing and operating medical and national security radiation emergency management and response capabilities; and managing education programs to help ensure a robust supply of scientists, engineers, and technicians to meet future science and technology needs. ORISE creates opportunities for collaboration through partnerships with other DOE facilities, federal agencies, academia, and industry in a manner consistent with DOE objectives and the ORISE mission.

ORISE includes a 94-ha (232-acre) area on the southeastern border of the ORR that from the late 1940s to the mid-1980s was part of an agricultural experiment station owned by the federal government and, until 1981, was operated by the University of Tennessee. The site houses offices, laboratories, and storage areas for the ORISE program offices and support departments.

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

Since 1947, DOE and its predecessor agencies have moved nuclear weapons, weapons components, special nuclear materials, and other important national security assets by commercial and government transportation modes. 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. Thus, modified and redesigned transport equipment to incorporate features that more effectively enhance self-protection and that deny unauthorized access to the materials was established. Also during this time, the use of commercial transportation systems was abandoned, and a totally federal operation was implemented. The organization within DOE/NNSA responsible for this mission is the Office of Secure Transportation (OST).

The NNSA OST Agent Operations Eastern Command (AOEC) Secure Transportation Center and Training Facility is located on the ORR. The NNSA OST AOEC is situated on approximately 485 ha (1,198 acres) on the ORR and operates under a user permit agreement with DOE ORO. The NNSA OST AOEC implements its assigned mission transportation operations, maintains applicable fleet and escort vehicles, and continues extensive training activities for its federal agents.

1.5 References

- DOE. 2001. *Cultural Resource Management Plan, DOE Oak Ridge Reservation, Anderson and Roane Counties, Tennessee*. DOE/ORO 2085. U.S. Department of Energy, Washington, D.C.
- DOE. 2004. *Environment, Safety and Health Reporting*. DOE Order 231.1A. Review date: 08-19-05. U.S. Department of Energy, Washington, D.C.
- LMES. 1997. *Wetland Survey of Selected Areas in the Oak Ridge Y-12 Plant Area of Responsibility, Oak Ridge, Tenn. Y/ER-27*. Lockheed Martin Energy Systems, Inc., Oak Ridge, Tennessee.
- MMES. 1993. *Identification and Characterization of Wetlands in the Bear Creek Watershed. Y/TS-1016*. Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee.
- NOAA. 2010. *Annual 2010 Local Climatological Data Report for Oak Ridge, Tennessee (Site KOQT)*. Published by the National Climate Data Center, Asheville, North Carolina.

Parr, P. D., and J. F. Hughes. 2006. *Oak Ridge Reservation Physical Characteristics and Natural Resources*. ORNL/TM-2006/110, UT-Battelle, Oak Ridge, Tennessee.

Rosensteel, B. 1996. *Wetland Survey of the X-10 Bethel Valley and Groundwater Operable Units at Oak Ridge National Laboratory*. ORNL/ER-350, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Zurawski, A. 1978. "Summary Appraisals of the Nation's Ground-Water Resources—Tennessee Region." U.S. Geological Survey Professional Paper 813-L.

