CHAPTER 3

3.0 AFFECTED ENVIRONMENT

The existing conditions of various environmental resources that could be affected by implementation of the proposed NTRLMP are described in this chapter.

3.1. The Northeastern Tributary Reservoirs

The NTRLMP addresses seven TVA tributary reservoir projects in the northeast corner of Tennessee and southwest corner of Virginia (Figure 1-1). Several characteristics of the NTRs are listed in Table 3-1.

Table 3-1. Characteristics of Seven Northeastern Tributary Reservoirs

Reservoir	Dam Location*	Length of Reservoir (miles)	Flood Storage (acre-feet)	Shoreline (miles)	Summer Pool Elevation (feet above msl**)	Annual Pool Variation (feet)
Beaver Creek	BCM 22.5	1.2	5,020	1.2	-	Detention only
Clear Creek	CCM 2.8	-	2,511	2.2	-	-
Boone	SFH RM 18.6	32.7	75,829	131.1	1,382	18
Fort Patrick Henry	SFH RM 8.2	10.4	0	27.1	1,263	5 (daily)
South Holston	SFH RM 49.8	23.7	252,757	181.1	1,729	21
Watauga	W RM 36.7	16.3	152,829	108.1	1,959	7
Wilbur	W RM 34.0	1.8	0	3.8	Run of the River◆	15

- = Not applicable

* Measured in river miles (RM) from the mouth of the respective river (SFH = South Fork Holston; W = Watauga) or creek; BCM = Beaver Creek Mile; CCM = Clear Creek Mile

** mean sea level = msl

◆ Elevation depends upon operation of Watauga Dam

Beaver Creek, Boone, Clear Creek, Fort Patrick Henry, and South Holston reservoirs, and a small portion of Wilbur Reservoir, are located in the Ridge and Valley ecoregion of Tennessee and Virginia. This region occurs between the Blue Ridge Mountains on the east and the Cumberland Plateau on the west. It is a relatively low-lying area made of roughly parallel ridges and valleys that were formed through extreme folding and faulting events in past geologic time (Griffith et al. 1998).

Within the Ridge and Valley ecoregion, Fort Patrick Henry, Boone, Beaver Creek, Clear Creek, the portion of South Holston Reservoir in Virginia, and Parcel 1 on Wilbur are located within the Southern Limestone/Dolomite Valleys and Rolling Hills subregion. This is a heterogeneous region composed predominantly of limestone and cherty dolomite. Landforms are mostly undulating valleys and rounded ridges and hills, with many caves and springs. Soils vary in their productivity, and land cover includes oak-hickory and oak-pine

forests, pasture, and intensive agriculture, as well as urban and industrial land uses. The portion of South Holston Reservoir located in Tennessee is located within the Southern Shale Valleys subregion, which consists of lowlands, rolling valleys and slopes and hilly areas dominated by shale materials. Small farms and rural residences occur throughout where land is used for grazing or farming tobacco, corn, or hay (Griffith et al. 1998).

Watauga and most of Wilbur reservoirs are located within the Southern Sedimentary Ridges subregion of the Southern Blue Ridge ecoregion (SBRE). The SBRE is one of the richest centers of biodiversity in the eastern United States and one of the most floristically diverse. This ecoregion includes the Appalachian oak forest, northern hardwoods, and at the highest elevations in Tennessee and North Carolina, the southeastern spruce-fir forest. Shrub, grass, and heath balds; hemlock; cove hardwoods; and oak-pine communities are also significant (Griffith et al. 1998). The Southern Sedimentary Ridges subregion includes some of the westernmost foothills of the Blue Ridge Mountains. The slopes are steep and elevations are generally from 1,000 to 4,500 feet above msl. The soils are underlain by Cambrian-age sedimentary rocks and support mostly a mixed oak and oak-pine forest (Griffith et al. 1998).

The seven NTRs are located along two major river systems: the South Fork Holston River, extending from southwest Virginia into northeast Tennessee and the Watauga River extending from North Carolina into northeast Tennessee. Boone, Fort Patrick Henry, and South Holston dams are located along the South Fork Holston River. Watauga and Wilbur dams are located along the Watauga River. Boone Dam is located approximately 1.4 miles downstream of the confluence of the two river systems, such that one arm of Boone Reservoir extends up the South Fork Holston River, and the other arm extends up the Watauga River. Clear Creek and Beaver Creek dams comprise the Bristol Flood Control Project, located in Washington County, in southwest Virginia. These creeks are within the Beaver Creek watershed and drain into South Fork Holston arm of Boone Reservoir.

3.1.1. Beaver Creek and Clear Creek Reservoirs

Beaver Creek and Clear Creek reservoirs are located in Washington County, Virginia. Clear Creek is a tributary of Beaver Creek. Both creeks are within the South Fork Holston River watershed (06010102). Both dams were built in 1965 to provide flood protection and recreation for the Bristol, Tennessee-Virginia, area. The Beaver Creek Dam is a 1,588-foot-long flood detention dam with no permanent reservoir pool. The detention basin of Beaver Creek has a flood-storage capacity of 5,020 acre-feet. The Clear Creek Dam is 670 feet long. Clear Creek Reservoir has a flood-storage capacity of 2,511 acre-feet and reaches 0.6 mile upstream from the dam. A detailed description of Beaver Creek and Clear Creek reservoirs and surrounding lands is provided in Volume II.

3.1.2. Boone Reservoir

Boone Reservoir is located in Sullivan and Washington counties, Tennessee. The reservoir is two-pronged, with one arm formed along the South Fork Holston River and one arm formed along the Watauga River. The reservoir is within the South Fork Holston River watershed (06010102). The Boone Dam stretches 1,532 feet across the South Fork Holston River, just downstream of the confluence with the Watauga River. The construction of Boone Dam occurred between 1950 and 1952, and the reservoir was named for frontiersman Daniel Boone, who played a major role in the history of the area. Three hydroelectric generating units are present at Boone Dam, with a power generating capacity of 81,000 kilowatts. Boone Reservoir is operated for a number of purposes, including power production, flood control, recreation, and management of water supply, water quality

and aquatic habitat. Management of reservoir lands are currently guided by the Boone Reservoir Land Management Plan (TVA 1999) and the Resource Management Plan for the Boone Management Unit (TVA 2002). Boone Reservoir has a flood-storage capacity of 75,829 acre-feet. A detailed description of Boone Reservoir and surrounding lands is provided in Volume III.

