1. Introduction to the Oak Ridge Reservation

The Oak Ridge Reservation (ORR) consists of three major government-owned, contractor-operated facilities: the Y-12 National Security Complex, Oak Ridge National Laboratory, and East Tennessee Technology Park. The ORR was established in the early 1940s as part of the Manhattan Project, a secret undertaking that produced materials for the first atomic bombs. The reservation's role has evolved over the years, and it continues to adapt to meet the changing defense, energy, and research needs of the United States. Both the work carried out for the war effort and subsequent research, development, and production activities have involved, and continue to involve, the use of radiological and hazardous materials.

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

1.1 Background

This document is prepared annually to summarize environmental activities, primarily environmental-monitoring activities, on the Oak Ridge Reservation (ORR) and within the ORR surroundings. The document fulfills the requirement of Department of Energy (DOE) Order 231.1A, *Environment, Safety and Health Reporting*, for an annual summary of environmental data to characterize environmental performance. The environmental-monitoring criteria are described in DOE Order 450.1A, *Environmental Protection Program*. The results summarized in this report are based on data collected prior to and through 2007. This report is not intended to provide the results of all sampling on the ORR. Additional 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. Corrections to the report for the previous year are found in Appendix A. Appendix B contains a glossary of technical terms that may be useful for clarifying some of the language 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 point of release to the environment; these measurements allow the quantification and official reporting of contaminants, assessment of radiation and chemical exposures to the public, and demonstration of compliance with applicable standards and permit requirements. Environmental surveillance consists of the collection and analysis of environmental samples from the site and its environs; these activities provide direct measurement of contaminant concentrations in air, water, groundwater, soil, foods, biota, and other media. Environmental surveillance data provide information regarding conformity with applicable DOE orders and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose/exposure assessments of ORR operations and effects, if any, on the local environment.

1.2 History of the Oak Ridge Reservation

Beginning in early 1943, thousands of scientists, engineers, and workers came from all over the United States to small crossroads communities such as Scarboro, Wheat, Robertsville, and Elza to build and operate three huge facilities that would change the history of the region and the world forever. These people came to rural East Tennessee to do whatever was necessary to end World War II and, as part of the then secret Manhattan Project, helped produce the first nuclear weapons.

The site was selected for use by 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. Very soon afterwards, the site was given its wartime name of "Clinton Engineering Works."

The workers' city, named Oak Ridge, was established on the reservation's northern edge. The "Secret City" grew to a population of 75,000 and was the fifth-largest city in Tennessee; however; it was not shown on any map. At the Y-12 National Security Complex (Y-12 Complex), south of the city, an electromagnetic method was used to separate uranium-235 (^{235}U) from natural uranium. At its peak operation, the Y-12 Complex employed 22,000 workers. A gaseous diffusion plant, later known as K-25, was built on the reservation's western edge and included a multistory process building covering more area than any other structure ever built. At that time, operated by 12,000 workers, the K-25 Plant separated ^{235}U from ^{238}U. Near the reservation's southwest corner, about 16 km from Y-12, was a third facility, known as X-10 (or Clinton Laboratories), where the Graphite Reactor was built. Employing only about 1,500 people during the war, X-10 was a pilot plant for the larger plutonium production plant built at Hanford, Washington. The Graphite Reactor used neutrons emitted in the fission of ^{235}U to convert ^{238}U into a new element, plutonium-239 (^{239}Pu).

The primary missions of the three sites have evolved during the past 60+ years and continue to adapt to meet the changing defense, energy, and research needs of the United States. The reservation contains three major DOE installations: the Y-12 Complex, formerly the Y-12 Plant; Oak Ridge National Laboratory (ORNL), formerly the X-10 site; and the East Tennessee Technology Park (ETTP), formerly the K-25 Site. DOE also operates a number of facilities in addition to the major installation sites (see Sect. 1.4).

1.3 Site Description

1.3.1 Location and Population

The city of Oak Ridge lies within the Great Valley of Eastern Tennessee between the Cumberland and Great Smoky Mountains and is bordered on two sides by the Clinch River (Fig. 1.1). The Cumberland Mountains are 16 km to the northwest; the Great Smoky Mountains are 51 km to the southeast. The ORR encompasses about 13,637 ha of mostly contiguous land owned by DOE in the Oak Ridge area. Most of it lies within the corporate limits of the city of Oak Ridge; 243 ha west of the ETTP are outside the city limits. The residential section of Oak Ridge forms the northern boundary of the reservation. The TVA's Melton Hill and Watts Bar reservoirs on the Clinch and Tennessee rivers form the southern and western boundaries (Fig. 1.2). The population of the ten-county region surrounding the ORR is about 911,080 with about 1.5% of its labor force employed on the reservation (Fig. 1.3). Other towns close to 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 to the east and has a population of about 182,340. Except for the city of Oak Ridge, the land within 8 km of the ORR is semirural and is used primarily for residences, small farms, and cattle pasture. Fishing, 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 average temperature for the Oak Ridge area during 2007 was 16.1°C compared with a 30 year mean temperature (1978–2007) of 14.6°C. The year 2007 was the second warmest measured in Oak Ridge (1948–2007). The coldest month is usually January, with temperatures averaging about 2.8°C. July tends to be the warmest month, with average temperatures of 25.5°C.

