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United States Department of the Interior
National Park Service

National Register of Historic Places Multiple Property Documentation Form

This form is used for documenting property groups relating to one or several historic contexts. See instructions in National Register Bulletin *How to Complete the Multiple Property Documentation Form* (formerly 16B). Complete each item by entering the requested information. For additional space, use continuation sheets (Form 10-900-a). Use a typewriter, word processor, or computer to complete all items

New Submission Amended Submission

A. Name of Multiple Property Listing

Historic Resources of the Tennessee Valley Authority Hydroelectric System, 1933-1979

B. Associated Historic Contexts

(Name each associated historic context, identifying theme, geographical area, and chronological period for each.)

1. The Character of the Tennessee Valley and the Coming of TVA
2. The Tennessee Valley Authority, 1933-1945
3. The Tennessee Valley Authority, 1945-1979

C. Form Prepared by

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D. Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this documentation form meets the National Register documentation standards and sets forth requirements for the listing of related properties consistent with the National Register criteria. This submission meets the procedural and professional requirements set forth in 36 CFR 60 and the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation.

(See continuation sheet for additional comments.)

William C. Walker, Dir., Env Permitting & Compliance 3/3/16
 Signature and title of certifying official: Date

Claudia Steyer 2/18/16
 State or Federal Agency or Tribal government -Deputy State Historic Preservation Officer

I hereby certify that this multiple property documentation form has been approved by the National Register as a basis for evaluating related properties for listing in the National Register.

Jan John
 Signature of the Keeper

4-12-2016
 Date of Action

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Provide the following information on continuation sheets. Cite the letter and title before each section of the narrative. Assign page numbers according to the instructions for continuation sheets in National Register Bulletin *How to Complete the Multiple Property Documentation Form* (formerly 16B). Fill in page numbers for each section in the space below.

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Paperwork Reduction Act Statement: This information is being collected for applications to the National Register of Historic Places to nominate properties for listing or determine eligibility for listing, to list properties, and to amend existing listings. Response to this request is required to obtain a benefit in accordance with the National Historic Preservation Act, as amended (16 U.S.C.460 et seq.).

Estimated Burden Statement: Public reporting burden for this form is estimated to average 18 hours per response including time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Direct comments regarding this burden estimate or any aspect of this form to the Chief, Administrative Services Division, National Park Service, PO Box 37127, Washington, DC 20013-7127; and the Office of Management and Budget, Paperwork Reductions Project (1024-0018), Washington, DC 20503

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E. Statement of Historic Contexts**1. THE CHARACTER OF THE TENNESSEE VALLEY AND THE COMING OF TVA***Introduction*

This multiple property documentation form includes twenty-five hydroelectric projects constructed between 1933 and 1979 as part of the Tennessee Valley Authority (TVA) Hydroelectric System in Alabama, Georgia, Kentucky, North Carolina, and Tennessee. (Mississippi and Virginia, served in some portion by TVA, are not included in this MPS as only hydroelectric projects built by TVA on the main stem (Tennessee River) and its tributaries are addressed. There are over 150 total TVA sites, including substations, fossil plants, and utility cooperatives within the region.) This documentation form provides the background and history of architectural resources associated with these projects within the ownership of the TVA. Within this documentation form are the property types of powerhouses, dams, navigational locks and lock control buildings, visitor buildings, recreational buildings, maintenance buildings, and other buildings and structures specifically associated with TVA's missions of hydroelectric power, flood control, navigation, improvement of quality of life, and recreation.

The TVA had such a major impact on the historic landscape of the region, this document is arranged to provide an overview of the pre-history and historical settlement of the Tennessee River basin. The context then discusses the early uses of the river for navigation, commerce, and hydroelectric power. The establishment of the TVA and its history to 1945 is then presented along with its impacts and significance to the region. This discussion is then followed by a historical narrative of the TVA from 1945 to 1979. These sections address areas of significance relating to the TVA's influence across the Tennessee Valley region in agriculture, architecture, conservation, engineering, military, industry, recreation, social history, and transportation. Property types are then presented along with registration requirements and supporting documentation.

The twenty-five hydroelectric projects that are intended to be nominated are the primary projects built by the TVA on the Tennessee River and its tributaries between 1933 and 1979 (*Figure 1*). The multiple property submission discusses only those built by the TVA and does not include those built prior to 1933 that were acquired by the agency, including:

1. Blue Ridge Dam, 1930, Fannin County, Georgia
2. Great Falls Dam, 1916, White and Warren Counties, Tennessee (NR-listed 6/5/1990)
3. Ocoee No. 1 Hydroelectric Station, 1911, Polk County, Tennessee (NR-listed 7/5/1990)
4. Ocoee Hydroelectric Plant No. 2, 1913, Polk County, Tennessee (NR-listed 10/31/1979)
5. Wilbur Dam, 1912, Washington County, Tennessee
6. Wilson Dam, 1924, Lauderdale and Colbert Counties, Alabama (NR-listed 11/13/1996)
7. Nolichucky Dam, 1913, Greene County, Tennessee

In addition to these pre-TVA projects, there are a series of smaller dams built on Bear Creek in Alabama and Beech River, Beaver Creek, and Clear Creek in Tennessee. These small dams were built for recreation and flood control in the 1960s and 1970s. They are not associated with or

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significant to the TVA hydroelectric system and are not included as part of this multiple property documentation.

The properties associated with the TVA Hydroelectric System may be eligible under National Register Criteria A and C and under Criterion Consideration G. Under Criterion A, the TVA Hydroelectric System is significant in the improvement of quality of life in the Tennessee Valley Region through generation of electrical power, control of seasonal flooding, navigation, and creation of public recreational facilities. Under Criterion C, the TVA Hydroelectric System is significant for its engineering and architectural character. Although all twenty-five of the hydroelectric projects were planned more than fifty years ago, actual completion of four of the projects did not occur until the late 1960s and 1970s (Nickajack, Tims Ford, Normandy, and Tellico), invoking Criterion Consideration G for properties not yet of fifty years of age. The last project, the Tellico Dam, was delayed for many years and was not completed until 1979. Even though they are less than fifty years of age, these four projects are integral to the TVA's overall unified hydroelectric system. The period of significance for the hydroelectric system spans from 1933 to 1979, which represents the period spanning from the year the TVA was enacted to the completion of the final project in the system.

The Geography of the Tennessee Valley as the Backdrop for TVA Development

Geographically, the Tennessee Valley includes a crescent-shaped, 41,000-square-mile watershed of the Tennessee River and its tributaries. Seven states are considered Tennessee Valley states, but only five are included in the Tennessee Valley Project Area for this nomination. The region of the Tennessee Valley is the area served by the TVA power grid, with 155 municipal and electric cooperatives receiving their power from the TVA in an area covering 80,000-square-miles.¹

The Tennessee River begins where the Holston and French Broad Rivers converge in Knoxville and then extends 652 miles to the confluence of the Ohio River. The river is fed by a number of tributaries upstream from Chattanooga including the Clinch, Little Tennessee, and Hiwassee. West of Chattanooga, the river goes through a mountainous gorge, flows into northern Alabama, then through northeastern Mississippi, and back north through western Tennessee and southwestern Kentucky. At this point, the Tennessee River flows into the Ohio River at Paducah, Kentucky. Major tributaries through this section include the Duck and Elk Rivers.² The topography of the region varies from rugged mountains and green forests to rolling hills and open fields.

The region is divided into two distinct halves: the Upper Basin and the Lower Basin (*Figure 2*). The Upper Basin, north and east of Chattanooga, has three sub-regions: Ridge and Valley, Blue Ridge, and Cumberland Plateau. The ridge and valley region stretches from northeast Tennessee to the northeast tip of Alabama and hosts the Valley's two largest cities: Chattanooga and Knoxville, thus making it the industrial capital of the Valley. The Blue Ridge region includes the Appalachian Mountains. The Cumberland Plateau is a highland area of rich subterranean resources, but infertile soil. The steep edge of the Cumberland Plateau separates the Lower Basin from the eastern Upper Basin. The Lower Basin has four sub-regions: Cotton-Producing, Highland Rim, Nashville Basin, and Interior Coastal Plain. The Cotton-Producing sub-region is characterized by rolling, limestone hills and is located in southeastern Tennessee and northern Alabama. North of the Cotton-Producing sub-region and on the western perimeter is the Highland Rim with varying fertility. The Interior Coastal

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Plain is a hilly region with poor clay and sand soils. The Nashville Basin is characterized by large tracts of pasture, smaller agricultural tracts, and a number of industries.

The Influence of the Tennessee River System on Prehistoric Cultures and Early Settlement

The earliest documented occupation of the Tennessee Valley region occurred at the end of the last glacial advance and is referred to as the Paleo-Indian period (12,000 - 8000 BC). Paleo-Indian culture across the Highland Rim, an area that extends from northern Alabama across Middle Tennessee and into Kentucky, consisted of small nomadic bands that subsisted by hunting and gathering.³ Paleo-Indian lithic artifacts have been recovered from high elevations, suggesting hunting activity in a tundra habitat, as well as on terraces and hills along rivers.⁴ Additionally, evidence of Paleo campsites in the adjacent lowlands along rivers and streams has been discovered. One such site, the Quad Site located in northern Alabama near Decatur, is situated on the Tennessee River between shoals downstream and bluffs upstream. Another site of Paleo-Indian activity is the LeCroy site on the Tennessee River in Hamilton County, Tennessee. Both the Quad and LeCroy sites may have been winter quarters. In all, thirty-one counties in Tennessee and northern Alabama have found artifacts proving the existence of Paleo-Indian activity.⁵

Environmental warming resulted in the cultural adaptation referred to as the Archaic Period (8000 - 1000 BC), with three divisions, Early, Middle, and Late. Each division is defined primarily by changes in stemmed-projectile point styles. During the Early Archaic period the dominant means of subsistence was hunting, although plant foods, aquatic resources, and small game were other food sources.⁶ Archaeological remains from Early Archaic sites have been found in the mountain region of North Carolina and in Alabama, Kentucky, and Tennessee, particularly along the Tennessee River. The Archaic way of life in Tennessee was characterized by that of the "Eva" group, a main settlement near the junction of the Tennessee River and Cypress Creek in Benton County, located a mile west of the Kentucky Dam.⁷ Another early Archaic site was located at the current location of the Tellico Dam on the Little Tennessee River.⁸

The Middle Archaic period brought increasing importance to plant foods and aquatic resources and a change in settlement along rivers. By the Late Archaic period there is archaeological evidence of plant cultivation, including squash, sunflower, and various grasses.⁹ Middle Archaic period artifacts have been located on the Tennessee River floodplain in what is now Kentucky Lake. Archaeological investigations in the Land Between the Lakes National Recreational Area identified a number of sites having Late Archaic Period components.

The development of pottery and the bow and arrow are distinctive elements of the Woodland period (1000 BC - AD 900), which is divided into three sub-periods: Early, Middle, and Late. During the Early Woodland period, there is good evidence that the focus of settlement moved increasingly to the bottomland.¹⁰ By the Late Woodland period, larger sites are found, indicating the use of villages that were occupied and abandoned repeatedly over a long duration.¹¹ Woodland cultures were further marked by population growth, permanent settlement, and subsistence on agriculture, as well as hunting and gathering. Maize was introduced during the Early and Middle Woodland periods, but wild resources continued to be major food sources into the Late Woodland period.¹² In Tennessee, many settlements were located in the major river valleys and along smaller rivers and creeks, including

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Candy Creek on the Hiwassee River in Bradley County. In Alabama, the Hopewell Complex, also known as the Copena Mortuary Complex, appeared in the Tennessee Valley region along with groups of conical mounds along the Tennessee River. Woodland sites have been located along the Tennessee River in Kentucky including Roach Village, located in Trigg County near the Tennessee River. This village contains artifacts from the Woodland, Archaic, and Paleoindian periods and a Mississippian house.¹³

The Mississippian period (900-1650 AD) defines the Late Prehistoric Era. Three phases (Early, Middle, and Late) are distinguished by pottery, house construction, and village location, composition, and layout.¹⁴ Increasing dependence on corn agriculture supplemented by hunting and gathering provided a stable and plentiful food supply that supported an increased population. The Mississippian period is noted for increasingly complex societies organized in chiefdoms, platform mounds associated with a public plaza, and houses constructed of wattle and daub.¹⁵ In eastern Tennessee, mound sites have been located from Chattanooga northeastward into the valleys of the headwaters of the Tennessee River. One site in particular on Hiwassee Island, near the convergence of the Hiwassee and Tennessee Rivers, has provided a near complete picture of Mississippian life. Another strategically placed settlement, the Dallas Island site, was located twenty miles upstream from Hiwassee Island and contained three large temple mounds. The Dallas site is now submerged under Chickamauga Lake.

The river's influence continued during the late Mississippian period as prehistoric cultures developed into the protohistoric Native American tribes of the Yuchi, Creeks, Choctaw, Shawnee, Chickasaw, and Cherokee. In the early eighteenth century, these tribes were dwelling in a semi-circle located south of the Tennessee River, which ran through their common hunting grounds.¹⁶ The Yuchi were among the mound-building people and are among the oldest permanent residents of the Southeast United States. At the time of Hernando de Soto's expeditions, the Yuchi were a large and powerful tribe that he noted in the highlands north of the Tennessee River.¹⁷ Epidemics following the wake of the Spanish expeditions ravaged the Yuchi and decimated their population. It was estimated that the combined populations of the three bands of Yuchi never exceeded 3,000 to 5,000 persons.¹⁸ European-American and Canadian explorers reported different Yuchi bands along the headwaters of the Tennessee River and on an island in the lower Tennessee River near Muscle Shoals.¹⁹ It is assumed that the latter group moved up the Tennessee River during the early part of the eighteenth century and settled near the Cherokee on the north bank of the Hiwassee River in Polk County, Tennessee.²⁰ The Cherokee forced most of the Yuchi out of Tennessee in 1714, and others were incorporated into the Shawnee and Cherokee tribes.²¹ In 1836, the U.S. government forcibly removed 2,500 Creeks, including 900 Yuchi, to Oklahoma. Only 216 Yuchis are recorded in the 1930 U.S. census.²²

The early historic Muscogee, descendants of the Mississippian culture, settled autonomous regional governments that united to form the Creek Confederacy, joined by trade, religion, and common languages. Creeks were located in chiefdoms across the Tennessee Valley region, separated by vacant buffer zones. The rivers played a vital role by providing an intricate network of trails connecting all the villages.²³ Colonization of the southeast region and the accompanying invasions of territory, wars, plagues, slave raids, and forced relocation compelled surviving tribes to repeatedly form alliances and settle new villages. An attack by Creeks on Fort Mims on the Alabama River initiated the Creek War (1813-1814), also known as the Red Stick War. Major General Andrew

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Jackson led troops from west Tennessee, and General John Cocke led the East Tennessee forces, which included a number of Cherokee warriors. The Red Sticks were defeated at Tallushatchee and Talladega in 1813, and the final defeat at the Battle of Horseshoe Bend in 1814 led to the Treaty of Fort Jackson, where General Jackson extracted 22 million acres of land from the Creek Council.²⁴

The Choctaw tribe traces its roots to a mound-building, maize-based society that flourished in the Mississippi River Valley for more than a thousand years before European contact. Although their first encounter with Europeans ended in a bloody battle with Hernando de Soto's fortune-hunting expedition in 1540, the Choctaw came to embrace European traders who arrived in their homeland nearly two centuries later. The Choctaw Nation occupied lands in what is now central and south Mississippi.²⁵ The Choctaw joined Andrew Jackson's army in the War of 1812 to fight the Creeks. The Choctaw became known as one of America's Five Civilized Tribes, which also included the Chickasaw, Cherokee, Creek, and Seminole.

The Chickasaw and Cherokee were the primary tribes in the Muscle Shoals region of Alabama. In general, the Tennessee River served as the dividing line between the two tribes at Muscle Shoals. Northwestern-most Alabama, where Pickwick Dam is currently located, was originally occupied by both the Cherokee and the Chickasaw, with Caney Creek as the boundary line. Historic Old Riverton, as this site was later referred to, is now inundated beneath the waters of Pickwick Lake.²⁶ Over eighty Cherokee settlements were located in the southeastern region of North America during the eighteenth century.²⁷ Cherokee hunting territory extended beyond settlement areas into Virginia and Kentucky. Around the turn of the nineteenth century, a wide area of north Alabama was claimed as sacred hunting ground by both the Cherokee and Chickasaw Nations. Of all the Southeastern tribes, the Cherokee most extensively used the Tennessee River for transportation and located their towns on the banks of the river, on islands in the river, and on its tributaries.

Anglo-American Settlement in the Tennessee Valley Project Area

Spanish, French, and English traders and explorers also relied extensively on the river, and their activity in the region overlapped that of Native tribes, sometimes resulting in conflict. The earliest European explorers to the southeast region were the expeditions of Hernando de Soto in 1540 and Juan Pardo in 1566.²⁸ De Soto came upon the Tennessee River in Chattanooga and continued down the river for 150 miles to present-day Guntersville. In 1673, James Needham, commissioned by Virginia trader Abraham Wood, was sent to establish trading relations with the Cherokee along the Little Tennessee and Tellico Rivers.²⁹ Though Native Americans killed Needham on his second trip to the region, his partner Gabriel Arthur was able to develop a lucrative trade network with the Cherokee. English settlers quickly entered the Tennessee Valley region, some via the Holston River and others by the Watauga and Nolichucky Rivers. They established relations among the tribes, particularly the Cherokee and the Chickasaw. French traders built a number of trading posts along the Tennessee River, but they were dissuaded from moving into the western Tennessee Valley by the impediment of the Muscle Shoals.³⁰

When the French and Indian War broke out in 1754, the Cherokee, seeking protection from the French, asked the Virginia and South Carolina colonial governments to build a fort in their country.³¹ South Carolina built Fort Loudoun (NHL 6/23/1965), completed in 1757. Fort Loudoun secured the southern frontier for the English during the early years of the war, as the French had powerful allies with the Creeks of Alabama. Fort Loudoun remained the westernmost English outpost until 1760

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when it was abandoned during the Cherokee War. North Carolinians reoccupied it in 1761 after the British victory.³²

The period of time following the Cherokee War (1759-1761) has become known as the “decade of the long hunters.” Long hunters traversed Tennessee and Kentucky to hunt, trap, or trade, but rarely established homes or permanent settlements. Hundreds of others entered the wilderness including surveyors, explorers, and land speculators. The most famous scout in the area was Daniel Boone who first entered Kentucky in 1767. In 1775, as an agent for land speculator Richard Henderson of North Carolina and the Transylvania Company, Boone blazed the Wilderness Road from Tennessee into Kentucky and founded Boonesboro.³³

The first settlement in East Tennessee was established along the Watauga River in 1769. Within a year, hundreds of settlers pushed into the area. Four settlements were established in the Upper Tennessee Valley: the Watauga settlement near present-day Elizabethton, Sapling Grove (Bristol), North of Holston settlement, and Nolichucky Settlement (Erwin). The Wataugans purchased 2,000 square miles of Cherokee land along the Watauga River and land below the South Holston and the Virginia line.³⁴

In dire need of funds following the Revolutionary War, the U.S. Congress urged states claiming western lands to cede them to the newly formed government. The government surveyed the lands, sold them, and then applied the proceeds towards operating expenses. On May 26, 1790, Congress created the Southwest Territory, which eventually became the state of Tennessee.³⁵ According to the 1790 census, settlers of the Tennessee Valley were 65% English, 12% Scotch, 7% Ulster Scotch, 12% German, 5% Irish, 2% French, and 0.4% Dutch.³⁶

William Blount was appointed as Territorial Governor of the territory, an area encompassing nearly 43,000 square miles.³⁷ The Cherokee and Creeks, angered by white settlement on the Holston and Tennessee Rivers, demanded the return of their land that they claimed was common tribal hunting ground. In 1791, Blount entered the Treaty of Holston with the Cherokee, who agreed to the extension of boundaries for white settlements in exchange for government protection and annuities. Blount selected Knoxville on the Tennessee River as the territorial capital and county seat in 1792, a year after it was platted.³⁸ At the same time, Knox, Jefferson, and Hamilton Counties were formed. On January 11, 1796, a constitutional convention met in Knoxville and petitioned the U.S. Government for admission to the Union. John Sevier became the first governor, William Cocke and William Blount were elected as United States Senators, and Andrew Jackson was elected as the member of the House of Representatives. On June 1, 1796, Tennessee was admitted as the sixteenth state to the Union.

The Southwest Territory, now Tennessee, grew to 105,602 people in 1800.³⁹ Settlers in the east lived as far west as Clinch River, and those west of the Cumberland Plateau lived along the Cumberland River primarily between Carthage and Clarksville. The Cherokee claimed the land between the two groups, and the Creek and Chickasaw tribes claimed the land between the Mississippi and Tennessee Rivers. During Sevier’s governorship, Tennessee experienced rapid growth, prosperity, and economic development. The population expanded to almost 150,000 in 1809, with more than sixty percent of the state’s population living in Middle Tennessee.⁴⁰

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The Compact of 1806 opened lands in Tennessee, once secured by the federal government, for sale. The western part of the state still belonged to the Chickasaw, and the Cherokee Reservation remained intact east of the Tennessee River and south of the French Broad River. The remainder of the state was clear of Native-American claims by this time. North Carolina published the muster rolls of her Revolutionary companies so that heirs of soldiers could claim land grants. Military claims amounted to more than eight million acres.⁴¹ The Hiwassee District, between the Little Tennessee and Hiwassee Rivers, was purchased from the Cherokee in 1819, then surveyed into townships and sold. The Ocoee District, between the Hiwassee and Tennessee Rivers, and the area between the Little Tennessee and Hiwassee Rivers were made available in 1838.

The federal government acquired present-day Alabama as part of the 1783 Treaty of Paris, which ended the American Revolution. The British forfeited its claims to all lands east of the Mississippi River, and in April 1798, the Mississippi Territory was created out of lands formerly claimed by the colony of Georgia. Congress created the Alabama Territory out of the eastern section of the Mississippi Territory and named William Wyatt Bibb as territorial governor. The population grew rapidly: 1,250 residents in 1800, 9,046 in 1810, and 127,901 in 1820.⁴² In July of 1819, a constitutional convention was held at the temporary capital city of Huntsville, where a state constitution was written and application to the Union was made. On December 14, 1819, Alabama was granted statehood, and Bibb was elected as Alabama's first governor.

By 1820, Alabama's population had grown to more than 125,000 persons, with slaves making up thirty-one percent.⁴³ The emerging cotton economy significantly impacted the slave labor system in the Tennessee River Valley and other river valleys and precipitated a growing desire for land. Settlers of the upper and lower river valleys were involved in agriculture, but the need for slave labor developed differently. Landholders in lower Alabama began raising cotton with slave labor on large tracts of land, whereas farmers in northern Alabama focused mainly on smaller, subsistence agriculture.

The Trail of Tears and the TVA Project Area

During the early nineteenth century, the Tennessee River Valley experienced an increasing influx of American settlers from east of the Appalachians, as pioneers spilled westward from the mountains into the Valley's rolling hills and vast plains seeking new land and opportunity. As conflicts erupted with Native Americans claiming land rights, the federal government's attempts at land treaties devolved into a policy of forced removal. For Native Americans, the life-giving Tennessee River became associated with the Trail of Tears, transporting detachments of Cherokee, Creek, and Chickasaw tribes from Alabama, Georgia, North Carolina, and Tennessee to the Indian Territory, present-day Oklahoma.

The end of the War of 1812 and the Creek War promoted western expansion. The Creek uprising turned many Euro-American settlers against the Jeffersonian policy of civilizing and assimilating the Indians and initiated a movement for their removal from the Southeast region. As president, Jackson implemented the Indian Removal Act, not sparing even the acculturated Cherokee, despite their demonstration of coexistence and their assistance in Jackson's defeat of the Red Sticks. In 1814, Jackson split the Creek Confederacy into the Muscogee and Seminole Nations. The Muscogee were forcibly removed from the Southeast between 1824 and 1838 on the Trail of Tears to Oklahoma.

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With Anglo-European settlement moving into Mississippi, the Choctaw were the first of the southern tribes to emigrate west to the Indian Territory. The Choctaw had become factionalized and felt so much pressure from American officials that they signed the Treaty of Dancing Rabbit Creek in September of 1830.⁴⁴ While the majority of the Choctaws opposed removal, the treaty was signed by an acculturated leadership reflecting a small number of the tribe. The majority of the Choctaws, some 19,200, moved to the Indian Territory by foot or by steamboat. Another 8,000 were allowed to stay on a small reservation in central Mississippi.

While the Chickasaw objected to leaving their ancestral land, assimilation under Mississippi law represented an undermining of their cultural and social traditions. The federal government attempted to divide the tribe by offering lands east of the Mississippi to members of mixed heritage. The Chickasaw signed the treaty, as a means of affirming their political sovereignty. Before Congress ratified the treaty, however, Levi Colbert, a Scots-Chickasaw chief for the tribe, sent an official letter of protest. Several Chickasaw exploration parties traveled to the west in search of new land, but failed in negotiations with the previously relocated Choctaw there. By 1837, the federal government had lost patience with the Chickasaw and forcibly removed them along with other tribes of the Southeast.

The U. S. Army forced the removal of more than 20,000 Creeks in 1836 and 1837. The last of the remaining Creeks were removed to Oklahoma by 1840. The Creek and Chickasaw interactions with the Tennessee River were minimal compared to that of the Cherokee. The Creek involvement with the Tennessee River appears to have consisted primarily of passage along the river via steamboat from Tusculumbia directly to Paducah, a destination accessible in one day. Chickasaw representatives traveled along the same route as the Creek, but the emigration of some 4,500 Chickasaw in 1837 followed an overland route to Memphis.

Four Cherokee detachments traveled by steamboat and flatboat down the Tennessee River in 1838. These detachments on the "Water Route" were led by Lieutenants Edward Deas, Captain G.S. Drane, John Drew, and R.H.K. Whitely. The river conditions affected how each of these groups reached Paducah and the length of the trip. These detachments traveled in flatboats, floating rapidly through dangerous point for navigation given names such as the suck, pot, skillet, and pan.⁴⁵

The last group of Cherokee to leave the east floated down the Hiwassee and Tennessee Rivers to Ross's Landing,⁴⁶ paying for pilots to safely transport them through the "Suck" and other hazardous areas near Chattanooga. Past Decatur, the Capt. John Drew detachment paid tolls to use the Muscle Shoals Canal, which bypassed the worst of the rapids in the Muscle Shoals area. At Tusculumbia, John Ross purchased the steamboat *Victoria* for \$10,000, and the detachment boarded the boat for the trip downriver.⁴⁷

John Bengé led the one detachment of Cherokee from Alabama. Consisting of approximately 1,000 Cherokee, Bengé left from a camp in Wills Valley on October 4, 1838. The detachment crossed the Tennessee River at Gunter's Landing (now Guntersville) in Alabama and traveled through Tennessee, eventually crossing the Duck River by bridge or ferry. On November 3, 1838, the group crossed the Tennessee River at Reynoldsburg, an important ferry crossing and steamboat stop on the river before, moving through Kentucky on their way to Indian Territory.⁴⁸

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A number of Cherokee avoided removal and remained in the western North Carolina region. Cherokee households from the Valley River and Nottely River settlements joined Buffalo Town, forming an enclave that eventually became known as the Snowbird Band of Cherokee.⁴⁹ The Snowbird Cherokee remained autonomous until their consolidation with the Qualla Cherokee in 1889 to form the Eastern Band of the Cherokee Indians. Today, the Cherokee of Graham County, North Carolina, hold sizable tracts of trust lands along Snowbird Creek and maintain a number of tribal-run facilities for the benefit of band members.⁵⁰

Commerce and Navigation along the Tennessee River

The rapid increase in population in the Tennessee River Valley resulted in the settlement of dozens of communities along its banks and the development of commercial businesses, industries, and transportation networks. The Tennessee River, the fifth largest river in the United States in terms of flow, held great economic promise for towns and cities along its course, but was characterized as hazardous, treacherous, and unreliable, due to its shoals, shallows, and whirlpools, changing gradients, and seasonal variations in depth. For much of the nineteenth century, the Tennessee River was controlled by a few improvements, such as dikes and spillways. Originally, only flatboats, rafts, and keelboats could navigate the river. The upper section was shallow and filled with short rapids, while the middle section contained whirlpools and the Muscle Shoals, leaving only the lower section easily navigable. In the early nineteenth century, cotton, corn whiskey, and other goods were transported by keelboat down the Ohio and Tennessee Rivers to New Orleans. Their operators, unable to travel upstream, sold their boats at New Orleans and began the long walk home via the Natchez Trace and other early road systems.

Periodic floods and droughts made travel up and down the river even more difficult and prevented industries from locating their businesses on the banks. Average rainfall in the Tennessee River Valley was exceeded only by the rain forests of northwest America. The intensity of flood-producing storms was exceeded only along the coastal drainage systems to the south, making damaging floods an expected natural consequence.⁵¹

While the convenience of river transportation and fertile soil of the Lower Basin attracted settlers to northern Alabama and the Muscle Shoals region (Florence, Tusculumbia, Muscle Shoals, and Sheffield), low water lines, dangerous rapids, and shoals hindered travel on this particular thirty-seven mile stretch of the river. The cotton that many farmers cultivated in Morgan County, for example, had to be stored in warehouses on the riverbank, awaiting shipment to New Orleans until the water level was high enough to navigate the shoals. In 1823, the U.S. House of Representatives passed a bill appropriating money for roads and canals to transport mail. Muscle Shoals was designated as one of the most important projects, with the goal of opening the Tennessee River to steam navigation between Knoxville, Tennessee, and Paducah, Kentucky. Originally, work began on a canal in 1831, but was soon abandoned. Unfortunately, during low water levels, boats could not reach the canal; during high levels, the canal was unnecessary. Efforts to connect the Tennessee River to the national water transportation system were unsuccessful.

The growing cotton industry and hindered river transportation in northern Alabama pushed railroad development there. In 1836, the State of Alabama, eager to facilitate a bypass of this section of the river, prompted funding for a railroad. Believed to be the first railroad west of the Allegheny

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Mountains, the Tuscumbia-Courtland-Decatur Railroad ran from Decatur to Tuscumbia, where the river was again navigable. The Tuscumbia Railroad Company built a connector between its depot in Decatur to Tuscumbia Landing on the river. Tuscumbia Landing was used by steamboats beginning in the 1820s and was a vital link in the surface transportation system in north Alabama. This rail line provided incentives for growth, and Decatur gradually emerged as a center for industry. In 1853, a new railroad between Tuscumbia and Decatur was begun. By 1855, two railroads intersected at Decatur, making the city a major hub for the north-south and east-west lines. The development of river navigation and railroads continued to expand north Alabama's market for industrial and agricultural commodities. In turn, urban populations grew, and communities continued to build new post offices, public schools, universities, churches, commercial buildings, and residences. The growth of the region was clearly reflected in rising populations in each of the counties from the beginning to the mid-twentieth century.

In the Upper Basin, Chattanooga and Knoxville were relatively isolated given the Appalachian Mountains to the east and the dangerous Tennessee River just west of Chattanooga. The Tennessee River Gorge, the fourth largest river gorge in the eastern United States, was notorious for its navigational hazards. Problem areas with names such as Tumbling Shoals, the Holston Rock, the Kettle, the Suck Shoals, the Deadman's Eddy, the Pot, the Skillet, the Frying Pan, and the ten-mile Narrows severely hindered river transportation. These obstacles prevented boats from travelling between Memphis or New Orleans and towns in East Tennessee. Goods were primarily exported rather than imported. Several attempts were made to remove the river's obstacles, and in 1830, \$60,000 was raised for river improvements. Studies in 1831 and 1832 concluded that locks and dams could provide the best solution for navigation, but it was decided to deepen the channel given the available funds. In 1835, regular steamboat service was made possible from November until June between Knoxville and Decatur.⁵² Year-round navigation on the Tennessee River, though, could not be maintained; steamboats could make the trip only during the months when the river was highest.⁵³

While river transportation on other more navigable rivers to the west was significant, the advent of the railroads in the Upper Tennessee River Valley in the 1850s became the primary mode of shipment. Buyers on the Atlantic Coast seeking to reach grain and livestock farmers in the Tennessee Valley sought a connection with Chattanooga. In 1849, the Western & Atlantic Railroad completed a line from Savannah, Georgia, to Chattanooga, which quickly became a main junction for other lines. Factories for iron working, furniture manufacturing, and textile production were built near rail yards, as were warehouses for grain, timber, cotton, and other raw materials. Goods were then shipped out via the rails.