3.1.3. Fort Patrick Henry Reservoir

Fort Patrick Henry Reservoir is located in Sullivan County, Tennessee, and Fort Patrick Henry Dam stretches 737 feet across the South Fork Holston River in the South Fork Holston River watershed (06010102). The construction of Fort Patrick Henry Dam occurred between 1951 and 1953, and the reservoir was named after the colonial fort, also known as Long Island Station. The Fort Patrick Henry Dam has two generating units and a generating capacity of 59,400 kilowatts of electricity. Fort Patrick Henry Dam was built primarily for hydropower, but the dam is also used to regulate the flow of water downstream, to ensure a reliable supply of water for local industry and for cooling water at TVA's John Sevier Fossil Plant, and to provide recreational opportunities. A detailed description of Fort Patrick Henry Reservoir and surrounding lands is provided in Volume IV.

3.1.4. South Holston Reservoir

South Holston Reservoir is located in Sullivan County, Tennessee, and Washington County, Virginia, and South Holston Dam stretches 1,600 feet across the South Fork Holston River in the South Fork Holston River watershed (06010102). The construction of the earth-and-rock fill dam began in 1942. However, the construction was halted soon after, in favor of other wartime construction efforts. Construction resumed in 1947, and the dam was completed in 1950. South Holston Dam has one hydroelectric unit and a power generating capacity of 38,500 kilowatts. With a flood-storage capacity of 252,757 acre-feet, South Holston Reservoir is operated for many purposes, including flood control, power production, recreation, and management of aquatic habitat. Water levels in the reservoir vary about 21 feet during normal years to provide for flood storage and augmentation of the flow of water during the drier seasons of the year. A detailed description of South Holston Reservoir and surrounding lands is provided in Volume V.

3.1.5. Watauga and Wilbur Reservoirs

Watauga and Wilbur reservoirs are located in Carter and Johnson counties, Tennessee, on the Watauga River in the Watauga watershed (06010103). Watauga Dam is a 900-foot earth-and-rock fill structure. Construction of the dam began in 1942, but was halted later that same year due to other wartime construction efforts. Construction resumed in 1946, and the dam was completed in 1948. Watauga Dam has two hydroelectric generating units with a capacity of 57,600 kilowatts of electricity. Watauga Reservoir has a flood-storage capacity of 152,829 acre-feet and is operated for many uses, including flood control, power generation, recreation, and management of water quality and aquatic habitat. Watauga is the highest reservoir (over 1,900 feet above msl) in the Tennessee River system.

Wilbur Dam stretches 375 feet across the Watauga River and is located almost 3 miles downstream from Watauga Dam. The construction of Wilbur Dam occurred between 1909 and 1912. Wilbur Dam has four hydroelectric generating units. Upon completion of construction, two hydroelectric generating units were installed in 1912. Another hydroelectric generating unit was added in 1926. TVA acquired Wilbur Dam in 1945 and installed a fourth hydroelectric generating unit. Detailed descriptions of Watauga and Wilbur reservoirs and surrounding lands are provided in Volume VI.

3.2. Land Use

Existing land use patterns along the shoreline and back-lying land have been influenced by whether TVA acquired the land and whether TVA has subsequently sold, transferred, or retained the land. TVA originally acquired about 10,953 acres of land on the seven NTRs (Table 1-1). About 55 percent (6,020 acres) of this land has been sold for private use or transferred to other federal and state agencies for public use. TVA presently manages a total of approximately 4,933 acres of land on these reservoirs, which are the subject of this NTRLMP.

As described in Section 2.4.1, TVA typically retained the land below the MSC fronting the transferred or sold lands. A large proportion of the back-lying acreage disposed of was transferred to the USFS and is now national forest system land along the shorelines of the NTRs. Transfer agreements to other public agencies allow for management of these retained lands by those agencies, consistent with their management of the adjacent back-lying land (see TVA-Owned and Jointly Managed Shoreline in Table 3-2 below). In contrast, in cases where TVA sold back-lying land to private persons or entities, the sale deeds typically allow for rights of ingress and egress across the TVA-retained marginal strip, and therefore, the back-lying landowners typically have the right to apply to TVA for permission to construct private water use facilities.

Table 3-2. Northeastern Tributary Reservoirs Shoreline Ownership Data

Reservoir	Flowage Easement Shoreline		TVA-Owned Shoreline Access		TVA-Owned and Jointly Managed Shoreline		TVA-Owned and Managed Shoreline		Total Shoreline Miles
	Miles	% of Total Miles	Miles	% of Total Miles	Miles	% of Total Miles	Miles	% of Total Miles	Miles
Boone	108	82	0.5	<1	19	14	4	3	131
Fort Patrick Henry	9	32	5	19	9	32	4	15	27
South Holston	43	24	3	<1	133	73	4	2	181
Watauga	48	44	0.5	<1	55	51	4	4	108
Wilbur	0	0	0	0	1	37	2	61	4
Total	**208**	**46**	**9**	**2**	**217**	**48**	**18**	**4**	**451**

Most of the residential development along the reservoirs is on land TVA sold with shoreline access rights across the TVA-owned marginal strip of land below the MSC (Zone 7 – Shoreline Access) or on private land on which TVA purchased the right to flood to a certain elevation (Zone 1 – Flowage Easement Shoreline). The SMI EIS shoreline ownership data for five of the seven NTRs is presented in Table 3-2. The 451 miles of shoreline along the five reservoirs is managed by TVA, either as flowage easement or shoreline access land. Clear Creek and Beaver Creek are omitted from the table because they are part of the Bristol Flood Control Project, which was not included in the scope of the SMI EIS.

To clarify shoreline development trends on the NTRs, TVA used aerial photography and Geographic Information System mapping to estimate the amount of shoreline available for residential development. The amount of developed residential shoreline ranges from greater than 60 percent of the shoreline on Boone Reservoir to less than 1 percent on

Wilbur Reservoir (Table 3-3). No residential development surrounds Beaver Creek and Clear Creek reservoirs, which are developed for public recreation (Table 3-3). A negligible amount of shoreline available for residential development exists on Wilbur Reservoir. In total, around Boone, Fort Patrick Henry, South Holston, and Watauga reservoirs, 46 percent of the combined shoreline (about 217 shoreline miles) is available for residential development. Development has already occurred on about 43 percent of the shoreline available for residential development (about 94 shoreline miles).

Table 3-3. Percent of Shoreline Available for Residential Development and Percent of Available Shoreline Developed

Reservoir	Percent of Total Shoreline Available for Residential Development*	Percent of Available Shoreline Already Developed
Beaver Creek	-	-
Clear Creek	-	-
Boone	83	66
Fort Patrick Henry	52	43
South Holston	25	14
Watauga	45	20
Wilbur	<1	<1
Total	**46**	**43**

- = Not applicable
* Sum of flowage easement and shoreline access

Development around the four major reservoirs over the last 15 years has been steady, as many farms have been turned into residential developments, primarily single-family homes. In recent years, multifamily developments have become more prevalent. Under the TVA Land Policy, TVA can no longer consider new residential land use requests on TVA-managed land. Therefore, the amount of shoreline available for residential use will not change as a result of the land planning process.