Average annual precipitation in the Oak Ridge area for the 30 year period from 1978 to 2007 was 1,340.3 mm, including about 27.9 cm of snowfall annually (NOAA 2006). Total rainfall during 2007,

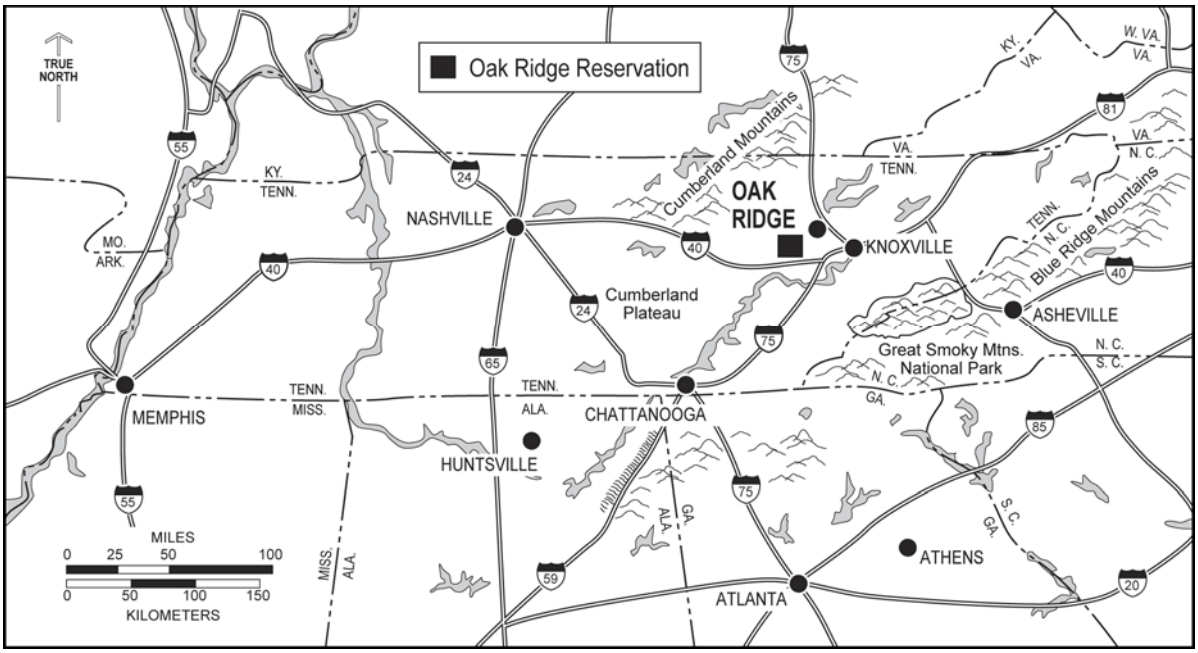

Fig. 1.1. Location of the city of Oak Ridge.

