1. Site and Operations Overview

Setting:

The U.S. Department of Energy currently oversees activities on the Oak Ridge Reservation (ORR), a government-owned, contractor-operated facility. The reservation contains three major operating sites: the Oak Ridge Y-12 Plant, Oak Ridge National Laboratory, and East Tennessee Technology Park (formerly the K-25 Site). The ORR was established in the early 1940s as part of the Manhattan Project, a secret undertaking that produced the 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) radiological and hazardous materials.

Update:

Both the *Oak Ridge Reservation Annual Site Environmental Report* and *Environmental Monitoring on the Oak Ridge Reservation: 1998 Results* are now available on the World Wide Web at http://www.ornl.gov/Env_Rpt/aser98/aser.htm.

Secretary Of Energy Bill Richardson has set aside 3000 acres of the ORR as a Scenic and Wildlife Management Refuge to be jointly managed by the Tennessee Wildlife Resources Agency and the Department of Energy.

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 monitoring and documentation criteria are described within the requirements of U.S. Department of Energy (DOE) Order 5400.1, "General Environmental Protection Program." The results summarized in this report are based on the data collected prior to and through 1998. The 1998 results are compiled in *Environmental Monitoring on the Oak Ridge Reservation: 1998 Results* (LMER 1999a). This report is intended to fulfill the requirements of DOE Order 5400.1. The data and information are in accordance with the DOE-approved Environmental Monitoring Plan for the Oak Ridge Reservation (DOE 1998d). This report is not intended to provide the results of all sampling on the ORR. Additional data collected for other site purposes, such as environmental restoration Remedial Investigation Reports and waste management characterization sampling, are presented in other documents that have been prepared in accordance with applicable DOE guidance and/or laws. All sampling results are captured in the Oak Ridge Environmental Information System (OREIS), which can be accessed at http://eimdb-web.bechteljacobs.org:8080/oreis/help/oreishome.html. This report is available on the World Wide Web at http://www.ornl.gov/Env_Rpt/aser98/aser.htm or from the project director.

Environmental monitoring on the ORR consists 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 prior to release into 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; this provides direct measurement of contaminants in air, water, groundwater, soil, foods, biota, and other media subsequent to effluent release into the environment. Environmental surveillance data verify the ORR's compliance status and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose/exposure assessment of ORR operations and effects, if any, on the local environment.

1.2 DESCRIPTION OF SITE LOCALE

The city of Oak Ridge lies in a valley between the Cumberland and Blue Ridge mountain ranges and is bordered on two sides by the Clinch River. The Cumberland Mountains are 16 km (10 miles) to the northwest; the Blue Ridge Mountains, which include the Great Smoky Mountains National Park, are 51 km (32 miles) to the southeast (Fig. 1.1).

The ORR encompasses about 34,516 acres of the contiguous land owned by DOE in the Oak Ridge area. The majority lies within the corporate limits of the city of Oak Ridge; 608 acres, west of the East Tennessee Technology Park (ETTP), is in Roane County, outside the city limits. The residential section of Oak Ridge forms the northern boundary of the reservation. The Tennessee Valley Authority's (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 798,925, with 5% of its labor force employed on the reservation (Fig. 1.3). Other towns in close proximity to the reservation include Oliver Springs, Clinton, Karns, 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 167,535 as reported in *Population Estimates of Tennessee Cities and Counties, 1990–1996* (TDECD 1996a). 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, boating, water skiing, and swimming are popular recreational activities in the area.

1.3 CLIMATE

The climate of the region may be broadly classified as humid continental. The Cumberland

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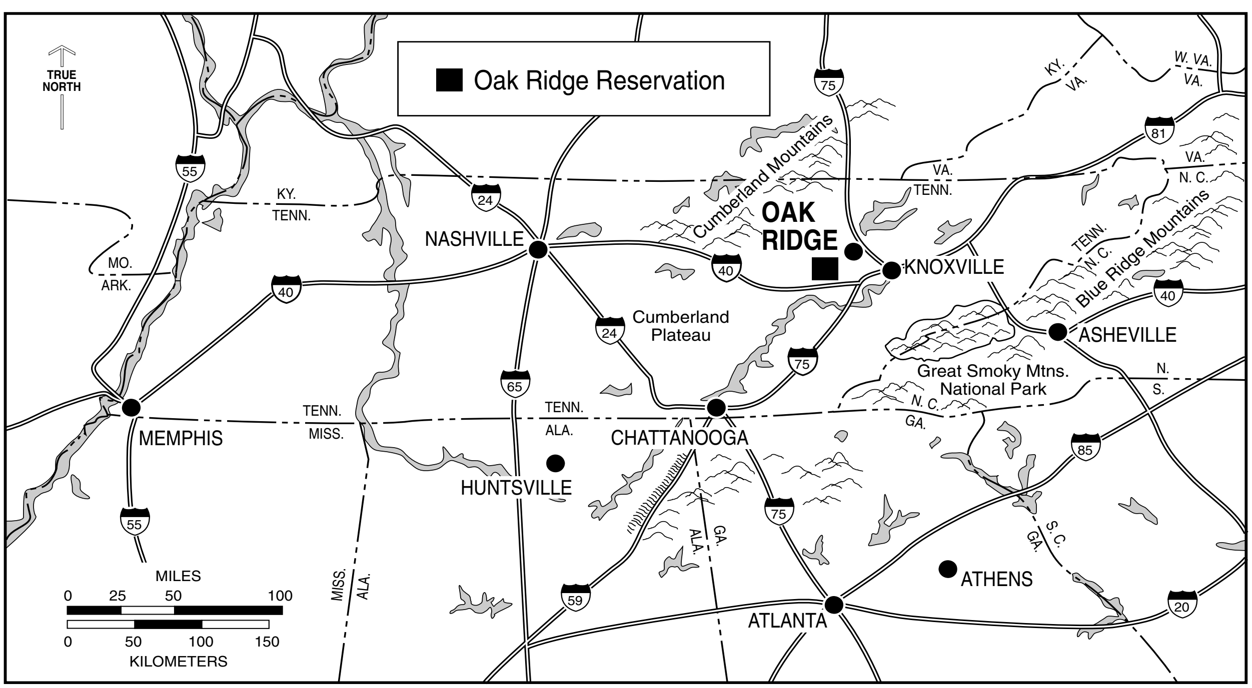

Fig. 1.1. Location of the city of Oak Ridge.