Many of the TVA-managed parcels on the NTRs have existing land use agreements that commit a parcel to a specific use. The majority of the land use agreements are for uses such as utilities, highways, and other public infrastructure. Most of these public infrastructure uses affect narrow linear tracts with small acreages. A total of approximately 916 acres is designated for public or commercial recreation or fronts national forest land (Table 3-4). A large proportion of the public recreation agreements are for campgrounds, day use areas, and city parks that are operated by local, county, and state government agencies. Commercial recreation agreements include docks, marinas, and campgrounds on several of the reservoirs, which are described in more detail in Section 3.3.

Table 3-4. Northeastern Tributary Reservoirs Land Use Agreements by Category (2008)

Land Use Agreement Categories	Number of Agreements	Acres (approximate)
Recreation		
Public Recreation	13	719.5
Commercial Recreation	9	29.5
Land Fronting National Forest System Lands	2	167.5
Project Operations		
Highways/Roads	11	18.3
Railroad	1	<1.0
Municipal Uses (office buildings, parking lots, industrial parks, etc.)	0	0.0
Utilities		
Wastewater/water treatment	2	24.4
Sewer Lines	3	1.3
Electric Lines	31	40.5
Telephone Lines	11	8.0
Water Lines	2	3.5
Gas Lines	1	1.0
Fiber Optic Lines	5	3.6
Other		
Sufferance Agreements	2	<1.0
Private - Homes/Driveways	1	<1.0
Total	**94**	**1,017**

3.3. Recreation

The northeastern Tennessee Valley region provides numerous opportunities for outdoor recreation within a one-day drive of nearly one-third of the nation's population. Four Tennessee state parks, two Virginia state parks, one national park, three national forests, 10 TVA reservoirs, and countless smaller parks and nature centers make up the recreation fabric of the NTRs region. Recreational opportunities provide a variety of individual, social, and cultural benefits.

TVA-managed lands in the NTRs region include 4,933 acres along TVA reservoirs, some of which provide a high-quality and diverse array of recreation opportunities. Recreation facilities on TVA-managed lands include campgrounds, marinas, swimming beaches, picnicking facilities, fishing piers, boat ramps, visitor buildings, and other day use facilities.

The inventory of recreation areas on NTRs includes public and private recreation areas. Public facilities are owned and/or operated by TVA or other government entities, whereas private facilities are commercial areas operated for profit and occur on private land, on TVA land with land right agreements, or on combinations of private and public lands under agreement. Modern recreation facilities and amenities on shoreline properties adjacent to the NTRs include: 13 campgrounds, 8 marinas, 31 developed boat launches/ramps, and many day use facilities such as picnic areas, swimming beaches, ball fields, fishing piers,

and a golf course. Detailed descriptions of recreation areas are provided in individual RLMPs (Volumes II-VI).

Thirty-nine high-quality developed recreation facilities are provided on TVA-managed land on the NTRs (Table 3-5). These facilities primarily occur on parcels allocated as Zone 6 (Developed Recreation) or Zone 2 (Project Operations, i.e., Dam Reservation). TVA-managed developed recreation facilities include a public campground, day use areas, visitor/observation buildings, a swimming beach, and developed river access sites. In general, regulations on TVA developed recreation facilities prohibit hunting, possession and use of firearms, use and consumption of alcohol, and camping outside designated campsites. Recreational use of motorized vehicles is restricted to roadways and is otherwise prohibited on TVA lands and in the reservoir drawdown zones. Fishing is permissible in accordance with applicable state regulations.

Table 3-5. Developed and Dispersed Recreation Sites Located on the Northeastern Tributary Reservoirs

Reservoir	No. Developed Recreation Sites	No. Dispersed Recreation Areas	No. Dispersed Recreation Sites
Beaver Creek and Clear Creek	2	0	0
Boone	11	7	59
Fort Patrick Henry	4	2	7
South Holston	11	6	27
Watauga and Wilbur	11	2	2
Total	**39**	**17**	**95**

TVA-managed lands around the NTRs also offer abundant opportunity for dispersed recreation, which consists of passive, informal opportunities that are predominantly nature based or water based. Dispersed recreation typically occurs on parcels allocated as Zone 2, 3, or 4 (Project Operations, Sensitive Resource Management, and Natural Resource Conservation, respectively), and on undeveloped Zone 6 (Developed Recreation) parcels. Generally, dispersed recreation amenities include: rustic trails for fishing access/walking/hiking/horseback riding, primitive campsites, primitive swimming and launching sites, and hunting and fishing areas.

As of 2008, 17 areas identified and assessed on the NTRs contained a total of 95 dispersed recreation sites (Table 3-5). A site is defined as an area of impact where a recreation activity occurs; an area is the sum of the sites near one another on a TVA parcel. Regulations designed to protect resources and users of dispersed recreation lands prohibit motorized-vehicle use except where permissible for fishing access and launching boats from primitive sites during winter drawdown season. Hunting and fishing are permissible, unless otherwise posted, consistent with statewide regulations. Likewise, possession and use of firearms and other weapons is permitted subject to all applicable state regulations. Camping stays are limited to a maximum of 14 days within any 30-day period. After 14 days, campers must move at least one river mile before reestablishing a campsite. Consumption of alcohol is governed by local ordinances, unless otherwise posted.

Some improvements may be made to dispersed recreation areas when necessary to provide access for the user (e.g., parking lot), improve health and safety of the user (e.g.,

installation of seasonal portable toilets), or mitigate damage to natural resources (e.g., hardening of recreation sites to reduce severity of impacts).

3.4. Prime Farmland

The FPPA requires that all federal agencies evaluate impacts to farmland prior to converting such land permanently to nonagricultural land use. Prime farmland is defined by the U.S. Department of Agriculture (USDA) as land that has the best combination of chemical and soil physical characteristics for meeting the nation's short- and long-range needs for food and fiber. Prime farmland can consist of cultivated land, pastureland, or forestland, but it is not urban, built-up land or covered by water.

The Commonwealth of Virginia has designated farmland of statewide importance that is exceptional for the production of food, feed, fiber, forage, and oil seed crops. Generally, state agencies identify farmlands of statewide importance as those areas that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable. In some states, additional farmlands of statewide importance may include tracts of land that have been designated for agriculture by state law. Consideration for protection under the FPPA extends to farmland of statewide importance.

To evaluate effects to prime farmland and farmland of state importance, TVA identifies soil classifications using the USDA, Natural Resources Conservation Service Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx).

About 430 acres of prime farmland and 167 acres of farmland of statewide importance occur around the seven NTRs (Table 3-6). No land of either designation occurs around Wilbur Reservoir. Farmland of statewide importance occurs in Washington County, Virginia, near Beaver Creek, Clear Creek, and South Holston reservoirs. Detailed descriptions of the parcels containing prime farmland are provided in the individual RLMPs (Volumes II-VI) and in Appendix G.