Knoxville actively pursued a rail connection with the east coast as well. Knoxville received most of its goods from the northeast despite high costs (\$13,750 to transport \$70,000 worth of goods), though less expensive from Charleston.⁵⁴ A severe economic depression beginning in 1837 delayed the construction of a railroad until 1855. Prior to the completion of the railroad, Knoxville's commerce and industry reflected the isolated nature of the town. Manufacturing concentrated on local needs: leather, leather goods, guns, wagons and carriages, iron, and spirits. After the railroad, Knoxville became a major merchandising and distribution center and served as the headquarters of many coal companies. Completion of the railroad severely dampened the kinds of exported goods to New Orleans via steamboat. Though, given the relatively higher railroad rates, heavier freight such as salt, iron, and marble continued to be transported by water. Railroads extended in all directions out of the

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city and contributed to the local economy and population. Knoxville's population was 730 in 1810; after the coming of rail lines, the population jumped from 2,076 in 1850 to 5,300 in 1860.⁵⁵ Even as late as the early twentieth century, Knoxville identified itself as "both a highway and railway center," but not a port city.⁵⁶

Unlike the towns in the Upper Tennessee Valley, Paducah, Kentucky, was ideally situated and developed early as a significant river port. Located just past the confluence of the Tennessee and Ohio Rivers, fifty miles upstream from the confluence of the Ohio and Mississippi, and twenty miles downstream from the confluence of the Cumberland and Ohio Rivers, Paducah's port facilities were important to both trade and transportation by 1838. A brick factory was established, and a foundry for making rail and locomotive components was built, ultimately contributing to the "river and rail" industrial economy. By 1850, Paducah had dry-dock facilities and boat making operations, making it an ideal place as headquarters for barge companies. Paducah's proximity to coal fields made it an important railway hub for the Illinois Central Railroad, a primary north-south railway connecting the industrial cities of Chicago and St. Louis to Gulfport, Mississippi, and New Orleans. In the decades following the Civil War, Paducah continued to capitalize on its river and rail connections. Exports included tobacco, whiskey, iron, timber, and produce. Many jobs were created by this rise in industry. While the dry-dock and river packet industry were still providing major economic growth in Paducah, the latter part of the 1800s saw major advancement toward the railroad. At this time, Paducah became the second largest manufacturing and distribution center in Kentucky.⁵⁷

The Tennessee River and the Civil War

Tennessee, North Carolina, and Alabama were among the states to secede from the Union in 1861, precipitating the Civil War. The formation of the Confederacy and the advent of hostilities made occupation of the Tennessee River Valley one of the strategic objectives of the Federal government. In order for the Union to win the war, federal forces had to be sent deep into Confederate territory, which required the arming and moving of Federal troops. Supply lines were crucial; given the size of the western theater (385,000 square miles), poor roads, and few railroads, control of the rivers was vital to success. Fortifications were built along the Tennessee River, and battles were fought in towns along the Tennessee River, including Chattanooga, Knoxville, Decatur, and Florence, as Union soldiers advanced deeper into Confederacy territory.

To defend Tennessee's borders, Governor Isham Harris sought sites for forts on the Tennessee and Cumberland Rivers that were north of railroad crossings and south of the Kentucky state line. Fort Donelson (NR 10/15/1966) was built atop a 100-foot hill above the Cumberland River near Dover, Tennessee, and Fort Henry (NR 10/10/1975) was built on low ground just south of the Kentucky border frequently flooded by the Tennessee River. Due to the flooding of Fort Henry, Fort Heiman (NR 12/12/1976) was built on the high ground across the river. These forts fell to Union troops during the Cumberland and Tennessee Rivers Campaign of 1862. When Fort Henry surrendered on February 4th, the Tennessee River was open for Union gunboats and materials as far as Muscle Shoals. On February 16th, the garrison at Fort Donelson surrendered to Brig. Gen. U. S. Grant, opening up the Cumberland River and forcing the Confederate evacuation of Nashville. The Confederate troops were forced to fall back, giving up Kentucky and much of West and Middle Tennessee. Following the battles of Forts Henry and Donelson, more than 500 sick and wounded soldiers were transported to Confederate earthworks constructed by troops under Brigadier General

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Daniel Ruggles in Florence, Alabama. These earthworks would later come under attack from the same Union gunboats that attacked Fort Henry. Once able to control the Tennessee River in Florence, Union forces were able to occupy north Alabama.

On April 16, 1862, Confederate troops under Gen. Albert Sidney Johnston surprised Maj. Gen. U. S. Grant at Pittsburg Landing (Shiloh) on the west bank of the Tennessee River. Although successful on the first day, the Confederate army was defeated on the second day of battle following the arrival of Union reinforcements. Confederate troops withdrew and fell back to Corinth, Mississippi, after heavy losses. An estimated 13,047 Federal casualties and 10,699 Confederate casualties resulted from the two days of fighting. Over the next year, much of north Alabama was occupied by Union forces, and Chattanooga was captured in September of 1863 by Maj. Gen. William Rosecrans' Federal army. Rosecrans' army was defeated at the battle of Chickamauga on September 20th and fell back to Chattanooga. Grant replaced Rosecrans, but Confederate troops, hoping to starve the Union forces into surrender, were able to cut off Federal communications and supply lines by controlling the Tennessee River. Once Grant seized Brown's Ferry on the Tennessee River and erected a pontoon bridge, he was able to reopen supply and communication lines and repel Confederate forces into north Georgia, leaving the Union forces in control of Chattanooga and opening up Georgia for a Union invasion. At the Battle of Chattanooga, each side suffered about six thousand casualties.⁵⁸

The Knoxville Campaign was a series of battles during the fall of 1863 designed to secure control of that city. In 1863, Union forces captured Knoxville, a key railroad and commercial center of East Tennessee. Union troops built several forts to defend the city, and in November of 1863, Confederate Lt. Gen. James Longstreet led a small army northeast from Chattanooga to recapture it. A battle took place south of Knoxville on the Tennessee River at Campbell's Station on November 17, 1863, ending with 970 casualties and the withdrawing of Union forces to Fort Sanders at Knoxville. On November 29, Confederate forces attacked Fort Sanders, and within twenty minutes the Confederates suffered 813 casualties, while the Union suffered only thirteen.⁵⁹ Longstreet abandoned the siege on December 4th and withdrew towards Rogersville, Tennessee. One final battle of the Knoxville Campaign took place at Bean's Station on the Holston River on December 14. There were an estimated 1,600 total casualties. Union Maj. Gen. Ambrose Burnside's successful defense of Knoxville along with Grant's victory in Chattanooga put much of East Tennessee under Union control for the remainder of the Civil War.

The Tennessee River affected other campaigns of the Civil War. The Atlanta Campaign of 1864 was led by Union Maj. Gen. William T. Sherman, whose troops defeated the Confederate Army of Tennessee in a series of battles in north Georgia and around the city. Confederate Lt. Gen John Bell Hood was forced to surrender Atlanta in September and then moved his army northwest to Alabama, from where he planned to invade Middle Tennessee and force Sherman to pull back from Georgia in pursuit. Hood attempted to cross the Tennessee River at Decatur, Alabama. The heavily fortified Union stronghold repelled Hood, who then marched west to Florence. There, Hood waited three weeks for the flooded Tennessee River to subside before crossing and marching toward Nashville. This delay allowed Union troops to concentrate their forces, and Hood's army was defeated at the Battles of Franklin and Nashville. Hood's army retreated back across the Tennessee River in late December, and most of the fighting in the Tennessee River Valley came to an end.

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After the Civil War, steamboat usage and river trade continued on the Tennessee River. In some areas, steamboat usage was revived due to the destruction of numerous railroads. In Chattanooga and Knoxville, despite repeated destruction of railroad facilities during the war, continuous repair and restoration left the railroads fairly operable. Postwar state aid enabled the lines to resume profitable operations. Muscle Shoals proved to be the most serious obstruction on the Tennessee River. In the 1870s, under the supervision of Col. George W. Goethals, the previously abandoned canal project was restarted, and in 1890 and 1911, canals were constructed around the shoals. It was the first major development of infrastructure with dramatic effects on the growth of the region, including the growth of the iron manufacturing industry and establishment of new towns, such as Sheffield and New Decatur (later re-named Albany).

Early Development of Hydroelectric Power and its Impact of the Tennessee River Valley

It was during the post-Civil War years that use of rivers for hydroelectric power began to have a dramatic effect on the industrialization and manufacturing capabilities of America. Hydroelectric power and advances in transferring electricity over long distances allowed industries to locate in a wider range of areas and increased productivity. The first use of hydroelectric power in the United States took place at Niagara Falls, New York in 1861. By the mid- to late 1880s, the number of hydroelectric plants began to grow rapidly in response to the growth of the electric light industry. In 1886, forty to fifty electric light plants were either on line or under construction in the United States and Canada.⁶⁰

Hydroelectric systems consist of a variety of components and equipment that work together to produce energy. Among these are dams, intake structures, water delivery systems, and prime movers. Water delivery systems can be canals, flumes, tunnels, pipelines, or penstocks. Plants with high heads also typically have surge tanks, stand pipes, and relief valves. The term "head" refers to the amount of water pressure exerted to provide energy. The higher the head the greater the water pressure to drive the prime movers. Prime movers are the water turbines or impulse wheels, which drive electrical generators. This equipment along with the generators usually is enclosed in a powerhouse, which also contains the control and switching equipment.⁶¹ The earliest hydroelectric plants were direct current stations built to power arc and incandescent lighting.

Hydroelectric systems generate power through moving water. A reservoir of water is created by damming a river. Water flow is controlled and a constant water level is maintained. This stored water is then piped into turbines through a delivery system such as a penstock. Penstocks are controlled by valves or turbine gates in order to adjust the flow rate. Water leaves the turbines through what is called a tailrace. Turbines are rotary engines that convert the energy of moving water into mechanical energy by driving the axles of the generators (Figure 3). A turbine is basically a wheel with paddles, propellers, blades, or buckets arranged on its circumference that catch the moving water, which forces the wheel to turn, imparting energy.⁶² The design of the turbine depends on the available head of water; high heads require a Francis-type turbine, while low heads use Kaplan or propeller-turbines. Attached to the top of the turbines via a vertical drive shaft are electric generators. The mechanical energy created by the turbines is transferred through the drive shaft to operate the generators. Water that flows through the turbines is recycled in pumped storage plants.⁶³

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Dam construction is one of the largest and most expensive undertakings in the development of a hydroelectric plant. Dam construction in the nineteenth century included those made of masonry, earth, and timber. Dam building technology was fueled by the desire to lessen the expense of dam construction. Efforts focused on using smaller volumes of material and on designs that employed less costly materials and fewer skilled laborers. Arch dam designs reduced the volume of required construction materials by transferring thrusts to the abutments, which meant the dam itself could be thinner. The first such dam constructed was the 1885 Bear Valley Dam near San Bernardino, California. The dam was slender for its time with a twenty-foot thick base, and supported a sixty-five-foot head. The use of steel in dam construction also came into play in the late nineteenth century, but it did not come into general use.⁶⁴

Innovative designs in dam construction appeared in the early twentieth century with the work of Nils Frederick Ambursen and John S. Eastwood. In 1903, Ambursen patented a slab and buttress design for a reinforced concrete dam in which the weight of the water was distributed across an inclined upstream face. The design calls for a row of triangular buttresses that support cast-in-place reinforced concrete slabs. In 1904, Ambursen patented a curved sloping downstream spillway to carry water from the crest. This design created a "shell-dam" with a hollow core between the buttresses. Some power companies who used this design elected to install the facility's powerhouse inside the dam's hollow interior rather than build a separate structure.⁶⁵ In the early twentieth century John S. Eastwood developed a multiple arch dam that featured "a series of reinforced concrete cylinder sections (arches) set at an angle . . . joined at their edges, and resting on triangular buttresses reminiscent of those used by Ambursen."⁶⁶ This design greatly reduced the amount of material needed as the arches were very thin.

The water delivery systems that carry water from the dams and associated reservoirs include canals, flumes, tunnels, pipelines and penstocks. With the development of hydroelectricity, only subtle changes occurred in the construction of canals and flumes, which had been in use for irrigation and other purposes for centuries. In the eastern United States, closed conduits were more common than flumes. Plank lined and later concrete lined pressure tunnels enabled companies to connect streams, storage reservoirs, and power plants while bypassing ridges and other obstacles.⁶⁷ Pipelines and penstocks transfer the water to the turbines. Pipelines are defined as "pressure conduits that run from a dam or the foot of a canal to the surge tank or standpipe."⁶⁸ Pipelines are connected to turbine cases by penstocks. Penstocks typically have steep slopes and are able to withstand high pressures. Pipelines and penstocks are often confused, and it is not uncommon for the entire system to be referred to as a penstock. Throughout the late nineteenth century, wood stave pipelines were used in hydroelectric facilities to carry water along gentle slopes. Welded steel versions later became the norm.⁶⁹

Pressure within long pipelines and penstocks often calls for pressure-relief devices or venting in the system. Early hydroelectric systems installed safety valves known as standpipes to relieve pressure along the lines. Intense surges and rising pressure forced water to spill out of the top of the standpipes. Larger and taller pipes created simple surge tanks to conserve this water. In 1911, the differential surge tank was introduced. This piece of equipment contains a riser that is similar in diameter to the pipeline that is enclosed by a much larger diameter tank. It featured ports midway up the riser that helped to prevent oscillations within the tank and conduit.⁷⁰

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Prime movers of a hydroelectric system are the impulse wheels or turbines. The design of impulse waterwheels changed little from the 1880s to the 1920s. Pelton wheels, as they were commonly called, revolved around horizontal shafts that could be connected directly to generators. Early versions were connected to generators with flexible rawhide. In the 1890s, overshot waterwheels avoided misalignment problems by connecting directly to an extension of the generator shaft.⁷¹ Control mechanisms such as needle valves and jet deflectors were also common features at high head installations.

Low- and medium-head hydroelectric developments turned to water turbines in the late nineteenth and early twentieth centuries. Turbines are reaction wheels that are driven by the flow and pressure of water that moves against vanes or buckets. Early turbines were either outward or inward flow units, which are distinguished by the path of water as it travels through the unit. "Inward flow runners receive water through guide vanes mounted around their periphery and discharge it at their centers."⁷² Axial wheels force water along a path parallel to the runner shaft.

In the late nineteenth century, stock pattern turbines emerged that met the needs of most hydroelectric plants. However, these turbines could not meet the needs of large-scale hydroelectric facilities that developed in the twentieth century. These installations required custom designed turbines to fit their specific needs. Impulse wheels continued to be used at sites of a thousand feet or more at the turn of the century, but Francis or mixed-flow turbines became the norm for moderate- to high-head developments in the twentieth century. A key factor in this turbine was the development of the Kingsbury bearing, an oil-film, pressure-wedge bearing connecting the turbine and generator and allowing vertical suspension of the turbine. Invented by Albert Kingsbury in 1898, it was first used in a commercial hydroelectric plant in 1912. The design did not require pumps or other external pressure equipment, and the bearings had the capacity to carry vertical reaction turbines of great magnitude. This greatly altered powerplant design. The Kingsbury bearing and variations of the design were commonplace by 1915, and large scale plants were being built with vertical reaction turbines, which hung from the new bearings. By 1920, vertical Francis turbines were built that had up to 60,000 horsepower at heads of over 600 feet.⁷³

Propeller turbines were first used in low-head hydroelectric facilities in 1916. Several versions of the propeller design emerged, but all were "smaller, lighter, and less prone to damage from passing ice and debris than their Francis counterparts."⁷⁴ In addition, propeller runners operated at high speeds and were more economical. The design was perfected by Dr. Viktor Kaplan, and Kaplan units first appeared in the United States in 1929.⁷⁵

The presence of ample waterways within the Appalachian Mountains made the Tennessee Valley region especially attractive for companies pursuing hydroelectric power in the late nineteenth century. At first, electrical power in the region was limited to small direct-current dynamos and generators used to power individual homes and businesses. The hydroelectric potential of the region's many rivers and streams remained untapped until the successful demonstration of the use of alternating current generation at New York's Niagara Falls in 1895. Unlike direct current (DC), alternating current (AC) allowed electricity to be generated at one voltage, increased through transformers to a higher voltage for transmission, and then decreased through transformers for distribution to consumers. Alternating current was also more economical since it could transmit high voltages via copper wires

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through long distances. This allowed for the possibility of electrical generation at one source, and the transmission of current to consumers in urban areas or to industrial clients.

The earliest use of large-scale hydroelectric power to provide electricity in North Carolina was the Idols Hydroelectric Plant on the Yadkin River. In 1898, the Fries Power and Manufacturing Company built the state's first hydroelectric plant to power textile mills, streetcars, and small manufacturing plants in the nearby towns of Salem and Winston. When it was constructed, the plant transmitted electric power thirteen and one-half miles to a substation in Salem.⁷⁶ The first hydroelectric power station built in Tennessee was the Loop Plant on the Elk River near the town of Winchester. Completed in 1901, this development consisted of a twenty-foot high, concrete dam and a powerhouse with a 100-kilowatt generator.⁷⁷ Similar independent small-scale hydroelectric stations were developed throughout the state that served immediate localities.

Few improvements took place along the Tennessee River in the late nineteenth century, but planning efforts began to improve navigation at both the Tennessee River Gorge and the Muscle Shoals. In 1898, several Chattanooga business interests formed the Tennessee River Improvement Association to lobby for efforts to extend year-round navigation to Chattanooga. Major Dan C. Kingman of the U.S. Army Corps of Engineers (USCOE) created a dam design that would flood the Tennessee River Gorge and remove the swift current and various hazards that had long prevented large-scale navigation through this stretch of the river. In 1904, Kingman's friend, Josephus Conn Guild, offered to build the dam with private funding in exchange for the rights to the dam's hydroelectric power. Congress passed the enabling legislation on April 27, 1904, and the Chattanooga and Tennessee River Power Company was formed to oversee the project.⁷⁸ The dam was originally scheduled for completion in 1909, but numerous difficulties brought about primarily by the soft bedrock upon which the dam was built continuously stalled construction, and by 1910, only the lock and powerhouse had been completed. Engineers finally began to make progress after employing the use of pressure grouting and concrete caissons - the first use of either in a major dam construction project— and Hales Bar Dam (NR 11/25/2008) was finished on November 11, 1913. Hales Bar Dam was the first dam on the Tennessee River to not only improve navigation, but also provide electricity.

In 1909, construction began for the Ocoee Dam No. 1 in the Tennessee River valley and was finished in 1911. Located in Parksville, Tennessee, Ocoee Dam No. 1 is 135 feet high, has five generating units, and stretches 840 feet across the Ocoee River. This dam created one of the first artificial lakes in the state, and the plant provided electrical power to the cities of Cleveland, Nashville, Chattanooga, Athens, Sweetwater, Loudon, Lenoir City, and Knoxville, Tennessee, in addition to Rome and Dalton, Georgia.⁷⁹ In 1912, University of Tennessee engineer professor John A. Switzer noted that the "year of 1912 will be notable in the annals of Tennessee, because it marks the beginning of a new era - the era of water power development." Switzer pointed to the new hydroelectric facilities on the Watauga and Ocoee Rivers as significant to the state's future industrial development. He accurately predicted that "it means the inevitable, and the prompt expansion of our manufacturing interests; since the certainty of obtaining power at a low cost will assuredly attract manufacturing enterprise."⁸⁰ On January 28, 1912, a group of citizens gathered in the Ridgedale powerhouse in Chattanooga and cheered when the switch was thrown to transfer the electricity of Ocoee No. 1 throughout the region.⁸¹

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The first large hydroelectric dam in Alabama was constructed in 1912 on Lock 12 on the Coosa River (now Lay Dam), and transmission lines were established to Birmingham. Lay Dam was completed in December of 1913, electricity generated by April of 1914, and power transmitted to Birmingham by July of that year.⁸² In Kentucky, the Dix Dam, located between Mercer and Garrard Counties, was the state's first major hydroelectric dam. Dix Dam was considered the largest rock-filled dam in the world and was capable of generating up to 30,000 kilowatts.⁸³ Construction of Dix Dam began in 1923, but it did not generate power until October of 1927. The top of the dam is 287 feet above the riverbed.

These initial plants were the first of dozens of hydroelectric facilities that would be built in the region over the next several decades. Numerous companies were formed to build dams and power plants in these years with varying degrees of success. Some plants operated only for a short period of time before they proved uneconomical and went out of business. Others were eventually purchased or consolidated with emerging larger utility companies

The scale of hydroelectric production in the Tennessee River Valley dramatically increased through the projects built by the Aluminum Company of America, known as Alcoa. A pioneer in modern aluminum production, the company is rooted in the late nineteenth-century scientific efforts and discoveries of Charles Martin Hall. In 1886 at age twenty-two, Hall discovered a new process for making low-cost aluminum. Hall's process involved "passing an electric current through a fused bath of cryolite and alumina," and separated aluminum from its oxide.⁸⁴ Because the procedure could be done relatively inexpensively, it made commercial use of the metal feasible.

In 1888, Hall went to Pittsburgh, where he found financial backers to support his ideas, and the Pittsburgh Reduction Company was chartered later that year. The funds were used to build and equip a small plant where Hall immediately began work on developing a commercially feasible aluminum smelting process.⁸⁵ By 1890, the company was producing around 475 pounds of aluminum per day. The small Pittsburgh plant was becoming inadequate, and the company needed to enlarge its operations. In March 1891, the organization moved to New Kensington, Pennsylvania, along the Allegheny River. The new plant produced pig aluminum ingot, and within two years the company added a sheet-rolling mill. In 1895, the company opened a second plant at Niagara Falls, New York.⁸⁶

The company experienced rapid success and growth in the late nineteenth and early twentieth centuries as markets for aluminum increased dramatically. The metal was used for a variety of products including kitchen utensils, medical and surgical instruments, foils, bottle caps, military implements, wire baskets and brushes, automobiles, and eventually airplanes. Stock in the company sold well and attracted major investors such as Andrew W. and Richard B. Mellon. The Mellon family became involved with the company first as bankers to secure loans for a new plant. Impressed with the organization, the Mellons invested in its stock and by 1925 held over thirty-five percent of its preferred and common stock.⁸⁷

In addition to raw materials, Hall's aluminum process required extraordinary amounts of electrical power, and so the company sought out the least expensive methods for its production. In 1909, the company focused on the Little Tennessee River and its tributaries in the Great Smoky Mountain region of Tennessee and North Carolina. The gorge through the Smoky-Unaka Mountains made by the Little Tennessee River proved to have a large number of favorable dam sites, and the company pursued the location for construction of hydroelectric systems.⁸⁸

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Alcoa gained riparian and power rights along the mountainous waterways through the purchase of the Knoxville Power Company and the Union Development Company in Tennessee and the Tallassee Power Company in North Carolina.⁸⁹ In October 1910, Alcoa purchased the Howard Farm, a 1,100-acre tract of land at the mouth of the gorge of the Little Tennessee River. The company established a headquarters camp on the property and began field surveys and engineering investigations of the area. The camp consisted of the original ca. 1870 Howard farmhouse and several temporary buildings. In 1912, a post office was established on the site and was given the name "ALCOA," which was taken from the initial letters of the company's name. The site was later renamed Calderwood. Between fifty and one hundred employees, mostly engineers, were based at Alcoa.⁹⁰

A top priority of the Alcoa group was to locate a site in the vicinity of the Little Tennessee River on which to establish a smelting plant. The search began in 1912, and the mountainous terrain, which was so beneficial to the hydroelectric systems, was a challenge for choosing a plant site. Two hundred thousand kilowatts needed to be transmitted over the rough countryside, which was subject to severe storms. Rather than construct one large plant outside the mountainous region, the company considered building many small plants in the bottom lands along the river. However, transportation facilities were also important, and locations near Spartanburg, South Carolina, and Knoxville, Tennessee, were good candidates.⁹¹

As Alcoa was scouting for a site to build its smelting plant, the Tennessee Electric Power Company was beginning to construct a power development in the Knoxville area. As the need for aluminum was pressing, Alcoa entered a short-term contract with the Tennessee Electric Power Company in October of 1912 for power to be supplied to a site along the Little Tennessee River. In 1913, a site north of Maryville, Tennessee, was selected for the aluminum reduction and fabricating plant. Alcoa purchased 664 acres, and construction of the plant and temporary worker housing began in the fall of 1913. Operations began at the new plant, the largest of its kind in the country, on March 6, 1914.⁹²

While the new plant was busy producing aluminum, the company's engineers were busy with the design and construction of its own dams and power stations along the Little Tennessee and its tributaries. These hydroelectric developments include Cheoah (NR 05/21/2004), Santeetlah (NR 05/21/2004), Calderwood (NR 08/21/1989), and Chilhowee (NR 05/27/2004). The falling water from the dams flows through the penstocks and into the turbines to create electricity. The power then traveled from the powerhouses to the reduction works at Alcoa, Tennessee. Alcoa later formed a subsidiary division of the company to manage its hydroelectric facilities. Named Tapoco, the division reflected the name of the original power company of the region, the Tallassee Power Company.⁹³

The Cheoah facility was the first of the four Tapoco hydroelectric developments constructed. Construction of the Cheoah Dam began in March of 1917, and the facility began operation in April of 1919. Upon its completion, the Cheoah Dam was the highest overflow dam in the world to date, and the powerhouse had the world's largest hydroelectric generating units.⁹⁴ In the late 1920s, demand for aluminum increased, and Alcoa's interest in producing power along the Little Tennessee was renewed. The company's second development to be completed along the Little Tennessee watershed was the Santeetlah facility, located approximately five miles upstream from the Cheoah Dam. Construction began on this project in early 1926 and was completed in 1928. The company's third hydroelectric project to be completed on the Little Tennessee was Calderwood. Initial work on the

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Calderwood facility actually began in 1918, but was suspended as World War I was drawing to a close. Work resumed on the project in July of 1927, and the facility was completed in April of 1930.

While Alcoa was building and operating its plant in Tennessee, the completion of a large dam in north Alabama also came to fruition. Construction began in 1918 on the Wilson Dam in Lauderdale County on the Tennessee River. The dam was constructed to provide electricity to two nitrate plants the federal government built at Muscle Shoals. Nitrate was an important component of explosives, and large amounts of this material were needed when America entered World War I. The National Defense Act of 1916 was passed to authorize immediate construction for two nitrate plants to be powered by an adjacent hydroelectric facility. Federal engineers selected Muscle Shoals as the construction site after surveys determined that it had the most potential for the development of water power east of the Rocky Mountains. Built between 1918 and 1924 by the USCOE, the project employed more than 18,000 workers. The signing of the Armistice ended World War I in November of 1918 when the Wilson Dam was only partially completed.

Wilson Dam was not completed until 1924, and then only forty percent of its electric-generating capacity was installed. The navigation facilities at the dam consisted of a double-lift lock whose tandem chambers - sixty feet by 292 feet on the upper lock and sixty feet by 300 feet on the lower lock - had a combined maximum lift of ninety feet.⁹⁵ The completion of the Wilson and Hales Bar Dams improved navigation on the Tennessee River, lessening the hazards of the Muscle Shoals and Tennessee River Gorge. These dams were built with locks that provided for the safe navigation of barges and other vessels. Completion of the Norris Dam in 1936 permitted releases that created a depth of up six feet below Pickwick Landing Dam. Finally, following the completion of the Kentucky Dam, a nine-foot navigation channel was available from Paducah to Knoxville by April of 1945.⁹⁶ These development improved transportation of freight on the Tennessee River from 940,000 tons in 1933 to over two million tons in 1945.⁹⁷

The Coming of TVA

The advances in hydroelectric power in the Tennessee Valley occurred at a time when the region suffered from poverty and exploitation of natural resources. Most residents in the Tennessee Valley lived on small farms that often provided only basic subsistence. Fifty-one percent of the 2.3 million people living in the Valley in 1930 were farming families. Another twenty-four percent were non-farming rural families whose income came from city or country factories.⁹⁸ Less than twenty-five percent of the Valley population lived in cities, with Chattanooga and Knoxville being the only cities in the Valley with populations greater than 100,000.⁹⁹ Settlement patterns throughout the Valley consisted of individual homesteads and crossroads communities.

Not only was the Tennessee Valley region rural, it was highly impoverished in the early twentieth century, which was reflected in nearly every facet of life. In the early 1930s, the average net income for a family was \$639 per year compared to the national average of \$1,835 per year. Three-fifths of the Valley counties had family incomes under \$500 per year, and one-fifth earned less than \$250 per year.¹⁰⁰ Nearly ninety-six percent of farms were without electricity compared with the national average of eighty-six percent. Only three percent of farms had running water. Disease-borne illnesses in the Valley were higher than national rates of the period, and the number of health professionals was substantially lower than for the rest of the nation. The Valley states were ranked among the ten

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lowest in educational quality; only one-third of the national average was spent on education for children in the Valley. The illiteracy rate among adults in the Valley was almost twice the national average. The 1930 census indicates that 6.8% of whites over ten years old were unable to read or write compared to 1.5% for whites nationally. In northern Alabama, thirty-three percent of black adults were illiterate.¹⁰¹

Between 1920 and 1930, approximately 1.25 million people moved out of Valley states to escape the area's economic difficulties.¹⁰² This migration pattern is reflective of the national movement during a period when the population living on farms decreased from eighty-five to twenty-three percent. From 1920 to 1930, six million people across the nation migrated from farms to cities.¹⁰³ Loss of employment opportunities during the Depression, however, reversed this pattern, as people returned to farm life as a means of subsistence. Half (51.2% or 1.6 million) of the Valley's residents were farmers occupying 24.5 million acres. Nearly forty-three percent of these farmers were tenant farmers and did not own the land they farmed.¹⁰⁴ This increase in rural population combined with poor agricultural practices put additional stress on the natural resources and economy of the region.

In the 1930s, the Valley's economic structure was based on its natural resources. By the 1930s, farming, forestry, and mining industries had decimated the region's landscape. Of the thirteen million acres of cultivated land in the region, eighty-five percent had been extensively damaged by soil erosion.¹⁰⁵ Limited crop farming of corn and cotton in west Tennessee and of tobacco in east Tennessee stripped the soil of nutrients. The steep topography in areas played a large role in the erosion and mismanagement contributed greatly to the declining quality. As fertility diminished, farmers planted on marginal lands to make up the loss and continued intensive farming on the depleted land, further diminishing productivity. Farmers were trapped in a cycle of poverty. Improving soil fertility involved costly expenses with possible future gains, but tight margins. Farmers could not afford to skip a year of production. The negative effects of misguided agricultural practices impacted ridge-and-valley and cotton-producing sub-regions most severely. In cotton-producing areas, large expanses of fertile cotton fields were divided into smaller parcels for tenant farmers and sharecroppers. Additionally, the stripping of timber from the native landscape contributed to erosion.¹⁰⁶

Early settlers in the Tennessee Valley had found a region nearly completely forested. As more settlers moved to the area, a growing market for lumber and need for agricultural fields led to the destruction of the forests. In 1909, lumber production reached an all-time high of 1.6 million board feet.¹⁰⁷ The virgin forests continued to be heavily harvested until 1929. By the 1930s, the landscape was almost barren or forested with inferior-quality second- and third-growth trees. Only fifty-five percent of the 36.6 million acres in the Valley was still forested by the early 1930s.¹⁰⁸ Remaining forests were highly susceptible to fires, disease, insects, and livestock damage. The Blue Ridge's Appalachian forests in particular were heavily logged in the early 1900s and greatly stripped by the 1930s. On the Highland Rim of middle Tennessee, overcutting of oak and hickory left the land barren and badly eroded. The federal government reclaimed large tracts of land in the Interior Coastal Plain, perhaps the most misused of timber and agricultural lands in the Valley. In east Tennessee, the creation of the Great Smoky Mountains National Park was a public-private effort to preserve some 500,000 acres of native forest and cease clear-cutting of timber within its boundaries.

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Surface mining also contributed to erosion and destruction of the natural Valley landscape, which yielded over twenty-five minerals and fuels including coal, phosphate, mica, feldspar, kaolin, and limestone. The most flagrant example of surface mining's effects occurred in the Copper Basin, 60,000 ore-rich acres in southeastern Tennessee. In 1843, copper was discovered in southeastern Polk County. In 1850, the first deep mine for copper, the Hiwassee mine, opened. Within three years, eleven mines were operating in this area of Tennessee.¹⁰⁹ Beginning in 1904, a new process of smelting was introduced that replaced the environmentally devastating process of open-roasting of ore. Enclosing copper furnaces allowed for the capture of sulfuric dioxide, which became a lucrative byproduct of copper mining. Yet by that time, mining practices had caused siltation of streams and rivers and rendered the landscape so toxic, it resisted efforts of reforestation. New mines throughout the country lured workers away, leaving many Valley mines abandoned. The diminishing quality of farmland, spent mines, and the Great Depression contributed to widespread poverty in the region.