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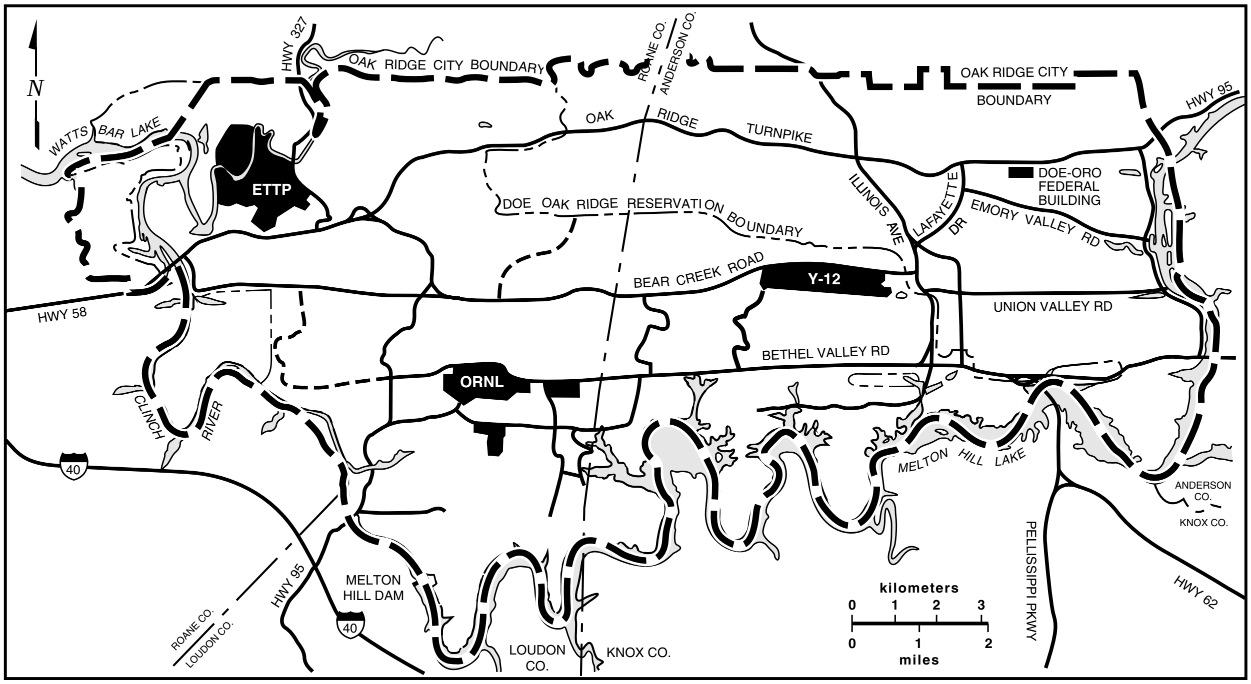

Fig. 1.2. The Oak Ridge Reservation.

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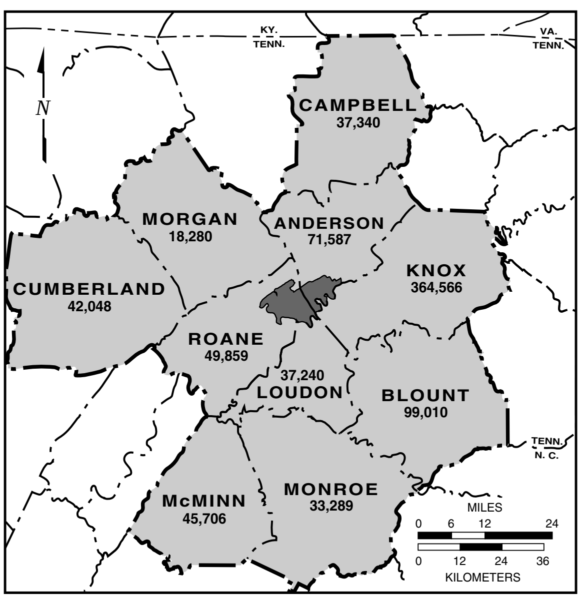

Fig. 1.3. The ten-county region surrounding the Oak Ridge Reservation. [Population figures are July 1, 1996, estimates taken from *Population Estimates for Tennessee Counties, 1990–1996* (TDECD 1996b).]

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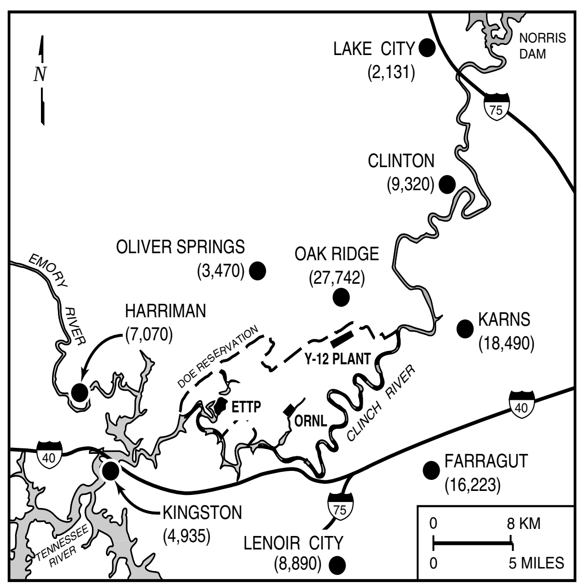

Fig. 1.4. Locations and populations of towns nearest to the Oak Ridge Reservation. [Except for the Karns community, population figures are July 1, 1996, estimates taken from *Population Estimates for Tennessee Cities and Counties, 1990–1996* (TDECD 1996a).]

Mountains to the northwest help to shield the region from cold air masses that frequently penetrate far south over the plains and prairies in the central United States during the winter months.

During the summer, tropical air masses from the south provide warm and humid conditions that often produce thunderstorms; however, anticyclonic circulation around high-pressure systems centered in the western Gulf of Mexico can bring dry air from the southwestern United States into the region, leading to occasional periods of drought.

1.3.1 Temperature

The mean annual temperature for the Oak Ridge area is 14.0°C (57.2°F) (NOAA 1997). The coldest month is usually January, with temperatures averaging about 2.2°C (36°F) but once dipping as low as –31°C (–24°F). July is typically the hottest month of the year, with temperatures averaging 24.9°C (76.8°F) but occasionally peaking at over 37.8°C (100°F). In the course of a year, the difference between maximum and minimum daily temperatures averages 12.5°C (22.5°F). The 1998 average temperature as measured at the meteorological towers on the ORR was 15.8°C (60.4°F).

1.3.2 Winds

Winds in the Oak Ridge area are controlled in large part by the valley-and-ridge topography. Prevailing winds are either up-valley (northeasterly) daytime winds or down-valley (southwesterly) nighttime winds. Wind speeds are less than 11.9 km/hour (7.4 mph) 75% of the time; tornadoes and winds exceeding 30 km/hour (18.5 mph) are rare. Air stagnation is relatively common in eastern Tennessee (about twice that of western Tennessee). An average of about two multiple-day air stagnation episodes occurs annually in eastern Tennessee, to cover an average of about 8 days per year. August, September, and October are the most likely months for air stagnation episodes.

1.3.3 Precipitation

The 30-year annual average precipitation is 138.5 cm (54.5 in.), including about 24 cm (9.3 in.) of snowfall (NOAA 1997). Average rainfall on the ORR in 1998 as measured at the meteorological towers was 128.4 cm (50.6 in.). Precipitation in the region is greatest in the winter months (December through February). Precipitation in the spring exceeds the summer rainfall, but the summer rainfall may be locally heavy because of thunderstorm activity. The driest periods generally occur during the fall months, when high-pressure systems are most frequent.