Table 3-6. Approximate Number of Acres and Parcels Having Prime Farmland or Farmland of Statewide Importance Around the Northeastern Tributary Reservoirs

Reservoir	Prime Farmland		Farmland of Statewide Importance	
	Acres	No. Parcels*	Acres	No. Parcels*
Beaver Creek	18	1	120	3
Clear Creek	0	0	3	1
Boone	58	5	0	0
Fort Patrick Henry	50	8	0	0
South Holston	292	10	44	11
Watauga	12	1	0	0
Wilbur	0	0	0	0
Total	**430**	**25**	**167**	**15**

*Some parcels may contain both prime farmland and farmland of statewide importance.

The geographic extent of the NTRs reaches Carter, Johnson, Sullivan, and Washington counties in Tennessee, and Washington County, Virginia. The proportion of total county area in farms ranges from 18 percent in Carter County to 57 percent in Washington County, Tennessee (Table 3-7). Prime farmland is found in each of the five counties, comprising between 3 and 17 percent of the total area in a county (Table 3-7).

Agriculture census data show that during the 20 years between 1987 and 2007, the number of farms in the five counties has decreased between about 10 and 73 percent (Table 3-7). However, during the same period, the number of acres of land in farms increased in Carter County, and decreased between 1.9 and 43 percent in the other four counties. In 2007, the average size of farms ranged from 64 acres in Sullivan County to 111 acres in Washington County, Virginia. Between 1987 and 2007, the average size of farms increased in all counties except Sullivan County.

Table 3-7. Acreage of Prime Farmland and Farming Trends in the Counties Adjacent to Northeastern Tributary Reservoirs

County	Percent of Total Area in Farms	Acres Prime Farmland	Percent Prime Farmland	Percent Change From 1987 to 2007*		
				Number of Farms	Land in Farms (Acres)	Average Size of Farms (Acres)
Carter, Tenn.	18	10,337	5	-32.9	4.5	27.6
Johnson, Tenn.	23	5,331	3	-73.1	-43.4	17.6
Sullivan, Tenn.	31	14,461	5	-11.9	-18.8	-6.3
Washington, Tenn.	57	36,382	17	-15.7	-4.5	9.7
Washington, Va.	54	13,319	4	-10.1	-1.9	7.2

*U.S. Department of Agriculture, Agriculture Census, http://agcensus.mannlib.cornell.edu/

3.5. Terrestrial Ecology

3.5.1. Plant Communities

Vegetation classes commonly found around the reservoirs include evergreen forest, evergreen woodlands, evergreen-deciduous forest, deciduous forest, deciduous woodlands, shrublands, and herbaceous vegetation. Descriptions of vegetation classes are adapted from Grossman et al. (1998) and are found in the glossary of this EIS (Section 7.2).

Throughout the South Fork Holston River and Watauga River watersheds, deciduous forests and woodlands are the most common and the most diverse vegetation classes found in the watersheds surrounding the NTRs. Deciduous forests and woodlands cover approximately 35 percent of the landscape and are composed of diverse communities ranging from mesic (moist) cove hardwood forest to xeric (dry) upland oak forests. Evergreen-deciduous forests occupy approximately 20 percent of the land cover and primarily consist of moist mixed-hardwood forests and dry pine and pine-oak forests. Less than 15 percent of the land cover is evergreen forests and evergreen woodlands. In addition, small areas (less than 1 percent) of floodplain hardwood forests, along with scrub-shrub wetland communities, occur along the backs of coves along the reservoirs. Herbaceous vegetation in the form of row crops, grass fields, and agricultural areas, along with cleared areas within transmission line rights-of-way and along roadsides, are abundant

around Boone, Fort Patrick Henry, and South Holston reservoirs, where approximately 30 percent of the land use is herbaceous vegetation. Only about 12 percent of the land use surrounding Wilbur and Watauga reservoirs is herbaceous vegetation. Land use/land cover information was obtained from TDEC (2000; 2006a; 2006b).

During April and May 2007, field surveys were conducted on selected uncommitted parcels to assess terrestrial plant communities. Two rare plant communities were identified during field surveys. While not federally or state-listed as threatened or endangered, these plant communities are considered to be imperiled and their occurrence is tracked by NatureServe. Along the north shore of Watauga Reservoir on Parcels 2, 3, 4, 5, and 6 is Carolina Hemlock (Eastern Hemlock)/Great Laurel Forest, which is ranked G1 (globally critically imperiled) under the NatureServe ranking system. Carolina hemlock communities, in general, have a restricted range, occurring only in the Southern Blue Ridge and upper Piedmont ecosystems and are probably native to North Carolina and Tennessee. Occurrences are typically small and restricted to rocky bluff habitats. All occurrences are threatened by fire suppression and the hemlock woolly adelgid (*Adelges tsugae*), an exotic pest (NatureServe 2008). During field surveys, hemlock wooly adelgid was observed on both hemlock species.

A small, isolated area of northern white cedar limestone seepage woodland is found near Parcel 24 on Watauga Reservoir. This plant community type is ranked G2/G3 (G2 = imperiled globally; G3 = globally rare or uncommon). It typically is found on cliffs, associated with seepage over limestone or dolomite. Stands are dominated by northern white cedar and may contain several rare plant species such as showy lady's slipper, starry Solomon's plume, and shining ladies tresses (NatureServe 2008).

Invasive nonnative species of plants occur on most of the planned TVA parcels around the NTRs. EO 13112 defines an invasive species as one that is not native to that ecosystem and whose introduction does or is likely to cause economic or environmental harm or harm to human health. Invasive nonnative plants affect native terrestrial plant communities by competing for space and resources, which ultimately could degrade botanical diversity and wildlife habitat. Invasive species are typically robust plants that are not subject to natural controls of native insects and diseases. Consequently, invasive species may spread across the landscape beyond the control and reclamation measures applied by landowners and managers on individual land holdings (Miller 2003).

The Federal Noxious Weed List of 2006 (USDA 2007) lists invasive, nonnative plant species that are controlled by federal law. No listed plants are reported from the lands around the NTRs. However, 15 species listed by the Tennessee Exotic Plant Pest Council (TN-EPPC) in 2001 as a severe threat to native ecosystems (Rank 1) were observed on NTR lands. Species included autumn olive, bush honeysuckle, Chinese lespedeza, Chinese privet, English ivy, garlic mustard, Japanese honeysuckle, Japanese stiltgrass, Johnson grass, kudzu, mimosa, multiflora rose, oriental bittersweet, princess tree, and tree of heaven. Other nonnative species such as crown vetch, tall fescue, shrubby bushclover, Queen Anne's lace, periwinkle, and small carpet grass were also encountered. All of these species have the potential to adversely impact the native plant communities because of their potential to spread rapidly and displace native vegetation. All of the TN-EPPC Rank 1 (severe threat) species are considered high priority when TVA plans management of invasive plants (James 2002).