The Depression essentially halted all private hydroelectric development in the United States. Some plants in the northeast, Alabama, and North Carolina were completed in 1930 and 1931, but most were postponed or abandoned. Several additional factors contributed to the stalled growth in hydro plants. Demand for energy declined after 1929, and after World War I, thermal plant efficiencies rose and generating costs decreased.¹¹⁰ At the same time, capital costs for building hydro plants were increasing due to the less than ideal construction sites requiring more extensive engineering. Costs for property rights, flowage, and transmission lines were increasing as well. While private utility development waned through the 1930s, public utility development, at the local and federal level dramatically increased. With the advent of Franklin Roosevelt's New Deal, a debate ensued over public vs. private generation, transmission, and distribution of power.

In the early twentieth century, the federal government had yet to define its role in large-scale waterpower development and electric power as pertained to interstate commerce. The Rivers and Harbors Act of 1889 merely required the Corps of Engineers to review all plans for dams or other structures on navigable rivers. The Waterpower Acts in 1901 and 1910, therefore, were passed to address government regulation of hydroelectric development. These two acts provided for federal licensing of such projects, authorizing the Secretary of the interior to grant rights-of-ways for dams, reservoirs, power plants, and transmission lines over public lands. Licenses issued under the Waterpower Acts were revocable, which could make securing capital investment difficult. Increased demand for power as the United States entered World War I necessitated compromise between supporters and opponents of the Waterpower Acts.

The Federal Water Power Act of 1920 established the Federal Power Commission, comprising the Secretaries of War, Interior, and Agriculture, and served as the compromise to the previous Waterpower Acts. The Act of 1920 authorized term licenses of fifty years for power developments on navigable streams, public lands, forest reserves, and at government dams. Projects on public lands could revert to the government at the end of the term for cost less depreciation. Power companies were required to maintain their facilities, provide navigation around dams, and pay rent for federal lands and assessments for storage and flood control. Though the cost of a license was steep, the 1920s saw a boom in hydro plant building. The later Federal Power Act of 1930 changed the commission make up and installed a new Federal Power Commission with five appointed members. In 1935, the Commission's licensing power was expanded to cover hydroelectric plants on private lands and non-navigable streams.

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President Theodore Roosevelt's administration (1901-1909) was the first to propose that the government should administer, not just regulate, electrical power generation and distribution. This idea was promoted for the next twenty years. Before public power became a political issue, the federal government had built and operated hydroelectric plants. In 1902, the U.S. Reclamation Service (later named the Bureau of Reclamation) was established to build irrigation projects in the West and built hydroelectric plants to drive pumps. The largest of the early reclamation dams was the 1905-1911 Roosevelt Dam on the Salt River near Phoenix, Arizona. Surplus electricity was sold to the city of Phoenix and marked the federal government's entry into commercial power production. Overall, there were fourteen hydroelectric plants associated with the Bureau of Reclamation projects between 1906 and 1940.

During World War I, the federal government began intensively developing waterpower and distribution, while encouraging independent utilities to form power pools to share loads and generating capacities. The National Defense Act of 1916 authorized the construction of government-owned hydroelectric plants and nitrate plants. A Haber-Bosch process plant was built in Sheffield, Alabama, and a cyanamide plant was contracted at nearby Muscle Shoals as a backup. Muscle Shoals was selected because it offered a large undeveloped hydroelectric site on the Tennessee River for a 60,000-kilowatt coal-fired generating station to meet the electricity demand to operate the cyanamide plant. The cyanamide plant was completed in 1918 and included a transmission line from the steam plant. The war ended before the steam plant went online and therefore did not contribute to the war effort. Construction of the Muscle Shoals hydro plant was suspended; in 1925 it was completed and dedicated as Wilson Dam.

The interconnections created by the electric industry during wartime were extended into the 1920s, but the Wilson Dam and power plant were not easily assimilated. President Harding's administration wished to dispose of it as surplus property, but no local or regional utility could afford to bring the dam into operation. Auto-maker Henry Ford offered to buy Wilson Dam as a southern manufacturing center, but political opponents of private power companies blocked the sale. The question of what to do with Wilson Dam following World War I led to prolonged debates pitting against one another the interests of farmers, land speculators, fertilizer producers, and advocates of public versus advocates of private ownership of electric power. Conflict also occurred around navigation problems and improvements and later about stream planning, following disastrous floods in 1927. Senator George W. Norris, concerned about monopolies in the field of electric power, gained favor in his support of government-operated hydroelectric plants on the Tennessee River. Norris believed the government rates would serve as a measuring stick for the fairness of rates charged by privately held utility companies. By the late 1920s, continued federal operation of Wilson Dam had gained support. The debate continued until Franklin Roosevelt signed George Norris' Tennessee Valley Authority (TVA) Act of 1933.

2. THE TENNESSEE VALLEY AUTHORITY, 1933-1945

The Tennessee Valley Authority (TVA) came into being with President Franklin D. Roosevelt's New Deal. By 1933, the Tennessee Valley was a picture of southern rural poverty. While the Tennessee Valley had ample resources for the foundation of a robust economy, their development, production, and consumption were limited. In the early 1930s, Roosevelt pondered the conditions of the Valley,

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Down in this region, where people never have had adequate incomes, is it possible for us to develop small industries, where the people can produce what they use, and where they can use what they produce, and where, without dislocating the industry of America, we can absorb a lot of this unemployment, and give population a sound footing on which it can live?¹¹¹

Economic development of the region depended on good transportation, adequate flood control, and an abundant supply of cheap power. While navigation, flood control, and hydroelectric power were the three priorities listed in the Tennessee Valley Authority Act of 1933, an underlying ethic of the agency's mission was conservation of the Valley's natural resources and educated development of its farmlands. If agricultural lands were allowed to continue to deteriorate, the resulting siltation would reduce the capacities of reservoirs, which would in turn block navigation channels, increase floods, and decrease hydroelectric power. Therefore conservation was a necessity to complement TVA's hydroelectric projects.¹¹² As a regional resource development agency, the TVA developed a unified plan for working with local and state agencies.

Similar bills to the TVA Act had previously been passed by Congress, but were vetoed by Presidents Coolidge and Hoover. Franklin D. Roosevelt entered the White House on March 4, 1933, and the TVA bill passed on May 18, 1933. TVA's many objectives included improving navigation on and controlling seasonal flooding of the Tennessee River, as well as power development, reforestation, diversified industry, retirement of poor farm land, and the development of the natural resources for the general social and economic betterment of the nation.¹¹³

President Roosevelt appointed three men to the board of the newly created TVA, each with a background complementary to the multifaceted mission of TVA. Arthur E. Morgan, the first chairman appointed to the board, was not only an experienced civil engineer, but was also an academic leader. He gained notoriety in his work stabilizing the Miami River in Ohio. Prior to his appointment at TVA, Morgan was president of Antioch College, where he established the enduring policy of incorporating work practicum hours into the school curriculum.¹¹⁴ Harcourt A. Morgan brought an agricultural background that informed TVA's conservation mission. He had started his career in Louisiana cotton fields, fighting boll weevils and learning the degrading effect of the crop on soil quality. As a fourteen-year president of the University of Tennessee and dean of its department of agriculture, Morgan was instrumental in persuading the shift in Tennessee farming from row crops to pasture and livestock.¹¹⁵ Finally, David E. Lilienthal, an attorney and Harvard graduate, had served by governor's appointment on the Wisconsin Public Service Commission. There, his rhetoric established him as a proponent of utility regulation.¹¹⁶ Collectively, the backgrounds of these three individuals spoke to the TVA mission of integrating civil engineering and social progress. TVA capitalized on each man's strengths: Harcourt Morgan was placed in charge of fertilizer production and agriculture, Arthur Morgan was responsible for dam construction, education, rural living, and social and economic planning, and Lilienthal was to supervise the TVA's power policy.

Two divisions of the TVA were assigned major roles in combating soil erosion, the Agricultural Division and the TVA Forestry Division. The Agricultural Division worked with county agents and various state extension departments in advocating practices such as terracing, crop rotation, and the use of phosphate fertilizers to strengthen topsoil and pasture and increase crop yields. The Reforestation and Soil Erosion Section of the Forestry Division was assigned to concentrate on

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reseeding and reforesting sub-marginal land not suitable for agriculture.¹¹⁷ One of the first tasks of the TVA was to initiate soil surveys of the twenty-eight million acres lying in the Tennessee River watershed. Only a handful of counties in the region had conducted such surveys, and the TVA surveys assisted in identifying problem areas and prioritizing which areas needed assistance first.

The TVA and Civilian Conservation Corps (CCC) combined forces to combat the erosion problem and put people to work by undertaking an extensive reforestation and erosion control program. Two forest tree nurseries capable of producing over 50 million seedlings a year were established, one in Muscle Shoals, Alabama, and one in Clinton, Tennessee.¹¹⁸ The CCC, created on April 5, 1933 to employ young men in conservation projects, set up thirty-eight camps in the Tennessee Valley to provide a large public work force for planting trees and building small check dams. By 1935, nineteen CCC camps were established in the region, of which thirteen were in Tennessee.

Agriculture and agribusiness had been the Tennessee Valley's most important single industry, providing up to one-third of all jobs, but mechanized agriculture could release workers to support the industrial growth in the region.¹¹⁹ Three industries were supported by the Valley pre-TVA – textiles, wood products, and chemical processing – and these accounted for seventy percent of the employment in manufacturing.¹²⁰ Many of the Valley's natural resources were exported north and processed into finished products. In order for natural resources to remain in the Valley for processing, the region needed to attract industrial investment. Inexpensive and abundant electricity supplied by the TVA hydroelectric dams was vital to this endeavor, as it attracted manufacturing jobs needing large power supplies. Additionally, if large manufacturers located plants in the region, a reliable means of transportation was required, specifically, by river.

The engineering of the Tennessee River into a navigable waterway was one of the primary mandates of the 1933 TVA Act. The physical characteristics of the Tennessee River had rendered it unreliable as an inland waterway since Euro-American pioneers first settled the region. From north of Knoxville to the convergence with the Ohio River, the Tennessee River drops a total of 513 feet in elevation. While navigable from the Ohio River to Florence, Alabama, the Tennessee River was treacherous above this point due to the presence of the Muscle Shoals, dangerous currents near Chattanooga and other natural hazards. The TVA Act authorized the construction of a navigation channel adequate for nine-foot draft vessels on the Tennessee River from Paducah, Kentucky, to Knoxville, Tennessee, a distance of 652 miles.

River levels could be made consistent through the construction of a series of dams and reservoirs, which could store and release seasonal rainfall as needed. The TVA Act specifically authorized the construction of the Cove Creek Dam (later named the Norris Dam) across the Clinch River, and President Roosevelt ordered the Wheeler Dam's construction on the main river. TVA swiftly began construction of the two projects. By May of 1934, TVA Chairman Morgan reported that the Board had four additional dams planned, two on the main stem between Wilson Dam and the mouth of the Tennessee, one on the Little Tennessee, and one on the Hiwassee Rivers.

The announcement of TVA's ambitious construction program was hailed by many groups and organizations in anticipation of jobs and boosts to local economies. In November of 1934, the magazine for southern contractors, *The Dixie Contractor*, heralded,

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During the next 5 years, the US Govt will spend in the TN Valley, under the direction of the TVA the stupendous sum of \$310,000,000...An appropriation of \$98 mil for the work has already been made by Congress. Other appropriations which will be requested are as follows: \$72 mil in 1935, \$56 mil in 1936, \$41 mil in 1937, \$45 mil in 1938, and \$40 mil in 1940. It is by far the largest single government expenditure ever to be made in the South.¹²¹

TVA's first hydroelectric project was the Norris Dam. TVA purchased 153,000 acres of land for the project, which was to include not only the dam and reservoir but also the planned community of Norris. Originally called the Cove Creek Dam, its name was changed to honor George W. Norris (July 11, 1861 – September 2, 1944), the Nebraska Senator who advocated public utilities as a means of regional development. Considered the "Father of TVA", Norris had championed a federal role in social progress through power plants and economic development. Auto-maker Henry Ford's offer on the idle munitions base at Muscle Shoals galvanized Norris's belief that public, not private, power should be the instrument of progressivism.¹²²

The TVA's first chairman, Arthur E. Morgan, elaborated his vision of TVA as a social laboratory in a 1933 nationwide radio broadcast, stating that, "TVA is established in an effort to bring about orderly wholesome development of economic and social life."¹²³ As part of the vision of the TVA, officials saw in their projects an opportunity to affect a new architecture in the design of both the plant facilities and employee housing. The progressive philosophy would be interpreted through TVA's hydroelectric structures. As one author noted,

The TVA was, in fact, an early platform for the development of modern architecture in the United States. Established barely a year after Alfred Barr, Henry-Russell Hitchcock, and Philip Johnson opened their exhibit on modern architecture at the Museum of Modern Art (MoMA) in New York in 1932, the Authority drew young talent from across the country, who leapt at the opportunity to put their own visions into practice.¹²⁴

TVA's chief architect Roland Wank was an immigrant from Hungary, and his ideology of a socialist transformation of America informed his architectural design. While studying and practicing architecture in Czechoslovakia, Wank was influenced by the Bauhaus movement and the work of Walter Gropius. The Bauhaus movement stressed geometric purity, functionalism and technical excellence, principles Wank embraced in his design work. When he immigrated to the United States, Wank joined the architectural firm of Fellheimer and Wagner. Wank demonstrated a particular interest in industrial and transportation buildings and was the project architect for the firm when it designed Cincinnati's Union Station from 1929 to 1933. Wank was then hired as the chief architect for TVA in 1933.

At TVA, Wank assembled a team of young and talented architects who saw a chance not only for steady employment in the midst of the Depression, but also an opportunity for the expression of modernist and progressive ideals. When Wank was hired at TVA, he inherited a set of draft plans for the Norris project previously prepared for the site by the U.S. Corps of Engineers. The plans included decorative arches on the dam and classical details on the powerhouse. He replaced the Corps' traditional neo-classical designs with functional compositions of minimal detailing, employing the Streamlined Moderne style. This style emphasized the use of geometric shapes and sleek curves and

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was widely used for public and commercial buildings in the 1930s. Wank redesigned the project to eliminate ornamentation and emphasized the sheer wall of the dam, using it as the main spillway rather than down an adjacent hillside. The design of the Norris powerhouse was also made utilitarian and with influences of the Streamlined Moderne style.

The benefits of the TVA would not be limited to those employed at the site. The design of TVA's hydroelectric projects was intended to be easily accessible to the public and the visitor's experience was incorporated into the planning of the site and powerhouse. Wank impressed upon a receptive board of directors that government projects were beholden to their real stockholders, the American taxpayers, and should be open for public viewing. Further, Wank stated that the design of powerhouses should both welcome the public and convey strength in purpose. Thus, TVA powerhouses were designed as massive monoliths with visitor reception areas.¹²⁵ Landscaped roads culminated in vistas and overlooks of the viewing of the dam and powerhouse. Visitor reception areas and buildings were designed to provide information on the dams and powerhouses and views not only of the project but also the adjacent scenery.

TVA engineers and architects intentionally created an experience aimed to impress visitors with a bold panorama featuring a massive dam rising above the river and holding back a reservoir of power. The breath-taking sight conveyed a force more powerful than nature, illuminating for the American public a new age of planning, technology, and efficiency. In order to perpetuate its work, TVA required public approval, thus all aspects of site design made public visitation a priority, from scenic approaches to efficient guided tours to an avant-garde economy of architectural details. TVA's project sites embodied progressivism and innovation to an American public with increasing access to electricity back at home. A 1940 article in *Magazine of Art* claimed the TVA has mastered "the architecture of public relations."¹²⁶

The interior of the Norris powerhouse was also designed for the public, with a pristine visitor reception area featuring marble walls and terrazzo floors, and the generator room was designed with tile floors and walls. Upon entering the powerhouse reception area, visitors were greeted with modern comfortable furniture, murals, and the inscription "BUILT FOR THE PEOPLE OF THE UNITED STATES OF AMERICA" (Figure 4). The public restrooms off the reception area had terrazzo floors, marble walls and aluminum doors. Visitors could enter observation rooms to look through thick glass at the control room beyond or take a tour to the gallery and see the large turbines in the generating rooms.

The Norris project also had free-standing visitor building that featured an elliptical canopy over the main entrance flanked by porthole windows. These porthole windows were one of the defining characteristics of the Streamlined Moderne style of the 1930s.¹²⁷ (This building was replaced with the larger visitor building in 1950). For visitors, the experience of the hydroelectric projects was meant to both welcome and impress through the facility's modern architectural design and feats of engineering.

The monumentality of the dams was also expressed through Wank's canting or angling of the face of each dam. Instead of a sheer vertical design, the canting on the dam's face allowed for an angled spillway symbolizing the water it was holding back. The depth of the concrete splayed out on the downriver sides of the dams emphasized their strength and power.¹²⁸ The direct expression of materials was also used in the dams and powerhouses through the use of rough, board-formed

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concrete. Immense layers of concrete were poured into wood frames as the dams and powerhouses grew progressively higher. Once the concrete hardened, the boards were removed leaving the wood graining plainly visible. Rather than applying a final skim or smooth coat, the board-formed concrete surface was left exposed. After viewing this exterior treatment, architectural critic Talbot Hamlin wrote that the walls of the dams and powerhouses “have life.”¹²⁹ The European architect Le Corbusier visited Norris Dam in 1946 and after observing this concrete surface, later used it in his designs.¹³⁰

The Norris project set the precedent for all of the TVA’s projects and served as a model of public design. To that end, the TVA planned a permanent town with attractive residences within an English garden city encompassed by woodlands (Norris District NR 7/10/1975). Lead designers of the Norris village were Earle Draper and John Nolen, Jr., both city planners. Nolen was also a co-writer of the TVA Act of 1933, and Draper championed recreational development at TVA sites.

Initially the demonstration village at Norris was ambitious, providing for a possible capacity of 5,000 residents. Several upper-end houses were constructed of brick, mid-range designs had wood exteriors, and low-end dwelling had board-and batten siding to emulate local cabins. Another group of concrete-block dwellings on finished cement floor slabs were considered innovative in their low maintenance cost. Ensuing discussions, however, quickly reduced a program of 1,000 houses to 500, then 250, not including dormitories. Ultimately, permanent housing at Norris consisted of 294 single-family dwellings, ten duplexes, and five apartment buildings consisting of thirty total units.¹³¹

At the time, the TVA touted the town of Norris as a remedial alternative to “slum clearance projects” characteristic of urban public housing development. The TVA staff described the experimental model as a success in public planning, stating that Norris created a decent environment through modest means and was significant, at the very least, due to the rarity of planned communities in the U.S. This significance was not lost on other public agencies, such as the Federal Housing Authority and the Public Works Administration. TVA planners noted that the design of Norris occurred on acquired land, explicitly commenting that the project could be readily imitated on similarly acquired land.¹³² TVA Chairman Morgan envisioned the planned town fostering small business and agricultural pursuits; in reality, Norris eventually evolved into a bedroom community for TVA employees.

In addition to the hydroelectric project and the construction of the community of Norris, TVA also built the Norris Freeway in 1934. This two-lane paved highway was completed by TVA to transport materials from the railroad in Coal Creek (later renamed Lake City, and more recently Rocky Top) to the project site and to provide better access between its administrative offices in Knoxville and Norris. The design selected by the TVA was a “freeway,” which was defined as having limited vehicular access from side roads or adjacent properties. This approach provides for the use of easy grades and smooth curves to facilitate high-speed traffic. While freeways had been completed in other states, the Norris Freeway was the first limited access highway in Tennessee.¹³³ The Norris Freeway cost \$1.5 million to build and extended twenty-one miles between Coal Creek in Anderson County and Halls Crossroads north of Knoxville. The freeway contained two ten-foot traffic lanes with two- to four-foot shoulders within a 250-foot right-of-way. TVA limited billboards and commercial uses along the freeway for aesthetic reasons and required 75-foot construction setbacks. The Norris Freeway was later incorporated into the federal and state highway systems as U.S. Highway 441 and State Route 71. Phoebe Cutler, in her book *The Public Landscape and the New Deal*, describes that:

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To arrive at Norris, the delegates travelled on the world's first utilitarian, limited-access road. A workaday road in parkway garb, the Norris Freeway epitomized the blending of commerce and recreation in the Tennessee Valley.¹³⁴

Construction of the Norris Dam began on October 1, 1933. A particularly innovative decision was the TVA's choice to build its projects by force account, i.e., by hiring their own employees, rather than by selecting contractors through a traditional bidding process. The TVA engineers believed this approach would reduce overall design and construction costs, as well as reduce time to completion. The TVA projects were intended to alleviate unemployment as extensively as possible. To that end, TVA hired part-time labor in several shifts, rather than hiring strictly full-time employees.

The dam gates at Norris were closed on March 4, 1936 (*Figure 5*). The approval, funding, and completion of the project actually preceded TVA's presentation of its unified development plan to Congress on March 31, 1936. This report elaborated TVA's multifaceted mission of improvement of navigation, flood control, and quality of life throughout the region, specifically recommending the construction of nine main-river dams and three or more tributary storage dams. The Norris plant, TVA's first, was placed in operation July 28, 1936. The project resulted in hundreds of new jobs. The effects of the project were evidenced quickly, as the Anderson County seat of Clinton almost doubled its population. The Norris Dam was credited with being "...one of the major turning points which determined the ultimate direction Anderson County's social, economic, and political development would take."¹³⁵ The design of the Norris project set the precedent, in engineering, architecture, and site plan, for the other fifteen hydroelectric projects constructed over the next decade.

As Wank's prototype, the Norris design was widely praised at the time and in later evaluations of its impact on American architecture. Author Walter Creese argued that Norris Dam's "outstanding achievement was in establishing a bold beginning for future cooperation among architecture, engineering and landscape architecture. The dam materialized itself, represented democracy in a noble way, and engaged the attention of many of the best thinkers of the time."¹³⁶

Over the next decade, Wank and his team of architects designed sixteen hydroelectric projects. In addition to Wank, the design team included two mechanical engineers, four other architects including Rudolph Mock, and the architectural engineer, Harry B. Tour, the principal liaison with the engineering division.¹³⁷ The team was also enhanced in 1936 when TVA hired the Italian architect Mario Bianculli, who had worked for several architectural firms in New York. This group of designers is credited with not only the engineering and construction accomplishments of TVA, but also the architectural significance they achieved.

Architecturally, the TVA affected a new face of public design beginning with the Norris project and reinforced by the construction of fifteen more hydroelectric projects through World War II. Though each project was site specific, the team of TVA engineers, planners, and architects, led by Roland Wank, imbued a common sense of modernism and functionality into the buildings, structures, and site plans. The unifying design characteristics embodied the unified plan of the TVA Act. The exteriors of the powerhouses were of concrete or limestone panels, and many were designed with large banks of aluminum windows. The large gantry cranes used to service the generators were custom-designed to be sleek and streamlined. Interiors of the powerhouses were built with terrazzo floors, marble walls, and aluminum doors. Interior light fixtures, stair handrails, and door pulls were detailed accents often

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repeated within each project. Given this approach and the intensity of the work, TVA achieved a “pervasive consistency and harmony” in the sixteen hydroelectric projects completed between 1933 and 1944.¹³⁸ The sixteen hydroelectric projects on the Tennessee River and its tributaries designed by Wank and his team were:

1. Norris Hydroelectric Project, Clinch River, 1936
2. Wheeler Hydroelectric Project, Tennessee River, 1936
3. Pickwick Landing Hydroelectric Project, Tennessee River, 1938
4. Guntersville Hydroelectric Project, Tennessee River, 1939
5. Chickamauga Hydroelectric Project, Tennessee River, 1940
6. Hiwassee Hydroelectric Project, Hiwassee River, 1940
7. Cherokee Hydroelectric Project, Holston River, 1941
8. Watts Bar Hydroelectric Project, Tennessee River, 1942
9. Chatuge Hydroelectric Project, Hiwassee River, 1942
10. Ocoee No. 3 Hydroelectric Project, Ocoee River, 1942
11. Nottely Hydroelectric Project, Nottely River, 1942
12. Fort Loudoun Hydroelectric Project, Tennessee River, 1943
13. Apalachia Hydroelectric Project, Hiwassee River, 1943
14. Douglas Hydroelectric Project, French Broad River, 1943
15. Kentucky Hydroelectric Project, Tennessee River, 1944
16. Fontana Hydroelectric Project, Little Tennessee River, 1944

The engineering of the Tennessee River required extensive model testing and site planning. The TVA’s engineers examined sites all along the river to identify those best suited for dam construction. After selecting a site, the TVA engineers then utilized models to determine hydraulic characteristics and architectural effects of various components, such as the spillway, apron, drum gates, and outlet conduits. Uses of models allowed for study and solution of many engineering problems specific to the site that could not be solved simply mathematically. The Norris Dam model, for example, was built on a scale of 1:72 and constructed of steel structural pieces, sheet metal, concrete, and lumber. Topographical features were simulated with concrete, sand, and fine gravel.¹³⁹ Other dams were also first modeled prior to the drawing of plans and construction.

In addition to the models, the TVA developed its network of hydroelectric projects in the context of the natural conditions at each location. Site, plans, materials to be used, architectural designs, exact placement of a dam axis and its associated components, spillway type, and many other engineering nuances of each project took into account the natural topography, elevation changes, rock strata, foundation bedrock, annual rainfall, and watershed volume. Extensive amounts of mapping and surveying were also needed to purchase lands required for the reservoirs and relocate existing highways and utilities. For each project large-scale topographical maps had to be prepared to determine the location of the project, plan the plant layout, and determine operating pool levels. Surveying and mapping included basic control surveys, aerial photography, land ownership reconnaissance surveys on small-scale photographic mosaics and deed copying of tens-of-thousands of acres, marking and mapping contours of hundreds miles, planning an mapping relocation of roads, rail lines, and utility lines, drainage surveys for malaria control, and numerous other adjustments and computations as the work progressed.¹⁴⁰

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After the Norris project was initiated, construction of the Wheeler Hydroelectric Project began on November 21, 1933 (*Figure 6*). The *Dixie Contractor* wrote on November 14, 1934,

The construction of the dams, with accompanying locks, as planned, will provide a navigable nine-foot waterway along the entire course of the TN River, up to Knoxville...The first step in making the TN navigable will be taken on December 1, 1934 when the lock at Wheeler Dam will be completed, some time before the dam and power house are finished. This lock will have a 59-foot lift...¹⁴¹

Filling of the Wheeler Reservoir began in the fall of 1936. The first power unit went into commercial operation on November 9th of that year, and the facility was first operated for flood control in January of 1937. On initial installation, the powerhouse's generating capacity was 32,400 kilowatts per unit, with two units initially in operation. When the Wheeler project was completed, it opened a navigation channel for a stretch of sixty-nine miles upstream (to the site of the future Guntersville Dam).

In 1935, TVA had reviewed and concurred with the U.S. Corps of Engineers findings along the Tennessee River for the building of a dam in the Guntersville area. TVA launched a full investigation into the project site at Guntersville in July. By November 27th of that year, the TVA Board of Directors authorized construction plans for a dam at Guntersville five miles north of the original site selected by the Corps. Upon approval of plans, TVA made an agreement with the Corps to design and construct all facilities and structures at the dam site with the exception of the navigational locks, which would be the Corps' responsibility.

Work commenced on the Guntersville project on December 4, 1935. Its lock opened for navigation on January 16, 1939. The first power unit went into commercial operation on August 1, 1939; the second, on October 13, 1939, and third, on January 17, 1940. On initial installation, the powerhouse's generating capacity was 81,000 kilowatts in three units. Upon completion, the Guntersville project provided a nine-foot navigable channel to (pre-TVA) Hales Bar Dam, eighty-two miles upstream. The Guntersville project was also of value for flood control in retaining and regulating water release from upstream storage reservoirs, contributing to flood control operations on the lower Ohio and Mississippi Rivers.¹⁴²

One of the great engineering achievements of the TVA hydroelectric system was flood control. The surge of water on the Tennessee River and its tributaries was at times too great, causing flooding over their banks and on the Ohio and Mississippi Rivers. According to reports in *The Dixie Contractor*, the resulting floods cost "millions of dollars in lost crops and property and hundreds of lives."¹⁴³ The TVA dams were planned to eliminate the danger of floods by storing water in reservoirs and gradually releasing it. Flood control on the Tennessee River increased the effectiveness of levees on the Mississippi River, providing security to six million acres of productive land and reducing the frequency of flooding on an additional four million acres.¹⁴⁴

Because of its location in a low bend of the Tennessee River, the city of Chattanooga was a focal point for flood prevention. The Norris Dam is credited with saving Chattanooga an estimated \$45 million dollars and 58,000 agricultural acres downstream from flood damage in 1936.¹⁴⁵ In 1937, with only three dams and reservoirs in place, a flood that left a million people homeless in the Ohio and Mississippi valleys had little effect on the Tennessee River.¹⁴⁶

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In the midst of its construction projects, TVA received public attention not only for its engineering achievements, but also for its role in social matters. At the TVA project sites, the agency built small communities to accommodate its workers. These camps included workers' dwellings and dormitories, recreational buildings and facilities, community buildings, hospitals and/or clinics, and commissaries. TVA's temporary community at Guntersville Dam was profiled in the *Birmingham News* on July 16, 1936. Under the headline "Miniature City Built at Site of Dam," the article described TVA's construction of comfortable quarters for the fifty families who lived in the village.¹⁴⁷ The village contained a community house, which had a post office, motion picture theater, school and library. The article described the housing as "attractive little bungalows" for married workers and dormitories for single men.¹⁴⁸ The design and spatial arrangement of TVA village buildings were carried over to subsequent projects, and in some cases, actual buildings were relocated from one to another site as the schedule of construction progressed.

At the Pickwick Landing Hydroelectric Project (1934-1938), TVA built two separate villages, one each for white and black workers. The white village included fifteen brick homes and eighty-five of frame construction, as well as four dormitories to accommodate 660 men. The African-American village had twenty-five frame dwellings and a dormitory for 108 men. This village also had a segregated community building and cafeteria.¹⁴⁹ The Pickwick Landing village was a model of electrical power use, including electric heat, a new innovation. Newspapers such as the *Knoxville Sentinel* hailed the village with "TVA Builds All Electric Town, All Houses in Pickwick Have Automatic Heating – First in Country."¹⁵⁰ Each house was built with wall heating units and automatic thermostats, as well as electric refrigerators and stoves. Workers were able to rent these dwellings from TVA, and the electricity they used was deducted from their paycheck.

The segregation of the workers' villages was in keeping with the social policies of the South, and TVA chose not to challenge the practice. To this point, African-American were prohibited from living in the model town of Norris, and TVA built segregated parks and recreational areas. TVA purported to employ African Americans in numbers comparable to their percentage of the area's population, though there are discrepancies in the historical record. Most of the jobs assigned to African Americans were for unskilled labor positions such as reservoir clearance and ditch digging.¹⁵¹ While TVA sought to portray itself as a progressive agency of the period, it received criticism from African-American leaders for not doing enough in its employment and social practices.¹⁵²

Still, TVA was praised for its accomplishments in the region and continued planning and constructing additional hydroelectric projects. When work had commenced at Norris in 1933, there were just two dams with locks on the Tennessee River - Wilson Dam, which provided a fifteen-mile channel, and Hales Bar Dam, which furnished a six-foot depth for thirty-three miles. Over the next eleven years, the TVA built seven dams with locks and completed the channel on the river. This massive endeavor required the hiring of hundreds of engineers and support staff. The TVA's hydroelectric projects employed thousands of workers in the depths of the Depression during the 1930s. By September of 1935, the magazine the *International Engineer* reported that "More than 15,000 persons are employed on the TVA project in making surveys, clearing reservoir areas, building dams, reforestating barren lands, controlling soil erosion, building highways, and in other activities designed to achieve the purposes of the Federal TVA program."¹⁵³ The benefits of the TVA on local economies was widely praised and recognized.