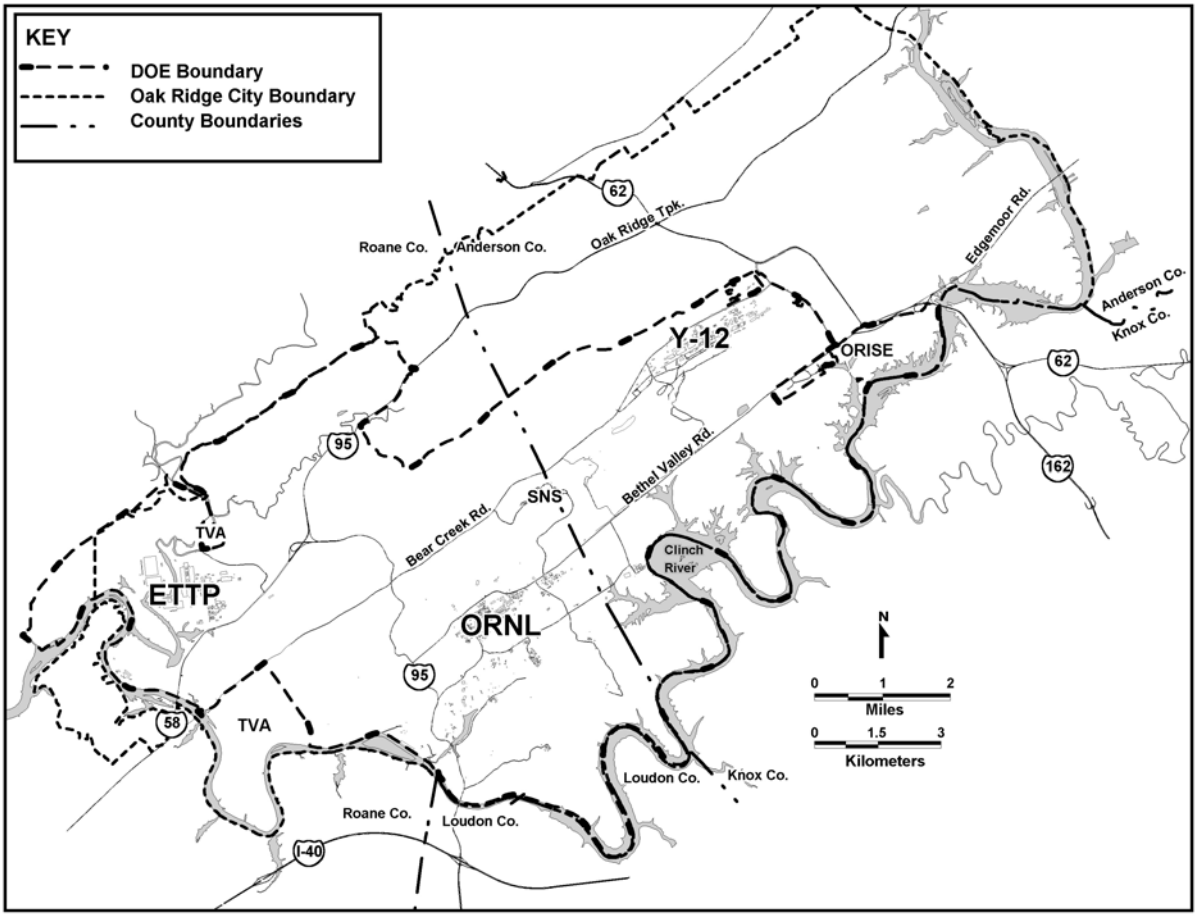

Fig. 1.2. The Oak Ridge Reservation.

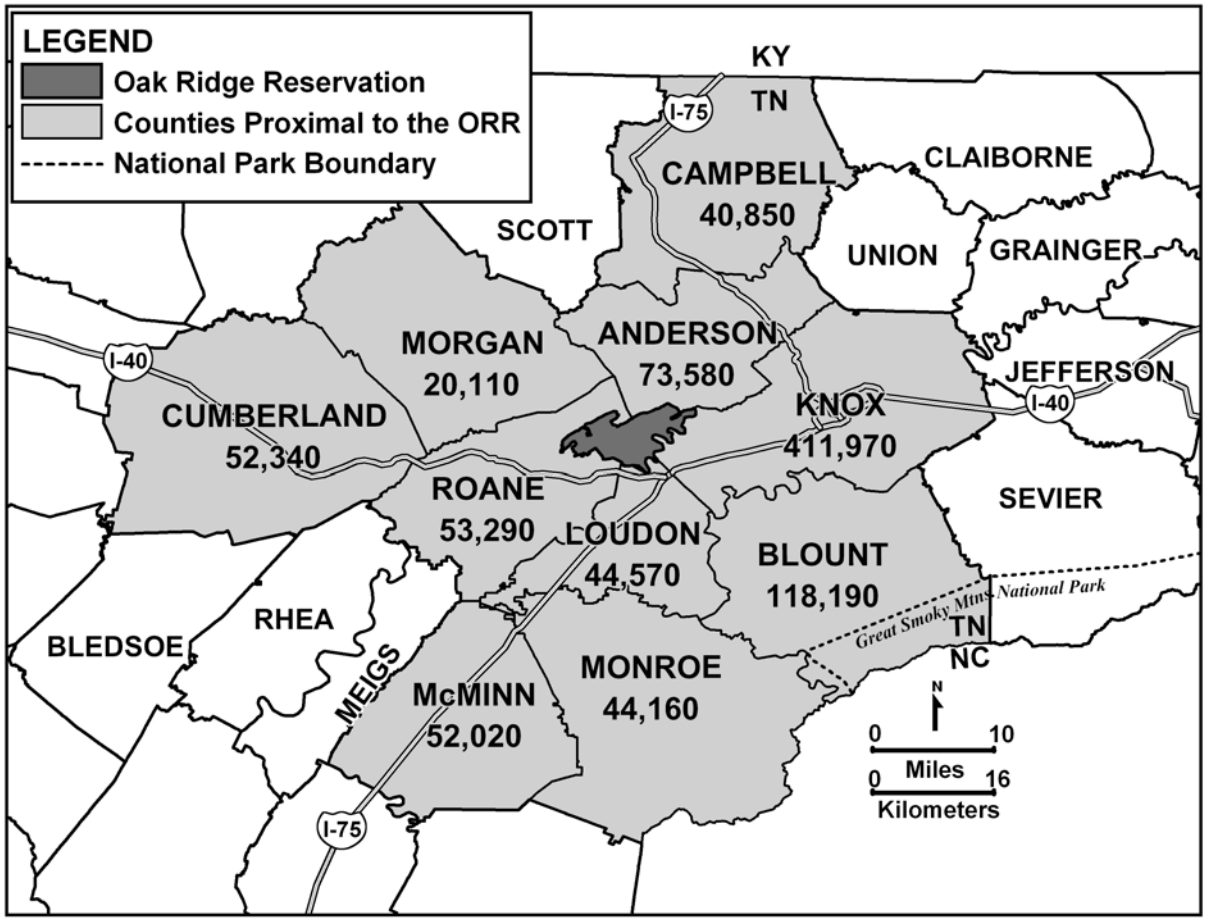

Fig. 1.3. Population by county in the ten-county region surrounding the Oak Ridge Reservation.

(measured at the Oak Ridge National Weather Service meteorological tower), was 911.4 mm, and total 2007 snowfall was 2.5 cm. It is the driest year on record in Oak Ridge (60-year record), marking the fourth consecutive year with below-normal precipitation. Monthly summaries of precipitation averages, extremes, and 2007 values are provided in Appendix C, Table C.1.

In 2007, wind speeds at ORNL Tower C (MT2) measured at 10 m above ground level averaged 1.2 m/s. This value increases to about 2.9 m/s for winds at 100 m 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 ORR towers can be found in Appendix C (Figs. C.1–C.17). Additionally, wind direction and speed frequencies during precipitation events can be found in Appendix C (Figs. C.18–C.21). In Appendix C, Figs. C.22–C.28 provide information on wind direction and speed with respect to stability class.