3.5.2. Wildlife Communities

The variety of land forms, soils, climate, and geology across the Ridge and Valley ecoregion and SBRE support an extremely diverse assemblage of animals. The Ridge and Valley ecoregion contains long stretches of ridges with adjacent valleys that run in a southwestern-to-northeastern direction. In this ecoregion, deciduous and mixed evergreen-deciduous forests are interspersed with agriculture and urban dominated areas. Wildlife ranges from forest-dependent species to those that tolerate highly modified habitats. The SBRE contains the largest area of contiguous, mature forest habitat in the eastern U.S. (Franzreb and Phillips 1995). Forests in the SBRE provide globally significant habitat for many species, especially amphibians and land snails (Ricketts et al. 1996). The array of microclimates and diversity of habitats are associated with high levels of species richness and species with limited geographic ranges. The high elevations found in the SBRE also provide habitat for relict populations of animals typically found at more northern latitudes.

Several forest types are found on TVA public lands along the NTRs. Deciduous forests provide a diversity of habitat for wildlife. Oak-hickory forest is the most abundant forest type in the eastern U.S. (Flather et al. 1999) and is prevalent on NTR lands. The numerous bird species that nest in deciduous forests include wild turkey, whip-poor-will, ruby-throated hummingbird, red-eyed vireo, blue-headed vireo, wood thrush, gray catbird, black-throated green warbler, black-and-white warbler, ovenbird, hooded warbler, and scarlet tanager. Riparian corridors along streams within deciduous forests provide nesting habitat for Acadian flycatcher, northern parula, and Louisiana waterthrush. Many additional bird species migrate through or winter in the area. Common mammal species of deciduous forests include black bear, white-tailed deer, red bat, eastern chipmunk, eastern gray and southern flying squirrels, white-footed mouse, southern red-backed and woodland voles, short-tailed shrew, gray fox, least weasel, and bobcat.

Seepages, streams, and temporary ponds in deciduous forests provide habitat for numerous amphibians including American and Fowler's toads; green, northern cricket, and other frogs; spotted and other mole salamanders; red and mud salamanders; and northern dusky and other salamanders in the genus *Desmognathus*. Reptiles commonly found in deciduous forests, especially near water, include eastern fence lizard, ground skink, five-lined skink, eastern box turtle, eastern worm snake, black racer, and ring-necked snake.

Evergreen and evergreen-deciduous forests provide nesting habitat for woodland birds including pine and yellow-throated warblers, great crested flycatcher, and chuck-will's-widow. Birds that winter in this forest type include red-breasted nuthatch, red crossbill, and pine siskin. Other animals that inhabit evergreen and evergreen-deciduous forests but are not restricted to them include white-tailed deer, wild turkey, black bear, eastern mole, eastern kingsnake, smooth earth snake, eastern fence lizard, and six-lined racerunner. Additionally, streams, wetlands, and other seasonally wet areas in this forest type provide habitat for a variety of salamanders, frogs, and toads.

Nonforested habitat in this area includes agricultural fields, transmission line rights-of-way, and pasture. These early successional habitats provide habitat for a variety of bird species including eastern bluebird, eastern meadowlark, American crow, American kestrel, and red-tailed hawk. Amphibians and reptiles that use these habitats include spring peeper, chorus frog, and common garter snake.

Bird and mammal diversity greatly increases at edge habitats, especially those between forested areas bordered by early successional habitats. Birds commonly found at these

edge habitats include wild turkey, great crested flycatcher, white-eyed vireo, Carolina wren, blue-gray gnatcatcher, brown thrasher, blue-winged warbler, prairie warbler, common yellowthroat, yellow-breasted chat, indigo bunting, eastern towhee, field and song sparrow, and orchard oriole. Mammals expected at edges include eastern cottontail, woodchuck, eastern harvest mouse, red fox, coyote, long-tailed weasel, and striped skunk.

The reservoirs provide abundant open water habitats and associated riparian (shoreline) zones that are used by a variety of wildlife. Common species include great blue heron, green heron, belted kingfisher, common yellowthroat, and northern parula. No heron colonies occur on or within 3 miles of the NTRs. Shallow embayments, especially those with emergent vegetation, provide habitat for waterfowl. Common waterfowl include wood ducks, Canada geese, and mallards. Other waterfowl present include American black duck, gadwall, green-winged teal, ring-necked duck, lesser scaup, common goldeneye, bufflehead, hooded merganser, and common merganser.

Shorebird use of the NTRs is limited as most reservoirs have steep, rocky banks and limited embayments or exposed mud flats that would provide suitable foraging areas. Most of the mud flats available on the NTRs are small and are comprised of rocky soils, providing poor-quality habitat for most shorebird species. However, notable exceptions are mudflats located at Austin Springs on Boone Reservoir, Roan Creek on Watauga Reservoir, and mudflats on South Holston Reservoir. Species such as least sandpiper, which forage along the margins of reservoirs, and killdeer, which are not restricted to foraging on mudflats, are commonly observed on the NTRs. Other species observed on better mudflats include pectoral and spotted sandpipers, and uncommon species including ruddy turnstone, dowitchers, wimbrel, black-necked stilt, American avocet, and sanderling.

Common amphibians found in the riparian zones include green frog, American bullfrog, northern cricket frogs, eastern narrowmouth toad, and eastern red-spotted newt. Reptiles include northern water snake, common snapping turtle, and painted turtles. Common mammals include mink, muskrat, raccoon, and American beaver.

Caves also provide unique habitat for certain insect and wildlife species. Seventy-five caves occur within 3 miles of the NTRs. All caves except one are greater than 200 feet away from any northeastern tributary reservoir parcels. Actions greater than 200 feet away from a cave do not normally adversely affect cave habitat. One cave exists within Parcel 6 on Boone Reservoir, which is committed as a sensitive resources management parcel. Because caves are extremely fragile and biologically significant, TVA maintains an undisturbed 200-foot-wide buffer zone around this cave.

3.6. Endangered and Threatened Species

This section describes federally listed and state-listed plants, terrestrial animals, and aquatic animals observed on or near the NTRs. In addition to field surveys, species observations were documented from the TVA Natural Heritage database. The database was searched for record occurrences within 5 miles of the NTRs for plants, within 10 miles for aquatic species, and within 3 miles for terrestrial species (ranges are based upon standard TVA practices developed to best evaluate each resource, which have been approved by the USFWS). Records considered “extirpated” or no longer occurring at the documented location were not included in this evaluation.