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In north Alabama, the coming of TVA to Morgan County and the county seat of Decatur had a dramatic effect on business and employment. By the early 1930s, Decatur had suffered a major loss when the Louisville & Nashville Railroad closed its repair shops, laying off over 2,000 workers. The improved river navigation on the Tennessee led to the creation of new businesses such as the Alabama Flour Mills and the Tennessee Valley Fertilizer Cooperatives.¹⁵⁴ In neighboring Limestone County, some 50,000 acres were taken for the Wheeler Dam project, yet the jobs it offered fostered optimism and a noticeable uplift in the community's morale.¹⁵⁵ The government of Athens, Alabama, voted to switch to TVA power on June 1, 1934, and in 1936 the municipality obtained a loan from the Rural Electrification Administration to extend electric lines into the rural areas of the county. Hundreds of rural families in the county received electric power through this program over the next several years.¹⁵⁶

During this period, Congress continued to approve funding for TVA projects. On August 12, 1935, the Hiwassee Project was authorized. The flood-prone Hiwassee River historically caused extensive damage 112 miles downstream at Chattanooga. Thus, management of the Hiwassee River was integral to TVA flood control and prevention of financial losses in this major city.

Chattanooga was a focal point for not only engineering of the river system, but also in the struggle between TVA and private electrical companies. Chattanooga was the home of the Tennessee Electric Power Company (TEPCO), which had supplied the city's electrical power since 1913 via its powerhouses on the Ocoee River. Many Chattanooga residents welcomed the chance to have a competing source of electricity and advocated for TVA to build a dam close to the city. The Tennessee legislature authorized a city referendum on March 12, 1935 to provide for the sale of eight million dollars in bonds to finance the acquisition of a municipal power distributions system, which would then sell TVA current.¹⁵⁷ After a vociferous campaign by supporters and detractors, the bond measure passed easily, and the Chattanooga Power Board was formed.

Chattanooga's lobbying for a nearby dam was rewarded in 1935 when TVA announced plans to build Chickamauga Dam just upstream from the city. The TVA's ability to provide an increasing amount of electric power at reduced rates was vital to the economic growth in the Tennessee Valley region. Not only were citizens pleased with the prospect of increased power, but also for the potential flood control. Prior to TVA, private corporations, most notably TEPCO or the Alabama Power Company, provided electricity to area towns. These power companies claimed TVA's implementation of large dams was a scheme to generate power, not to meet navigation or flood needs. The Supreme Court case of *Ashwander v. Tennessee Valley Authority* in 1936 upheld a Circuit Court's ruling of 1935 that Congress might dispose of any power generated at Wilson Dam. Opponents argued that the decision applied only to Wilson Dam and led eighteen power companies to file suit (TEPCO case) against TVA arguing that TVA was engaged in the electric power business in a way that was detrimental to their interests.

The lawsuit by the power companies against TVA had mixed public support. While some felt that TVA should not be in the electricity business, others hailed it for providing reasonable cost controls on private utility companies. The TVA position in the lawsuit was upheld and in 1939, TEPCO sold its holdings to TVA for \$78.4 million. As part of the TEPCO sale, the TVA acquired the 1913 Hales Bar Dam, located downstream from Chattanooga, and the adjacent coal-fired steam plant built in the

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1920s. To meet the required specifications, the dam was raised to provide the nine-foot channel across the reservoir to the Chickamauga Dam.¹⁵⁸

Thousands of workers were employed for the construction of the Chickamauga Hydroelectric Project, which began in January of 1936. Filling of the reservoir began on January 15, 1940. The first power unit went into commercial operation on March 4th, the second on May 2nd, and the third on July 15th, 1940. Each generator had a rated capacity of 30,000 kilovolt-amperes. The Chickamauga Hydroelectric Project supplied electrical power during World War II to various industries in the region. In September of 1940, President Franklin Roosevelt traveled to the city to dedicate the Chickamauga Dam.¹⁵⁹ Roosevelt spoke to a crowd estimated at 80,000 people where he extolled the virtues of the TVA and the positive changes it had brought to the region.

Also during 1940, TVA completed its project on the Hiwassee River. The Hiwassee dam was closed, and the reservoir began filling on February 8, 1940 (*Figure 7*). The project's first generator was placed in service on May 21, 1940, and construction was completed in December of the same year.¹⁶⁰ Each new TVA project reinforced the storage capacity across the system of dams and reservoirs. Following construction of the Chickamauga and Hiwassee projects in 1940, TVA completed hydroelectric projects at Watts Bar (1942) and Fort Loudoun (1943). In concert, these projects, as well as those further upstream, were designed to have sufficient storage capacity to prevent a catastrophic flood.

Construction of the large hydroelectric projects also involved the completion of studies by the TVA on agricultural, manufacturing, conservation, and recreational characteristics of the region. The efficient operation of the hydroelectric projects required clean water free of excessive siltation and a healthy watershed. TVA employed scientists and planners to work with local, state, and other federal agencies on soil conservation, reforestation projects and advanced farming techniques. The need for the conservation assistance offered by TVA was amply illustrated when a survey on the soil conditions of Tennessee was published in 1935 by the U.S. Department of Agriculture. This survey found that over eleven million acres had lost 75% to 100% of their topsoil, and fewer than four million acres of the state's almost twenty-seven million acres of farmland were undamaged.¹⁶¹

The TVA's erosion control techniques went through a period of experimentation refining techniques first applied at Norris Dam, where gully erosion was stopped with check dams and diversion ditches and various grass seeds applied. By 1939, TVA had assisted the planting of some eighty-four million seedlings on 60,000 gullied and eroded acres. Some five million seedlings were planted by farmers, while the rest were the result of CCC efforts. The TVA nurseries produced twenty-four million seedlings each year as part of this program.¹⁶² With TVA's assistance, over 530,000 small check dams were built between 1933 and 1942 and the agency also assisted on nearly 10,000 erosion control projects on private lands.¹⁶³ The TVA also established educational programs to demonstrate how landowners could revive their lands. The emphasis on conservation implementation resulted in the creation of TVA's Division of Forestry Relations in 1937, establishing duties including surveys of the character of water and forest resources, operation of forest nurseries, and promoting beneficial forestry practices.

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In addition to introducing soil conservation methods on a regional scale, one of the most important contributions of TVA was its development of enhanced fertilizers for agricultural production. During the 1930s, the plants at Muscle Shoals became the site of fertilizer research, development, and demonstration in the National Fertilizer Development Center. The TVA concentrated on developing new and better phosphate fertilizers, or what it called triple superphosphates.¹⁶⁴ The TVA became the main research and development center for fertilizer and helped develop granulated forms for easier application on fields.

The TVA worked with county extension agents throughout the region to introduce the new enhanced fertilizers. Test demonstration farms were created to assess the increase in crop yields under this program. In Kentucky, the TVA's new phosphate fertilizers were used by the University of Kentucky and its extension agents for fifteen hundred farmers in forty-eight counties. By 1937, crop yields had increased by as much as sixty percent as a result of the additives.¹⁶⁵ During World War II, the TVA's fertilizer program switched over to produce ammonia nitrate for explosives, but after the war the plant once again produced new and improved plant nutrients.¹⁶⁶

The TVA's efforts influenced a shift in cultivation and production techniques, as well as diversification of crops and farm products. In addition to reforestation and erosion control, restoring the fertility to the soil and curbing erosion so to enhance the productivity of the land was a high priority. The TVA's plan to expand farmland yields included the increased use of fertilizer, planting of legumes instead of row crops, allocation of more acreage to pastures, and removal of marginal lands from cultivation. Due to the TVA's program, agricultural output rose in the Tennessee Valley. The adoption of new fertilizer technology developed by TVA enabled farmers to maintain and be more efficient on existing lands, decreasing unit costs.

Mechanization and electricity also led to increased productivity and increased sales. With refrigeration, safe lighting, and other labor-saving devices made affordable due to low electric rates and rural electrification, farmers increased productivity and income. One of the TVA's first customers was a rural cooperative from Alcorn County, one of the poorest counties in northeast Mississippi. Farmers utilized electrification so successfully, that the cooperative was able to pay off its loan from the TVA in less than half the contracted amount.¹⁶⁷ With electricity, farmers could refrigerate milk and expand dairy operations, use fans to cool poultry houses, and install water pumps for livestock and irrigation.

Another benefit of electricity to agricultural production was the quick-freezing of fruits and vegetables. A fast-freezing machine developed by TVA exemplified how lower electric costs affected farmers of the Tennessee Valley Region. Frozen products brought a higher price and raised farm income, allowing farmers to get more income from fewer acres, allowing them to sod marginal or steep lands, curbing erosion at the same time as increasing productivity. By the early-1940s the TVA provided assistance to thirteen plants in the region that produced frozen vegetables for sale domestically and abroad.¹⁶⁸

The TVA played a significant role in supplying electricity for the military during World War II and the Cold War. TVA's dams and powerhouses began generating electricity in the 1930s, as World War II broke out in Europe in 1939. In preparation for possible involvement in the war, President Roosevelt and Congress authorized the TVA to build additional hydroelectric projects. Following the Japanese

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attack at Pearl Harbor, the timetables for completion of projects such as Douglas and Fontana were accelerated. The TVA's electricity was originally designed to assist the production of aluminum at Alcoa, Tennessee, and other war industries in the region. The availability of large amounts of electrical power led the military to select the site of Oak Ridge, Tennessee, for the secret Manhattan Project.

The Manhattan Project was the result of the discovery of the enormous energy potential of the uranium atom. In 1939, German scientists announced that the nucleus of the uranium atom could be caused to split by bombardment with neutrons (fission). The binding energy of the nucleus so released was tremendous, ten million times larger than the energy released by chemical reactions.¹⁶⁹ This discovery was confirmed by laboratories around the world, including four in the U.S., and physicists worldwide became excited about the possibilities uranium fission held.¹⁷⁰ Foremost among these possibilities was the development of atomic weaponry, and the race to build the first atomic bomb began.

American scientists Leo Szilard and Eugene P. Wigner approached Albert Einstein to prepare a letter to President Franklin Roosevelt regarding the implications of this scientific development. Roosevelt readily understood the letter's urgent tone and ordered Major General Edwin M. Watson to conduct further investigations.¹⁷¹ In October of 1940, Roosevelt organized a committee charged with managing theoretical scientific experimentation, which approved funding for uranium fission research. The Japanese attack on Pearl Harbor in December of 1941 brought the United States into World War II, and the urgency to develop atomic power intensified. On December 2, 1942, scientists working at the University of Chicago under the direction of Arthur Compton attempted a controlled nuclear reaction by specifically arranging tons of uranium and graphite. The experiment, which was conducted on a squash court located beneath the university's football stadium, proved successful. From this experiment scientists learned precepts fundamental to understanding fission research: two fissionable materials, plutonium-239 and uranium-235 could create an explosion.

As scientific investigation moved forward, the Army Corps of Engineers began seeking sites for uranium separation and plutonium production in earnest. A remote inland site with abundant water and electrical power was required. In an attempt to aid construction and security requirements, the Army initially planned that all manufacturing facilities would be constructed in a single installation. The need for acquiring thousands of acres became readily apparent. Site requirements involved constructing a town for the thousands of workers needed for the project's construction and plant production phases. Requirements for the installation were specific: the site must be isolated and located in a moderate climate permitting year-round construction; a steady supply of workers was vital as was access to both motor and railroad transportation systems, the terrain must be composed of an interlocking ridge and valley system confining the devastating results of an explosion should one accidentally occur. Most importantly, there had to be enormous quantities of electricity available for the proposed production facilities.¹⁷²

In April of 1942, officials traveled to East Tennessee and identified a possible site between the rural communities of Clinton and Kingston. The area met transportation, water, and electrical criteria, as this region of Tennessee bordered the Clinch River and was served by two railroads. Most importantly, the site had the availability of TVA electrical power. An official with the Atomic Energy Commission later said about selecting the site in Tennessee, "But most of all we needed electric

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power, an enormous amount of electric power to supply the electric-magnetic process involved in producing the atomic bomb. And the Tennessee Valley Authority gave us that.”¹⁷³ Over the next year, the city of Oak Ridge was created along with the three nuclear production plants code named Y-12, X-10 and K-25. Powered by TVA electricity, these three plants slowly produced the uranium and plutonium necessary for the production of atomic weapons.

In addition to supplying electrical power for the Manhattan Project, the TVA sent large quantities of electricity to the Aluminum Company of America (ALCOA) at its plants near Maryville. ALCOA was founded in 1907 and built smelter plants in various locations. The smelting process required enormous amounts of electricity, and ALCOA had developed a series of hydroelectric projects on the Little Tennessee River and Yadkin Rivers in North Carolina to supply power to its plants. In 1914, ALCOA established the company town of Alcoa outside of Maryville, Tennessee, and built a large smelting complex. The North Plant, completed in 1941, covered fifty-five acres and was the largest plant under one roof in the world.¹⁷⁴

ALCOA was already a major customer of TVA before the war, but the demands for the military increased production dramatically. The aluminum production of ALCOA was one of the most important war-time industries for the building of military aircraft. The strategic advantage of air power was demonstrated early in the war by the German and Japanese air forces. Once America entered World War II, President Roosevelt and Congress supported and approved funding for the transition of peace-time manufacturing to war production. Roosevelt called for the production of hundreds of bombers and fighter planes each month, and the largest producer of aluminum for military aircraft was ALCOA.

The need for electrical power during World War II led to TVA's construction of the Fontana Dam in North Carolina on the Little Tennessee River. Control of the Little Tennessee River was integral to TVA's unified development of the Tennessee River system. ALCOA had recognized the value of the Little Tennessee's hydroelectric potential as early as 1917, building three power plants on its tributaries, the Cheoah, Calderwood, and Santeetlah. ALCOA also considered construction of a hydroelectric project at Fontana, and after TVA was established, the agency began negotiations with the company towards that end. An agreement between the two parties was complicated, in that ALCOA's three downstream dams would be subject to TVA's water release schedule at the Fontana project. The 1941 agreement gave control of the ALCOA plants to TVA in exchange for power allotments to the company.¹⁷⁵ Work commenced on the Fontana project on January 1, 1942. The project continued uninterrupted until completion, and the dam was closed on November 7, 1944. The first power unit went into commercial operation on January 20, 1945; the second on March 24, 1945. When it was completed, Fontana Dam was the tallest in the TVA system and the tallest east of the Mississippi River.

From 1941 to 1945, ALCOA experienced a 600-percent increase in production and a \$300-million expansion. In 1943, the aluminum industry was the largest single electricity user in the country consuming twenty-two billion kilowatts annually. By 1945, ALCOA's fifteen hydroelectric plants in East Tennessee and western North Carolina were furnishing fifty percent of its power while the TVA supplied the other half.¹⁷⁶ The contributions of ALCOA and the rest of America's aluminum industry to the war effort resulted in the completion of over 250,000 military aircraft from 1941 to 1945.¹⁷⁷

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The TVA's electrical power was also used for many other war-related industries. America's military needed extensive amounts of explosives and ammunition, and three large ordnance works were built in the TVA region. The Volunteer Ordnance Works was completed in 1942 just northwest of Chattanooga with its main mission to produce trinitrotoluene (TNT) for the military. A companion plant, the East Tennessee Ordnance Works, was built in 1942 at Copperhill, Tennessee, east of Chattanooga. Located in the mining community of Copperhill, this plant provided sulfuric acid (oleum), which was used in the TNT process. This ordnance works ceased operation with the end of World War II. At Kingsport, the military contracted with the Tennessee Eastman Corporation to build the Holston Ordnance Works. This plant produced Composition B, a highly explosive combination of RDX (explosive nitroamine) and TNT. By 1944, this was the largest manufacturer of high explosives in the world and at its peak it employed 7,000 workers.¹⁷⁸

The TVA built a new ammonia plant at Muscle Shoals to produce tons of elemental phosphorous used by the armed forces for incendiaries, smokescreens, and other military uses. Of the 100,000 tons of elemental phosphorous used by the armed forces for incendiaries, smokescreens and other military uses, three-fifths was produced by TVA at its plants.¹⁷⁹ Various industries in the TVA region also expanded during the war years as they re-tooled products for the war effort. In Elizabethton, Tennessee, the North American Rayon and American Bemberg plants increased production to supply the military with parachutes made from rayon.¹⁸⁰ Established in the 1920s, these companies reached their peak employment of 6,000 workers during the war years.

Two industries at Decatur, Alabama, also contributed significantly to the armed forces during World War II. The Decatur Iron and Steel Company supplied the U.S. Army with thirty-three towboats and thirty-three landing craft for tank transport. Eleven more of the latter went to ally Great Britain. Some of these were converted into armored landing craft for the Normandy invasion. Many other landing craft from Decatur were used as well at the Normandy invasion and throughout the Pacific. The Ingalls Ship Building employed 1,500 workers at this time and built over one-hundred barges and twenty small (176-foot) freighters during the war (*Figure 8*).

The importance of the TVA to the war effort was illustrated in a letter from Robert P. Patterson, Under Secretary of War who wrote in 1942, "The War Department has leaned heavily on the TVA to provide a tremendous amount of the power required for the military program. Its confidence in the TVA to produce results is well justified."¹⁸¹ By the spring of 1945, the TVA had sixteen hydroelectric projects producing electricity, nine of which were completed and came on-line during the war. The agency estimated that it produced one-tenth of all of the power produced for war purposes by all the private and public power systems in the country.¹⁸²

Another important function of TVA during the war was the work of its Maps and Surveys Department. Based in the Chattanooga office, this section used aerial photography to map more than a half-million square miles of Europe and the Pacific to assist the military.¹⁸³ This mapping was an outgrowth of the agency's efforts to map the Tennessee Valley Region before the war. The mapping for the military involved thirty separate operations by a group of specialized cartographers.¹⁸⁴ The maps produced by TVA were used by the military for the D-Day Invasion of 1944 as well as many other operations.

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The electrical power supplied by TVA resulted in the successful development of the first atomic weapons. After the testing of the atomic bomb in New Mexico, the first bomb was dropped on the Japanese city of Hiroshima in August of 1945. Following a second atomic bomb blast on the city of Nagasaki, Japan surrendered, ending World War II. With the end of the war, many of the industries in the valley re-tooled their plants for peace-time purposes.

TVA's influence was significant to regional development during the war period. As TVA completed dams and reservoirs on the Tennessee River, a navigable channel was completed all the way to Knoxville by 1945. Water transportation offset the higher railroad rates of the South and laid the foundation for much of the region's industrial growth. In Chattanooga, industry grew and diversified, and the city became a feed-grains and flour-milling center. By 1944, one-hundred towboats were operating on the Tennessee River, owned by approximately forty companies or individuals. The TVA assisted in the construction of a number of public terminals along the river for the importing and exporting of agricultural and manufactured products. Private terminals were also built including the oil terminals of the Gulf Refining Company at Perryville and Chattanooga, Tennessee, and Sheffield, Decatur, and Guntersville in Alabama. In Guntersville, grain was unloaded at the Cargill, Inc. elevator and then distributed throughout the Southeast. Clay taken off barges at Whitesburg, Alabama, was unloaded at the brickyards of the Alabama Brick and Tile Company.¹⁸⁵

The importance of the TVA to the river transportation of the region was illustrated in September of 1943 at the dedication of the TVA terminal at Guntersville. The celebration of the opening of the terminal was a momentous occasion: "One of the greatest assemblies in modern Alabama history will occur when the nation's front ranks transportation men come to this Tennessee Valley town Friday for the dedication of the Guntersville River terminal."¹⁸⁶ The event was attended by Governor Prentiss Cooper of Tennessee, Governor Chauncey Sparks of Alabama, the presidents of various terminal and barge companies, and TVA Directors David Lilienthal, James Pope and Harcourt Morgan. The *Birmingham News* hailed the opening of the terminal stating, "For the first time cheap and direct water transportation will be available for transporting the South's products into those sections where lies the greatest buying power of the nation."¹⁸⁷ After the dedication of the Guntersville terminal, a similar celebration was held the next day for the formal opening of the river terminal at Decatur. The Decatur event was marked by the launching of two ships by the Decatur Iron and Steel Company and the Ingalls Shipbuilding Company.¹⁸⁸

Following the TVA's defeat of TEPCO in 1939, Congress passed an amendment to the TVA bill in 1940 to the effect that states and counties affected by TVA operations should receive payments from TVA based on a percentage of electrical generation income in lieu of taxes. Secondly, the TVA had the right to build and operate steam plants as well as hydroelectric facilities for the production of power. And thirdly, TVA was authorized to set the rates at which its wholesalers could sell electricity to the public. The TVA decided to set rates low enough to generate a large demand for electric power and appliances. Neighboring utilities followed suit and found the policy to produce much higher profits than charging a higher price for lower volume. As a result of the amendment and the low energy prices, electricity consumption skyrocketed. In addition, rural living and living in poorer sections of cities were radically transformed, industries were brought into Tennessee, industrial employment increased, and incomes rose.

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The TVA continued to study the Tennessee River and its tributaries for suitable hydroelectric projects. The Fort Loudoun Hydroelectric Project was proposed in 1939, and the bill recommending \$1,000,000 to start the Fort Loudoun project passed both Houses of Congress and was signed by the President on April 18, 1940. TVA formally approved the project on July 3, 1940. The closure of the dam and filling of the reservoir began August 2, 1943. Of the first two generating units placed in operation, Unit 2 was placed in service November 9, 1943, followed by Unit 1 on January 15, 1944.¹⁸⁹ Work commenced on the Watts Bar project on July 1, 1939. The Watts Bar Reservoir began filling on January 1, 1942, and the lock opened for navigation on February 16, 1942. The first power unit went into commercial operation on February 11, 1942; the second, on April 6, 1942, and third, on July 23, 1942. The fourth and fifth units were added and placed in operation on March 12 and April 24, 1944, respectively.¹⁹⁰

Architecturally, the Watts Bar visitor building and control building represented an innovative design. The two components were designed as one structure and featured a streamlined primary façade with an elliptical wall and deck for viewing the dam below. The sleek design was accented by steel and aluminum railings and large banks of windows. TVA architects also used the Streamlined Moderne style in the design of several of the original lock operations buildings. One of the most notable is the building at Kentucky Dam that was designed with a curved primary façade in the shape of a ship. In addition to its elliptical façade, the building also displays numerous porthole windows on the side elevations. The lock operations buildings at Chickamauga and Guntersville were designed with similar details and rather than have curved primary facades display more angularity with chamfered corners. The lock buildings at Fort Loudoun and Watts Bar are also very similar to each other and have flat roofs, wide eaves, porthole windows to illuminate the interior staircases, open breezeways, and a second story visitor's deck set within an open breezeway.

As the first projects were completed, TVA publicized the designs in a variety of books and periodicals. By 1939, entire issues of *Architectural Forum*, a prominent magazine devoted to the promotion of architectural design, regularly featured discussions and photographs of TVA's hydroelectric projects. Writers in the August, 1939, issue of *Architectural Forum* praised the design of the Norris Dam: "Because the lives of such structures as these are counted in centuries, great efforts have been made by TVA designers to eliminate features which would tend to "date" them, such as the absurd pseudo-Classic elements which mar the otherwise handsome dam at Muscle Shoals."¹⁹¹

In 1941, the TVA was part of an exhibit at New York's Metropolitan Museum of Modern Art and showcased the designs of its dams and powerhouses. Architectural critic Lewis Mumford was impressed by the work of Wank and his fellow architects and stated that in the TVA, America has produced "modern architecture at its mightiest and its best."¹⁹² Talbot Hamlin had particular praise for Wank when he reviewed the nation's modernist architecture constructed in the 1930s in his book *Architecture Through the Ages*, published in 1953. "And although much of the building produced was undistinguished, some of it – like occasional schools and especially the dams and powerhouses of the Tennessee Valley Authority, of much of which Roland Wank was chief architect – were extraordinary manifestations of the new ideals."¹⁹³

In addition to the architecture, the landscapes of the hydroelectric projects were also of great importance to TVA. Planning and landscape architectural work was under the supervision of Earle Draper, a professionally trained landscape and community planner. Draper worked with the firm of

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John Nolen in Massachusetts before setting up his own practice in Charlotte, North Carolina in 1917. Draper became well known for his designs of dozens of mill towns throughout the Carolinas and Georgia, as well as residential developments incorporating designed landscapes and parks. By the early 1930s he was well known throughout the South and was chosen by TVA to head the Land Planning and Housing Division. Draper assembled a team to plan communities such as Norris, as well as the general plan and layout of the hydroelectric projects.

In Kentucky, the TVA examined several sites for the construction of the Kentucky Dam on the Tennessee River. A private corporation had previously explored constructing a dam near the community of Aurora. The TVA purchased the rights to this company, but decided to build the dam about twenty miles further downstream.¹⁹⁴ Located on the county line between Kentucky's Livingston and Marshall Counties, the Kentucky Dam was begun on July 1, 1938. The reservoir created by the dam resulted in TVA's purchase of 300,000 acres of land from some 2,600 families.¹⁹⁵ Construction took six years, with the first generator going online on September 14, 1944. When completed, the dam was 206 feet in length, the longest in the TVA system. The dam had five generating units which would eventually produce 160,000 kilowatts of electricity.

In June of 1940, the Advisory Commission to the Council of National Defense was created. On June 14th, the TVA submitted a proposal to the Advisory Commission for increasing the production of power in East Tennessee. The TVA recommended the Mossy Creek site on the Holston River, a location not initially considered integral to the original navigation goals of its mission. The proposal included a 90,000-kilowatt dam at Mossy Creek and a 120,000-kilowatt dam near Watts Bar, southwest of Knoxville. The proposal also recommended increasing capacity at the existing Wilson and Pickwick Landing Dams in northern Alabama and necessary transmission facilities. The TVA proposal, seeking a supplemental appropriation of \$25,000,000, was submitted to Congress and reached the President's desk through the Bureau of the Budget on June 17th.¹⁹⁶

The Mossy Creek site was renamed Cherokee, and filling of the reservoir began on December 5, 1941, with the closure of the dam. The first power unit went into commercial operation on April 16, 1942 and the second on June 7, 1942. Built in a similar design to Cherokee, the Douglas Hydroelectric Project was constructed by TVA during this same period. Filling of the Douglas Reservoir began February 19, 1943, with the closure of the dam. The first power unit went into commercial operation on March 21, 1943. On initial installation, the powerhouse's generating capacity was 60,000 kilowatts in two units. The Douglas Dam construction was completed in a record thirteen months, underscoring the urgency of TVA's war emergency program.

In addition to the Cherokee and Douglas projects, the TVA Board of Directors requested funding for four additional dams on the Hiwassee and Ocoee Rivers in North Carolina, Tennessee, and Georgia. These were the Apalachia, Chatuge, Nottely, and Ocoee No. 3 hydroelectric projects. Initially, the bill recommended \$40,000,000 in funds be approved for these projects with \$1,000,000 available immediately. However, the entire \$40,000,000 was approved due to the fears of America's possible involvement in World War II. The final bill for the Hiwassee projects passed both Houses of Congress and was signed by the President on July 16, 1941. The TVA formally approved the project on July 17, 1941.

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The Apalachia Dam was built in North Carolina with a powerhouse twelve miles downstream in Tennessee on the Hiwassee River. The closure of the Apalachia Dam and filling of the reservoir began on February 14, 1943. Of the two generating units placed in operation, Unit 2 was placed in service on September 22, 1943, followed by Unit 1 on November 17, 1943.¹⁹⁷ The Chatuge and Nottely projects were authorized in fiscal year 1941. The timing of initiating construction was based on the release and availability of the Hiwassee project's labor force following its anticipated completion. The TVA formally approved the projects on July 17, 1941 and the closure of the Chatuge Dam and filling of the reservoir began on February 12, 1942. At Nottely, the dam was closed and the reservoir began filling on January 24, 1942. Unlike other TVA projects during this period, the Chatuge and Nottely Hydroelectric Projects were established strictly for water storage in support of other TVA projects. However, both dams were constructed with the ability to add power generation at a later date. The initial projects consisted of a rolled earth dam, concrete spillway, intake, and valve house. Single hydroelectric generators were added to these projects after World War II. In 1939, the TVA acquired the Ocoee River properties belonging to TEPCO and examined the potential to build an additional hydroelectric project on the river. The project, designated as Ocoee No. 3, consisted of a dam, a two-and-one-half-mile tunnel and powerhouse. The TVA formally approved the project on July 17, 1941 and the closure of the dam and filling of the reservoir began April 30, 1943.

Once the engineers selected the appropriate sites for the dams, the landscape architects went to work designing the dams and powerhouses to blend into their surroundings. Roads were designed to give the visitor sweeping vistas of the projects and accentuate the monumental aspects of the structures. At each project, a visitor building was carefully sited to provide expansive vantage points to view the reservoir and dam through floor-to-ceiling windows or along exterior balconies.¹⁹⁸ After parking at the visitor building or nearby parking areas, visitors would walk along concrete sidewalks to landscaped overlooks. These overlooks often took the shape of curves with low concrete walls, and at several locations such as Norris and Fontana, concrete benches provided seating areas for visitors to rest. At Wheeler, a series of descending staircases led visitors to the lobby of the powerhouse from the parking area above. These overlook areas often featured adjacent landscaped picnic areas with concrete tables.

An outgrowth of TVA's attention to its own project site plans was assistance to local governments in similar development. In TVA's focus on development of the region's natural resources, recreation was considered second to manufacturing as a way to economic prosperity and as a means of pulling farmers away from unproductive land. The rugged peaks, scenic streams, changing vistas, and temperate climate of the Appalachian Mountains provided an ideal recreational location. The waters impounded by the hydroelectric dams in the 1930s and 1940s created the "Great Lakes of the South," which the TVA developed into prime boating, fishing, and recreational areas. The TVA's reservoirs provided more than 11,000 miles of shoreline, more than 600,000 acres of water surface, and more than half a million acres of government-controlled surrounding lands.¹⁹⁹ The TVA created demonstration parks at Norris and Big Ridge in the eastern half of the Valley and Wheeler, Wilson and Pickwick Landing in the western half. These parks were designed with swimming beaches, boat docks and ramps, vacation cabins and picnic areas for public use. Visitors were now afforded the opportunity to canoe, sail, fish, swim, hike, picnic, bird watch, and camp. The parks created by the dams' reservoirs experienced over 1.5 million visitors in 1938.²⁰⁰ Attendance outstripped capacity, and the local demand created the need for the states to build more parks.

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The recreational opportunities of the region became another focus of TVA planners. The states in the Valley region had few state parks, and the creation of the TVA's reservoirs would provide enormous opportunities for recreational pursuits. As reservoirs were created, the TVA staff prepared studies for each project to determine their recreational potential. TVA reviewed the most promising locations for boat docks, boat ramps, picnic areas, and campgrounds along the projected shorelines. If property was identified as surplus but also had development potential, the agency was authorized to dispose of this surplus land for recreational use to local or state agencies.²⁰¹ TVA developed a number of demonstration parks such as at Norris and Pickwick Landing to illustrate the potential economic benefits of recreation. During the 1930s the TVA assisted the states in the region to develop state park systems and leased lands for state park creation.

When TVA was formed, a small staff was tasked to inventory and evaluate the potential for recreational development in the region. The TVA summarized this inventory in two reports, *The Scenic Resources of the Tennessee Valley* and *Recreation Development of the Southern Highlands Region*, published in 1938. These studies helped establish the concept of scenic and recreational resources as assets to the region with enormous potential for tourism and economic development. When the studies were completed, only Kentucky and Virginia in the TVA states had formal state park systems.²⁰² Concurrent with the TVA studies and regional meetings, the Tennessee legislature created a Department of Conservation in 1937 which included a division of state parks. In the same year, Georgia created its Division of State Parks. In Alabama, the state park system was enhanced in 1939 when the Department of Conservation was established.

In addition to the TVA projects for power generation, planners continued to assist local and regional governments with land acquisition for state and municipal parks. An extension of conservation and economic development efforts, TVA worked closely with local and state planning offices to develop resource-based industries in the region. Recreation was considered second to manufacturing as a way to economic prosperity and as a means of pulling farmers away from unproductive land. The rugged peaks, scenic streams, changing vistas, and temperate climate of the Appalachian Mountains provided an ideal recreational location.

TVA entered into a memorandum of agreement with the conservation departments of Alabama, Kentucky, and North Carolina in the early 1940s to work together for recreational development. Two main efforts came from these agreements: identification of park lands along the shoreline for public recreation use, and technical advisory and planning services to local governmental agencies and private individuals seeking to create recreational opportunities.²⁰³ It was the intent of this arrangement to create a managed shoreline with carefully planned parks of quality design. With this agreement, numerous state parks were created along TVA's reservoirs in these states.