1.3.4 Evapotranspiration

Regionally, annual evapotranspiration has been estimated to range from 81 to 89 cm (32 to 35 in.), or 60 to 65% of rainfall (Farnsworth et al. 1982). Evapotranspiration in the Oak Ridge area is 74 to 76 cm (29 to 30 in.), or 55 to 56% of annual precipitation (TVA 1972, Moore 1988, and Hatcher et al. 1989). Evapotranspiration is greatest in association with the growing season, which in the vicinity of the ORR is 220 days, from mid-March through mid-October. During this period, evapotranspiration often exceeds the rate of precipitation, resulting in soil moisture deficits.

1.4 SURFACE WATER SETTING

All waters drained 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). Because the ORR lies within the Ridge and Valley Province, it is composed of a series of drainage basins or troughs containing many small streams feeding the Clinch River rather than one simple stream valley. Each of the major facilities on the ORR lies within a separate drainage basin or watershed, and surface water at each of the plants drains into a tributary or series of tributaries, streams, or creeks, eventually reaching the Clinch River.

The largest of the drainage basins is that of Poplar Creek, which receives drainage from a 136-square-mile area, including the northwestern sector of 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 (EFPC), which discharges into Poplar Creek east of the ETTP, originates within the Y-12 Plant near the former S-3 Ponds and flows northeast along the south side of the Y-12 Plant. Various Y-12 Plant wastewater discharges to the upper reaches of EFPC from the late 1940s to the early 1980s left a legacy of contamination [e.g., mercury, polychlorinated biphenyls (PCBs), uranium] that has been the subject of water quality improvement initiatives over the past 10 to 15 years. Bear Creek (BC) also originates within the Y-12 Plant with headwaters near the former S-3 Ponds where the creek flows southwest. Bear Creek is mostly affected by stormwater runoff, groundwater infiltration, and tributaries that drain former waste disposal sites in the Bear Creek Valley Burial Groundwater Waste Management Area.

Both the Bethel Valley and Melton Valley portions of Oak Ridge National Laboratory (ORNL) are in the White Oak Creek (WOC) drainage basin, which has an area of 6.37 square miles. WOC headwaters originate on Chestnut Ridge north of ORNL. At the ORNL site, the creek flows east along the southern boundary of the developed area then flows southwesterly through a gap in Haw Ridge to the western portion of Melton Valley, where it collects the flow from Melton Branch. The waters of WOC 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.

1.4.1 Surface Water Monitoring

Surface water is monitored at each of the plant sites as well as on the ORR. Program details and results are given in the facility-specific chapters: Sect. 7.4 for the ORR, Sect.3.4 for the ETTP, Sect. 5.4 for ORNL; and Sect 6.5 for the Y-12 Plant.

1.5 GEOLOGICAL SETTING

The ORR is located in the Tennessee portion of the Valley and Ridge Province, which is part of the southern Appalachian fold and thrust belt. As a result of thrust faulting and varying 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 Conasauga Group, both consisting of dolostone and limestone, constitute the Knox Aquifer. A combination of fractures and solution conduits in this aquifer control flow over substantial areas, and relatively large quantities of water may move relatively long distances. Active groundwater flow can occur at substantial depths in the Knox Aquifer [300 to 400 ft (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 1000 gal/min (3784 L/min).

The remaining geologic units on the ORR (the Rome Formation, the Conasauga Group below the Maynardville Limestone, and the Chickamauga Group) constitute the ORR Aquitards, which consist mainly of siltstone, shale, sandstone, and thinly bedded limestone of low to very low permeability (Fig. 1.5). Nearly all groundwater flow in the aquitards occurs through fractures. The typical yield of a well in the aquitards is less than 1 gal/min (3.8 L/min), and the base flows of streams draining areas underlain by the aquitards are poorly sustained because of such low flow rates.

1.5.1 HYDROGEOLOGICAL SETTING

1.5.1.1 Groundwater Hydrology

When rain falls, a portion of the rainwater accumulates as groundwater by soaking into the ground, infiltrating soil and rock. The accumulation of groundwater in pore spaces of sediments and bedrock creates sources of usable water, which flows in response to external forces. Groundwater eventually reappears at the surface in springs, swamps, stream and river beds, or pumped wells. Thus, groundwater is a reservoir for which the primary input is recharge from infiltrating rainwater and whose output is discharge to springs, swamps, rivers, streams, and wells.