3.6.1. Plants

Field surveys and reviews of the TVA Heritage database show that no federally listed plant species have been recorded within 5 miles of the NTRs. No designated critical habitat for federally listed plants is present in or around the NTRs. Two federally listed species are known from the surrounding counties. In Carter County, near Wilbur and Watauga reservoirs, the federally listed as endangered spreading avens (*Geum radiatum*) occurs on Roan Mountain. This species is restricted to high-elevation rocky summits of the Southern Appalachians, and neither plants nor suitable habitat for this species were observed during rare plant surveys conducted in the NTRs study area during 2007. A single population of the federally listed as threatened small whorled pogonia (*Isotria medeoloides*) occurs in Washington County, Tennessee. However, no populations of this species were found during surveys for rare plants conducted during April and May 2007.

Thirty plant species listed by the State of Tennessee are known to occur within 5 miles of the NTRs. Lists of state-listed plants potentially present around each reservoir are provided in the individual RLMPs (Volumes II-VI). There were no records of listed plants occurring within 5 miles of Beaver Creek, Clear Creek, or South Holston reservoirs in Virginia.

Three state-listed plant species were identified on NTRs parcels during field surveys conducted in 2007. Previously undocumented populations of the endangered branching whitlow-wort (*Draba ramossima*) were found on Fort Patrick Henry (Parcel 10a) and Watauga (Parcels 5 and 6). A previously undocumented population of Virginia heartleaf (*Hexastylis virginica*), a species of special concern, was identified on Watauga Parcel 50. Carolina hemlock (*Tsuga caroliniana*), a threatened species, was observed on Watauga Parcels 2 and 5 and is known to occur on Watauga Parcels 3, 4, and 6.

3.6.2. Terrestrial Animals

Field surveys and reviews of the TVA Heritage database indicated the endangered gray bat (*Myotis grisescens*) and Virginia big-eared bat (*Corynorhinus townsendii virginianus*) are the only federally listed animal species recorded within 3 miles of the NTRs (see individual RLMPs for species lists). The gray bat roosts in caves year-round and typically forages over open water habitats including streams, rivers, and reservoirs. A substantial colony of gray bats inhabits a cave in Sullivan County, approximately 0.5 mile east of Boone Reservoir, and in the same county with Fort Patrick Henry and South Holston reservoirs. No other caves providing potentially suitable habitat for gray bats were observed during field surveys conducted for the NTRLMP. Gray bats likely forage over all the NTRs, but in lower numbers than those observed on TVA's main stem reservoirs. There is potential foraging and roosting habitat for the Virginia big-eared bat within 3 miles of Watauga Reservoir, but the nearest record of the species is a single observation greater than 2.5 miles from that reservoir.

In addition, four federally listed species are known from surrounding counties, but have not been identified within 3 miles of the NTRs. The Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*) and the spruce-fir moss spider (*Microhexura montivaga*), both endangered, typically occur at elevations greater than 5,000 feet within spruce-fir forests and in mixed conifer-northern hardwood forests. The spruce-fir moss spider is restricted to five mountain tops. The distributions of these two species do not occur, and no suitable habitat exits, within 3 miles of any of the NTRs. A single Indiana bat (*Myotis sodalis*), an endangered species, was captured near Jefferson National Forest, greater than 15 miles from South Holston Reservoir. Although many caves occur in the NTRs region, none is known to be occupied by Indiana bats or to be suitable for occupation by the

species. The threatened bog turtle (*Glyptemys muhlenbergii*) has been recorded from Johnson County, near Watauga and Wilbur reservoirs. While no bog turtles have been recorded within 3 miles, habitat suitable for this species exists within 3 miles of the NTRs.

Twenty animal species listed by the states of Tennessee, Virginia, or North Carolina occur within 3 miles of the NTRs. With a single exception, no state-listed species were identified on parcels surveyed for the NTRLMP. A southern bog lemming (*Synaptomys cooperi*), a species deemed in need of management, was captured on South Holston Reservoir Parcel 2. Habitat suitable for the southern bog lemming species exists within 3 miles of NTRs parcels. The individual RLMPs provide additional detail regarding listed species and suitable habitat found near each of the NTRs.

3.6.3. Aquatic Animals

A review of the TVA Natural Heritage database indicated that the shiny pigtoe pearlymussel (*Fusconia cor*) and tan riffleshell (*Epioblasma florentina walkeri*), both federally listed as endangered, have been recorded within the watersheds that comprise the NTRs study area. The fluted kidneyshell (*Ptychobranchus subtentum*) and slabside pearlymussel (*Lexingtonia delabelloides*), both candidates for federal listing, also have been reported. Historic records of the little-wing pearlymussel (*Pegias fabula*), a federally listed as endangered species, are known from the Middle Fork Holston River upstream of South Holston Reservoir. No TVA-managed parcels are located near those records. The spotfin chub (*Cyprinella monacha*), federally listed as threatened, has been recorded downstream of the Fort Patrick Henry and South Holston dams. However, due to discharges of cold and deep water from the dams, the tailwater habitat is likely no longer suitable for this species.

In addition to federally listed species, 20 state-listed aquatic species, including fish, mussels, and a snail, have been recorded within the watersheds forming the NTRs. Detailed descriptions of listed aquatic species in each reservoir are provided in the RLMPs (Volumes II-VI).

3.7. Wetlands

Wetlands are defined by TVA Environmental Review Procedures (TVA 1983) as: "[T]hose areas inundated by surface or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, mud flats, and natural ponds." Wetlands are ecologically important because of their beneficial effect on water quality, their moderation of flow regimes by retaining and gradually releasing water, their value as wildlife habitat, and as areas of botanical diversity. Wetlands exist within and adjacent to TVA reservoirs and are influenced by surface water and groundwater connections to the water levels in these reservoirs.

Land use/land cover data generated by the USEPA in 1999 indicated wetlands comprise less than 0.3 percent of land cover in the South Fork Holston River watershed (TDEC 2006a; 2006b). Wetlands constitute less than 0.1 percent of land cover in the Watauga River watershed (TDEC 2000).

Data prepared for the TVA *Reservoir Operations Study* (TVA 2004) provide general estimates of the type and extent of wetland acreage associated with TVA reservoirs. National Wetland Inventory data indicate wetlands on and near the NTRs are primarily

forested wetlands located in the floodplains of rivers and streams (Table 3-8). Small areas of emergent/scrub-shrub wetlands (typically less than 0.10 acre) are associated with reservoir shorelines and coves. Isolated wetlands such as bogs, seeps, and fens are relatively rare. Aquatic bed wetlands and mudflats are seasonal habitats; aquatic bed wetlands are associated with the summer growth of aquatic vegetation and are relatively uncommon on the NTRs. The large amount of aquatic bed and mudflat habitat shown for Watauga Reservoir is a function of the time of year when aerial photography was processed. Mudflat habitats are more common as these habitats are associated with reservoir drawdowns. Wetlands tend to be smaller and do not occur as frequently on tributary reservoirs because of the relatively steep drawdown zones, the rolling to steep topography of adjacent lands, shoreline disturbance caused by wave action, and the lower predictability and shorter duration of summer pool levels.