In 1946, the TVA transferred to the state of Kentucky 1,400 acres of land in Marshall County that became known as "Kenlake State Park."²⁰⁴ Two years later, the village site at the Kentucky Dam was sold to the state for \$76,000, and Kentucky Dam Village State Park joined the state's park system. The TVA played a major role in establishing two of Alabama's first state parks. In 1947, the TVA gave the State of Alabama title to 3,740 acres on Guntersville Reservoir for recreational purposes. The transfer of the property was hailed by Alabama Conservation Director Bert Thomas, who stated, "Alabama is indebted to the Tennessee Valley Authority and to all those persons and organizations who worked to make this transfer of title possible. We hope, with the aid of the legislature, to make

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this park one of the finest in the entire United States.”²⁰⁵ Originally known as Little Mountain State Park, it was later renamed Lake Guntersville State Park and became one of the most visited parks in the state. Recognizing the economic potential of recreation and tourism, the City of Guntersville launched a five-year program in 1949 to become “a playland of the South.”²⁰⁶ This program included building a recreation center on the waterfront, completing a marina, and encouraging the construction of new hotels, motels, and cabins to cater to visitors. In September of 1949, the TVA leased 2,200 acres and the village at Wheeler Dam to the State of Alabama for the creation of Joe Wheeler State Park.²⁰⁷ At the time of its transfer, the Wheeler Village consisted of fifteen brick dwellings, seventeen frame dwellings, garages, picnic shelters, and other structures. While several of the dwellings housed state park employees, the others were for tourist accommodations. Joe Wheeler State Park was the first state park in northwest Alabama.

The unexpected benefits of recreation were realized by the city of Guntersville, Alabama, following the completion of the Guntersville Dam. The dam closed its gates, and the reservoir gradually filled over a two-week period in January of 1938. Some residents of Guntersville thought their city was ruined because of the loss of the local farm economy, while others appreciated the elimination of flooding and the picturesque setting of town on the water.²⁰⁸ For the city, the real impact of the reservoir came at a dedication ceremony on August 26, 1939. A hydroplane boat race was held and to the surprise of residents, almost 60,000 people came to witness what came to be known as the “Dixie Motor Races.”²⁰⁹ It was thought to be the largest crowd ever gathered in north Alabama, and traffic was backed up more than ten miles. The great success of this event led to annual races on the lake and a boost to the local economy.

As at Guntersville, each of the TVA reservoirs required the removal of thousands of residents from their homes. In some cases, families had been living on the same land for several generations. The forced relocation of so many landowners by TVA’s projects led to some resentment against the agency. The TVA purchased property from willing sellers as often as possible but also proceeded with condemnation where owners resisted. Some cases went to court, where judges decided on the fair market value of the property. Overall, the number of contested cases over TVA’s purchase offer was limited. For the Norris project, for example, less than five percent of the land acquired was contested, and court settlements awarded only 16.8 percent over the prices TVA had offered.²¹⁰ The large amount of acreage purchased for the Kentucky Dam was achieved by TVA offering generally higher prices than current market value.²¹¹ In North Carolina, some mountain residents complained that the price they received for their valuable bottom land along rivers and streams was inadequate to buy similar land elsewhere.²¹²

Before reservoir lands were inundated, the TVA sent archeologists to do investigations and excavations where possible. One of the largest archeological efforts took place at the Chickamauga Dam when the Dallas and Hiwassee Island pre-historic sites were investigated by the University of Tennessee. A team of archeologists spent weeks investigating these sites, and artifacts were later catalogued and stored at the McClung Museum at the University. Several important archeological reports were also published which provide extensive information on the prehistory of the Tennessee River Valley.²¹³

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The completion of the Fontana and Kentucky Dams in 1944 and their dedications the next year marked the culmination of TVA's monuments of the New Deal. Fontana was the highest dam built by TVA, and Kentucky Dam was the longest, stretching for a mile and a half across the Tennessee River. World War II ended in August of 1945 with the surrender of Japan following the dropping of two atomic bombs on the cities of Hiroshima and Nagasaki. The contributions of the Manhattan Project and the TVA in ending the war then became widely known and hailed. On October 10, 1945, President Harry Truman dedicated the Kentucky Dam before 15,000 cheering spectators (*Figure 9*).²¹⁴ With the dam as a backdrop, Truman said, "Why has TVA succeeded so well? Why does it have the esteem of the people of this Valley, and attract the attention of other regions of America, and of the entire world? To me the answer is clear--TVA is just plain commonsense. It is commonsense hitched up to modern science and good management. And that's about all there is to it. Instead of going at the river piecemeal with a dam here and a dam there, the river was treated as a whole. The dams were all designed so that they would fit together as a unit and in that way get the most service out of the river for mankind."²¹⁵

At the end of World War II, the TVA had completed sixteen hydroelectric projects in five states supplying power to tens of thousands of consumers across the region. The TVA's programs in agriculture and conservation had begun the restoration of vast areas of agricultural and forest lands. The TVA was already leasing lands for state parks, and more would follow in coming years. The mandate to create a nine-foot channel for navigation on the Tennessee River was also accomplished with the completion of the Kentucky Dam. The TVA continued to have its critics for interfering with private enterprise and forcing people off their land, but the accomplishments of the agency in only twelve years had a profound effect on the lives of the residents of the Tennessee Valley.

In many studies, the TVA is regarded as one of the most successful efforts of the New Deal. As one author noted:

First, it erected sixteen dams in the years 1933-1945, which not only controlled the annual spring floods that regularly devastated the river valley but also offered employment to thousands of area residents. Opening a nine-foot channel from Knoxville, Tennessee to Paducah, Kentucky, the TVA made that portion of the Tennessee River navigable for the first time. Government agricultural specialists worked with farmers to combat soil erosion and create watersheds. Implementing broad-based regional planning that cut across state lines, the federal agency landscaped parks, created rural libraries, and improved school systems. By altering the water levels at the system's dams, TVA eliminated malaria as a serious health problem. The disease previously afflicted one-third of the region's population. Finally, the TVA brought electricity to the Tennessee valley, where only 3 percent of the population had access by 1933. The Electric Home and Farm Authority also allowed people to buy electrical appliances at affordable prices.²¹⁶

Another historian observed that the TVA

...contributed mightily to the war effort by providing the electricity for the secret Oak Ridge atomic bomb research complex and for plants producing aluminum for airplanes and other war machinery. It brought new recreation facilities to the Tennessee Valley. It

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continued to bring commercial benefits to valley industries and save billions of dollars through flood control. It was however, no longer the bold experiment in regional planning that its creators and well-wishers had hoped would change the face of America.²¹⁷

The success of the TVA had led President Roosevelt to consider expanding similar experiments to other river valleys including those of the Ohio, Missouri, Arkansas and Columbia. Private interests particularly those in the electric power field, successfully lobbied against any expansion of federal programs similar to the TVA. Such programs would provide competition to established power companies, a criticism that the TVA continued to confront. Historian Robert McIlvaine observed that "The main reason the TVA was not replicated was not that it failed, but that it worked so well."²¹⁸

3. THE TENNESSEE VALLEY AUTHORITY, 1945-1979

The year 1945 represents a point of transition for TVA. Significant cultural and economic events coupled with intra-TVA changes influenced a new period in the history of the agency. Changes to the TVA program of hydroelectric projects are evident in their architectural design as well as their infrequency, compared with pre-war construction. During the three decades following the war, TVA pursued coal-fired steam plants and nuclear facilities in a climate of growing environmental concerns, as political and public support waned for TVA Congressional appropriations. The TVA struggled with the paradox of supplying the growing demand for electricity in the region while deflecting the image of a monolithic power company. These difficulties characterize the period from 1945 to 1979 and are manifest in both the internal workings of TVA and the projects it proposed.

In 1945, the end of World War II coincided with the stepping down of TVA chairman David Lilienthal, who then became chairman of the U.S. Atomic Energy Commission. Lilienthal had been a key figure at TVA since its creation in 1933. He was largely credited with articulating TVA's distinct role and self-image. Lilienthal understood that TVA's unique creation as a corporate entity allowed the agency to operate on the fringe of federal government. Preaching an ideology of grassroots democracy, Lilienthal had crafted TVA into a laboratory for social progressivism. The grassroots rhetoric was delivered in every medium available, (newspaper, magazine, movies, speeches, photographs, exhibits from World Fairs to high schools, letters to social researchers), to win over the public and to influence planning policy and models. The TVA derived its autonomy and autocracy from this vantage point, distancing itself from the federal government.²¹⁹

On the occasion of announcing Lilienthal's successor, President Harry S. Truman's speech of October 28, 1946 praised TVA, stating, "the non-political and efficient character of its management and the high caliber of its staff have changed opposition to support, until today in the Tennessee Valley and throughout the country the TVA receives almost unanimous approbation and support." Truman named Gordon R. Clapp to serve as TVA's new Chairman through May of 1954. Clapp had previously served as TVA's Director of Personnel beginning in 1933; he became General Manager in October of 1939. In appointing Clapp, Truman sought to preserve continuity in TVA's brand of public planning. Truman noted that TVA's accomplishments to that point had reversed bitter opposition among the public, saying, "... to a large degree TVA's success has been due to Mr. Clapp's skill as an administrator, to his qualities of character and devotion to the public service, and to a vision and

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understanding that have so largely aided in the formulation of TVA policy.”²²⁰ Clapp’s appointment was, therefore, anticipated as a seamless transition.

Indeed, as an advisor to Chairman Lilienthal, General Manager Clapp had a good deal of influence on Lilienthal’s job of engendering public support, as well as that of the President. A memo from Clapp in early 1942 prepped Lilienthal for his meeting with Truman in which the chairman needed to assert TVA’s accomplishments as a special entity, out from under federal micro-management. TVA had always casted itself as a unique organization of multi-purpose planning, not just a power utility, for fear of being subsumed into a federal department that would stifle its agenda. Lilienthal and Clapp’s wish to thwart this creeping concern was vexed by the increasing demand for electricity during the peak of the war. But the rising need for more electricity and the desire to prevent private competition kept TVA in the business of building more hydroelectric plants.

The TVA also pursued the construction of coal-fired steam plants. The Watts Bar steam plant was TVA’s first, constructed in 1941, during the war. TVA’s first post-war funding request for a steam plant occurred in 1946. The TVA’s 1946-1947 annual report explained the dire need for development of the Tennessee Valley Region, which still lagged behind national standards. Chairman Clapp told a U.S. House subcommittee in 1948 that TVA was the sole electricity provider in the region, seemingly without a sense of the irony in its supplanting of pre-TVA power companies. The U.S. House rejected the bill for a TVA steam plant.²²¹

The TVA resumed construction of the South Holston Hydroelectric Project on August 7, 1947. The project had begun February 16, 1942. In October of that year, however, work had been ordered stopped, as the project was not deemed essential to war efforts. The South Holston project was one of four on the Holston River and its tributary, the Watauga. From 1948 to 1953, TVA focused on the design and building of these four projects, collectively called the Upper Holston projects. Chief architect Roland Wank had departed TVA in 1944 to join the firm of Albert Kahn Associates in Detroit, and while the influence of his team of architects can still be seen in these projects, overall they do not have the same unity of materials and design that marked those built before 1945.

By the end of World War II, TVA had completed sixteen dams and powerhouses that reflected the aesthetics of architect Roland Wank and his team. Though he continued as a consulting architect for TVA until his death in 1970, Wank’s departure coincided with the rise of a new aesthetic in the Cold War period. At the end of World War II, a populist version of the International Style began to dominate American architecture, as Art Deco and Moderne styles waned. Wank’s successor, Mario Bianculli, left the TVA in 1945 to form an architectural firm in Chattanooga, closing the chapter on pre-war design.²²²

Post-war architecture reflects the influence of the International style cultivated by European architects such as Mies Van Der Rohe, Le Corbusier, Walter Gropius, and Albert Kahn. The style is characterized by functional compositions with minimal detailing. The International style informed the design of the Upper Holston and later projects. Of this group of four projects, the Fort Patrick Henry powerhouse most closely resembles the designs of Wank and his fellow architects. The powerhouse is integral with the dam and displays a large band of “boxed” aluminum clerestory windows to illuminate the generator room. In contrast, the Boone and Watauga projects were built with powerhouses separated from the control buildings. The Boone powerhouse was of concrete

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construction, while Watauga had a structural steel frame with an exterior of aluminum panels. The two control buildings were similar to each other with flat roofs and exteriors of concrete and brick. The South Holston powerhouse was built with an exterior of aluminum and also featured a wall of fixed aluminum windows on its primary elevation. While their visitor lobbies retained the pre-war inscription of "Built for the People of the United States," they no longer were embellished with marble or other decorative accents.

The three powerhouses built in the 1960s and 1970s (Melton Hill, Nickajack, and Tims Ford) would reflect an even further advance towards stoic lack of adornment. The last two projects completed by the TVA, Normandy and Tellico, were designed for flood control and to assist in water flow for the downstream powerhouses. As a result these projects lack powerhouses and do not produce any power. Hydroelectric projects built between 1945 and 1979 are:

1. Watauga, Watauga River, 1948
2. South Holston, South Fork, Holston River, 1950
3. Boone, South Fork, Holston River, 1952
4. Fort Patrick Henry, South Fork, Holston River, 1953
5. Melton Hill, Clinch River, 1964
6. Nickajack, Tennessee River, 1967
7. Tims Ford, Elk River, 1970
8. Normandy, Duck River, 1976
9. Tellico, Little Tennessee River, 1979

Completion of the South Holston Dam occurred when it was closed on November 20, 1950. Its single generator was placed in commercial operation on February 13, 1951.²²³ The project embodies the post-war shift in architectural design. The South Holston powerhouse is a highly diluted version of the definitively Streamlined Moderne style of the pre-war powerhouses. The building is instead a utilitarian, steel-frame building with an exterior of aluminum panels and a façade of fixed windows recessed with steel mullions. The South Holston project reservation includes a visitor building planned before the war. Its construction began in 1950, but was deferred until 1953. The building is constructed of steel frame and concrete bearing walls, and its exterior walls consist of aluminum frames and louvers and insulated glass panels. The main building is connected to detached restrooms via a paved terrace and sheltered passage way. The building is typical of the post-war Miesian style that would be applied to several of TVA's other visitor buildings. These were built in the 1950s and featured exteriors of concrete and stone veneer and central breezeways faced with wood siding. These plans included one-story designs with flat roofs, as at Cherokee and South Holston, while others were banked into the slopes with a lower level and butterfly roofs, as at Douglas, Fort Patrick Henry, and Melton Hill. The lower levels were designed to house offices of TVA security, while the main level featured the reception room with a large bank of windows overlooking the adjacent dam and lake. Some of the reception rooms were built with terrazzo floors and displayed information on TVA and its mission, as well as murals commissioned by the agency.

Similarly, the architecture at the 1948 Watauga Hydroelectric Project is restrained and functional in design. The site plan of the Watauga project takes advantage of a natural drop in elevation, relying on engineering design to dictate location of components that were previously integral to the dam. The powerhouse, control building, and intake are all free-standing, rather than massed. Separated by the

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river or a distance of some thousands of feet, these structures are prudently basic and severely minimalistic. The control building has a steel-frame wing with aluminum siding and an office wing of reinforced concrete and brick. The Watauga visitor building features Crab Orchard stone, vertical tongue-in-groove siding, extensive use of glass, and a butterfly roof. The attractive mid-century modern design simultaneously stands out architecturally from the utilitarian structures and expresses its own function as a viewing point overlooking the project site.

Some architectural historians suggest that TVA's shift from the Streamlined Moderne style to minimalistic design can be explained as a product of Cold War ideology. Leading into the war, the architecture of federal facilities expressed energy and movement. The buildings featured curved lines and smooth, metallic surfaces evoking the aero and nautical designs of national defense manufacturing for which TVA generated power. Post-war science and politics, however, required a more stoic architectural approach. Form-to-function design conveyed secrecy, security, and impenetrability. Before and after the war, the TVA welcomed visitors to its hydroelectric projects, where the architecture spoke to its period, ensuring Americans of the good public work undertaken at these sites. With increasing amounts of TVA electricity going to Cold War research at Oak Ridge's restricted sites, TVA's power plants were the face of national defense.²²⁴ The original, Streamlined Moderne-style visitor building at Norris, TVA's first hydroelectric project, was razed and replaced with a design more typical of mid-century Miesian architecture. The 1950 building has a concrete butterfly roof with a wide eave overhang, facade walls of fixed-glass windows, textured concrete exterior walls, exposed steel frame, and panels of small, square tiles, in a random-pattern color scheme.

The TVA continued building new hydroelectric projects into the early 1950s. The Fort Patrick Henry Hydroelectric Project, begun in 1950 and completed in 1953, utilized restrained architectural design in the powerhouse and visitor building. The rectangular plan powerhouse is a large, concrete building with minimal embellishment, with its project name in red, enameled steel letters and exterior walls displaying a textured surface achieved through the use of board-form concrete, as used on the exteriors of some of the pre-War powerhouses. The visitor building has a flat roof and an exterior of random-course stone veneer. Windows span three sides of the building. The minimalist design affords panoramic views and is similar to other TVA visitor buildings completed in the 1950s.

The Boone and Fort Patrick Henry Hydroelectric Projects were planned on a coordinated schedule. The Boone Dam was closed December 16, 1952, and the first of its three generators was placed in commercial operation on March 6, 1953 (*Figure 10*). The Fort Patrick Henry Dam was closed October 27, 1953, and the first of its two generators was placed in commercial operation December 5, 1953. Each site has a visitor building constructed overlooking the reservoir. The two projects illustrate architecturally a movement towards minimalism, with form-to-function buildings. A unique decorative feature at each project was an original mural within each visitor building. Painted by Kingsport-based TVA staff artist Robert Birdwell, each mural depicts a montage of scenes illustrating TVA's contributions to the region. The Fort Patrick Henry project would be the last of TVA's hydroelectric projects for another decade. At that point, with the most advantageous sites for hydro plants already developed, steam plants would be needed to meet new power demands. The TVA officials grew uncomfortably closer to the appearance of a federal power utility, obscuring its social mission.

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TVA officials feared that deviation from a multi-pronged mission risked intervention from the federal government and wished to perpetuate the agency's autonomous status. While General Manager, Clapp had recommended natural resource development to offset the appearance of a power company.²²⁵ The primary natural resource of the Tennessee Valley was the timber in its twenty-one-million acres of forest lands. During the 1950s, TVA produced pamphlets promoting hardwood manufacturing and sponsored re-planting of trees.²²⁶ Clapp's program of natural resource development also covered agriculture, regional studies, recreation, and tributary watersheds, particularly the Elk and Duck Rivers in Tennessee. The idealism of an emerging conservation movement informed Clapp's agenda. Yet his tributary idea struggled to gain traction. Congress, TVA staff, state and local officials, and the public did not respond with the enthusiasm afforded the big hydro projects.²²⁷

The reluctance to apply TVA's program at the tributary level is perplexing given the agency's success within the region. By the 1950s, TVA's pre-war influence was evident on the landscape and in the regional economy. By the mid-twentieth century, the availability of TVA's abundant electrical power contributed to the Tennessee Valley Region's manufacturing growth, surpassing that of the rest of the country. Manufacturing income in the Valley increased by 502 percent between 1929 and 1953 compared with 443 percent of the rest of the South and 321 percent in the nation.²²⁸ During this period, the Valley's total income saw a shift from agriculture to manufacturing; agricultural income declined from twenty-three percent to eleven percent, while manufacturing increased from fifteen percent to twenty-two percent.²²⁹

Through TVA's guidance, farming in the Valley improved on several levels. Many farmers had switched from corn and cotton to soybean and wheat production, which helped control erosion and was more profitable. While the number of small farms and farmers decreased in the region in the decades following World War II, the average crop yield per acre increased. The widespread use of tractors and other mechanized farm equipment increased efficiency, reducing the need for planting by hand or by animals. The changes in agriculture in the region since 1945 was summed up in an article in *Alabama Rural Electric News* in July 1963: "Farm efficiency has increased more in the past eighteen years than the preceding 120 years."²³⁰

By 1958, TVA's conservation program had furnished North Carolina landowners with over thirty-four million seedlings as part of reforestation efforts.²³¹ In Tennessee and Alabama, many counties benefited from TVA's forestry and conservation programs. Farm woodlots and forest areas were "altered quietly" by the application of scientific forestry practices, such as tree harvesting and planting of fast-growing trees on idle land.²³² As the forests of the Southeast matured, new industries took advantage of this renewable resource which provided wood for paper, furniture, turpentine, and many other products. In 1967, a compilation of reports was published assessing the economic impact of the TVA. In his review, TVA Chairman Aubrey Wagner noted that "as one measure, the Valley produced about \$100 million worth of wood products annually in the early 1940s. By 1960, the figure was \$500 million and in 1963 it was \$575 million."²³³

TVA also worked closely with private enterprise in the region to help foster industrial growth. With TVA's planning assistance, the Bowaters Southern Paper Corporation built a \$60 million pulp mill at Calhoun on the Hiwassee River in 1952. The company located at Calhoun because of the TVA's

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assurance of adequate power and available renewable forests planted by TVA.²³⁴ This mill employed hundreds of workers and for many years was one of the largest producers of newsprint in the country.

Many smaller industries also opened manufacturing plants in communities across the region in these years. Industrial employment increased significantly in the mountains of western North Carolina in the early 1950s. The Berkshire Knitting Mills Company, based in Reading, Pennsylvania, opened a large mill in Andrews in 1952. This mill produced socks and hoses, employed 380 workers, and represented an investment of three million dollars.²³⁵ This investment was followed in the county by the construction of the Duffy Silk Company's plant at Andrew, employing eighty workers. In Murphy, a hosiery plant was built in 1950 with fifty-five employees, and a dress plant was constructed in 1955 with 130 workers.²³⁶

For all of TVA's achievements and influence within the region before World War II, the agency struggled in the post-war years to retain a cohesive mission. David Lilienthal's ability to articulate a grassroots rhetoric and manifest it in concrete measures seemed to have left TVA with him. As chairman, Clapp had a new conundrum: how to keep TVA in the public eye as a coordinator of regional development, while pushing local officials to assume the leadership role. The TVA believed that local government and service agencies should formulate community-based planning, establishing ownership, thus longevity, of programs the TVA sought to install around the country. Yet, this limited role risked the TVA being rendered unneeded. Clapp's general manager, George Gant, even questioned whether TVA should continue to exist at all.²³⁷

Gant, however, pushed forward, giving an internal speech in 1949 that defined the two-part body of TVA work: one group of programs centered on the physical resources of completed hydroelectric projects, their dams and power-generating operations. The second set of programs provided technical assistance to state and local government and businesses. Over the next decade, the TVA struggled to maintain the balance. In fact, this expansion of power plants was at odds with the language of the Tennessee Valley Authority Act of 1933, which stated that providing power should be primarily "for the benefit of the people... particularly the domestic and rural consumers," whereas industrial sale of electricity "shall be a secondary purpose, to be utilized principally to secure a sufficiently high load factor and revenue returns which will permit domestic and rural use at the lowest possible rates and in such a manner as to encourage increased domestic and rural use of electricity."²³⁸

Yet, escalating world tensions drove an increased demand for power at Oak Ridge's uranium enrichment plants. Completion of the Paducah Gaseous Diffusion Plant for uranium production in 1952 also required large quantities of TVA's power. The expansion in the use of TVA power by the nation's atomic defense plants mirrored the increase in Cold War expenditures with the start of the Korean War in 1950. Two of the explosive plants in the region also continued to supply the military's needs during the Cold War. The Volunteer Ordnance Works at Chattanooga produced explosives for the Korean and Vietnam conflicts before finally closing in 1977. The Holston plant closed at the end of World War II but was reactivated in 1949. Renamed the Holston Army Ammunition Plant, it supplied Composition B to the military during the Korean, Vietnam and Iraq Wars and remains in operation today.

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Congress relented on funding for coal-fired steam plants, and by 1950, TVA had two in construction. In fiscal year 1951, TVA supplied 2.2 billion kwh to federal defense agencies (mainly AEC at Oak Ridge), representing thirteen percent of TVA sales. Sales in 1956 amounted to 30.5 billion kwh with a forty percent increase in 1955 alone. In 1956, the TVA furnished at least half the power required by all AEC defense plants in the United States.²³⁹ By 1954, TVA had seven of the world's largest coal-fired plants (with forty generating units) completed or in progress. At that time, thirty-six percent of TVA power was produced at coal-fired steam plants, while its hydroelectric plants accounted for sixty-four percent of its electricity.²⁴⁰

Steam plants, however, inherently lacked other benefits that demonstrated social progress, such as flood control, navigation, and regional development, by which TVA defined itself. Still, TVA's industrial designs of the plants received praise, and *Progressive Architecture* magazine bestowed a design award for excellence to the TVA for its Gallatin Steam Plant at Gallatin, Tennessee in 1954.²⁴¹ Despite the standardized inscription in TVA power plants, the increasing supply of power to Oak Ridge undermined TVA's ideological image "for the people." Half of all TVA power by industrial users during the post-war years went to AEC facilities at Oak Ridge and Paducah, throwing TVA's power generation and social agenda out of balance.²⁴² The pre-war hydroelectric projects all included a family readjustment program to consider the social, economic, and religious services displaced along with the residents of reservoir areas. Given the comparatively limited land-taking of steam plants, these social efforts were not necessary, removing TVA from a role of direct public contact. Clapp's post-war program focusing on local participation attempted to re-insert the TVA presence.

Congressional funding ceased for TVA steam plants in 1953. The TVA was able to self-fund seven more steam plants after 1955 from power revenues. The TVA's steam plants relied on coal, which was rising in cost, affecting TVA's mission to provide low electrical rates to residential customers. While the coal plants successfully met energy demands, the public became increasingly aware of air pollution and the negative effects of surface mining of coal. New attention to environmental conditions also illuminated water quality issues in TVA's reservoirs. Booming industries compromised the region's streams with wastes.²⁴³

The TVA was particularly criticized for contributing to the environmental degradation of the Appalachian Mountains, which it was supposed to help conserve. The energy development policies of the TVA in the 1950s spurred demand for coal at a time when surface-mined coal was just beginning to enter the market. The strip-mining of coal deposits led to the removal of topsoil and forests in the mountains, especially in the states of Kentucky and West Virginia. Historian Ronald Eller chastised TVA in his study of the Appalachian Region, with "Thus the agency that had been created to conserve the soil and improve quality of life through cooperative regional planning contributed both directly and indirectly to the further desolation of the mountains."²⁴⁴ Other critics such as Kentucky legislator Harry Caudill decried TVA's policies supporting the strip-mining industry.

Following construction of seven coal-fired steam plants in the 1950s, the TVA initiated its own measures to safeguard surface-mined lands, since it was itself a major consumer of coal. The TVA required its suppliers to reduce the adverse effects of coal mining and established an inspection force. Where coal companies resisted compliance, states passed regulations to minimize surface mining and its impact on the region's soil and water resources: Virginia in 1966, Tennessee in 1967, and Alabama and Georgia in 1969. Laws were also passed to promote the reclamation of surface

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coal mines, but they were weak and difficult to enforce, and the effectiveness of such programs was widely debated.

These developments influenced an internal rift among TVA staff. Clapp emphasized the integrity of the organization as a whole, the sum of its parts. In light of ever-expanding dedication to power production, the TVA leaders' insistence otherwise was increasingly challenged. A particular milestone helped to solidify the point: in 1956, TVA installed Unit 2 in the Hiwassee hydroelectric powerhouse, which was originally placed in operation with a single unit in 1940. Unit 2 was the first integrated, reversible pump-turbine ever designed and installed in the country. The TVA's 1956 annual report described the unit:

Operated as a generator, the unit has a capacity of 59,500 kilowatts [when] it is operated as a conventional generator....In reverse operation, however, the generator operates as a motor of 102,000 horsepower, turning the turbine which then acts as a pump. As a pump, the unit takes water from the reservoir of Appalachia [sic] Dam...and pumps it back up into the Hiwassee Reservoir. In a test operation, the unit pumped 4,000 cubic feet per second against a head of 238 feet....This operation helps to maintain the head of water for power generation at the project and provides additional water to be run through the Hiwassee turbines.²⁴⁵

Further evidence of TVA's shift in mission was TVA's 1956 report boasting an average residential electricity use twice the national average, and at less than half the cost.²⁴⁶ Some TVA staff embraced power production as TVA's mainstay. Engineers in the Power Division ignored the broad-mission rhetoric from above, operating independently, figuratively and literally. With headquarters in Chattanooga, power engineers had a sense of separation, especially given their branch accounted for the bulk of TVA revenue, expenditures, and employees. In the post-war political climate, Congressional support for TVA was not a given, as it had been in the Lilienthal years. Clapp was so faithful to the TVA doctrine he was willing to defy public opinion if necessary, to keep the mission on course. At a time when TVA needed to bolster its Washington connections, Clapp's apolitical nature was increasingly a liability.²⁴⁷

Clapp's appointment as TVA Chairman expired on schedule in 1954 at a time of uncertainty for the organization. His successor, Herbert Vogel, brought an unprecedented perspective of an outsider. President Dwight Eisenhower, who described the TVA as "creeping socialism," appointed Vogel, a retiring brigadier general from the Army Corps of Engineers. Some within the TVA speculated that Vogel was put in place to close down the organization. Eisenhower did oppose further congressional appropriations for TVA's steam plants, but it was his appointee Vogel who helped secure an alternative source of funding. The Bond Revenue Act of 1959 allowed for the issue of bonds to private investors or the U.S. Treasury and re-paid with power revenues. The Bureau of the Budget insisted on approving the bond issues as it would an appropriation request. Vogel agreed, though other TVA officials balked. A revised version of the bill removed scrutiny by the Bureau of the Budget and instead installed a veto mechanism by either House of Congress within ninety days of notification of a new steam plant project. In this manner the TVA wrestled financial autonomy away from the federal office, but the deal eliminated presidential approval. Eisenhower refused to sign the bill, despite ardent urging from private power companies to do so. Where his predecessor Clapp lacked political

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skills, Vogel persuasively insisted on and was granted a meeting with Eisenhower, deftly smoothing out the language of the bill.²⁴⁸

The Chamber of Commerce derided the legislation, stating the Bond Revenue Act would not relieve U.S. taxpayers of subsidizing TVA. The organization called for discontinuing TVA's role in power production, limiting TVA's authority to non-power functions, and transferring operations of power facilities to local companies. In a 1958 letter to the *Washington Post*, the Chamber of Commerce broadcast its growing criticism for funding TVA projects, stating that the "Tennessee River flows through seven states and drains forty-eight." According to the Chamber of Commerce, the preferential treatment afforded the TVA came at a cost of between \$268 million and \$470 million during the fiscal year to taxpayers outside the TVA service region. Vogel responded that the Chamber's information was based on "fundamental misconceptions of Congressional policy," as he pointed out comparable funding for projects in Houston, Pittsburgh, and the Great Lakes region.²⁴⁹

All these projects, Vogel stated, enabled growth and development, just as TVA's projects had. In addition to the water-related shipping industries that developed along the Tennessee River, industrial development concentrated at three areas by the mid-twentieth century. The power available from nearby Kentucky Dam led to the establishment of several major industries at Calvert City, located just downstream from the dam. In 1948, the Pennsylvania Salt Manufacturing Company built a two million-dollar hydrofluoric acid plant, and the Pittsburgh Metallurgical Company, Air Reduction Company, and B.F. Goodrich Chemical Company also built major plants by the mid-1950s. These industries led to the employment of almost 700 workers by 1955.²⁵⁰ Over the next decade, these and other companies continued to expand and represented investments in the area of \$115 million, employing more than 2,000 workers.²⁵¹ Not the least of the TVA's achievements was the averted disaster to the city of Chattanooga during a twenty-day deluge of rain in early 1957. Flood waters overloaded the Holston, Clinch, and Little Tennessee Rivers, all tributaries of the Tennessee River. The TVA orchestrated precise flood storage and careful release across its system of dams, based on constant monitoring of 600 gauge stations. Flood control was carefully balanced among the main river's three projects above Chattanooga – Fort Loudoun, Watts Bar, and Chickamauga Dams. The flood control on the part of the TVA's dams was estimated to have averted \$66 million in damage to Chattanooga.²⁵²

Not long after the flood of 1957, the TVA submitted a budget request that included a new hydroelectric project, Melton Hill on the Clinch River. This was the first proposal for a hydroelectric project in almost ten years. By then, the Bond Revenue Act had set a precedent of alternative funding, and the Bureau of the Budget denied the Melton Hill project for two consecutive years on the policy of no funding for new multi-purpose projects. For fiscal year 1961, the TVA for the third time requested funding for the Melton Hill Project, in the amount of \$8,100,000. On August 26, 1960, the House and the Senate passed the bill with funding for a new lock at Wheeler Dam and for the Melton Hill Project. For the latter, the Bureau of the Budget allowed one-half (\$4,050,000) of TVA's request, requiring the balance should be derived from power proceeds. TVA protested the terms as "purely arbitrary, but accepted."²⁵³

The Melton Hill project represented a change in policy: Melton Hill is the only TVA hydroelectric project not fully funded through Congressional appropriations. All power installation expenditures were covered by funds derived from the sale of power and/or power bonds. It was also the only TVA

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dam on a tributary with a navigational lock.²⁵⁴ Construction of the project began September 6, 1960, and Unit 1 of the powerhouse was placed in operation on July 3, 1964 (*Figure 11*). The Melton Hill powerhouse is a purely functional structure. The rectangular plan has structural steel frame walls of precast concrete panels; its only architectural embellishment is a clerestory of structural block glass. As found at all previous hydroelectric projects, Melton Hill's powerhouse interior includes TVA's signature "BUILT FOR THE PEOPLE OF THE UNITED STATES OF AMERICA, (1960-1964)".