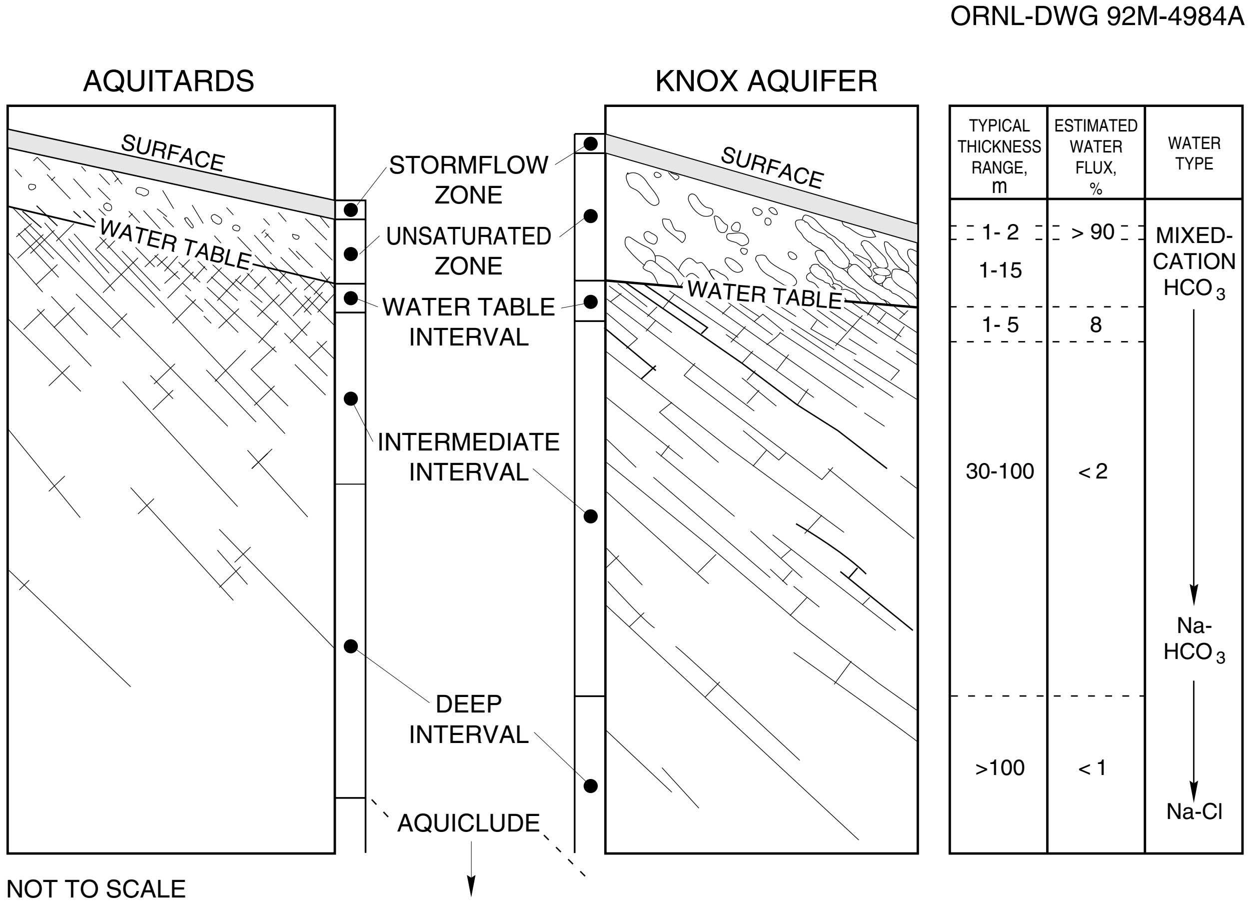

Fig. 1.5. Vertical relationships of flow zones of the ORR: estimated thicknesses, water flux, and water types.

Groundwater hydrology at its simplest is a fairly technical subject requiring the use of some technical language for adequate explanations of groundwater distribution and movement. Since groundwater distribution and movement on the ORR is quite complex and is a key component of the pollution potential of the ORR, it is considered important to discuss here some of the technical essentials necessary for understanding the role of groundwater in the overall existence and movement of contaminants on the reservation. Appendix H contains a glossary of technical terms that may be useful for clarifying some of the language used in this section.

Groundwater on the ORR occurs both in the unsaturated zone as transient, shallow subsurface stormflow and within the deeper saturated zone. An unsaturated zone of variable thickness separates the stormflow zone and water table. Adjacent to surface water features or in valley floors, the water table is found at shallow depths and the unsaturated zone is thin. Along the ridge tops or near other high topographic areas, the unsaturated zone is thick and the water table often lies at considerable depth [50 to 175 ft (15 to 50 m) deep]. In low-lying areas where the water table occurs near the surface, the stormflow zone and saturated zone are indistinguishable.

As noted earlier, two broad hydrologic units are identified on the ORR: the Knox Aquifer and the ORR Aquitards, which consist of less permeable geologic units. Figure 1.6 is a generalized map showing surface distribution of the Knox Aquifer and the ORR Aquitards. Many waste areas on the ORR are located in areas underlain by the ORR Aquitards.

1.5.1.2 Unsaturated Zone Hydrology

In undisturbed, naturally vegetated areas on the ORR, about 90% of the infiltrating precipitation does not reach the water table but travels

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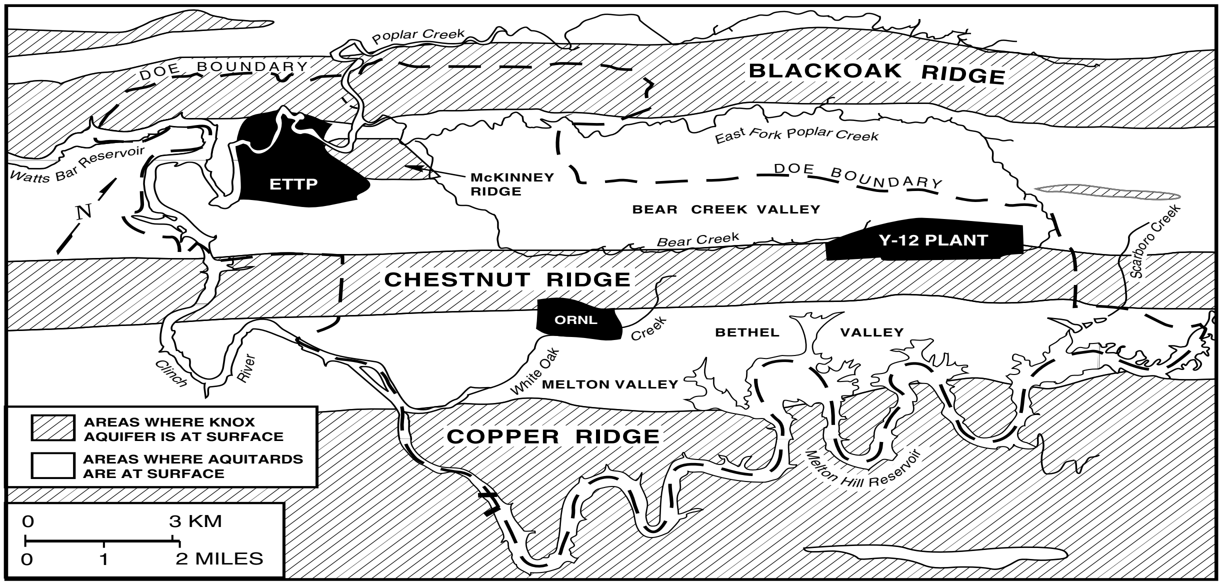

Fig. 1.6. The Knox Aquifer and the aquitards on the Oak Ridge Reservation.

through the 1- to 2-m-deep stormflow zone, which approximately corresponds to the root zone. Because of the permeability contrast between the stormflow zone and the underlying unsaturated zone, the stormflow zone partially or completely saturates during rainfall events, and then water flows laterally, following very short flow paths to adjacent streams. When the stormflow zone becomes completely saturated, flow of water over the land occurs. Between rainfall events, as the stormflow zone drains, flow rates decrease dramatically and water movement becomes nearly vertical toward the underlying water table.

The rate at which groundwater is transmitted through the stormflow zone is attributed to large pores (root channels, worm bores, and relict fractures). Stormflow is primarily a transport mechanism in undisturbed or vegetated areas, where it intersects shallow waste sources. Most buried wastes are below the stormflow zone; however, in some trenches a commonly observed condition known as "bathtubbing" can occur, in which the excavation fills with water and may overflow into the stormflow zone. All stormflow ultimately discharges to streams on the ORR.

1.5.1.3 Saturated Zone Hydrology

As shown in Fig. 1.5, the saturated zone on the ORR can be divided conceptually into four flow zones in a vertical cross section: an uppermost water table interval, an intermediate zone, a deep zone, and an aquiclude. The presence and thickness of any zone may vary across the ORR. Available evidence indicates that most water in the saturated zone in the aquitards is transmitted through a 3- to 20-ft (1- to 6-m) thick layer of closely spaced, well-connected fractures near the water table (the water table interval) as shown in Fig. 1.7.