Table 3-8. Summary of Wetlands on TVA Northeastern Tributary Reservoirs by Area and Type[5]

Reservoir	Wetland Type				
	Combined Aquatic Beds and Mud Flats (Acres)	Emergent (Acres)	Forested (Acres)	Scrub-Shrub (Acres)	All Types (Acres)
Beaver Creek	0	2	<1	3	6
Clear Creek	0	4	5	3	12
Boone	2	7	28	11	48
Fort Patrick Henry	0	1	40	1	42
South Holston	9	32	7	4	52
Watauga	752	2	13	16	783
Wilbur	21	7	0	0	28
Total	**784**	**55**	**93**	**38**	**971**

Source: TVA 2004

Field surveys conducted on selected parcels around the NTRs indicated the presence of moderate and high-quality wetlands on Fort Patrick Henry, South Holston, and Watauga reservoirs. The TVA Rapid Assessment Method (TVARAM), which is a version of the Ohio Rapid Assessment Method designed specifically for the TVA region, was used to assess wetland conditions and identify wetlands with potential ecological significance (Mack 2001). Using TVARAM, wetlands may be classified into three categories. Category 1 wetlands are described as “limited quality waters.” They are considered to be a resource that has been degraded, has limited potential for restoration, or is of such low functionality that lower standards for avoidance, minimization, and mitigation can be applied. Category 2 includes wetlands of moderate quality and also wetlands that are degraded but exhibit reasonable potential for restoration. Category 3 generally includes wetlands of very high quality and wetlands of concern regionally and/or statewide, such as wetlands that provide habitat for species listed as threatened or endangered. Detailed descriptions of wetlands found around each reservoir are provided in the RLMPs (Volumes II-VI).

Large-scale analysis of land cover data over time and by ecoregion provides information on the status and trends of wetland resources. These data indicate an overall loss of forested wetland habitat in both the Southern Blue Ridge and Ridge and Valley ecoregions

[5] Areas are rounded to the nearest whole acre, which may lead to slight discrepancies in calculated totals.

(Loveland and Acevedo 2006). This loss is associated primarily with urbanization and agriculture. Emergent and scrub-shrub wetland acreage has remained relatively stable in the last 20 years, with some gain in open water/pond habitats (Dahl 2006).

3.8. Floodplains

As a federal agency, TVA is subject to the requirements of EO 11988 (Floodplain Management). The objective of EO 11988 is "to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative . . ." (43 *Federal Register* 6030 [10 February 1978]). The 100-year and 500-year flood elevations for portions of the South Fork Holston and Watauga rivers are provided in Appendix G. Descriptions of these floodplains are provided in the RLMPs (Volumes II-VI).

3.9. Cultural Resources

The Appalachian Highland region has been inhabited for at least 12,000 years. The areas around the major waterways of the region were the focus of prehistoric habitation, resource acquisition, and ceremonial activity for all of this time. Intensification of prehistoric occupation of the Appalachian Highlands is indicated by the frequency of archaeological sites attributable to the succeeding series of temporal/cultural traditions beginning with the Paleo-Indian Stage (ca. 12000-8000 B.C.) and continuing through the Archaic (8000-1200 B.C.), the Woodland (1200 B.C.-1000 A.D.), and the Mississippian (1000-1500 A.D.) stages. Following European contact, drastic cultural changes occurred, which for explanatory purposes have been divided into the Protohistoric-Contact Stage (1500-1750 A.D.) and the subsequent Historic era, which includes the Cherokee (1700 A.D.-present) and European- and African-American (1750 A.D.-present) occupations. The sustained presence of Native American groups in the Appalachian Highlands and their continuation of traditional religious and cultural practices are of great importance to communities of the region.

TVA is mandated under the NHPA, the *Archaeological Resources Protection Act* (ARPA) of 1979, the *Native American Graves Protection and Repatriation Act* (NAGPRA), as well as other legislation, to protect historic properties located on TVA land or affected by TVA undertakings. A historic property is defined in 36 CFR § 800.16(I)(1) as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior." In response to this mandate, TVA conducts inventories of its land to identify historic properties.

Prior to an undertaking, TVA must comply with Section 106 of the NHPA in order to identify, evaluate, and assess effects on historic properties and to determine the appropriate course of action. TVA may conduct the phased identification and evaluation procedure set forth in the regulations of the Advisory Council on Historic Preservation at 36 CFR § 800.4(b)(2). An undertaking is defined under 36 CFR § 800.16(y) as

> *"a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval."*

The area of potential effects (APE), as defined in 36 CFR § 800.16(d), is "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." For the NTRLMP, TVA has identified the APE for archaeological sites and historic structures in Tennessee as the TVA-retained land of 880 acres on Boone, 283 acres on Fort Patrick Henry, 2,099 acres on South Holston in Tennessee, 1,137 acres on Watauga, and 58 acres on Wilbur Reservoir. In Virginia, the APE is defined as the 290 acres on Beaver Creek, 14 acres on Clear Creek, and 185 acres on South Holston in Virginia.

A programmatic agreement (PA) was executed in October 2005 between TVA, the Advisory Council on Historic Resources, and the Tennessee SHPO regarding the implementation of TVA RLMPs for identification, evaluation, and treatment of historic properties that are eligible for inclusion in the National Register of Historic Places (NRHP) (Appendix G). This PA applies to all NTR land considered within the three alternatives. In 2008, TVA consulted with the Tennessee SHPO about the proposed NTRLMP (Appendix G). TVA proposed to fulfill its Section 106 responsibilities for the proposed NTRLMP by implementing the PA. The Tennessee SHPO concurred with this recommendation. TVA currently is coordinating with the Virginia SHPO to develop a similar PA addressing the identification, evaluation, and treatment for all cultural resources adversely affected by future proposed uses of TVA lands in Virginia planned in RLMPs. Until the Virginia PA is executed, TVA will incorporate the identification, evaluation, and treatment procedures to effectively mitigate adverse effects to historic properties pursuant to Section 106 of the NHPA.

3.9.1. Archaeological Resources

To support the characterization of TVA-managed lands around the NTRs, TVA conducted surveys for archaeological sites along portions of Watauga and South Holston reservoirs. Additionally, TVA evaluated results of previous surveys conducted along the NTRs. The TVA-managed land surrounding the reservoirs has not been systematically and completely surveyed for cultural resources. However, many archaeological sites have been identified on each of the NTRs. Some of the identified archaeological sites are located below the normal summer pool elevation. Certain sites are eligible or potentially eligible for listing in the NRHP. Descriptions of known archaeological resources are provided in the RLMPs (Volumes II-VI).