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).

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 (NAAQSs) for key principal pollutants, which are called "criteria" pollutants. These pollutants are sulfur dioxide (SO_2); carbon monoxide (CO); carbon dioxide (CO_2); nitrogen dioxide (NO_2); lead (Pb); ozone (O_3); particles with an aerodynamic diameter less than or

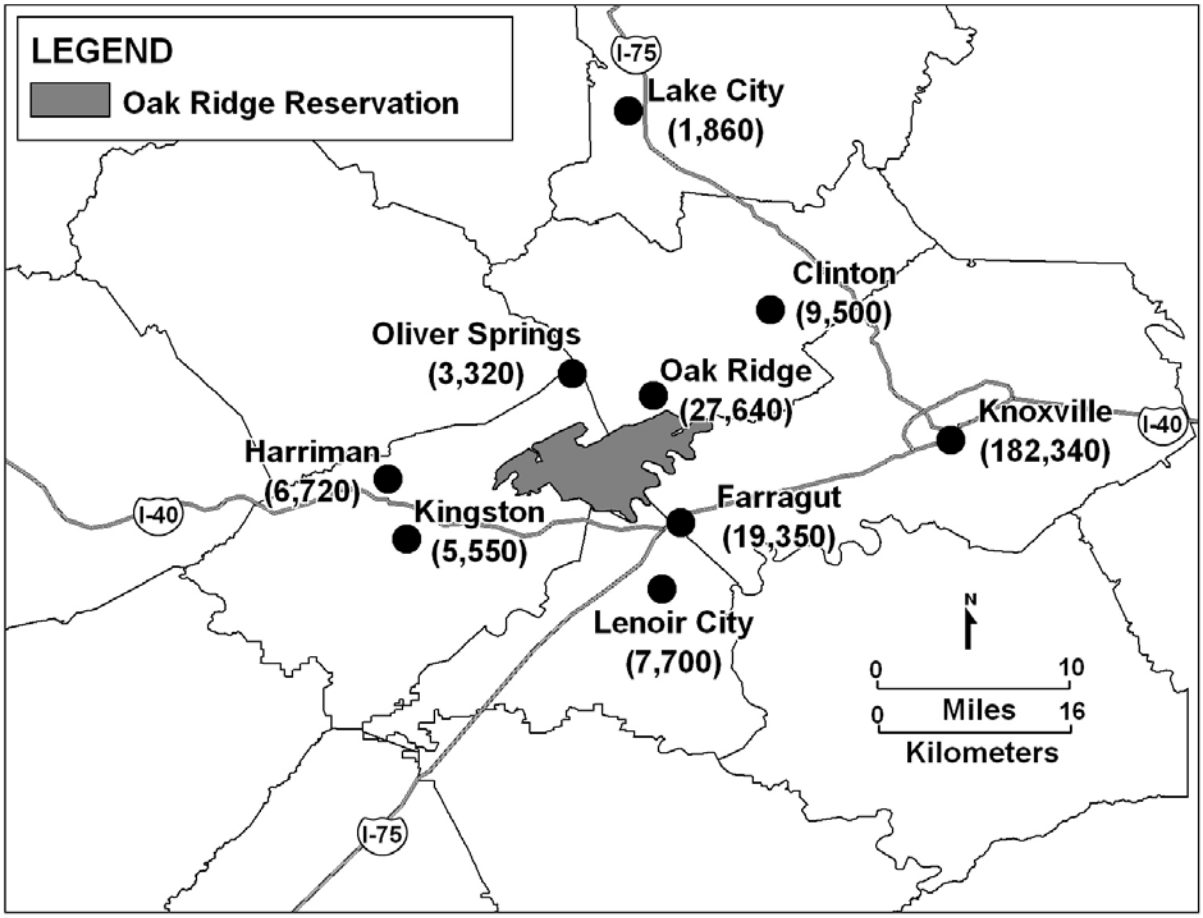

Fig. 1.4. Locations and populations of towns nearest to the Oak Ridge Reservation.

equal to 10 μm (PM_{10}); and the new, stricter federal standard, 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 NAAQSs are classified as attainment areas, and 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 h O_3 standard as part of the larger Knoxville 8 h basic O_3 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 as well. Air quality in the greater Knoxville and Oak Ridge area is in attainment with the NAAQSs for all other criteria pollutants for which EPA has made attainment designations.

1.3.4 Surface Water

Waters that drain from the ORR eventually reach the Tennessee River via the Clinch River, which forms the southern and western boundaries of the ORR (Fig. 1.2). The ORR lies within the Valley and Ridge Physiographic Province, which is composed of a series of drainage basins or troughs containing many small streams feeding the Clinch River. Surface water at each of the major facilities on 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.

The largest of the drainage basins is that of Poplar Creek, which receives drainage from a 352 km^2 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 near the former S-3 Ponds and flows northeast along the south side of the Y-12 Complex. Bear Creek also originates within the Y-12 Complex with headwaters near the former S-3 Ponds, where the creek 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 km^2. 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 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. 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). The typical yield of a well in the clastic formations on the ORR is less than 3.8 L/min, and the base flows of streams draining areas underlain by those bedrock formations are poorly sustained because of such low flow rates. Detailed information on ORR groundwater hydrology and flow is available in *Oak Ridge Reservation Physical Characteristics and Natural Resources* (Parr and Hughes 2006).