At Melton Hill, the visitor building is a two-story building banked into the hillside with a sheltered, cantilevered overlook terrace. The building has a flat metal roof, concrete deck with a metal railing, and fixed aluminum windows. The exterior surface is of stone veneer, precast concrete panels, and original Formica panels with fixed-light windows and original steel and full-light doors. The Melton Hill powerhouse was built integral to the dam and is a rectangular-plan building with a flat roof. The building's exterior was given a varied texture through the use of large banks of structural glass block windows that illuminated the generator room. The architecture of the project exemplifies the Miesian design popular for the period and allows for panoramic views of the site.

During construction of the Melton Hill project, new programs and turnover in directors characterized the changing composition of the TVA. Vogel admitted to his colleagues that he had allowed his initial opinion of TVA to be swayed by the Bureau of the Budget. Where his predecessor Clapp had clung to doctrine, Vogel came to respect and uphold foremost the competence and credibility of TVA's engineers. Vogel's esteem for their work was so high, he resigned his chairmanship a year early for tactical reasons. Aware that his term expired at the same time as that of then Tennessee Governor Buford Ellington, Vogel was concerned that President John Kennedy might appoint Ellington to replace him. Vogel believed that TVA officials should come from outside the Valley, in order to avoid provincialism.²⁵⁵ Ultimately, Kennedy filled Vogel's premature vacancy from within TVA, naming Aubrey J. ("Red") Wagner, TVA's general manager, in 1962.

With TVA since 1934, Wagner represented a revival of his mentor Clapp's philosophy of the agency as a resource development organization. Melton Hill represented the realization of Clapp's ideas in the form of the TVA's new Tributary Area Development (TAD) program. The TAD was the body through which the TVA carried out its mission of economic development in tributary regions, based on close work with community leaders at the local level. Specific programs were tailored to meet local needs, stimulating development and improving quality of life. Participation by private citizens was crucial to TAD's success, as goals were more localized to individual communities within the broader region. Under the TAD structure, local leaders and residents assumed greater roles than at larger TVA projects.²⁵⁶ TAD projects, therefore, can be seen as a culmination of TVA's goal under Chairman Clapp to guide state and local agencies into their own planning missions.

Working closely with TVA in the planning stages of Melton Hill, local towns and counties adopted zoning ordinances in advance of reservoir completion, in order to ensure planned shoreline development. The cities of Oak Ridge and Clinton also secured proper legislation from the State for establishing port authorities. The Tennessee State Planning Commission praised the collaborative planning effort spurred by the Melton Hill project. In its December 1960 report, "*Melton Hill Reservoir – Comprehensive Plan for Land Use Development*", the Commission touted "the first effort, to our knowledge, in the state whereby reservoir-affected cities and counties with their planning staffs have

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joined hands with the State Planning Commission and the Tennessee Valley Authority in preparing a future land use plan based upon population patterns, regional resources, and land use needs.²⁵⁷

As part of its mission, the TVA had acquired hundreds of thousands of acres for its hydroelectric projects and watershed conservation efforts. Long-term land ownership was not a major goal, however, and in many cases the TVA chose to transfer large tracts for public use to other federal or state agencies. In North Carolina, the TVA acquired 100,024 acres from 1933 to 1963 and transferred 32,566 acres to the U.S. Forest Service, 44,204 acres to the National Park Service, and smaller acreages to other agencies. Only 2,366 acres of the 21,994 acres remaining in TVA ownership in 1963 were above the full pool elevation of the reservoirs.²⁵⁸

TVA's influence on regional recreation development was evident in public use of its planned sites. Of the ten federal reservoirs nationwide receiving more than one million person-day visits in 1951, seven were in the TVA system. In addition to visitation at the lakes, the number of recreational fishermen also increased dramatically in the TVA states. In Tennessee, 13,000 non-resident fishing licenses were sold in 1941 – by 1951 this number had increased to 190,000.²⁵⁹ To accommodate this influx of recreational boaters and fishermen, the number of boat docks and fishing camps increased from fifty in 1941 to 200 in 1951. Developers took advantage of lands near the reservoirs to create retirement villages and summer homes. The number of homes and commercially operated services related to recreation multiplied and in 1980 the total value was estimated at approximately \$300 million.²⁶⁰ Visits to the reservoirs increased from seven million in 1947 to over seventy million in 1980.²⁶¹

Tennessee's state park system owes much to the TVA for its original development. Of the twenty state parks created in the state by 1962, the TVA developed seven of these, wholly or in part, and turned them over to the Division of State Parks, at first on a rental basis, but eventually by fee simple deeds.²⁶² The original demonstration parks created by the TVA in the 1930s in Tennessee included Pickwick Landing, Cove Lake (*Figure 12*), two on Norris Reservoir, and Harrison Island on Chickamauga Reservoir. These developments were eventually turned over to the State of Tennessee for state parks. The first of these was Harrison Bay State Park, leased by TVA in 1938. The remaining demonstration parks were leased by TVA as Cove Lake State Park (1940), Big Ridge State Park (1949), and Norris Dam State Park (1951).²⁶³ Pickwick Landing was originally operated as a private resort but came into the state park system in 1970. The TVA also leased or sold property along its shoreline for the creation of Booker T. Washington State Park, Warriors Path State Park, and Paris Landing State Park. The TVA assisted the Division of State Parks for seven years through the funding of a recreational consultant as these parks were developed.

The Tennessee River's network of interconnecting reservoirs and locks allowed pleasure craft to cruise the length of the river. Many new marinas were built along the shores of the reservoirs, as boating became more and more popular. In 1953, more than 48,000 vessels passed through the Tennessee River locks - 39,974 commercial boats and barges, 6,656 recreational craft and 1,757 government vessels (*Figure 13*). Several sections of the Tennessee River such as the Gunter'sville Reservoir became known for their boat races and fishing tournaments.

The creation of TVA's reservoirs often took some of a county's best farmland along the river, but the opportunity for recreational development enriched quality of life. In Decatur County, Tennessee, for example, soon after the flooding of lowlands for the Kentucky Reservoir, numerous subdivisions were

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built on the hills along the shoreline for retirement and summer homes. Various resorts and boat docks were also built, and recreation became a valuable asset."²⁶⁴ In Hamblen County, Tennessee, the completion of Cherokee Reservoir led to the shoreline and lake becoming a "recreational paradise for thousands" contributing to the County's economy.²⁶⁵ Chickamauga Reservoir at Chattanooga became a center for boating as well as visitation by over 300,000 visitors to the Booker T. Washington and Harrison Bay State Parks by the early 1960s.

During the 1960s and 1970s recreation at the TVA reservoirs continued to expand with new marinas and city-operated parks. Pickwick Landing became a state park in Tennessee in 1970 after TVA acquired it back from a private company. In these decades the Tennessee Valley region gained prominence for the construction of retirement villages and seasonal homes built to take advantage of the area's many recreational opportunities. The number of homes and commercially operated services related to recreation multiplied and in 1980 the total value was estimated at approximately \$300 million.²⁶⁶ Visits to the reservoirs increased from seven million in 1947 to over 70 million in 1980.²⁶⁷

In the 1960s, the sport of whitewater rafting became popular, and rivers throughout the Appalachian Mountains provided rafting and kayaking opportunities. In 1976, for the first time in sixty years, the Ocoee River's riverbed was filled with water while the Ocoee No. 1 Dam's flume was shut down for repairs. Whitewater rafters and kayakers soon flocked to the river, and an entire industry in whitewater recreation was created in Polk County. After repairs to the flume were completed, an agreement was made between the TVA and the rafting businesses in 1983 for the agency to provide water releases for 116 days each year from late March to early November. During the summer, TVA agreed to generate power for only two days each week. The loss of revenue from the sale of electricity was offset by the user tax fees from the rafters.²⁶⁸ The Ocoee River later gained fame as the site of the kayaking events during the 1996 summer Olympics. In addition to the Ocoee, the Hiwassee, Nolichucky, and Pigeon Rivers in the TVA region also became popular with whitewater enthusiasts.

During these decades the TVA continued to assist state park systems to lease or purchase property along its reservoirs. In 1962, the property that became Warriors Path State Park near Kingsport was acquired from the TVA.²⁶⁹ The TVA also donated property for local parks as well. The Hamilton County, Tennessee, government accepted 223 acres of property along the shore of Chickamauga Reservoir from TVA in 1959 for the creation of Chester Frost Park.²⁷⁰ The TVA worked with local communities to provide for seasonal water releases from its hydroelectric projects for recreation on the Ocoee and Hiwassee Rivers.

During the mid-1960s, dozens of industries located along the Tennessee River between Decatur and Muscle Shoals, Alabama. Attracted by abundant water and electricity, many chemical companies built large factories next to the river, and industries such as steel and aluminum also employed hundreds of workers. Near Muscle Shoals were the Reynolds Aluminum Company plant and the Ford Motor Company's die-casting plant. Decatur persisted as an industrial hub with its two major pre-war industrial employers, Ingalls Ship Building Company and the Decatur Iron and Steel Company, manufacturing a variety of barges, ferries, and towboats that were used in the transportation of grain, coal and iron ore. The *Alabama Rural Electric News* reflected on TVA's impact to the state in 1964: "With channels opened throughout the river and abundant low-cost electric power from TVA's dams

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and steam plants, vast new industries have been constructed at waterside in Alabama and up and down the valley."²⁷¹

Chattanooga had been an industrial and manufacturing center since the mid-nineteenth century, and the opening of the Tennessee River for year-round navigation made it an important port for feed grains and flour milling. By the mid-1960s, over nine million dollars was invested in grain elevators and milling facilities.²⁷² Other Chattanooga industries included Combustion Engineering Inc., which produced soil pipe and atomic reactor vessels and the General Portland Cement Company.

Other important industries that built plants along the Tennessee River by 1965 included the E.I. Du Pont de Nemours Company, which constructed a thirty million-dollar titanium dioxide plant at New Johnsonville. Near Pickwick Dam, the Tennessee River Pulp and Paper Company constructed a paper mill at a cost of forty million dollars. At Rockwood, Tennessee, the Tennessee Products and Chemical Corporation invested twelve million dollars in a ferroalloy plant and re-opened the Rockwood iron furnaces.

With navigation open on a year-round basis, shipping on the Tennessee River increased to over thirteen million tons per year by the 1960s, an expansion twelfefold since the 1930s.²⁷³ From 1933 to the late 1960s, the number of tons of freight traffic transported on the entire Tennessee River system increased from 940,000 to 22,000,000.²⁷⁴ The rapid increase in shipping on the Tennessee River from the 1940s to the 1960s led to the construction of new locks at several of the dams. By the 1960s, the original small locks were overwhelmed with the amount of commercial shipping, and new locks were built at Guntersville and Wheeler Dams. During this period, the TVA in coordination with the U.S. Corps of Engineers began expanding the size of its dam locks to accommodate the increase in river traffic the Tennessee Valley had experienced since the end of World War II.

During the construction of a new lock, Wheeler Dam was the site of one of the most disastrous events on the Tennessee River. On June 2, 1961, Wheeler's original lock's foundation failed when a previously undetected layer of clay, measuring one-sixteenth- to three-eighth-inch, was compromised. The repeated blasting for construction of the second lock ultimately triggered a collapse of the first. When the accident occurred, forty men were working on the new lock during the night under lights, and the collapse registered on earthquake monitors nearly 500 miles away. Two workers lost their lives, but fatalities could have been greater had the failure occurred during the day, when 150 men would have been on site. Water poured through the lock for four days, sending Wilson Lake a manageable volume equivalent to just three open spillway gates. TVA built a needle dam above the site to contain the water. River traffic was interrupted, hindering transportation, including between NASA sites at Huntsville and Florida, which threatened the nation's moon race. A land-based ferry system of trucks and temporary roads was used to circumvent Wheeler Dam and keep cargo in transit, including the Saturn rocket, a booster rocket in the moon program.²⁷⁵

In 1965, a new lock was completed at the Guntersville Dam at a cost of 17.5 million dollars. The new lock was double the size of the original lock and its capacity allowed it to load several barges at a time.²⁷⁶ Shippers on the river had long complained that the Guntersville Dam was a bottleneck because of the one small lock. The original small lock was being raised and lowered 600 times per month before the new lock was placed into operation.²⁷⁷ The new lock was designed to accommodate commercial traffic while the smaller lock was planned for use primarily by recreational

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boats. The improvements in the Tennessee River's transportation system helped to increase volume on the river and in 1975 the river bore an estimate 27.1 million tons of commercial freight ranging from automobiles to sand.²⁷⁸

A new hydroelectric project, a replacement of a pre-TVA dam, returned TVA to construction on the main river. Under Chairman Wagner, the TVA Board of Directors approved the Nickajack project on January 9, 1964. Construction of the Nickajack Dam and navigational locks were determined more cost effective than continued repairs to the 1913 Hales Bar Dam near Chattanooga. The TVA had acquired the Hales Bar Dam in 1939 as part of the holdings of the Tennessee Electric Power Company, knowing the dam had deficiencies since its construction. The TVA undertook corrections to address persistent foundation leaks in 1940. These repairs proved temporary; several years later, boils began to appear below the Hales Bar Dam. Another round of repairs in 1962 produced unsatisfactory results. The Bureau of the Budget agreed with the TVA's proposal to replace the Hales Bar Dam. For fiscal year 1964, the \$4.3 million already allocated for Hales Bar leakage abatement program would instead be transferred to the Nickajack construction project. Construction was completed in 1967.²⁷⁹ The design for the Nickajack powerhouse was another stride towards functionalism with the exterior built of pre-cast concrete aggregate panels and limited fenestration.

The Nickajack project was the second TVA project for which the planning staff of reservoir-affected cities and counties, as well as the State Planning Commission, participated in developing a comprehensive land use plan. On the heels of the Melton Hill project, the Nickajack project assessed population patterns, regional resources, and land use needs to maximize and create awareness of the project's benefits. The planning process addressed the project's potential impact on improving industry, wildlife, recreation, commerce, residential development, and open lands.²⁸⁰ The TAD program was carried forward with mixed results, some sparking such debate as to question TVA's future.

Under the TAD program, the TVA proposed projects on two tributaries, the Elk and Duck Rivers in Middle Tennessee. Local development groups that would work with TVA were established - the Tennessee Elk River Development Agency (TERDA), in 1963, and the Upper Duck River Development Association, in 1964. The TVA submitted a proposal for two new hydroelectric projects - Tims Ford and Tellico - to the Bureau of the Budget in late 1964. On the Duck River, the Normandy and Columbia Dam projects, both non-generating dam facilities, were planned in tandem. The proposed system was expected to aid in economic development of the Upper Duck River region, providing flood control, recreational opportunities, and improved water quality.

Concurrent with the rise of the TAD program was another new TVA project, the Land Between the Lakes in Kentucky. At the direction of President Kennedy, the TVA was to oversee the establishment of a National Recreational Area. Kennedy envisioned the experimental project as a wilderness preservation area and a demonstration of economic development where timber and industrial resources were limited. With the impoundment of the Cumberland River by the U.S. Corps of Engineers, the land between the Tennessee and Cumberland Rivers was examined for possible recreational use. This area, composed of sections of Trigg and Lyon County in Kentucky and Stewart County in Tennessee, had always been sparsely populated. The two largest towns were Model and Golden Pond, with fewer than 200 inhabitants.²⁸¹

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The plans for the recreational area were met with opposition by many of the residents, particularly in Kentucky. Land acquisition began in April of 1964, and the Fiscal courts of Lyon and Trigg Counties opposed the TVA, insisting that the lands should remain subject to development by private enterprise. Citizen groups formed to protest the federal control of the area. The controversial project displaced multi-generational residents who had enjoyed relative isolation due to their location between the two rivers. The nearly 1,000 total families decried the fast tracking of the project and the undervalued land assessments. The project found nationwide opposition to TVA's use of eminent domain to acquire, then re-sell, parcels to fund its projects.²⁸² However, many of the governments and citizens of neighboring counties supported the project because of the anticipated economic benefits of the parkland to the region. Kentucky Governor Edward Breathitt also approved the project, and the U.S. Congress funded the TVA's development of the park. While the Land Between the Lakes became a hugely popular recreational destination, the project was emblematic of TVA's over-reach that some Americans found objectionable.

The public and even some politicians came to feel that the TVA was over-building with projects at Normandy, Tellico, Columbia, and the Land Between the Lakes. The Tims Ford Hydroelectric Project was one of the last projects to reach completion without issue. President Lyndon Johnson signed the Public Works Appropriation Act on October 28, 1965, providing \$5.7 million for Tims Ford. Though the Tims Ford project vied for Congressional funding at the outset with the proposed Tellico project in East Tennessee, both projects were approved despite a questionable cost-benefit ratio of the latter. Construction of Tims Ford began on March 28, 1966; the non-generating Tellico Dam project received initial funding in 1966 and was begun in 1967. The Tims Ford Dam was closed on December 1, 1970 with a single generator to create hydro-power.²⁸³

The Tellico Dam project experienced much more opposition. A major concern of area residents was the ever-expanding taking line for the reservoir. The TVA abandoned its pre-war methodology of thorough deed research and interviews of displaced families. At Tellico, the agency repeatedly increased the acreage it would take, ultimately amounting to more than three times the land necessary for the reservoir. The superfluous land taking was intended for speculation and development that would offset the costs of the project and included a model community based on the Norris prototype. The Tellico town plan had the appearance of elitism without provisions for low- or moderate-income families.²⁸⁴

The U.S. Chamber of Commerce called the Tellico project a federal blueprint for land speculation and corporate favoritism. Archaeologists opposed the project on the grounds of Cherokee cultural material across the Tellico area. Environmentalists, invoking the Endangered Species Act with the discovery of the snail darter in Tellico waters, brought the project to an abrupt halt at ninety percent completion.²⁸⁵ From 1973 to 1979, the snail darter issue held up completion of the dam, though critics of the project claimed the fish was a scapegoat for an uneconomical financial model.

TVA ran into similar issues regarding the Columbia Dam. Though construction commenced in 1973, environmentalists noted the flat terrain of the proposed reservoir area and claimed impoundment of the Duck River would create a stagnant pool of algae. In contrast, the topography at the Normandy site, with steep hills and hollows, was far better suited for a reservoir. Columbia Dam opponents objected to the dam's disruption of the longest free-flowing river in the state. The location of the Normandy Dam, near the headwaters of the Duck River, was not as controversial. Lawsuits against

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the Columbia Dam in federal court resulted in construction delays, but ultimately the project went forward.

Opposition to the Columbia Project was based on environmental concerns as well as objections to the taking of family farmlands for a reservoir some thought unnecessary. TVA faced growing public concerns about air and water pollution, wildlife resources, private property rights, and energy costs. Environmentalists, local farmers, and even some in the TVA discouraged the Columbia project. Based on feasibility studies in 1933, 1951, and 1966, the agency had recommended against the building of a dam at Columbia, citing unfavorable benefit-to-cost ratios. The last study, however, revised the numbers enough to persuade funding of the project. Business leaders in Columbia lobbied Representative Joe L. Evins, instrumental in Congressional approval of the Tims Ford Hydroelectric Project.²⁸⁶ By comparison, opposition to the Normandy Project was limited, and the dam was completed in 1976. The Normandy Dam was designed primarily for flood control and recreation and did not provide any power generation.

In 1977, two species of freshwater mussels, both found in the Duck River, were added to the U.S. Fish and Wildlife endangered species list. Though an endangered species complaint was never actually filed against the Columbia Project, the momentum was against its completion. Between 1969 and 1983, TVA spent \$83 million on the Columbia site before work ceased. The concrete dam was ninety percent complete, and the entire project was approximately half finished. The structure stood abandoned until 1999 when it was demolished.²⁸⁷

TVA had known opposition from its creation, chiefly from the invested local power companies and displaced residents. By the 1970s, TVA detractors of the Tellico Dam project had expanded to include not just landowners within the reservoir, but those concerned about the far reach of eminent domain; average citizens interested in ecology, history, fishing and boating; and economists, archaeologists, biologists, attorneys, and other professional who challenged the TVA's planners.²⁸⁸ Ultimately, Congress amended the Endangered Species Act to grant TVA an exemption to complete the Tellico Project in 1979. As in the case of Normandy Dam, no power generation equipment was installed, but a canal diverted water from the Tellico Reservoir to the Fort Loudoun Reservoir to assist in power generation at the Fort Loudoun Dam.

TVA experienced dissension in internal and external politics as power distributors and consumers faced energy crisis measures during the 1970s. By 1975, only 23 billion kilowatts of the TVA's total of 109.8 kilowatts came from hydroelectric power. Almost eighty percent of TVA's electricity came from the coal-fired steam plants. The emissions from these plants eroded the air quality of the Southeast, and in 1978 the TVA and the Environmental Protection Agency (EPA) agreed on a plan to introduce new air quality control standards. These standards included replacing high-sulfur coal with lower-sulfur coal and installing scrubbers to reduce sulfur dioxide emissions.²⁸⁹

As part of the TVA's diversification of power sources, Brown's Ferry, the first of the agency's nuclear power plants, was completed in 1974 on the Tennessee River in Alabama. The TVA projected that nuclear power would become one of the agency's primary sources of electricity and began an ambitious program to build seventeen nuclear plants, the largest such endeavor in the country.²⁹⁰ The oil embargo and energy crisis of 1973 also spurred the TVA to begin energy conservation programs. Under new Chairman S. David Freeman, TVA's progressive language on energy conservation and

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environment seemed at odds with TVA constituents' desire for growth. Freeman's vision of the TVA transcended power production; he viewed the agency as a national laboratory of idealism. His philosophical approach seemingly complemented that of the Carter Administration at the time. However, neither the Carter nor successor Reagan Administrations embraced the lofty self-image of Freeman's TVA.²⁹¹

The Three Mile Island nuclear accident near Harrisburg, Pennsylvania, in March of 1979 highlighted the growing public concerns over the safety of nuclear plants. The TVA lowered its projections of electrical demands in the Valley Region and cancelled many of its nuclear projects. Cost overruns and new safety requirements also led the TVA to reassess its nuclear program and scale back construction. Since the 1980s, the TVA has limited the scope of its nuclear program, promoted energy conservation, streamlined its work force, and widened its programs in regional and community planning.

The TVA's hydroelectric projects continue to produce billions of kilowatts and are testimonials to their high quality of construction and operation. The majority of the dams, powerhouses, lock control buildings and visitor buildings retain integrity of their original design and architectural character. Only a few buildings and structures have been significantly altered in recent decades. The most notable of these is the Watts Barr control building which suffered a serious fire on September 27, 2002. The building experienced significant fire and smoke damage and currently awaits restoration.

For decades the TVA powerhouses welcomed visitors into their lobbies and limited tours of the facilities. After the terrorist attacks of September 11, 2001, however, security concerns led to the closing of most powerhouses to the public. Visitors are still welcome at the separate visitor buildings at the projects, and the Kentucky Dam has a reception room staffed by volunteers in the powerhouse. Today, the TVA recognizes the historical and architectural significance of its twenty-five hydroelectric projects built between 1933 and 1979 and their role in the agency's history.

The cancellation of the Columbia Dam on the heels of the equally controversial Tellico Dam represented the end of TVA's hydroelectric projects. Even then-TVA chairman S. David Freeman, appointed in 1977, commented during this period that the two projects should probably never have been built.²⁹² In retrospect, the Tellico Dam Project marked a transition for the TVA. No more hydroelectric projects would be constructed by the TVA, and the focus turned increasingly towards nuclear power and renewable resources. In their study of the Tellico Dam controversy, authors William Wheeler and Michael McDonald noted that "Tellico was, for TVA a pivot, a catalyst, and a watershed. The same agency that had received bad marks for noncompliance with NEPA standards under Aubrey Wagner would under S. David Freeman's direction, become an environmental bellweather."²⁹³

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F. Associated Property Types

1. Name of Property Type

Property Type: Historic Resources of the Tennessee Valley Authority Hydroelectric System, 1933-1979

Subtypes:

A. Hydropower-Related Properties

1. Dams
2. Powerhouses and Control Buildings
3. Pipelines, Tunnels, Surge Tanks, Penstocks and Canals
4. Switchyards and Transmission Towers
5. Storage and Support Buildings

B. Transportation-Related Properties

1. Navigational Locks
2. Lock Operation Buildings
3. Vehicular Roadbeds and Bridges

C. Recreation-Related Properties

1. Visitor Buildings
2. Picnic Areas
3. Campgrounds
4. Fishing Piers and Boat Ramps
5. Swimming Beaches

D. Maintenance-Related Properties

1. Grounds Operation Offices
2. Garages/Storage Sheds

E. Public Safety Service Buildings

2. Description:

The 1933 Tennessee Valley Authority Act established the TVA as a quasi-governmental body with the autonomy to devise an economic development plan for the Tennessee River Valley region. The multi-purpose legislation sought to improve navigation and flood control of the Tennessee River, spur agricultural and industrial development in the Tennessee Valley, and provide for national defense. To achieve these goals, the Act authorized the TVA Corporation to acquire real estate for the construction of dams, reservoirs, power houses, transmission lines, or navigation projects at any point along the Tennessee River and its tributaries. Between 1933 and 1979, TVA completed twenty-five hydroelectric sites comprising a number of identifiable and consistent property types essential to

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TVA's multi-faceted mission. These property types collectively form individual historic districts at each TVA site and are associated with important developments in the areas of agriculture, architecture, conservation, engineering, industry, military, recreation, social history, and/or transportation. This document evaluates the resources of the Tennessee Valley Authority hydroelectric system from the period 1933-1979 through subtypes based on function or purpose at an individual hydroelectric site.

All of the twenty-five sites include a dam, and all but two (Normandy and Tellico) have hydroelectric buildings and structures. Of the twenty-five projects TVA completed between 1933 and 1979, nine (Kentucky, Pickwick Landing, Wheeler, Guntersville, Nickajack, Chickamauga, Watts Bar, Fort Loudoun, and Melton Hill) include navigational locks and associated operational buildings. Some of the projects have vehicular roadways and bridges. As part of TVA's mission as a public agency, all the sites include some number of recreational facilities. Most of these buildings and structures were developed after World War II, due to war shortages of construction materials, but were planned components in each original design. Visitor buildings, picnic areas, campgrounds, boat launches, and swimming beaches are associated with recreation. At most of the project sites, the TVA also built maintenance yards to house the offices and equipment buildings needed to support the landscaping and grounds upkeep of the buildings and recreational areas. At a number of the sites the TVA constructed buildings for its own security forces, the TVA Police. These common property types can be found at the majority of the TVA's hydroelectric facilities. This document discusses the character-defining features and associative qualities of the property subtypes of Historic Resources of the Tennessee Valley Authority Hydroelectric System, 1933-1979.

Subtype A: Hydropower-Related Properties

1. Dams

The TVA primarily constructed two types of dams, gravity dams of concrete and rock and fill dams of stone and earth (*Figures 14-38*). Gravity dams are rigid structures that withstand water pressure due to their own weight. Advances in concrete and reinforced concrete led to the construction of many new gravity dams in the United States in the early twentieth century. Construction methods were progressively made uniform; reaching standardization around 1930. The cross section of gravity dams is in principle the minimum volume profile that gives no tensile strength to the dam body under normal conditions. The upstream face is vertical while the downstream face is usually inclined or canted at various angles. Concrete is typically poured in interconnected blocks to give optimum density, imperviousness, and mechanical characteristics. Gravity type dams are considered one of the safest types with few examples of failure since the mid-twentieth century.

Fourteen of the sixteen dams that TVA constructed prior to 1945 are concrete, gravity dams and range in height from ninety-four feet at Guntersville to 480 feet at Fontana. Many of the concrete dam structures are flanked by earth embankments to provide additional support and reinforcement along the reservoir banks. The dams have a series of steel radial sluice gates that are opened and closed to control water flow over the tops of the dams. Tainter gates, which are a type of radial arm floodgate, are also used to control water flow. Also associated with dams are gantry cranes (*Figure 39*). These steel cranes are located at the top of dams and are used to raise materials to the top of the dam. Typically, the cranes move along a steel track and help to raise and lower sluice and tainter gates. Additional trash rack gates are below the water level to keep debris from entering the

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penstocks, which lead to the turbine chambers. Once through the turbine chambers, the water is discharged into the tailwater areas below the dam. The dams built by TVA to 1945 primarily have exterior surfaces that are smooth or of board-form concrete. In the latter, the grain of the wood-board form is imparted into the concrete surface as the concrete sets and remains visible after the frame mold is removed (*Figure 40*).

While most dams were built with sluice gates to assist in excess water flow, others were built with diversion tunnels or morning glory spillway tunnels (*Figure 41*). At Fontana, the spillway opens into a tunnel that then discharges the excess water into the river below the dam. The Watauga and South Holston Dams have funnel or "morning glory" spillways (*Figure 42*). These are concrete structures with a circular mouth parallel to the water surface of the reservoir above the dam. The morning glory design allows rising reservoir water to spill into its mouth and be channeled down through its funnel, instead of going over the dam. This water is expelled at some distance below the dam and therefore protects the dam from the potentially harmful pressure of excessive reservoir levels.

On top of most dams are walkways to provide access to the cranes and gates. At Norris, Douglas, and Cherokee are two-story visitor observation towers built at the top of the dam. These provided visitors with views of the dam and powerhouse below. The design of nine of the dams accommodated vehicular local or state highways on the concrete deck of the dam or elevated above the dam on steel piers. For examples, the Norris Dam was built with the Norris Freeway (U.S. 441) on top of the dam, and Tennessee State Route 68 was constructed on steel piers over the top of Watts Bar Dam (*Figure 43*).

In addition to the gravity dams, the TVA also constructed five dams of earth and rock fill. Rock fill dams are strong but also require an impermeable sheathing on their upstream faces such as rock, rammed earth, or concrete. The Nottely and Chatuge dams, built in 1942, are of earth and fill, as are South Holston, Watauga, and Tims Ford. The Nottely, Chatuge, and Tims Ford projects have concrete sluiceways and gates that channel excess water away from the dam during periods of high water. Associated with these dams are intake buildings which assist in regulating the flow of water to the powerhouses. These are free-standing concrete and steel structures built within the reservoir and reached by elevated walkways (*Figure 44*).

Listed resources: There are no properties of this subtype in the TVA region built between 1933 and 1979 currently listed in or determined eligible for listing in the National Register.

2. Powerhouses and Control Buildings

Powerhouses are the buildings that contain the generators and turbines of hydroelectric systems and were often built integral with the dams or freestanding adjacent to the dams (*Figures 45-47*). Most powerhouses also contain a control room for the operation of the dam, however separate control buildings were also constructed by the TVA independent of the powerhouse. The TVA's powerhouses built before 1945 are typically of reinforced concrete construction and have exterior walls of concrete, board-form concrete or panels of Indiana Limestone. Those built after 1945 are of both concrete construction and steel frame with exteriors of concrete aggregate and aluminum panels.

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The powerhouses designed by the TVA architects range between two and four stories in height. The smallest powerhouses such as at Nottely and Chatuge have two floors with the generators on the lower level and the control panels and electrical switchboards on the main level. The larger powerhouses such as Norris, Fontana and Wheeler have multiple levels of much greater complexity.

The TVA powerhouses were built with both “indoor” and “outdoor” designs. Indoor designs are those where the generators are completely enclosed within a building and rest of the floor of the powerhouse with the turbine chambers below. The outdoor designs have generators that operate beneath exposed steel cowlings with their roofs protruding above the generator room. The majority of the powerhouses built by the TVA are the indoor type with the generators housed within a large generator or “service” bay. The outdoor design was used for the powerhouses at the Boone, Fort Loudoun, Hiwassee, Watts Bar, and Wheeler projects.