As in the stormflow zone, the bulk of groundwater in the saturated zone resides within the pore spaces of the rock matrix. The rock matrix typically forms blocks that are bounded by fractures. Contaminants migrating from sources by way of the fractures typically occur in higher concentrations than in the matrix; thus, the contaminants tend to move (diffuse) into the matrix. This process, termed diffusive exchange or matrix diffusion, between water in matrix pores and water in adjacent fractures reduces the overall contaminant migration rates relative to groundwater flow velocities. For example, the leading edge of a

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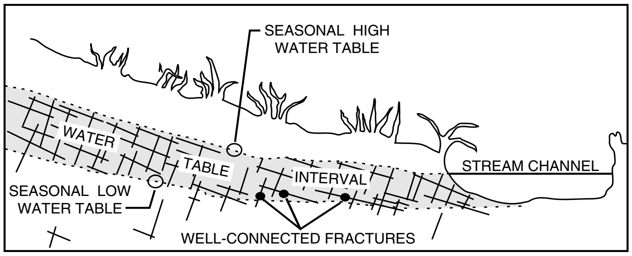

Fig. 1.7. Water table interval.

geochemically nonreactive contaminant mass such as tritium may migrate along fractures at a typical rate of 3 ft/day (1 m/day); however, the center of mass of a contaminant plume typically migrates at a rate less than 0.2 ft/day (0.66 m/day).

In the aquitards, chemical characteristics of groundwater change from a mixed-cation-HCO_3 water type at shallow depth to a Na-HCO_3 water type at deeper levels (about 100 ft). This transition, not marked by a distinct change in rock properties, serves as a useful marker and can be used to distinguish the more active water table and intermediate groundwater intervals from the sluggish flow of the deep interval. There is no evidence of similar change with depth in the chemical characteristics of water in the Knox Aquifer; virtually all wells are within the monitoring regime of Ca-Mg-HCO_3 type water. Although the mechanism responsible for this change in water types is not quantified, it most likely is related to the amount of time the water is in contact with a specific type of rock.

Most groundwater flow in the saturated zone occurs within the water table interval. Most flow is through weathered, permeable fractures and matrix rock and within solution conduits in the Knox Aquifer. The range of seasonal fluctuations of water table depth and rates of groundwater flow varies significantly across the reservation. In areas underlain by the Knox Aquifer, seasonal fluctuations in water levels average 17 ft (5.3 m) and mean discharge from the active groundwater zone is typically 85 gal/min (322 L/min) per square mile. In the aquitards of Bear Creek Valley (BCV), Melton Valley, East Fork Valley, and Bethel Valley, seasonal fluctuations in water levels average 5 ft (1.5 m) and typical mean discharge is 26 gal/min (98 L/min) per square mile.

In the intermediate interval, groundwater flow paths are a product of fracture density and orientation. In this interval, groundwater movement occurs primarily in permeable fractures that are poorly connected. In the Knox Aquifer, a few cavity systems and fractures control groundwater movement in this zone, but in the aquitards, the bulk of flow is through fractures along which permeability may be increased by weathering.

The deep interval of the saturated zone is delineated by a change to a Na-Cl water type. Hydrologically active fractures in the deep interval are significantly fewer in number and shorter in length than in the other intervals, and the spacing is greater. Wells finished in the deep interval of the ORR aquitards typically yield less than 0.3 gal/min (1.1 L/min) and thus are barely adequate for water supply.

In the aquitards, saline water characterized by total dissolved solids ranging up to 275,000 mg/L and chlorides generally in excess of 50,000 mg/L (ranging up to 163,000 mg/L) lies beneath the deep interval of the groundwater zone, delineating an aquiclude. Chemically, this water resembles brines typical of major sedimentary basins, which originated from an evaporating water body. The brines are thought to have been pushed westward and trapped by overthrusting rock during the formation of the Appalachian Mountains (approximately 250 million years ago). The chemistry suggests extremely long residence times (i.e., very low flow rates); however, some mixing with shallow groundwater has been observed (Nativ et al. 1997).

The aquiclude has been encountered at depths of 400 and 800 ft (125 and 244 m) in Melton and Bethel valleys, respectively (near ORNL), and it is believed to approach 1000 ft (305 m) in portions of BCV (near the Y-12 Plant) underlain by aquitard formations. Depth to the aquiclude in areas of the Knox Aquifer is not known but is believed to be greater than 1200 ft (366 m); depth to the aquiclude has not been established in the vicinity of the ETTP.

1.5.2 Groundwater Flow

Many factors influence groundwater flow on the ORR. Topography, surface cover, geologic structure, and rock type exhibit especially strong influence on the hydrogeology. Variations in these features result in variations of the total amount of groundwater moving through the system (flux). (Average flux ratios for the aquitards and the Knox Aquifer formations are shown in Fig. 1.5.) As an example, the overall decrease in open fracture density with depth results in a decreased groundwater flux with depth.

Topographic relief on the ORR is such that most active subsurface groundwater flow occurs at shallow depths. U.S. Geological Survey modeling (Tucci 1992) suggests that 95% of all groundwater flow occurs in the upper 50 to 100 ft (15 to 30 m) of the saturated zone in the aquitards. As a result, flow paths in the active-flow zones (particularly in the aquitards) are relatively short, and nearly all groundwater discharges to local surface water drainages on the ORR. Conversely, in the Knox Aquifer, it is believed that solution conduit flow paths may be considerably longer, perhaps as much as 2 miles (1.6 km) long in the along-strike direction. No evidence at this time substantiates the existence of any deep, regional flow off the ORR or between basins within the ORR in either the Knox Aquifer or the aquitards. Data collected in CY 1994 and 1995, however, have demonstrated that groundwater flow and contaminant transport occur off the ORR in the intermediate interval of the Knox Aquifer, near the east end of the Y-12 Plant.

Migration rates of contaminants transported in groundwater are strongly influenced by natural chemical and physical processes in the subsurface (including diffusion and adsorption). Peak concentrations of solutes, including contaminants such as tritium moving from a waste area, for instance, can be delayed for several to many decades in the aquitards, even along flow paths as short as a few hundred feet. The processes that naturally retard contaminant migration and store contaminants in the subsurface are less effective in the Knox Aquifer than in the aquitards because of rapid flow along solution features allowing minimal time for diffusion to occur.

1.5.3 Groundwater Monitoring Considerations

The groundwater monitoring programs at the ORR were designed to gather information to determine the effects of DOE operations on groundwater quality. Because of the complexity of the hydrogeologic framework on the ORR however, groundwater flow and, therefore, contaminant transport are difficult to predict on a local scale. Consequently, individual plume delineation is not always feasible on the ORR. Stormflow and most groundwater discharges to the surface water drainages on the ORR. For that reason, monitoring springs, seeps, and surface water quality is one of the best ways to assess the extent to which ground water from a large portion of the ORR transports contaminants; however, contaminant transport may occur at depth as well. The center of mass of the contaminant plume east of the Y-12 Plant lies at a depth of 300 ft (91.5 m).

1.5.3.1 Groundwater Monitoring Programs on the ORR

Groundwater monitoring programs at each of the major facilities on the ORR are discussed in the facility-specific chapters: Sect. 4.10 for the ETTP, Sect. 5.10 for ORNL, and Sect. 6.10 for the Y-12 Plant. The Integrated Water Quality Program (IWQP) (Sect. 3.3) has been established to track and prioritize CERCLA monitoring across the ORR.