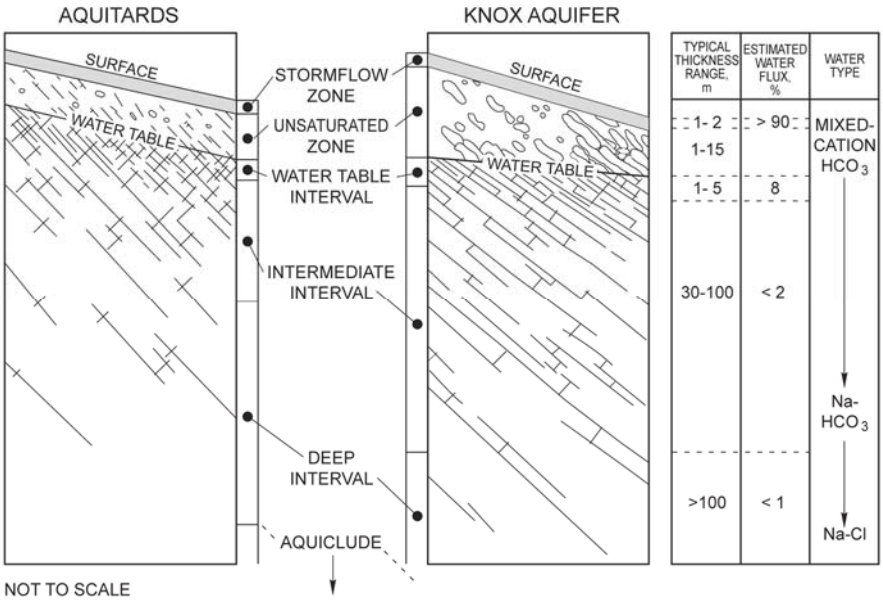

Fig. 1.5. Vertical relationships of flow zones of the Oak Ridge Reservation: estimated thicknesses, water flux, and water types.

1.3.6 Natural, Cultural, and Historic Resources

1.3.6.1 Wetlands

About 243 ha of wetlands have been identified on the ORR, most being classified as forested palustrine, scrub/shrub, and emergent wetlands. Wetlands occur across the ORR at low elevation, primarily in riparian zones of headwater streams and receiving streams, as well as in the Clinch River embayments. Wetlands identified to date range in size from several square meters at small seeps and springs to approximately 10 ha 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 reference documents to support wetlands assessments for upcoming projects and activities. A detailed wetland map of the ETTP area of responsibility has also been developed and is periodically revised and updated as needed.

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 given along with their status in Table 1.1. The list illustrates the diversity of birds on the ORR, which is also habitat for many unlisted species, some of which are in decline nationally or regionally. 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 recently been observed on the ORR 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. A gray bat was mist-netted outside a cave on the ORR in 2006. The state endangered peregrine falcon and the state threatened northern saw-whet owl 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 currently uncommon migrants or visitors to the reservation; however, the little blue heron is probably

Table 1.1. Animal species of concern reported from the Oak Ridge Reservation[a]
Sensitive wildlife species recently found on the Oak Ridge Reservation

Scientific name	Common name	Status[b]		
		Federal	State	PIF[c]
	Fish			
Phoxinus tennesseensis	Tennessee dace		NM	
	Amphibians and reptiles			
Hemidactylium scutatum	Four-toed salamander		NM	
	Birds			
Anhinga anhinga	Anhinga		NM	
Egretta caerulea	Little blue heron		NM	
Egretta thula	Snowy egret		NM	
Ardea alba	Great egret		NM	
Accipiter striatus	Sharp-shinned hawk		NM	
Buteo platypterus	Broad-winged hawk			RI
Falco peregrinus	Peregrine falcon	*d*	E	RI
Circus cyaneus	Northern harrier		NM	
Haliaeetus leucocephalus	Bald eagle	*e*	NM	
Bonasa umbellus	Ruffed grouse			RI
Colinus virginianus	Northern bobwhite			RI
Aegolius acadicus	Northern saw-whet owl	MC	T	RI
Tyto alba	Barn owl		NM	
Caprimulgus carolinensis	Chuck-will's-widow			RI
Caprimulgus vociferous	Whip-poor-will			RI
Chaetura pelagica	Chimney swift			RI
Ceryle alcyon	Belted kingfisher			RI
Melanerpes erythrocephalus	Red-headed woodpecker			RI
Picoides pubescens	Downy woodpecker			RI
Colaptes auritus	Northern flicker			RI
Sphyrapicus varius	Yellow-bellied sapsucker	MC	NM	
Contopus cooperi	Olive-sided flycatcher		NM	RI
Contopus virens	Eastern wood-pewee			RI
Empidonax virescens	Acadian flycatcher			RI
Empidonax trailii	Willow flycatcher			RI
Progne subis	Purple martin			RI
Poecile carolinensis	Carolina chickadee			RI
Sitta pusilla	Brown-headed nuthatch			RI
Hylocichla mustelina	Wood thrush			RI
Toxostoma rufum	Brown thrasher			RI
Lanius ludovicianus	Loggerhead shrike	MC	NM	RI
Vireo flavifrons	Yellow-throated vireo			RI
Dendroica cerulean	Cerulean warbler		NM	RI
Dendroica discolor	Prairie warbler			RI
Dendroica fusca	Blackburnian warbler			RI
Mniotilta varia	Black-and-white warbler			RI
Wilsonia citrine	Hooded warbler			RI
Wilsonia canadensis	Canada warbler			RI
Icteria virens	Yellow-breasted chat			RI