The exteriors of the powerhouses built before 1945 were designed by TVA Chief Architect Roland Wank in the Streamlined Moderne style and are remarkably similar. The powerhouses featured smooth exterior walls, banks of aluminum windows, and flat roofs. The names of the projects were outlined in bold aluminum letters on the building’s exterior. Because of the tall floor-to-ceiling heights required to install and move turbines and other equipment, the powerhouses were built with a large equipment entrance on the main façade. Some powerhouses retain their original steel equipment bay doors while others have replacement overhead track steel doors. Original pedestrian entrances into the buildings display aluminum and glass doors. Most powerhouses were built with large expanses or banks of aluminum and glass windows to allow light into the offices and generator rooms. Some windows are fixed panels while others were operable with upper or lower hopper and awning panels.

In contrast to the restrained exteriors, the visitor’s reception rooms, or main lobbies were designed with ornate interiors consisting of terrazzo floors, marble walls, plaster ceilings and brushed aluminum doors (*Figures 48-52*). Details such as light fixtures, water fountains, and reception desks were all designed to harmonize and reflect their modern era. Many of the lobbies displayed painted murals and information on the TVA system. All of the lobbies had lettering on the wall proclaiming “BUILT FOR THE PEOPLE OF THE UNITED STATES.” From the reception rooms, visitors could enter rooms which had large glass windows to view the control operations beyond or enter galleries to observe the operations in the generator room.

Beyond the visitor’s lobbies, the interior of the powerhouses became more utilitarian in design, although the Streamlined Moderne style’s influence carried over into curved stairwells, aluminum doors, and office areas. The large generator rooms were built with tile floors, tile and concrete walls and concrete or steel paneled ceilings (*Figures 53-54*). In the multi-story office and service areas many of the corridors were built with terrazzo floors, plaster walls and ceilings. Descending below the generator rooms, the floors, walls and ceilings of the corridors and service areas are primarily of poured concrete. Connecting the powerhouse with the switchyard are concrete tunnels containing trays of electrical cables.

The main equipment within the powerhouses are the turbines, generators, and switchboards that transform the power of moving water into electrical energy. The majority of TVA’s hydroelectric facilities have mixed flow or Francis-type turbines, which combine inward and axial flow. Variations of

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this type of turbine were common by 1933. Most generators and turbines in the powerhouses are original but have been refurbished or rebuilt in past decades.

The powerhouses built after 1945 are simpler and more functional in form, as the influences of the Moderne era waned. The next powerhouses built by the TVA were on the South Holston River and its tributary, the Watauga. Constructed between 1948 and 1953, the South Holston projects include Fort Patrick Henry, Boone, Watauga, and South Holston. The Fort Patrick Henry project powerhouse is integral with the dam and displays a large band of "boxed" aluminum clerestory windows to illuminate the generator room. In contrast, the Boone and Watauga projects were built with powerhouses separated from the control buildings. The Boone powerhouse was of concrete construction, while Watauga had a structural steel frame with an exterior of aluminum panels. The South Holston project's powerhouse was built with an exterior of aluminum, but also featured a wall of fixed aluminum windows on its primary elevation. The Melton Hill powerhouse is of concrete with a row of structural glass block clerestory windows below the roofline. The Nickajack powerhouse built in 1967 has an exterior of aggregate concrete panels. The last powerhouse constructed by the TVA at Tims Ford has an exterior of concrete and fixed aluminum windows.

Almost all of the hydroelectric projects built by TVA before 1945 had the control operations located within the powerhouses. The one notable exception was the separate control building constructed at Watts Bar. The constrictions of the topography led to the placement of the control building on the bluff just above the powerhouse with the two connected by an underground tunnel. The control building was one of the TVA's most notable examples of the Streamlined Moderne style with an elliptical primary elevation with curved walls, large expanses of glass and an observation deck (*Figure 55*). The control building also served as the visitor's center which had an ornate lobby of terrazzo and marble. This building suffered a fire in 2012, but most of its decorative features were not damaged and have been stabilized awaiting restoration.

After 1945, the TVA also built two control buildings separate from their powerhouses at Boone and Watauga. These are both one-story in height and are similar with one-story office wings and high bay wings containing the control panel and equipment. The office wings have brick exteriors and fixed aluminum windows. The Watauga control building's high bay section is of aluminum panels, while the high bay wing at Boone is of brick. The interiors of these buildings are similar with visitor reception rooms, offices and the main control room.

3. Pipelines, Tunnels, Surge Tanks, Penstocks and Canals

This property type includes structures that are associated with the transference of water from a dam to the turbines within a powerhouse. Penstocks are conduits to supply the water from the dam directly to the turbine chambers and for the majority of the TVA's projects the penstocks are part of the dam structure. Some of the TVA projects have dams and powerhouses separated by many miles and require the transference of water via penstocks such as at Apalachia and Ocoee No. 3 (*Figure 56*).

Pipelines and tunnels are both used by the TVA at the Apalachia, Ocoee No. 3 and Hiwassee projects to transfer water from the dams downstream to the powerhouses. Pipelines transfer water above-ground while tunnels channel water below-ground. The only example of a pipeline in the TVA hydroelectric project is at the Apalachia Dam. This pipeline is elevated several feet off the ground and

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is supported by poured concrete piers or footings (*Figure 57*). This pipeline is above-ground for a short distance before it goes below-ground and becomes a tunnel to the surge tank. This pipeline and tunnel is 8.3 miles in length. The above-ground sections of the pipeline are eighteen feet in diameter and rest on steel support beams. Tunnels are also used to connect the Watauga and Ocoee No. 3 Dams with the powerhouses. The Ocoee No. 3 tunnel is 2.5 miles in length while Watauga's tunnel is 3,700 feet long.

Once the tunnels and pipelines reach the vicinity of the powerhouses the water flows into a surge tank. Surge tanks are steel devices that provide relief of pressure over long water conduit systems. For hydroelectric power, a surge tank is an additional storage space or reservoir fitted between the reservoir and the powerhouse or as close to the powerhouse as possible. Surge tanks mitigate pressure variations due to rapid changes in the velocity of water.

Surge tanks can be built directly into ground or as large, tall steel standpipes. At Apalachia, the surge tank is a cylindrical steel and concrete structure built below-ground into the ridge above the powerhouse. The Watauga project has a similar below-ground surge tank with a secondary surge tank of free-standing concrete adjacent to the powerhouse. Both the Hiwassee and South Holston projects have tall, freestanding surge tanks above the powerhouse (*Figure 58*). From the surge tanks the water continues into penstocks of steel pipes that then enter the powerhouse.

Canals can also be used to transfer water from one waterway to another. The only use of a canal in the TVA hydroelectric project is the canal built at Tellico Dam to provide water into the Fort Loudoun Reservoir. This short canal is less than 2,500 feet in length but is wide enough to allow barges into the Tellico Reservoir and add an additional 23 megawatts of power to the Fort Loudoun powerhouse.

4. Switchyards and Transmission Towers

Switchyards are enclosed areas adjacent to the powerhouses for the transformation of electrical current. The low voltage electricity produced by the generators in the powerhouses flows through electrical lines to the switchyards. In the switchyard, transformers increase the voltage to a level required for efficient transmission on transmission lines. High voltage (the pressure of the electrical current) is needed to transmit power efficiently over long distances and the transformers in switchyards increase electrical voltage for cross-country transmission. Switchyards contain a wide array of electrical equipment such as transformers, generators, surge arrestors and circuit breakers which are arrayed on a series of steel piers and grids (*Figure 59*).

Once the voltage is increased in the switchyards it is relayed away from the hydroelectric project by a series of steel transmission towers. The electricity is transmitted through cables that are suspended from the towers. The TVA's transmission towers are typically lattice design and rest on concrete piers. They generally range from 110 to 150 feet in height and there may be several transmission towers carrying the electrical cables away from the switchyard before the transmission lines leave a project's boundary.

At the majority of the TVA's powerhouses, the switchyards are located within several hundred feet as freestanding structures and receive power through underground cables. The Pickwick Landing Dam differs in that it has its switchyard built directly on top of the dam. The TVA's switchyards are

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enclosed within chain link fences and have gravel and concrete surfaces. The steel piers and towers in the switchyards which support the electrical equipment have concrete pier foundations.

5. Support Buildings and Structures

This property type refers to small ancillary buildings and structures which support the overall operations at the TVA's hydroelectric plants. These buildings and structures can include storage facilities, garages, oil purification facilities, and control equipment buildings. Support buildings are generally of concrete or metal construction, and may be located adjacent to the dams and powerhouses or within the switchyard enclosures.

Subtype B: Transportation-Related Properties

1. Navigational Locks

Navigational locks were built by the TVA in cooperation with the U.S. Army Corps of Engineers at all of the dams on the Tennessee River including Kentucky, Pickwick Landing, Wheeler, Guntersville, Nickajack, Chickamauga, Watts Bar, and Fort Loudoun (*Figure 60, 61*). This construction provided for a nine-foot channel and navigable waterway from the mouth of the river to Knoxville. A navigational lock was also constructed at the Melton Hill Dam on the Clinch River (*Figure 62*). These locks are similar in design and performance. From north of Knoxville to the convergence with the Ohio River, the Tennessee River drops a total of 513 feet in elevation. The TVA system of locks allows boats to ascend or descend the river in a controlled current travelling from one reservoir and water level to the next.

Each lock consists of a chamber of steel and concrete with parallel walls, steel gates at each end, and pumps for forcing the water into and out of the chamber. Some of the dams were built with only one lock while others had both a main and auxiliary lock. The original locks constructed before 1945 had chambers measuring sixty feet in width by 360 feet in length or 110 feet in width and 600' in length. As river traffic increased, new locks were added to several of the dams in the 1960s. The largest of these is at Pickwick Landing, which is 110 feet wide and 1,000 feet long. At the Kentucky Dam a new navigational lock is under construction which will be 1,200 feet in length upon its completion.

The locks are integrated with the overall dam design and sited close to the left or right bank of the river. The locks have concrete decks, chamber walls of reinforced concrete, and large vertical leaf-type steel gates which open and close the chambers. On top of each lock are a series of lock control buildings which were built in the 1950s and 1960s. These are small buildings of concrete block with metal roofs which house machinery for the lock controls.

2. Lock Operation Buildings

Adjacent to each of the navigational locks were the lock operations buildings. These were used by the lock operators of the U.S. Corps of Engineers to manage the lock system. Most are two stories in height and have the main control room on the first floor and offices on the second floor. The lock operation buildings at Kentucky (*Figure 63*), Chickamauga, Fort Loudoun, and Watts Bar date to the original construction of the dams. At Guntersville is the original lock operation building from 1939, but

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a new operation building constructed in 1965 now handles the lock traffic. The Wheeler lock operation building was built in 1963, and at Pickwick Landing the original building was replaced ca. 1980.

The pre-1945 lock operation buildings were designed in the Streamlined Moderne style. One of the most notable is the building at Kentucky Dam which was designed with a curved primary façade in the shape of a ship. In addition to its elliptical façade, the building also displays numerous porthole windows on the side elevations. The lock operation buildings at Chickamauga and Guntersville were designed with similar details and rather than have curved primary facades these were given more angularity with chamfered corners. The lock buildings at Fort Loudoun and Watts Bar are also very similar to each other and have flat roofs, wide eaves, porthole windows to illuminate the interior staircases and open breezeways and a second story visitor's deck set within an open breezeway.

The lock operation buildings constructed before 1945 retain much of their original and exterior detailing. The exterior walls are of smooth concrete and most windows are fixed aluminum design. Interiors feature terrazzo floors and plaster walls and ceilings. Those built after 1945 are of concrete construction with restrained detailing.

3. Vehicular Roadbeds and Bridges

The planning for TVA's hydroelectric projects included discussions with local and state officials to assess transportation issues. Construction of the TVA reservoirs often resulted in the elimination or rerouting of ferry crossings, bridges and highways. To facilitate crossings of the rivers and reservoirs, the TVA architects and engineers located some highways directly on top of the dams or planned for their construction at a later date. When Norris Dam was built, the Norris Freeway was designed to cross on top of the dam. This approach was also taken with the Wheeler Dam, and Alabama State Route 101 was incorporated into the top of the dam. At Hiwassee, an access road was built on top of the dam to connect with mountain settlements on the west side of the reservoir. At the Kentucky Dam the original design incorporated not only a highway across the top of the dam but also the Illinois Central Railroad tracks. Both the highway and railroad have since been relocated away from the dam.

With the increase in highway traffic in the 1950s, several of the dams were reconfigured to support elevated highways. These included the construction of State Route 153 over the Chickamauga Dam in 1954, State Route 128 over the Pickwick Landing Dam in 1963, State Route 73 (U.S. 321) over the Fort Loudoun Dam in 1963, and State Route 68 over the Watts Bar Dam, ca. 1965. These roadbeds and bridges reflect typical concrete and steel designs of their periods. The TVA also built several bridges to access their hydroelectric projects. Access bridges were completed over a railroad line at Nickajack, over the Ocoee River at Ocoee No. 3, and over the Elk River at Tims Ford.

Subtype C: Recreation-Related Properties

1. Visitor Buildings

An important approach in the design of the TVA's hydroelectric projects was to make them accessible to the public. This was addressed by incorporating welcoming public lobbies in each of the powerhouses and by constructing visitor buildings containing information on the TVA and hydropower. The visitor buildings were designed with the same Streamlined Moderne forms and

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details as the powerhouses (*Figure 64-66*). The most notable of these were built at Fontana, Watts Bar and Norris. At Fontana, the main elevation facing the dam has an elliptical observation bay and deck with large expanses of aluminum windows. The reception room and gift shop are separated from the public restrooms by an open breezeway. A unique feature of Fontana was the utilization of an incline cab for visitors to be transported to the powerhouse below. This incline and rail line remains extant although currently not in operation.

The Watts Bar visitor building and control building were designed as one structure and featured a streamlined primary façade with an elliptical wall and deck for viewing the dam below. The sleek design was accented by steel and aluminum railings and large banks of windows. The original visitor building at Norris was a stand-alone design and featured an elliptical canopy over the main entrance and the entrance was flanked by porthole windows. These porthole windows were one of the defining characteristics of the Streamlined Moderne style of the 1930s.²⁹⁴ This design was replaced with the larger visitor building ca. 1950.

After 1945, the TVA constructed a series of new visitor buildings at many of its projects. These designs were more reflective of the International style and featured exteriors of concrete and stone veneer and central breezeways faced with wood siding. The visitor buildings had restrooms and a viewing area as well as offices of the TVA Police. These plans included one-story designs with flat or butterfly roofs such as at the South Holston and Watauga projects while others were banked into the slopes with a lower level and butterfly roofs such as at the Douglas, Fort Patrick Henry, and Melton Hill projects (*Figures 65, 66*). The lower levels were designed to house offices of TVA security while on the main level the reception room had a large bank of windows overlooking the adjacent dam and lake. Some of the reception rooms were built with terrazzo floors and displayed information on TVA and its mission as well as murals commissioned by the agency.

2-3. Picnic Areas/Campgrounds

The majority of the TVA projects were designed for public access use and the encouragement of recreational activities. The TVA landscape architects designed attractive parking area, walkways, overlooks, benches and other structures to enhance the visitor experience. Picnic areas were designed with concrete picnic tables beneath shade trees or at open areas overlooking the dams (*Figure 67*). Following World War II, additional recreational opportunities were added to the projects including campgrounds. The campgrounds were designed to conform with the topography and were also built with concrete picnic tables, tent platforms and restroom/bathhouse facilities (*Figure 68*). A standardized plan restroom/bathhouse plan was widely used at the campgrounds and picnic areas developed in the 1950s and 1960s. In recent decades the TVA has built a number of picnic pavilions at the picnic areas and campgrounds. These are generally of frame construction and rest on concrete foundations.

These recreational areas were designed specifically at the hydroelectric projects and were intended to be part of the visitor's experience at the facilities. Other larger recreational areas such as the demonstration parks at Norris and Pickwick Landing were leased or sold to various states for their incorporation into state park systems.

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4-6. Fishing Piers/Boat Ramps/Swimming Beaches

In the years following World War II, the TVA made additional strides to provide recreational opportunities for visitors at the hydroelectric projects. The increased interest in boating led to the completion of parking areas and boat ramps. These were often sited downstream from the dams and generally consist of paved ramps which lead from the parking areas into the reservoir. The popularity of fishing at the projects led to the construction of a series of piers designed specifically for this purpose (*Figure 69*). Some of these were built in close proximity to the downstream side of the dam for fishing in the tailwaters area. Others were built further downstream near picnic areas and campgrounds. These piers are generally of concrete and with metal railings. Swimming beaches were also added at many of the projects upstream from the dams. These were built with sand beaches and often have associated picnic areas and bathhouses.

Subtype D: Maintenance-Related Properties

1. Grounds Operation Offices

The demands for regular maintenance and landscaping at the TVA hydroelectric projects led to the construction of maintenance yards after 1945. These maintenance yards were generally located some distance away from the dams and were enclosed within metal fencing. The maintenance yards typically contained a ground operations office along with a series of support buildings and structures. A standardized plan developed in the 1950s was employed at many of the projects for the grounds operation offices. These were one-story, concrete block buildings with an office area, workshop area and garage bays (*Figure 70*). These designs featured aluminum windows, gable roofs, and a shed roof dormer with clerestory windows. The interiors had wood floors and walls and ceilings of drywall. There were a number of variations in design of these offices with at least one frame maintenance office building remaining intact.

2. Garages/Storage Buildings

In addition to the grounds operations offices, the maintenance yards were also built with a series of support structures including equipment garages, storage sheds and hazardous material storage sheds. Some of these are original to the development of the maintenance yards after 1945 while others were built in recent decades. Those which date to the mid-twentieth century are utilitarian in form and are often of concrete block construction. Standardized plan hazardous material storage sheds were built at many of the projects and these are small concrete block structures with chain link doors for ventilation. Those built in recent decades are generally pre-fabricated steel or aluminum construction with flat metal or gable roofs.

Subtype E: Public Safety Service Buildings

As part of the TVA's open visitation policy of its project sites, Public Safety officers were on staff to lead tours. This program evolved into the TVA Police force, which patrolled the grounds of the hydroelectric projects and also oversaw security at the picnic grounds and campgrounds. Separate buildings to house the police force were built at many of the hydroelectric projects in the 1950s and 1960s. The offices of the TVA Police were housed in a variety of buildings. Some were designed with

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only police offices while others were also built with public restrooms. At the Kentucky project, the Public Safety Security (PSS) Building is located to the east of the powerhouse and is a one-story building with public restrooms. At the Cherokee project is a one-story, stone-veneer building with an open breezeway. Public restrooms are on one side of the breezeway with the police offices on the opposite side (*Figure 71*). As previously noted, a number of visitor buildings were designed with restrooms and viewing areas on the upper level with police offices on the lower level. The TVA police force was federalized during the 1990s and then disbanded in 2012, and these office spaces are now vacant or in the process of repurposing.

3. Significance

Criterion A

The historic resources of the Tennessee Valley Authority Hydroelectric System, 1933-1979 are significant under Criterion A for their association with events that made an important contribution to the broad patterns of development of the Tennessee Valley Region. These resources important under Criterion A relate to the following areas of significance: agriculture (for association with improvements in farming methods and development of fertilizers), conservation (for association with reforestation and erosion control from mining and agriculture), engineering (for association with development of a unified river system for flood control and advances in integrated lock and dam construction), industry (for association with power generation for residential and industrial use and economic development), military (for association with development of the Manhattan Project and other industrial development for the World War II war effort), recreation (for association with planning and development of public recreational facilities), social history (for association with the improvement of quality of life across the rural Valley region through job and education opportunities, economic development, and production of electricity), and transportation (for association with development of 652-mile navigable water transportation channel and its effect on the economy).

The historic resources of the Tennessee Valley Authority Hydroelectric System, 1933-1979 are comprised of the dams, powerhouses and control buildings, pipeline, tunnels, surge tanks, penstocks, and canals, switchyards and transmission towers, navigational locks, lock operation buildings, vehicular highways and bridges, visitor buildings, picnic areas, campgrounds, fishing piers, boat ramps, swimming beaches, grounds operation offices, garages and storage buildings, and public safety service buildings that compose individual historic districts, the twenty-five TVA hydroelectric project sites. Collectively, these resources are important to the overall TVA system that operates interdependently among the twenty-five project sites. The historic resources of the Tennessee Valley Authority Hydroelectric System, 1933-1979 reflect the multi-faceted contributions of the TVA within the Tennessee Valley region during this period.

As a component of FDR's New Deal program, TVA was established to address collectively the economic and social factors afflicting the Tennessee Valley, an especially impoverished region of the nation. TVA's planners and engineers considered the Valley, its people, and its problems as a unified whole: a problematic river channel had historically hampered navigation, impeding economic growth; seasonal flooding caused damages to crops, homes, and portions of towns and cities; row-crop agriculture (as well as mining) had eroded topsoil, hindering agricultural productivity; living conditions were below national standards in housing and education due to limited resources and isolation. TVA's system of dams and locks across the Tennessee River not only brought about flood control and

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navigational improvements, but engendered opportunities and amenities previously unknown to most area residents.

By engineering control of the river, TVA brought stability to flood-prone municipalities and isolated farmsteads. TVA also worked directly with county agricultural service agencies to introduce new farming methods and fertilizers, helping local farmers to reverse the ravages of soil depletion and erosion. In the process of clearing land for reservoirs, TVA employed local residents and addressed conservation issues. At project construction sites, TVA spread the necessary man-hours into as many part- and full-time shifts as possible to employ the greatest number.

Though thousands of residents were displaced by TVA's reservoirs, many people felt their lives were improved by the TVA projects; at some sites, employment with TVA helped to elevate tenant farmers to the status of property owners. Most residents of the region came to feel that the benefits of TVA projects outweighed their adverse effects. TVA played a prominent role in improving the people and culture of the Valley Region through electrification, the elimination of malaria, the promotion of regional and community planning, and overall quality of life. Although many cities and smaller communities in the region had some type of municipal power system, most rural areas had few electrical systems. In 1930, only ten percent of American farms had electricity, and even less in Valley states such as Kentucky, which only had four percent of its farms electrified.²⁹⁵ Most farmers still illuminated the interiors of their homes and farm buildings with kerosene lanterns, cooled their perishables with root cellars and springhouses, and heated their homes with wood or coal. Much of the rural south did not previously have electrical power, and residents' quality of life fell far below national standards. The electrical power produced by TVA was transmitted to many communities throughout the region, transforming daily life.

Tupelo, Mississippi, was the first community to acquire TVA electricity on February 27, 1934 from the Wilson Dam and many others soon followed. As the first dams were completed and transmission lines erected, the TVA partnered with the Rural Electrification Administration (REA) to bring electricity to farmers. For private companies, the cost of extending transmission lines into rural areas averaged two thousand dollars per mile, and the payback on this investment was poor compared to urban areas. President Roosevelt created the temporary Electric Home and Farm Authority in December of 1933 to assist potential consumers in the TVA region to purchase electrical appliances. The Electric Home and Farm Authority lent funds to farmers in test areas to determine what the market might be for TVA electricity. After appliance sales in the test areas increased by 300 percent, Roosevelt and Congress increased funding for the REA for rural electrification.²⁹⁶

By the end of 1935, the TVA had worked with the REA to build over 200 miles of rural electric lines in the region (*Figure 72*). A follow-up survey of households along the new rural lines in Alabama found that eighty-nine percent had electric irons to replace the heavy, iron ones which had to be heated on stoves or fireplaces, and that sixty-nine percent had radios for entertainment.²⁹⁷ As soon as farms were electrified, the purchase of labor-saving appliances soon followed.

TVA also signed its first large industrial contract in 1936 to provide 50,000 kilowatts of power to the Monsanto Chemical plant in Columbia, Tennessee.²⁹⁸ This was followed by contracts with the Aluminum Company of America (ALCOA) totaling 100,000 kilowatts in 1937. By the fiscal year of 1940, industry took nearly a third of the power sold by the TVA. The number of customers served by

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TVA power increased during 1939 from 94,900 to 365,800. In 1939, appliance sales totaling over seven million dollars were made by dealers in TVA-served areas. These sales included 15,806 refrigerators, 7,655 ranges, 2,621 water heaters, 962 water pumps, 2,002 electric space heaters, 8,936 washers, and 108,935 miscellaneous small appliances.²⁹⁹

As a public utility, TVA was able to sell its electricity sixty-three percent below the national average. When TVA power was installed in a community it was reported that "...where TVA power has been sold, domestic consumption has doubled in the first eighteen months, even in depression years. The average use in all communities during 1935 was 61% more than the national average."³⁰⁰ By 1939, 1,500 miles of transmission lines were built in the Valley Region to serve 105,800 consumers, of which one-third lived on farms.³⁰¹

The increase in electrification to urban and rural areas in the Tennessee Valley had a transformative effect on households and everyday life as well as overall economic development. Electricity was seen as a force that could give the Valley "universally high standards of living, new and amusing kinds of jobs, leisure, freedom, and an end to drudgery, congestion, noise, smoke and filth."³⁰² For farmers, electricity was promoted as a means of stabilizing the economy through preservation and marketing of agricultural products through refrigeration. To further the goals of TVA, the agency also sponsored classes and community meetings promoting modern appliances, improved farming techniques, and job training. In 1939, more than 5,000 classes for adults on subjects ranging from simple vocational training to regional planning and engineering were offered by TVA.³⁰³

TVA also created an attractive environment for development of the secret Manhattan Project during World War II. One of the primary reasons for locating the Manhattan Project's uranium plants at Oak Ridge was the assurance of large amounts of electrical power from the TVA system. The electricity produced in the TVA system was also utilized for operations at the Alcoa facilities for aluminum production in East Tennessee, the Ingalls Shipyard in Decatur for landing craft production, and numerous other factories in the region. Of the twelve billion kilowatt hours of energy produced among the TVA system from 1941 to 1945, sixty-six percent was devoted to the war effort.

The electrical power produced by the TVA's hydroelectric projects proved crucial to America's military during World War II. The Army's secret Manhattan Project, which would build the first atomic weapons, chose the site of Oak Ridge, Tennessee in 1942 in large part because of the availability of TVA power.³⁰⁴ Over the next year, the city of Oak Ridge was created along with the three nuclear production plants code named Y-12, X-10, and K-25. Powered by TVA electricity, these three plants produced the uranium and plutonium necessary for the production of atomic weapons. The TVA also sent large quantities of electricity to ALCOA's smelters at its plants near Maryville. ALCOA was already a major customer of TVA before the war, but the demands for the military increased production dramatically. The aluminum production of ALCOA was one of the most important war-time industries for the building of military aircraft. From 1941 to 1945, ALCOA experienced a 600 percent increase in production and a \$300 million expansion. By 1945, ALCOA's fifteen hydroelectric plants in East Tennessee and western North Carolina were furnishing fifty percent of its power while the TVA supplied the other half.³⁰⁵

After the war, TVA's power was increasingly made available to industries. During the early post-war years, the TVA supplied electricity at a rate less than half the national average per kilowatt-hour.

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Inexpensive and abundant electricity supplied by the TVA hydroelectric dams attracted manufacturing interests needing large power supplies, thereby creating jobs. Manufacturing helped diversify the historically agricultural economy. In addition, farmers could supplement their income with manufacturing work and receive an adequate and stable income. The pay rate for a manufacturing job in the region increased by 442 percent compared with the national average. By 1946, the TVA's power plants had a capacity of 2.5 million kilowatts of power and brought electricity to 668,000 households in the Tennessee Valley. Further, making the entire river navigable connected the Tennessee Valley to the nation's Inland Waterway System – eleven thousand miles of interconnected rivers linking geographic areas, major markets, suppliers of raw materials, processors and consumers.

In cities such as Chattanooga, electric heat and cooling systems gradually gained favor and replaced coal and gas furnaces. In 1947, the Electric Power Board of Chattanooga reported that the installation of electrical heating had jumped from 300 households to 1,114 households in just eight months and that the Board expected that number to increase to 1,400 by the end of the year. The Board stated that for the typical homeowner, "cheap power supplied by the TVA has provided a great deal of the stimulus towards electrical heating....By the time the savings in redecoration and labor are considered along with the increased cleanliness, comfort and convenience, he will find that his electric heating actually becomes an economical luxury."³⁰⁶

TVA also had a dramatic, beneficial impact on the region's degraded landscape. By 1942, through TVA's conservation program, 110,000 acres of eroded lands had been planted. Private landowners continued to receive free seedlings, and between 1943 and 1957, 240,000 acres of private land were planted for a total of 350,000 acres reforested.³⁰⁷ In 1953, 8,282,000 seedlings were grown at the Muscle Shoals tree nursery and distributed while the Clinton nursery produced 12.8 million seedlings. Of the twenty-one million seedlings produced in the 1953-54 season, twelve million were planted within the Tennessee Valley under a cooperative program involving state forestry and extension agencies. Planned production for 1954 was about twenty-one million with fourteen million scheduled for use in the Valley.³⁰⁸

In addition to reforestation, destructive wildfires and uncontrolled grazing of livestock in the forests were addressed through TVA's educational programs. In 1947, TVA and the North Carolina Division of Forestry began a five-year study of fire control involving 1,688,000 acres of private forest land in fifteen counties. A major objective was to demonstrate how intensive prevention efforts could reduce annual fire risk. As a result of these efforts, fire losses declined from three percent of the forest land burned annually prior to 1947 to 0.22 percent in 1952.³⁰⁹ Following World War II, the planting of new trees was also a high priority in North Carolina's mountains. By 1950, across the region the percentage of forestland burned each year dropped to 4.7% and continued to drop over the next twenty-five years to 0.3% in 1970. Livestock grazing decreased to 12% of the forestland by 1960.³¹⁰

Another of TVA's major achievements in the social life of valley residents was the elimination of malaria. Recognizing that mosquitos carried this virus, the U.S. Public Health Service was active in the early 1900s to promote methods to reduce the mosquito population and institute other control methods. Even so, malaria still affected thirty percent of the population of the Tennessee Valley Region by the early 1930s. By raising and lowering water levels in the reservoirs the TVA was able to prevent mosquitos to propagate.³¹¹ During mosquito breeding seasons, the water levels were lowered

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by several inches which were able to prevent mosquito propagation. The editor of the *Florence, Alabama Times* reminiscing in 1970, considered "...eradication of malaria the greatest achievement of TVA. It is an accomplishment largely taken for granted because since 1949 not a single case of malaria has been recorded within the vicinity of TVA reservoirs."³¹²

A further contribution of the TVA to the region was encouraging local and county planning efforts and the creation of local commissions. When the TVA was created in 1933, it employed a large number of planners and sociologists to study the natural and cultural resources of the region. Not only was this information necessary to assist in planning for the hydroelectric projects, but also to encourage overall economic development. The TVA worked closely with municipalities affected by their projects to assist in community planning, establishments of parks, and locations for river terminals. In his study of the South, historian Dewey Grantham observed that, "the Authority subsidized and in other ways encouraged the establishment of bureaus of public administration in the southern universities; it also played a major part in the emergence of state and municipal planning commissions in the region."³¹³

Chattanooga historian James Livingood noted that "the availability of cheap power resulted in unprecedented changes throughout Hamilton County. New industry moved in while, at the same time, lights were turned on in homes in isolated coves and in mountainside cabins. Many of the day's ordinary chores were now done by electrical "servants"; as drudgery was reduced and comfort increased, the amount of available human energy increased, along with an expanding sense of pride in person and property."³¹⁴

Rural electrification in the Tennessee Valley occurred within a remarkably short period of time. By 1956, over 500,000 farm families received TVA power from fifty-one rural electric systems.³¹⁵ Over eighty percent of the region's farms had electric service compared with three percent in 1933.³¹⁶ Electrification brought increased prosperity to farmers in the region and assisted in the development of new industries and manufacturers in small towns and rural areas. In cooperation with the REA, the TVA had a major effect in improving the lives of Valley residents.