1.6 DESCRIPTION OF SITE FACILITIES AND OPERATIONS

The facilities on the ORR began operating in 1943 as part of the Manhattan Project, producing components for the first nuclear weapons. The ORR remains a government-owned facility, although the nature of the work has changed. The primary missions of the three sites have evolved during the past 50 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 Oak Ridge Y-12 Plant (Y-12 Plant), ORNL, and the ETTP.

The DOE buildings and structures that are located on the reservation but outside the major sites consist of the Oak Ridge Institute for Science and Education (ORISE) Scarboro Operations Site, Clark Center Recreational Park, the Central

Training Facility, and the Transportation Safeguards maintenance facility.

The off-reservation DOE buildings and structures consist of the Federal Office Building, the Office of Scientific and Technical Information, most of the ORISE offices and laboratories, the Atmospheric Turbulence and Diffusion Division of the National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory, the American Museum of Science and Energy, the Lockheed Martin Energy Systems, Inc. (LMES) administrative support office buildings, and the former museum building. In addition to government-owned property, there are leased buildings housing a small portion of the government and contractor work force.

1.6.1 Lockheed Martin Energy Systems, Inc.

In late 1995, Lockheed Martin Corporation organized into several business sectors, each of which focused on a particular aspect of the company's business. During this reorganization, the Energy and Environment Sector was formed. All of the company's DOE business became part of the sector, including a new corporation, Lockheed Martin Energy Research Corporation (LMER), which was formed to operate ORNL. As a result, in 1998 LMES managed the Y-12 Plant and programs at the Paducah facility in Kentucky and the Portsmouth plant in Piketon, Ohio. LMES carries out energy research and development (R&D), production of enriched uranium and weapons components, and other goals of national importance. For more information, visit the LMES home page on the World Wide Web (http://www.ornl.gov/lmes.html).

1.6.1.1 Oak Ridge Y-12 Plant

Until 1992, the primary mission of the Y-12 Plant (Fig. 1.8) was the production and fabrication of nuclear weapon components. Activities associated with these functions included production of lithium compounds, recovery of enriched uranium from scrap material, and fabrication of uranium and other materials into finished parts. Fabrication operations included vacuum casting, arc melting,

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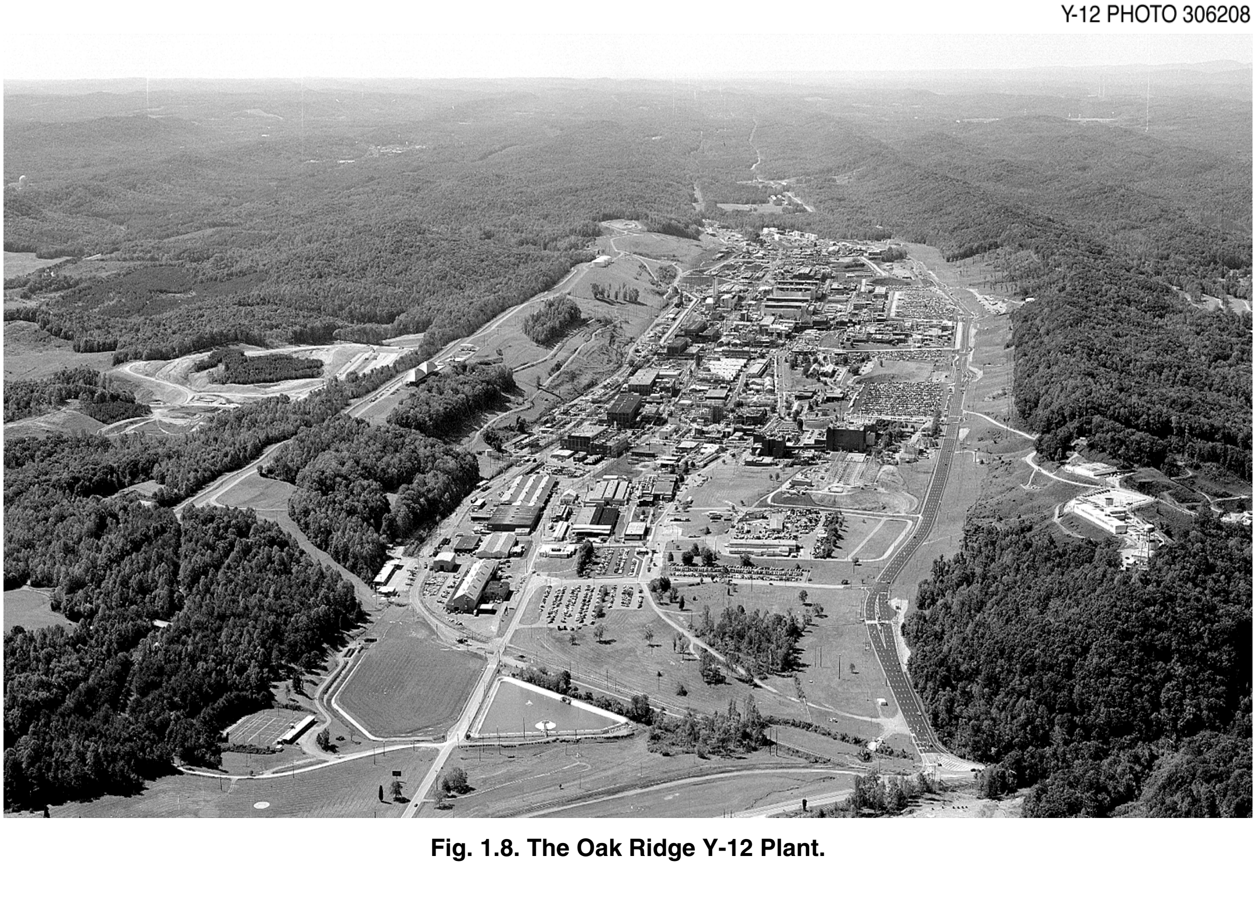

Fig. 1.8. The Oak Ridge Y-12 Plant.

powder compaction, rolling, forming, heat treating, machining, inspecting, and testing.

Current assignments in the Y-12 Plant Defense Programs include 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 DOE programs. Another mission of long standing is the support of other federal agencies through the Work for Others Program. In addition, the technology transfer mission has as its goal applying its unique expertise, initially developed for highly specialized military purposes, to a wide range of manufacturing problems to support the capabilities of the U.S. industrial base. The all-inclusive expertise at the Y-12 Plant includes proceeding from concept, through detailed design and specification, to building prototypes and configuring integrated manufacturing processes. For more information, visit the Y-12 Plant home page on the World Wide Web (http://www.y12.doe.gov).