Table 1.1 (continued)

Scientific name	Common name	Status[b]		
		Federal	State	PIF[c]
Helmitheros vermivorus	Worm-eating warbler			RI
Oporornis formosus	Kentucky warbler			RI
Seiurus motacilla	Louisiana waterthrush			RI
Vermivora chrysoptera	Golden-winged warbler	MC	NM	RI
Vermivora pinus	Blue-winged warbler			RI
Piranga rubra	Scarlet tanager			RI
Piranga olivacea	Summer tanager			RI
Pooecetes gramineus	Vesper sparrow		NM	
Passerina cyanea	Indigo bunting			RI
Pipilo erythrophthalmus	Eastern towhee			RI
Ammodramus savannarum	Grasshopper sparrow			RI
Spizella pusilla	Field sparrow			RI
Sturnella magna	Eastern meadowlark			RI
	Mammals			
Myotis grisescens	Gray bat	E	E	
Sorex longirostris	Southeastern shrew		NM	

[a]Land and surface waters of the ORR exclusive of the Clinch River, which borders the ORR. Some (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.

[b]Abbreviations:

E endangered
MC management concern
NM in need of management
RI species of regional importance
T threatened

[c]Partners in Flight.

[d]The peregrine falcon was federally delisted on August 25, 1999.

[e]The bald eagle was federally delisted on August 8, 2007.

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 well begin nesting here within a few years. Others, such as the northern harrier, great egret, and yellow-bellied sapsucker, are migrants or winter 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 federal and state threatened species, the spotfin chub (*Cyprinella monnacha*), has been sighted and collected in the city of Oak Ridge and is possibly present on the ORR. The Tennessee dace has been found in some sections of Grassy Creek.

1.3.6.3 Threatened and Endangered Plants

There are currently 23 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, have been removed from the state list as of

Table 1.2. Vascular plant species listed by state or federal agencies, 2007

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

[a]Status codes:
CE Status due to commercial exploitation.
E Endangered in Tennessee.
FSC Federal Special Concern; formerly designated as C2. See *Federal Register*, February 28, 1996.
S Special concern in Tennessee.
T Threatened in Tennessee.

[b]*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.

[d]Ramps 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.

November 17, 1999. Big-tooth aspen was recently found on the ORR but was removed from the state list at the January 2007 meeting of the Tennessee Heritage Program scientific advisory committee, which produces the state list. 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 as well, although they have not been located (Table 1.2).

1.3.6.4 Historical and Cultural Resources

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. These resources include the New Bethel Baptist Church and Cemetery (the church and two gravehouses), George Jones Memorial Baptist Church, Freels Cabin (a dwelling and one outbuilding), Bear Creek Road Checking Station, Bethel Valley Road Checking Station, and the Oak Ridge Turnpike Checking Station.

1.4 DOE Offices and Sites

1.4.1 The DOE Oak Ridge Office

The ORR is home to a world-leading research and manufacturing park, with major federal programs in the areas of science, environmental management, nuclear fuel supply, and national security. The ORO oversees and manages these programs at three primary sites: ORNL, ETTP, and the Oak Ridge Institute for Science and Education (ORISE).

The DOE presence in Oak Ridge has a major financial impact on the area as well; it serves as an economic engine, driving local, regional, and statewide development. DOE is credited with providing a $3.6 billion increase in the gross state product. It supports some 44,889 full-time jobs statewide, pays $76.9 million in state and local sales tax, and is the fourth largest employer in Tennessee.

With a federal and contractor workforce in Oak Ridge of more than 12,000 people, DOE is committed to continuing its strong ties to the communities in East Tennessee. The support of local communities has enabled the ORO to undertake some of the most complex work in the DOE, and there is more to come as the ORO advances in public and private sector growth in the areas of science, manufacturing, national security, and reindustrialization.

1.4.2 The National Nuclear Security Administration Y-12 Site Office

Established by Congress in 2000, the National Nuclear Security Administration (NNSA) is a semiautonomous agency within DOE that works in partnership with the U. S. Department of Defense, national laboratories, and production plants to conduct routine maintenance and repair; dismantle retired weapons; refurbish warheads through the Life Extension Program; and maintain the capability to design, manufacture, and certify new warheads for the foreseeable future.

As one of NNSA's major production facilities, the Y-12 National Security Complex is a diverse site that supports NNSA through manufacturing and reworking nuclear weapon components, dismantling nuclear weapon components returned from the national arsenal, serving as the nation's storehouse of special nuclear materials, and providing special production support to other programs.

The NNSA Y-12 Site Office (YSO) is responsible for operation of the Y-12 facilities. YSO employees perform program oversight, contract and administrative management, and technical evaluation and assessment to meet its mission.