Historian Paul Conkin grew up on a farm in Greene County, Tennessee, and later wrote about the transformative effect of TVA electricity: "The local TVA distributor had extended electric lines to all of the homes in our village by 1950. This meant that everyone could have a refrigerator and a stand-alone freezer."³¹⁷ Farmers bought pumps to supply fresh water from wells and springs and indoor bathrooms could then be installed and eliminate the need for privies. Electric heaters did away with burning wood or coal in stoves and fireplaces. Electric ranges in the kitchen did away with the time consuming and labor intensive use of wood stoves. As Conkin noted, "Thus, in not much more than a decade, most local families had reduced the amount of work dedicated to home sustenance by at least 80 percent – few or no morning and afternoon chores (feeding, milking, gathering eggs, slopping hogs), no wood cutting for fuel, little canning or preserving of meats and vegetables."³¹⁸

In Bradley County, Tennessee historian Roy Lillard wrote in 1976 that "the coming of the Tennessee Valley Authority in 1933 was a godsend, and changed the lives of Bradley County farm people immeasurably for the better."³¹⁹ In 1930, only three percent of county farmers had electricity, and TVA's power lessened the burden of everyday chores. Lillard also cited the importance of the soil erosion programs and how TVA, with the cooperation of the University of Tennessee, began a

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program of soil conservation that “literally changed the appearance of parts of the county from eroded waste land to green pastures.”³²⁰

A review of the conservation programs of the TVA in 1975 found that a total of 1.5 million acres of land in the region had been reforested, resulting in major economic benefits. At that time, new forest product industries in the region produced more than \$1 billion worth of products annually and employed approximately 50,000 workers.³²¹ Bowater Southern paper mill in Calhoun, Tennessee, reflected this investment in trees as a renewable resource.

Many observers in the 1970s noted the vast changes in the agricultural development of the Tennessee Valley Region. Mechanization and electricity led to increased productivity and sales. Rural electrification and affordable electric rates resulted in refrigeration, safe lighting, and other labor-saving devices, enhancing farmers’ productivity and income. With electricity, farmers could refrigerate milk and expand dairy operations, use fans to cool poultry houses, and install water pumps for livestock and irrigation. Kentucky Historian Thomas D. Clark wrote, “Tennessee Valley farmland – once ravaged by erosion, floods and short-sighted patterns of cultivation – has been rebuilt into some of the most productive in the nation. In 1975 TVA area farms produced crops with an average value of \$417 per acre (well above the national average of \$262 per acre.”³²² From 1934 to 1978, farm product sales increased from \$113 million to \$1.7 billion, with an average of \$324 worth of goods per farm compared to \$16,500.³²³ Poultry sales, due to the ability to cool poultry with electric fans, increased from \$6 million to \$436 million during the same time frame.³²⁴ Mechanized milking machines led to the increase in sales of livestock and livestock products from \$51 million to \$721 million between 1934 and 1978.³²⁵

Beyond these achievements, the TVA is recognized as revolutionizing fertilizer production not only in America but around the world. The TVA’s National Fertilizer Development Center at Muscle Shoals is widely recognized as having a significant impact on the increase in crop yields in the twentieth century through the research and technology of TVA scientists.³²⁶ Today, TVA holds a number of patents for fertilizers, contributing the nation’s abundant food supply. More than 300 patents and over 700 licenses are credited to TVA technology. The TVA Center in Muscle Shoals developed more than seventy-five percent of fertilizers used worldwide or their processes of manufacture.

The engineering of TVA’s dams and reservoirs to control flooding is considered one of the great paybacks of the initial investment in their construction. In 1975, the cumulative flood control benefits were reckoned to be \$1.5 billion – more than six times the amount of capital invested in the construction and maintenance of the dams and reservoirs.³²⁷ Floods on the upper reaches of man-river reservoirs have been substantially reduced.³²⁸ For example, a deluge of ten inches of rain in 1971 fell in Chattanooga in just two days but the flood waters were held at seven feet above crest as opposed to the estimated 22.5 feet above crest without the dams. Although the city experienced thirty-five million dollars in damages from the flood, the estimate without TVA’s system of dams and reservoirs would have been five hundred million dollars.³²⁹ Today, the TVA dams and reservoirs prevent about \$240 million annually in flood damage in the region.³³⁰

At present, there are approximately 185 public- and private-use terminals along the Tennessee River. Decatur is the busiest urban port, handling over five million tons of river freight annually. Other major ports include Paducah and Calvert City, Kentucky; Florence, Muscle Shoals, and Guntersville,

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Alabama; and Chattanooga and Lenoir City, Tennessee. The improvements in navigation on the river have contributed greatly to the economic and industrial development of the Tennessee Valley as a whole. In north Alabama, the poultry industry would not have located where it did without water transportation. Decatur and Chattanooga would not have had the industrial growth and thriving economies they do were it not for the Tennessee River. Substantial investments have been made in waterfront plants, terminals and distribution facilities all along the river, providing employment for thousands of residents. The TVA locks also provide passage between reservoirs for an average of 17,000 recreational craft each year. The number of marinas in the same Tennessee River counties more than doubled during this time period. Boating-related industries, including boat manufacturing and retail dealerships, also contribute to the regional economy. Since 1988, boat manufacturing operations and dealerships have increased about sixteen percent in counties adjacent to the river.

TVA's impact across the Tennessee Valley region is multi-fold, influencing agriculture, architecture, conservation, engineering, industry, military, recreation, social history, and transportation. In his history of Benton County, Tennessee, Dewey Grantham states that "Socio-economically, because of the T.V.A., Benton County and its neighbors have undergone a transformation undreamed of half a century ago...Like a multitude of others throughout the Tennessee River Valley, Bentonians of the T.V.A. era owe the memory of Senator George W. Norris a generous and lasting respect."³³¹ Grantham's summation applies to the whole of the region, whose people, land, and economy transformed dramatically under the influence of TVA planning and installation of its twenty-five hydroelectric projects.

Criterion C

The historic resources of the Tennessee Valley Authority Hydroelectric System, 1933-1979 may be significant under Criterion C as collections of buildings embodying the distinctive characteristics of a type, period, style, or method of construction. These resources may be significant under Criterion C in the areas of architecture for reflection of a design, style, or method of construction or planning of overall project site. The TVA dams, powerhouses, control buildings, navigational locks, lock operation buildings, and vehicular highways and bridges, visitor buildings, public safety service buildings, and recreational buildings and structures may be significant under National Register Criterion C if they are notable for their architectural design and are part of a unified engineering concept for their operations. They may also be significant under Criterion C for displaying representative or technologically advanced engineering characteristics or components. They may also be significant under National Register Criterion C if they are notable for their architectural or landscape design. Those built prior to 1945 reflect the Streamlined Moderne style widely used by TVA architects at their hydroelectric projects. Those built after 1945 may also be notable for their International-style design and the majority of these buildings retain their original character.

Over the course of the period of significance, TVA's powerhouses, control buildings, and visitor buildings in particular reflect a shift in architectural style from Streamlined Moderne to a more functional, utilitarian design based in Miesian architecture. This movement reflected international trends in architecture, which were applicable to changes within the TVA. Before the war, the TVA's architecture was designed to embody energetic forward movement that complemented the productivity of the war effort and invoked the machinery in its clean, sleek lines. After the war, a more discreet, utilitarian design emerged. While TVA still developed visitor buildings and recreational

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facilities for public use, its post-war projects conveyed a sharply functional design signifying architecture of purpose rather than aesthetics. Several of the last hydroelectric projects even omitted from its walls the homage to the public, "BUILT FOR THE PEOPLE OF THE UNITED STATES OF AMERICA," as found at all the pre-war powerhouses and/or visitor buildings. The architecture of TVA's hydroelectric projects clearly convey their sense of time.

Criterion Consideration G

All property types may be significant under Criterion Consideration G if they were planned more than fifty years ago, are part of an interdependent and interconnected hydroelectric system, are less than fifty years of age and meets the registration requirements set forth in this document.

The Tennessee Valley Authority had a remarkable impact on the landscape, politics, and culture of the Southeast from its inception in 1933 to the final project completion in 1979. The hydroelectric system built and operated by the agency resulted in a substantial improvement in the quality of life in the region. In addition to producing power, and improving navigation on the Tennessee River, erosion, and poor soil quality were significant issues the agency was empowered to upgrade. Part of the agency's mission was to build recreational facilities, build a model community, and work with both large and small industries to provide employment and utilize the "new" electric power effectively. In accomplishing this, the physical landscape was altered immensely, displacing families and entire towns in the name of improving living conditions for the greater population. While all of the projects of the TVA were begun over fifty years ago, the completion of this initial program of the agency did not end until 1979. As a result, properties associated with the TVA from 1933 to 1979 may meet criteria consideration G for their extraordinary significance in the areas of engineering, conservation, industry, recreation, and social history.

4. Registration Requirements

To be eligible for listing as a historic resource of the Tennessee Valley Authority Hydroelectric System, 1933-1979 under this MPDF, a resource must: a.) be located within the geographic area defined in Section G (below); b.) have been constructed during the period of significance between 1933 and 1979; c.) possess historical associations related to TVA's hydroelectric project development of the region; d.) retain sufficient historic integrity to convey its significance. Within the context of a designed TVA hydroelectric project site during the period of significance, resources should retain original location, physical elements, aspects of designs, and historic associations. The seven qualities of integrity should apply.

These aspects include:

Location - A resource must be located at its original site.

Design - A resource must retain the majority of its historic construction elements. A resource should retain its historic appearance and configuration, including its historic engineering components as relates to design and function.

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Setting - A resource's historic physical setting must be intact. It should not be concealed or obscured by substantial buildings and structures constructed past its period of significance.

Materials - A resource must retain and exhibit its historic construction materials. It will still retain integrity of materials if in-kind replacement materials are used, including earth, rock, concrete, steel, glass, and tile to match the historic material. Replacement materials that do not imitate those from a resource's period of significance, or where there is a substantial loss of historic fabric, will result in a loss of integrity.

Workmanship - A resource must retain the qualities of workmanship that were imbued in its historic design and materials.

Feeling - Resources must retain a sense of time and place from its period of significance.

Association - Resources must be able to retain sufficient characteristics to link the property with its role within the context of hydroelectric power.

Unlike residential and commercial buildings, which experience alterations as architectural sensibilities change, engineering sites are products of function and tend to avoid stylistic alteration. Interiors of powerhouses and control buildings, as well as lock operation buildings, are the most likely location of alterations and renovations. Some of these buildings may have been retrofitted with dropped ceilings of acoustical tile and florescent lighting, though these materials are found originally, as well. At some maintenance yards, it may be common for original wood-sash windows to be replaced with vinyl designs. These alterations generally do not diminish the historic physical integrity of the resource. Major alterations resulting in negative impact would include a change in height of a resource, change in roofline, removal of character-defining features, or massive addition. These kind of severe alterations negate the resource's integrity. The addition of numerous new recreational features may have a negative influence on the integrity of a project's site plan.

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G. Geographical Data

This Multiple Property Documentation Form includes the Tennessee Valley Authority's hydroelectric projects constructed in the Tennessee Valley Region. The TVA constructed hydroelectric projects from 1933 to 1979 in Alabama, Georgia, Kentucky, North Carolina and Tennessee.

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H. Summary of Identification and Evaluation Methods

The “Historic Resources of the Tennessee Valley Hydroelectric System, 1933-1979” is based on an intensive survey and study completed for the TVA by the authors in 2015. This survey included site visits at all twenty-five hydroelectric projects built by the TVA to identify buildings and structures completed during this time period. At each project buildings and structures were described and photographed for inclusion within National Register individual nomination forms.

Historical research was conducted at various repositories in the Southeast. These included a review of source materials at the Kentucky State Library in Frankfort, the Alabama State Library and Archives in Montgomery, the Tennessee State Library and Archives in Nashville, and the North Carolina State Library and Archives in Raleigh. In addition, research occurred at the TVA Library at the TVA offices in Knoxville. This library contains project books written specifically for each hydroelectric project, periodicals related to TVA and its development and hundreds of volumes devoted to the history of the TVA and region.

The history of the TVA has been assessed by dozens of authors since the 1930s and the bibliography is extensive. This study concentrated on the hydroelectric projects and some of the most informative publications utilized in this study included *High Dams and Slack Water; TVA Rebuilds a River* by Wilmon Henry Droze, *TVA: The First Twenty Years, A Staff Report*, edited by Roscoe C. Martin, *TVA: Bridge Over Troubled Waters* by North Callahan, the *Tennessee Valley Authority: Design and Persuasion* edited by Tim Culvahouse, and *Built for the People of the United States, Fifty years of TVA Architecture* by Marian Moffett and Lawrence Wodehouse. The TVA Historian Patricia Bernard Ezzell provided her insights into the hydroelectric projects through her own publications and personal review.

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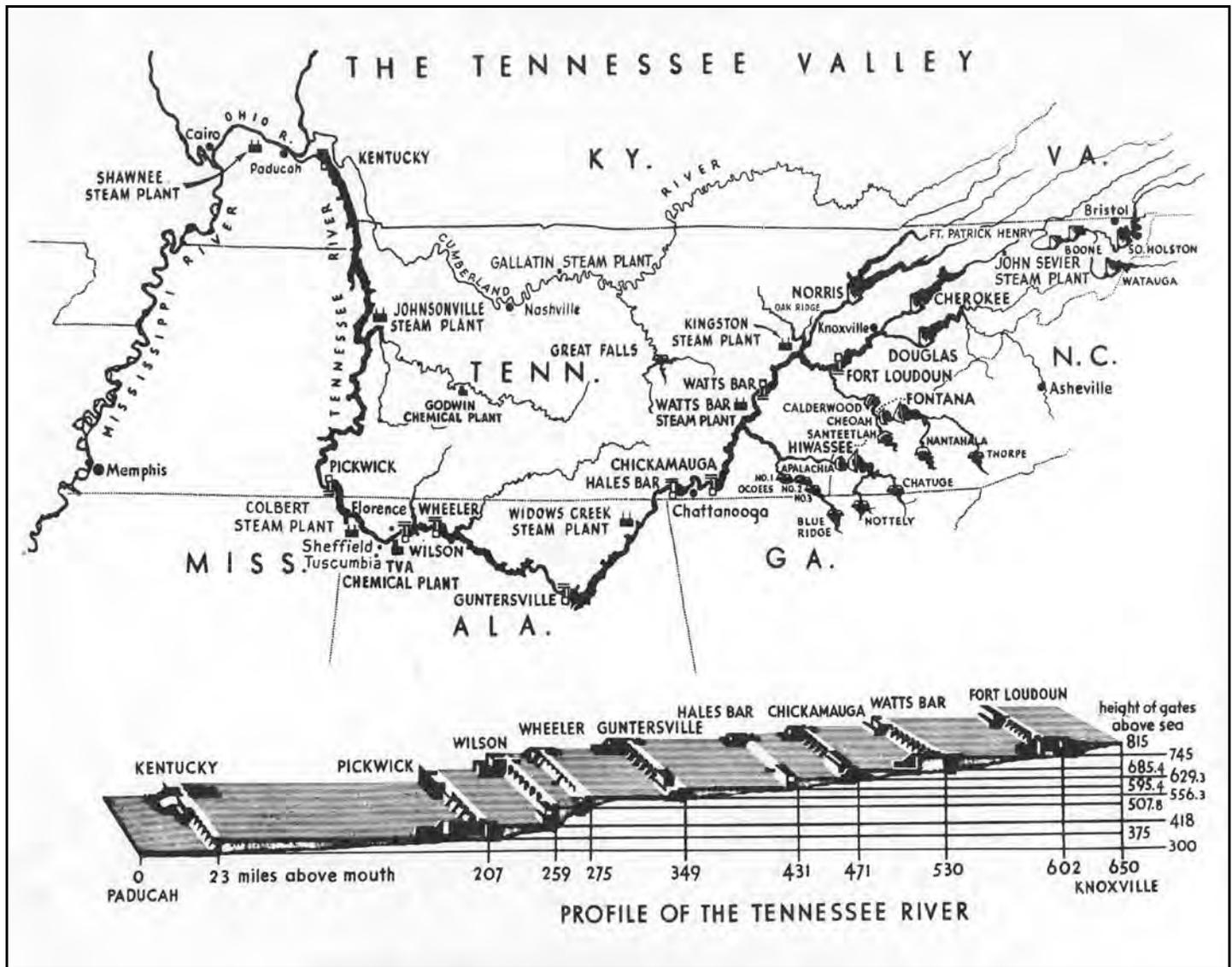


Figure 1: Map of the TVA System showing the location of the hydroelectric projects and profile of the Tennessee River.

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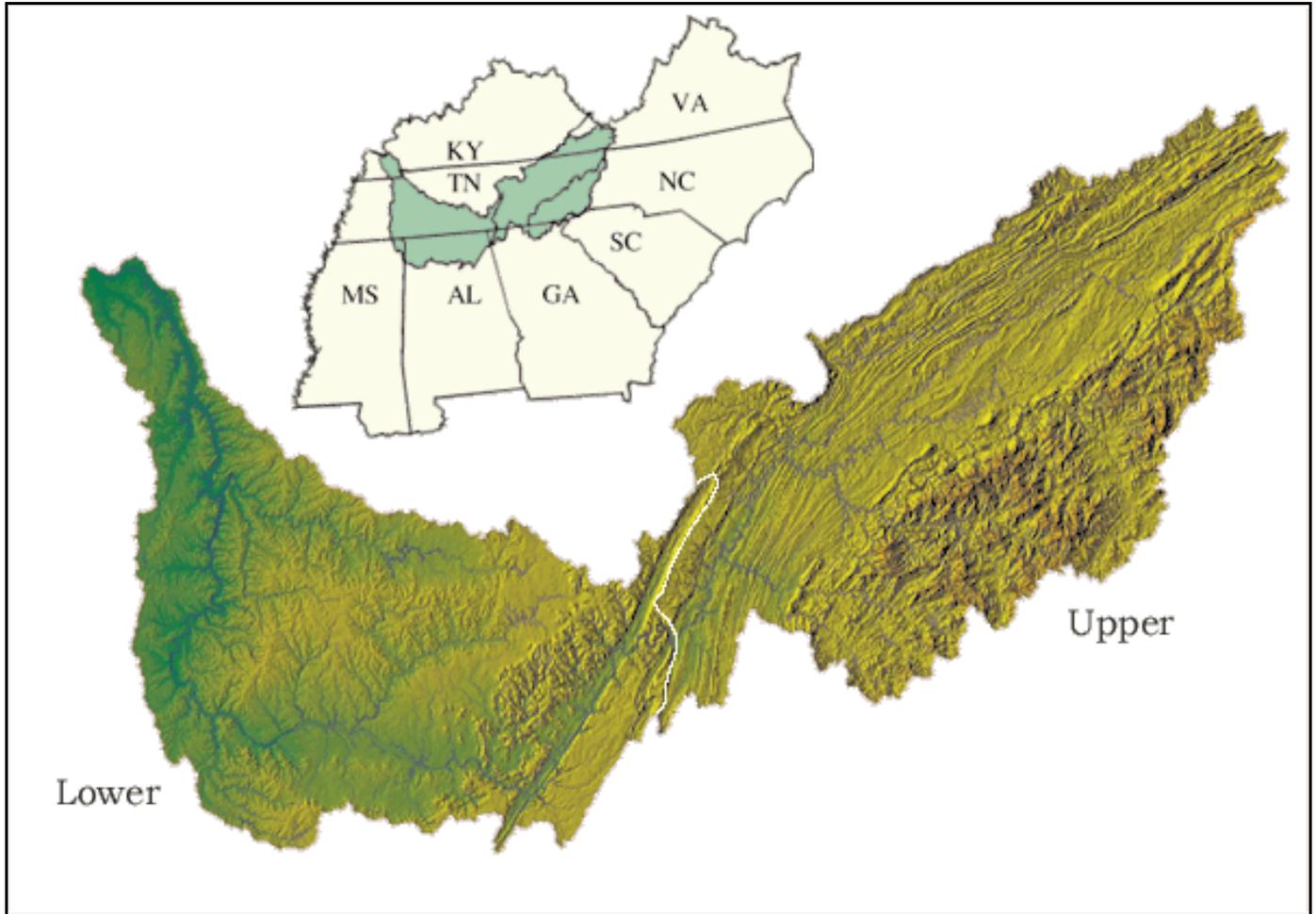


Figure 2: Map of the Tennessee River's watershed and Upper and Lower Basins.

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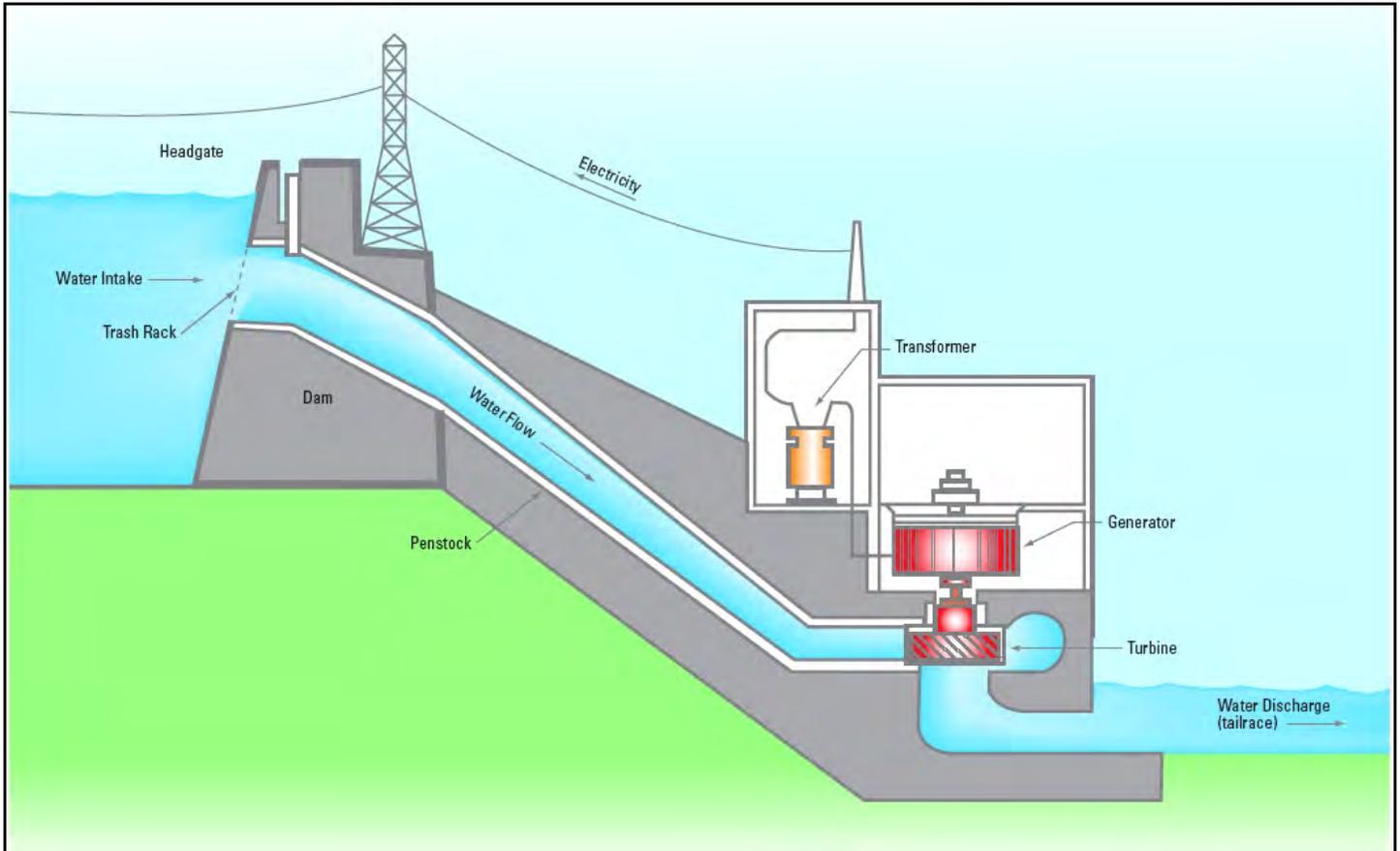


Figure 3: Cross section of a typical hydropower project.
(<http://brightmags.com/how-does-hydroelectric-power-work/>)

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**Figure 4: “BUILT FOR THE PEOPLE” insignia used at all TVA projects
(Reception Room at Pickwick Landing Powerhouse in 1939).
(Photo courtesy of the TVA)**

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Figure 5: Construction of Norris Dam in 1933 (Photo courtesy of the TVA).

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Figure 6: Construction of Wheeler Dam, April, 1935.
(Photo courtesy of the TVA)

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Figure 7: Hiwassee Dam following completion in 1940.
(Photo courtesy of the TVA)

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Figure 8: Naval vessel, built by the Ingalls Shipyard in Decatur, Alabama, and passing through the Wheeler Dam lock in 1944. *(Photo courtesy of the TVA)*

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Figure 9: President Harry S. Truman at the dedication of the Kentucky Dam, October 10, 1945.
(Photo courtesy of the TVA)

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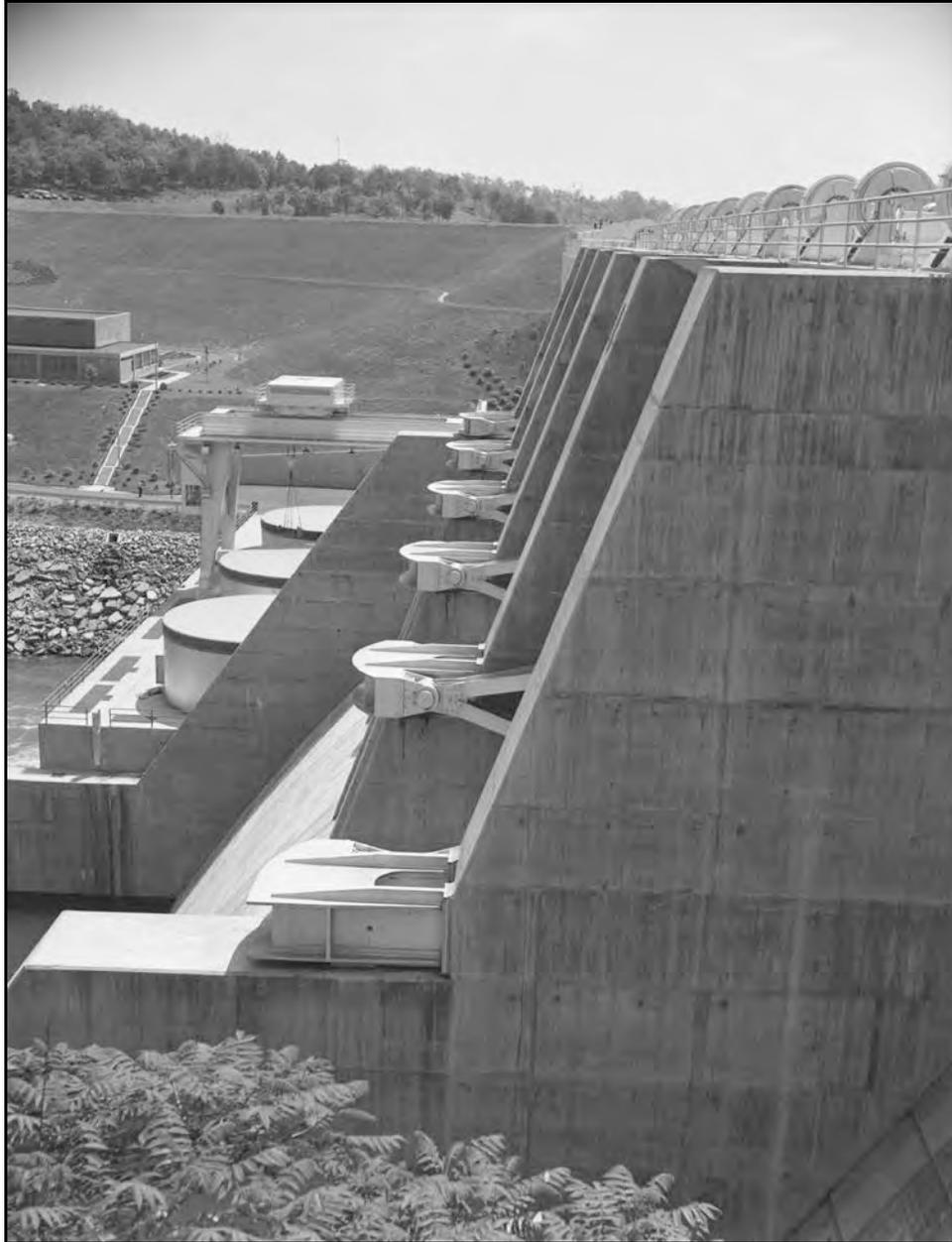


Figure 10: Boone Dam following completion in 1952
(Photo courtesy of the TVA)

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Figure 11: Melton Hill Dam, Powerhouse and Lock following completion in 1964.
(Photo courtesy of the TVA)

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Figure 12: A picnic at Cove Lake State Park on the Norris Reservoir, 1953.
(Photo courtesy of the TVA)

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Figure 13: Barge traffic on the Wheeler Reservoir in 1957.
(Photo courtesy of the TVA)

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Figure 14: Apalachia Dam.

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Figure 15: Boone Dam and Powerhouse.

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Figure 16: Chatuge Dam and Powerhouse.

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Figure 17: Cherokee Dam and Powerhouse.

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Figure 18: Chickamauga Dam and Powerhouse.

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Figure 19: Douglas Dam and Powerhouse.

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Figure 20: Fontana Dam and Powerhouse.

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Figure 21: Fort Loudoun Dam and Powerhouse.

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Figure 22: Fort Patrick Henry Dam and Powerhouse.

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Figure 23: Gunterville Dam and Powerhouse.

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Figure 24: Hiwassee Dam and Powerhouse.

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Figure 25: Kentucky Dam and Powerhouse.

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Figure 26: Melton Hill Dam and Powerhouse.

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Figure 27: Nickajack Dam and Powerhouse.

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Figure 28: Normandy Dam.

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Figure 29: Norris Dam and Powerhouse.

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Figure 30: Nottely Dam and Powerhouse.

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Figure 31: Ocoee No. 3 Dam.

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Figure 32: Pickwick Landing Dam and Powerhouse.

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Figure 33: South Holston Dam and Powerhouse.

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Figure 34: Tellico Dam.

Historic Resources of the Tennessee Valley Authority
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Figure 35: Tims Ford Dam and Powerhouse.

Historic Resources of the Tennessee Valley Authority
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Figure 36: Watts Bar Dam and Powerhouse.

Historic Resources of the Tennessee Valley Authority
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Figure 37: Wheeler Dam and Powerhouse.

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Figure 38: Watauga Dam.

Historic Resources of the Tennessee Valley Authority
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Figure 39: Cherokee Dam Gantry Crane.

Historic Resources of the Tennessee Valley Authority
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Figure 40: Board-form concrete exterior of the Chatuge Powerhouse.

Historic Resources of the Tennessee Valley Authority
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Figure 41: Spillway at the Chatuge Dam.

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Figure 42: "Morning Glory" spillway at the Watauga Dam.

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Figure 43: Tennessee State Route 68 Bridge over the Watts Bar Dam.

Historic Resources of the Tennessee Valley Authority
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Figure 44: Nottely Dam Intake Building.

Historic Resources of the Tennessee Valley Authority
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Figure 45: Apalachia Powerhouse.

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Figure 46: Ocoee No. 3 Powerhouse.

Historic Resources of the Tennessee Valley Authority
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Figure 47: Watauga Powerhouse.

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Figure 48: Reception Room at the Norris Powerhouse.

Historic Resources of the Tennessee Valley Authority
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Figure 49: Reception Room of the Cherokee Powerhouse.

Historic Resources of the Tennessee Valley Authority
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Figure 50: Reception Room of the Chickamauga Powerhouse.

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Figure 51: Marble staircase at the Douglas Powerhouse Reception Room.

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Figure 53: Guntersville Powerhouse Generator Room.

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Figure 54: Chickamauga Powerhouse Generator Room.

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Figure 55: Watts Bar Control Building.

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Figure 56: Penstocks leading from the Apalachia Tunnel to the Powerhouse.

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Figure 57: Pipeline from the Apalachia Dam which connects with the underground tunnel.

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Figure 58: Surge tank at the South Holston project.

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Figure 59: Fontana Dam switchyard.

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Figure 60: Fort Loudoun Dam lock.

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Figure 61: Guntersville Dam lock.

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Figure 62: Melton Hill Dam lock.

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Figure 63: Kentucky Dam Lock Operations Building.

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Figure 64: Fontana Dam Visitor Building.

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Figure 65: Watauga Dam Visitor Building.

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Figure 66: Fort Patrick Henry Dam Visitor Building.

Historic Resources of the Tennessee Valley Authority
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Figure 67: Nickajack Dam Picnic Area.

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Figure 68: Melton Hill Dam Campground.

Historic Resources of the Tennessee Valley Authority
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Figure 69: Fishing Pier at Nickajack Dam.

Historic Resources of the Tennessee Valley Authority
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Figure 70: Grounds maintenance office at Cherokee Dam.

Historic Resources of the Tennessee Valley Authority
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Figure 71: Public Safety Service Building at Cherokee Dam.

Historic Resources of the Tennessee Valley Authority
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Figure 72: Construction of rural electrical lines in Alabama in 1935 (Photo courtesy of TVA).