The Oak Ridge Centers for Manufacturing Technology (ORCMT), located on the Y-12 Plant site, apply skills, capabilities, and facilities developed during the 50-year history of the Oak Ridge complex to a variety of peacetime missions. Major programs at the Y-12 Plant include metrology (measurement science), machine tool technology, technology applications, manufacturing operations, and gear and thread technology. More than 15 centers are solving manufacturing problems and deploying technology. Oak Ridge has already helped nearly 4000 companies from 49 of the 50 states solve manufacturing problems, resulting in millions of dollars of savings and growth to industry.

Manufacturers nationwide can access information and services at the Y-12 Plant through a toll-free telephone service (1-800-356-4USA) that is a direct link to scientists, engineers, and other technical experts in the full range of manufacturing technologies. For more information on ORCMT, visit the Web site at http://www.ornl.gov/orcmt/.

1.6.2 Bechtel Jacobs Company LLC

The Bechtel Jacobs Company LLC contract for management and integration of the Environmental Management and Enrichment Facilities (EMEF) programs at the DOE sites in Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio went into effect April 1, 1998. Bechtel Jacobs Company LLC is a special-purpose company created solely to support EMEF. Bechtel Jacobs Company will be organized around eight major EMEF projects: the ETTP, Upper East Fork Poplar Creek and Bear Creek Valley (combined into the Y-12 project), Bethel Valley and Melton Valley (combined into the ORNL project), Legacy Waste, Waste Operations, Portsmouth, Paducah, and Enrichment Facilities. Each of these projects will be run by a project manager, who will control all work and people for that project. For more information on Bechtel Jacobs Company, visit their Web site at http://www.bechteljacobs.com/.

1.6.2.1 East Tennessee Technology Park

The ETTP was built as the home of the Oak Ridge Gaseous Diffusion Plant (ORGDP) (Fig. 1.9). Construction of ORGDP began in the 1940s as part of the U.S. Army's Manhattan Project. The plant's mission was production of highly enriched uranium for nuclear weapons.

Enrichment was initially carried out in two process buildings, K-25 and K-27. Later, the K-29, K-31, and K-33 buildings were built to increase the production capacity of the original facilities by raising the assay of the feed material entering K-27. After military production of highly enriched uranium was concluded in 1964, the two original process buildings were shut down. For the next 20 years, the plant's primary mission was production of only slightly enriched uranium to be fabricated into fuel elements for 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 R&D of laser isotope separation.

By 1985, demand for enriched uranium had declined, and the gaseous diffusion cascades at ORGDP were placed in standby mode. That same

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Fig. 1.9. The East Tennessee Technology Park (formerly the Oak Ridge K-25 Site).

year, the gas centrifuge program was canceled. The decision to permanently shut down the diffusion cascades was announced in late 1987, and actions necessary to implement that decision were initiated soon thereafter. Because of the termination of the original and primary missions, ORGDP was renamed the Oak Ridge K-25 Site in 1990. In 1992, the site also became known as the Center for Environmental Technology and the Center for Waste Management. The ETTP is the home of the EMEF business unit.

The current mission of the ETTP is to reindustrialize and reuse site assets through leasing of vacated facilities and incorporation of commercial industrial organizations as partners in the ongoing environmental restoration (ER), decontamination and decommissioning (D&D), waste treatment and disposal, and diffusion technology development activities.

1.6.3 Lockheed Martin Energy Research Corporation

On December 6, 1995, a contract was signed with DOE, effective January 1, 1996, that transferred the responsibility for operating ORNL from LMES to the newly formed Lockheed Martin Energy Research Corporation (LMER). This contract is to be rebid, with a new contractor to assume responsibility on April 1, 2000. LMER is responsible also for managing the Oak Ridge National Environmental Research Park, comprising 63.7% (almost 22,000 acres) of the reservation. Portions of the park overlap areas of responsibility of the ETTP, the Y-12 Plant, ETMC [East Tennessee Mechanical Contractors (formerly Johnson Controls)], and ORISE. For more information, visit the LMER home page on the World Wide Web (http://www.ornl.gov/home.html).

1.6.3.1 Oak Ridge National Laboratory

ORNL was the smallest of three facilities built in 1942 and 1943 on the newly acquired 58,575-acre federal reservation (now 34,513 acres) in Oak Ridge, Tennessee. From its modest beginning as a wartime pilot plant, ORNL has grown to become one of the world's premier scientific research centers and DOE's largest and most diversified multiprogram national laboratory.

ORNL uses a total land area on the ORR approaching 26,600 acres. The primary ORNL site, known also as X-10, comprises a main laboratory building complex in Bethel Valley and outlying facilities and waste management storage areas in Melton Valley. Both areas utilize approximately 4250 acres (Fig. 1.10). Of the remaining acreage, 21,980 acres comprise mostly undisturbed natural land that has been designated as the Oak Ridge National Environmental Research Park (Fig. 1.11), and approximately 350 acres are used by ORNL in the Solway Bend area for environmental monitoring. In addition, ORNL has contractual responsibility for wildlife management on the reservation as a result of an agreement between DOE and the Tennessee Wildlife Resources Agency (TWRA), which establishes reservation land as a Tennessee Wildlife Management Area.

ORNL, which has been engaged in a major reengineering effort aimed at improving its ability to support the missions of DOE, neared completion of this effort in 1998. As a multiprogram national laboratory, ORNL carries out R&D in support of all four of DOE's major missions: science and technology, energy resources, environmental quality, and national security.

1.6.3.2 Oak Ridge National Environmental Research Park

The Oak Ridge National Environmental Research Park is a 21,980-acre "outdoor laboratory" with relatively undisturbed ecosystems. The Research Park provides protected, biologically diverse land area for environmental research and education. It represents the eastern deciduous forest, with more than 1100 species of vascular plants, some of which are state-listed rare plants, and 315 wildlife species, some of which are state-listed or federally listed rare wildlife species (see Chap. 2, Tables 2.8 and 2.9 for a listing). The park is a biosphere reserve; an ORNL user facility; a site that contains seven registered State Natural Areas; an area that plays a significant role in nesting and migration of breeding birds; and the location of two National Historic Landmarks, Freel's Cabin and the Graphite Reactor. And as a late news break, in June 1999, Secretary Richardson set aside 3000 acres of the ORR in the 3-bend area (Freels, Gallaher, and Solway bends) as a wildlife reserve to be cooperatively managed by TWRA and DOE for preservation purposes.

The biological diversity of the Oak Ridge National Environmental Research Park serves as a foundation for ecological research into how the development and use of energy as well as other issues of national importance affect the environment. More than 700 individuals have performed research in the Oak Ridge National Environmental Research Park User Facility during the last 5 years. Users include students and faculty from more than 75 colleges and universities as well as participants from ORNL and other state and federal agencies. Field research facilities occur across the reservation and include Walker Branch Watershed, the Global Change Field Research Facility, Melton Branch Watershed, and the Bear Creek Valley Hydrology Field Sites.