1.4.3 Oak Ridge National Laboratory

ORNL is DOE's largest science and energy laboratory (Fig 1.6). Managed since April 2000 by UT-Battelle, a partnership of the University of Tennessee and Battelle, ORNL was established in 1943 as a part of the secret Manhattan Project to pioneer a method for producing and separating plutonium. Today the laboratory supports the nation with a peacetime science and technology mission that is just as important as, but very different from, its role during the Manhattan Project. 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 International Thermonuclear Experimental Reactor (ITER) international fusion experiment and the Bioenergy Science Center, which is sponsored by the DOE Office of Science.

Fig. 1.6. The Oak Ridge National Laboratory.

1.4.4 The Y-12 National Security Complex

The Y-12 National Security Complex (Fig. 1.7) is a premier manufacturing facility dedicated to making the United States and the world safer places. Operated by B&W Y-12 for NNSA, Y-12 plays a vital role in the DOE's nuclear weapons complex.

Y-12 helps ensure a safe and reliable U.S. nuclear weapons deterrent. Y-12 retrieves and stores nuclear materials, fuels the nation's naval reactors, and performs complementary work for other government and private-sector entities.

1.4.5 East Tennessee Technology Park

Construction of what is now ETTP began in 1943 as part of the Manhattan Project. The ETTP was built as the home of the Oak Ridge Gaseous Diffusion Plant (ORGDP) (Fig. 1.8). The plant's original mission was production of highly enriched uranium for nuclear weapons.

Later, the plant's primary missions were production of slightly enriched uranium to be fabricated into fuel elements for nuclear reactors and the recycling of fuel elements from nuclear reactors. Other missions during the latter part of this 20-year period included development and testing of the gas centrifuge method of uranium enrichment and the laser isotope separation research and development (R&D).

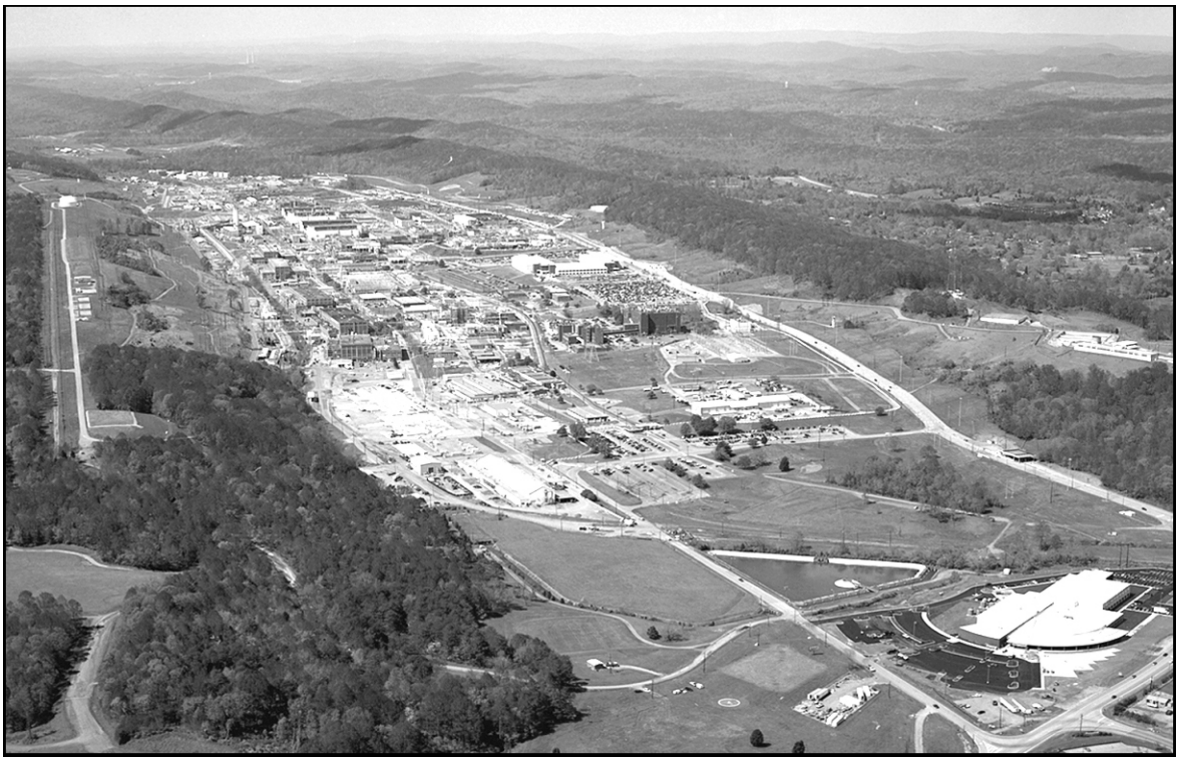

Fig. 1.7. Y-12 National Security Complex.

Fig. 1.8. East Tennessee Technology Park.

By 1985, demand for enriched uranium had declined, and enrichment operations had ceased. Because of the termination of the original and primary missions, ORGDP was renamed the "Oak Ridge K-25 Site" in 1990. In 1997, the K-25 Site was named the "East Tennessee Technology Park" to reflect its new mission.

DOE's long-term goal for ETTP is to convert the site into a private sector business/industrial park. The site is undergoing environmental cleanup of the land as well as decontamination and decommissioning (D&D) of most buildings on the site. The reuse of key site facilities through title transfer is part of the closure plan for the site. The cleanup approach makes land and certain buildings (e.g., office, manufacturing), that have been determined to be suitable for private use, available for title transfer to the Community Reuse Organization of East Tennessee (CROET) or other entities, such as the city of Oak Ridge. The transition of the site to a private-sector park helps to accelerate cleanup of ETTP, through cost avoidance, and offsets the previous effects of downsizing by stimulating the regional economy.

The reindustrialization of the site is accomplished through property transfers, including both title transfer and lease of underutilized land and facilities. During 2007, one building (the K-1652 Fire Station) and two parcels of land (ED-5 East and ED-7) were transferred to CROET.

George Jones Memorial Baptist Church, commonly called the Wheat Church (part of the early Wheat Community), located within the ETTP, predates World War II and is included in the *National Register of Historic Places* (National Park Service 2003).

1.4.6 Oak Ridge National Environmental Research Park

In 1980, DOE established the Oak Ridge National Environmental Research Park (Fig. 1.9). Consisting of about 8,094 ha, 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. The combination of protected, undeveloped areas with disturbed, developed, or developing areas within the Research Park allows the demonstration and assessment of various environmental and land-use options.

Major DOE Office of Science research programs use the ORR land to meet mission objectives. In fiscal year (FY) 2007 almost $7 million was spent on DOE-supported field-based environmental research directly dependent on the ORR land base. This expenditure is independent of construction of new facilities such as the SNS. The Office of Science considers the research and science value of the ORR to be critical and provides primary operations funding. The Oak Ridge National Environmental Research Park is one of the few sites in the nation where large-scale ecological research, environmental technology, and measurement science are integrated with 50 years of environmental monitoring and research.

The availability of the protected lands and field research sites on the ORR allows DOE to support major field experiments that could not be conducted if the lands and associated ecological systems were not protected and secured for such long-term studies. This research addresses fundamental questions about the effects of energy-related activities on ecological systems and compares such effects with the natural variation of ecological systems.

The Research Park is a DOE national user facility that has attracted more than 1,200 users from ORNL as well as from 150 colleges, universities, industries, and other state and federal agencies over the past 5 years. There were 227 users during 2007, representing 53 organizations, including educational institutions, state and federal agencies, and others.

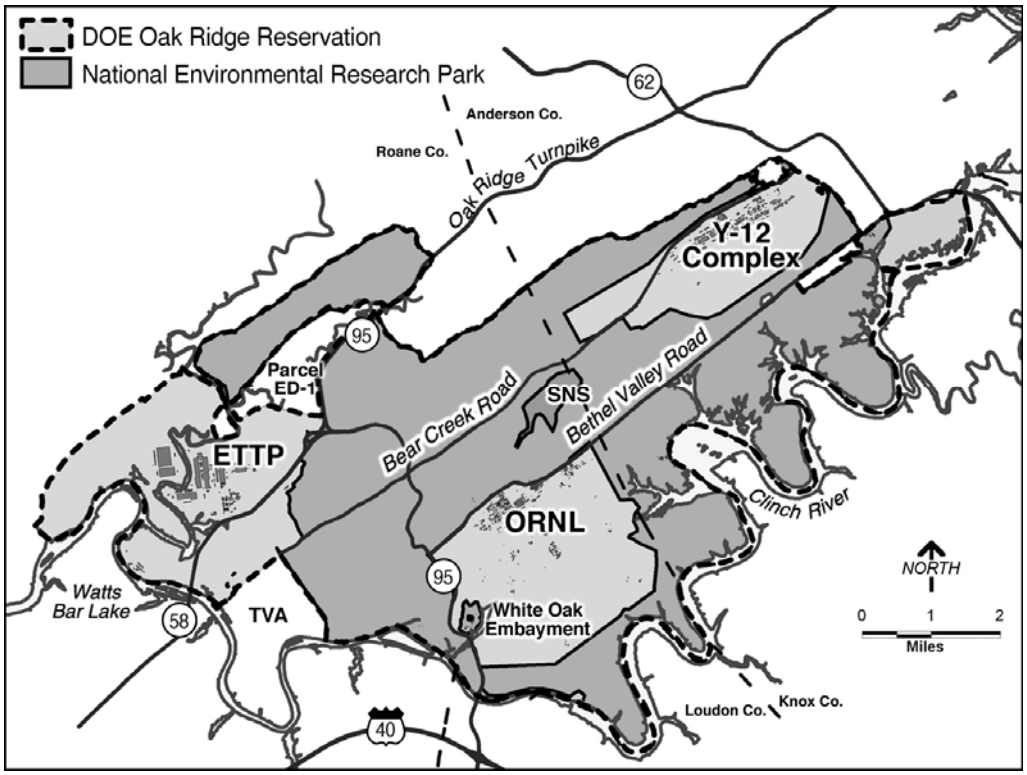

Fig. 1.9. The Oak Ridge National Environmental Research Park covers about 8,094 ha on the reservation.

1.4.7 Oak Ridge Institute for Science and Education

ORISE is managed for DOE by Oak Ridge Associated Universities (ORAU), a nonprofit consortium of 91 doctoral-granting members and 10 associate members. ORISE focuses on scientific initiatives to research health risks from occupational hazards, assess environmental cleanup, respond to radiation medical emergencies, support national security and emergency preparedness, and educate the next generation of scientists. ORISE includes a 94 ha 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 ORISE South Campus lies immediately southeast of the intersection of Bethel Valley Road and Pumphouse Road. The site houses offices, laboratories, and storage areas for the ORISE program offices and support departments, and it is being developed for other productive uses (Fig. 1.2).