The National Environmental Research Park has supported research in the following areas:

- **Ecosystems dynamics and biodiversity.** The large, unfragmented land provides a base for investigations into biogeochemical cycling, climate-change impacts, air quality, and biotechnology and offers opportunities for wildlife restoration.
- **Environmental characterization.** As the most hydrologically and geologically complex of all DOE sites, the Oak Ridge National Environmental Research Park provides opportunities for hydrogeologic and geophysical investigations, contaminant transport and fate studies, tracers for fractured media, microbial ecology, wetland surveys, and flora/fauna species/communities characterization.

1.6.4 Oak Ridge Institute for Science and Education

ORISE is managed for DOE by Oak Ridge Associated Universities (ORAU), a nonprofit consortium of 89 colleges and universities. ORISE includes 247 acres 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 Scarboro Operations Site (formerly the South Campus) lies immediately southeast of the intersection of Bethel Valley Road and Pumphouse Road. It houses some of the offices and laboratories of one of ORISE's operating divisions, the Chemical Safety Building, and other support structures, and the site is being developed for other productive uses.

For more information, visit the ORAU home page at http://www.orau.org and the ORISE home page at http://www.orau.gov/orise.htm.

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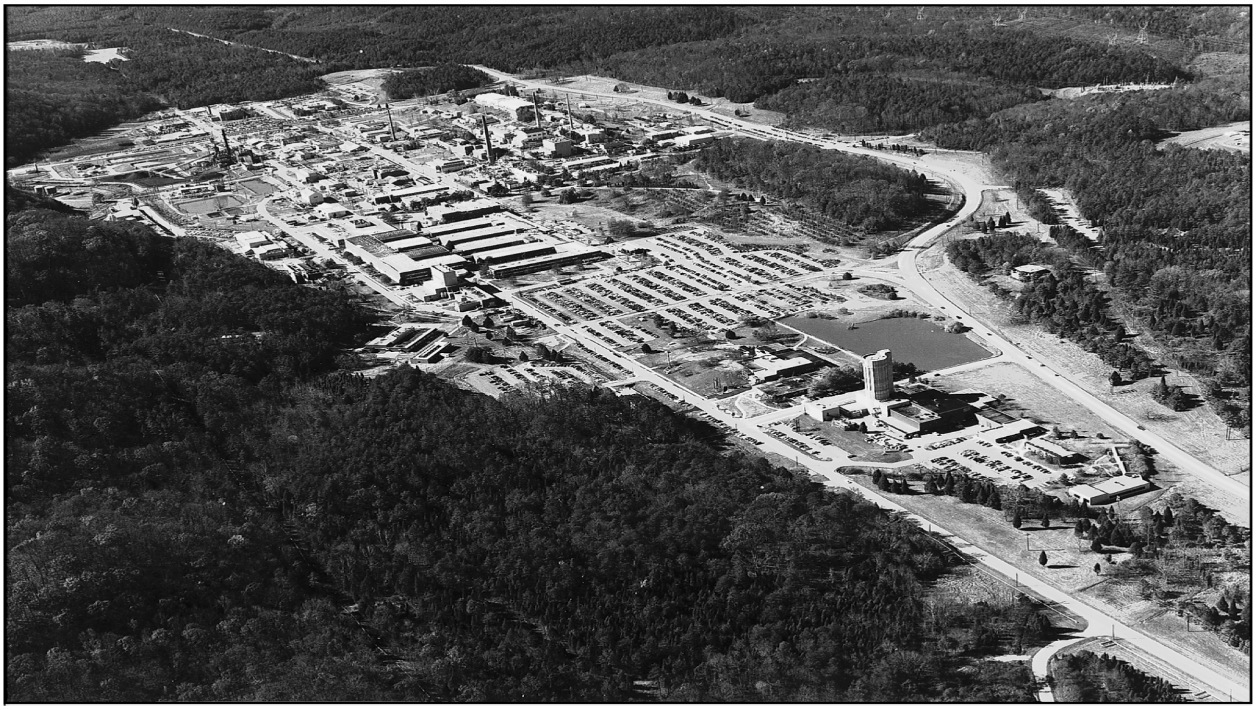

Fig. 1.10. The Oak Ridge National Laboratory.

ORNL 97-100684A/arb

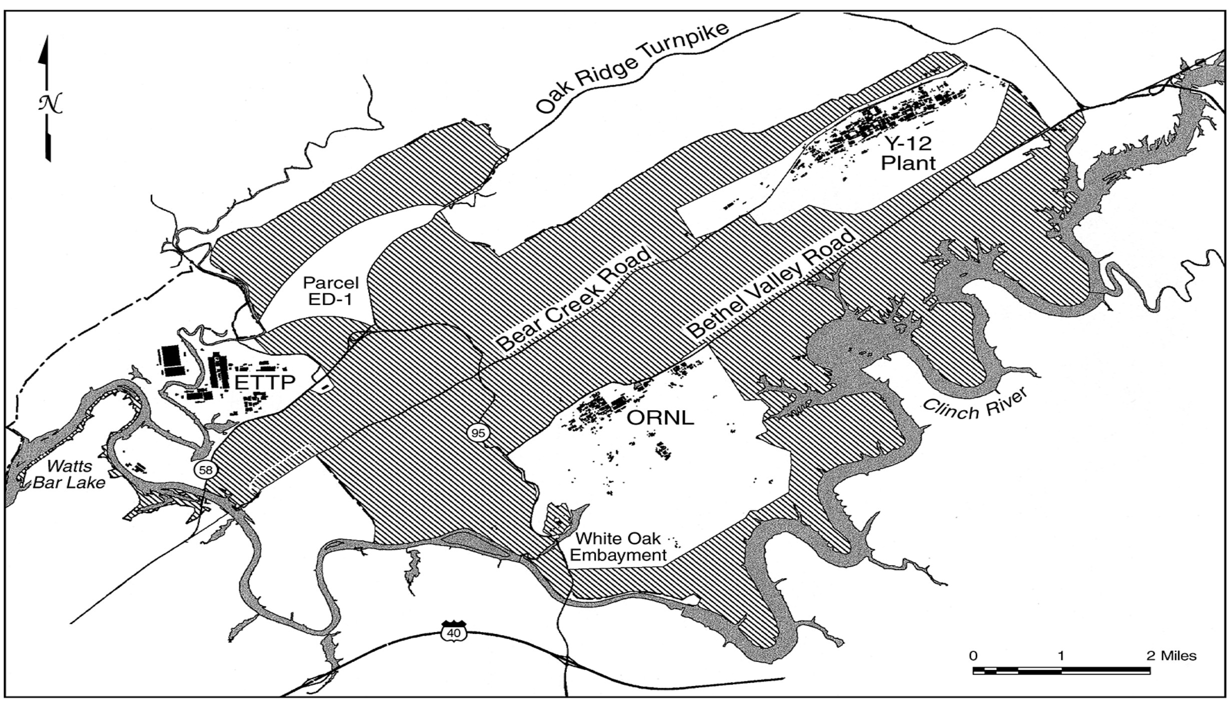

Fig. 1.11. The Oak Ridge National Environmental Research Park covers 21,980 acres on the reservation.