3.9.2. Historic Structures

Pursuant to Section 106 of the NHPA, TVA protects important historic structures located on TVA lands or affected by its undertakings. Such properties and other structures over 50 years old (including farm houses, communities, resorts, fortifications, churches, and cemeteries) occur on or near TVA land throughout the NTRs area.

Initially, European settlement in the early 19th century developed into an agricultural economy with farmsteads and small towns. Transportation networks evolved along the Tennessee River and its tributaries. Towns grew and prospered, and a plantation economy developed. Towns became river ports, and many ferry crossings were established. The later development of the railroad resulted in rail lines following the river valley. The Civil War brought destruction and economic devastation to the Valley. Following this war, development was slow. Agriculture, commerce, industry, and the river and rail systems gradually expanded.

The coming of TVA and the development of the NTRs resulted in further significant changes to the region. The acquisition of land for the reservoirs resulted in the removal of

many structures and other man-made features on these TVA lands. Very few structures remained, although many historic structures remain on adjacent non-TVA lands. Historic structures (and other man-made features) remain from all of these historical periods. The earliest settlements tended to be on the waterways, and many of these were lost to TVA's reservoir development. In addition, the richest farmlands and the most prosperous farms and plantations were located on the river bottoms. Many of these were also lost.

A complete survey for historic structures has not been conducted for all of the NTRs. However, to the extent practicable, structures over 50 years old were identified utilizing planimetric map data. Additionally, a preliminary field survey of uncommitted parcels indicated no historic structures are located on uncommitted parcels. However, the presence of historic structures on all NTR lands cannot be ruled out until a site visit has been conducted as part of a project-specific environmental review.

3.10. Managed Areas and Ecologically Significant Sites

This section addresses natural areas that are on, immediately adjacent to, or within 3 miles of each of the seven NTRs. Natural areas include managed areas, ecologically significant sites, and Nationwide Rivers Inventory (NRI) streams. Managed areas include lands held in public ownership that are managed by an entity (e.g., TVA, USFS, State of Tennessee, Sullivan County) to protect and maintain certain ecological and/or recreational features. A management plan or similar document defines what types of activities are compatible with the intended use of the managed area. Ecologically significant sites are either tracts of privately owned land that are recognized by resource biologists as having significant environmental resources, or tracts on TVA lands that are ecologically significant but not specifically managed by TVA's Natural Areas Program. NRI streams are free-flowing segments of rivers recognized by the National Park Service (NPS) as possessing remarkable natural or cultural values that may potentially qualify them as part of the National Wild and Scenic Rivers System.

3.10.1. Natural Areas on TVA Northeastern Tributary Reservoirs Lands

A review of the TVA Natural Heritage database indicated that no natural areas managed by the TVA Natural Areas Program are on any of the seven NTRs. One NRI stream and 10 natural areas either managed by other entities or recognized as ecologically significant are on or within Boone, South Holston, Wilbur, and Watauga reservoirs (Table 3-9). Descriptions of these natural areas are found in parcel descriptions in the accompanying RLMPs (Volumes II-VI). No natural areas are on Beaver Creek, Clear Creek, and Fort Patrick Henry reservoirs. No waterbodies designated as part of the National Wild and Scenic Rivers System are located within the South Fork Holston River or Watauga River watersheds.

Table 3-9. Natural Areas on TVA Northeastern Tributary Reservoirs Lands

Reservoir	Natural Area	Steward*	Location
Boone	Austin Springs Ecologically Significant Site	TVA	Parcel 34
	Overmountain Victory National Historic Trail	National Park Service (NPS) in partnership with states and other groups	South Fork Holston River, approximate RM 34.8; nearest Parcel 20
South Holston	Osceola Island Ecologically Significant Site	TVA (also used as a TVA-managed recreation area)	Island portion of Parcel 3
	Sullivan County Park	TVA permanent recreation easement to Sullivan County, Tenn.	Parcel 14
	Washington County Park	TVA permanent recreation easement to Washington County, Va.	Parcels 24 and 38
Watauga	Wilbur Cliffs Ecologically Significant Site	USFS	Parcel 1
	Appalachian National Scenic Trail	Appalachian Trail Conservancy	Parcels 1 and 59
	Watauga River (NRI stream)	NPS	Parcel 25
	Watauga River Potential National Natural Landmark	NPS	Parcel 25
	Watauga Lake Rare Plant Ecologically Significant Site	TVA	TVA right-of-way on USFS land adjacent to Watauga Reservoir
Wilbur	Wilbur Cliffs Ecologically Significant Site	USFS	Parcels 3, 4, 5, 6
	Wilbur Lake State Wildlife Observation Area	TVA and Tennessee Wildlife Resources Agency (TWRA)	Reservoir surrounded by Parcels 2, 3, 4, 5, 6

* Ecologically significant sites are not actively managed; "steward" indicates the entity responsible for general management of the land.

3.10.2. Natural Areas Adjacent to TVA Northeastern Tributary Reservoirs Lands

A review of the TVA Natural Heritage database indicated that several natural areas are adjacent to five of the NTRs, including USFS lands (Cherokee National Forest [CNF]), city and state parks, and the Appalachian Trail (Table 3-10). No natural areas are adjacent to Beaver Creek and Clear Creek reservoirs. Zone allocations of TVA land parcels are consistent with the management objectives of these back-lying public lands (see Chapter 2). The adjacent natural areas are listed below in Table 3-10 by reservoir along with the managing agency of the public land.

Table 3-10. Natural Areas Adjacent to TVA Northeastern Tributary Reservoirs Lands

Reservoir	Natural Area	Steward
Boone	Winged Deer Park	City of Johnson City, Tennessee; TWRA
Fort Patrick Henry	Warriors Path State Park	TDEC
South Holston	Cherokee National Forest (CNF)	USFS
	North Cherokee Wildlife Management Area	TWRA
	Jefferson National Forest	USFS
Watauga	CNF	USFS
	Pond Mountain Wilderness Area (CNF)	USFS
	Watauga Scenic Area (CNF)	USFS
	Big Laurel Branch Wilderness Area (CNF)	USFS
	Griffith Branch Cove (CNF)	USFS
	Wilbur Lake State Wildlife Observation Area	TVA; TWRA
	Wilbur Cliffs	USFS
Wilbur	Appalachian Trail	Appalachian Trail Conservancy
	CNF	USFS
	Big Laurel Branch Wilderness Area (CNF)	USFS
	Wilbur Cliffs	USFS

3.10.3. Other Natural Areas Within 3 Miles of TVA Northeastern Tributary Reservoirs Lands

Other natural areas within 3 miles of but not on or adjacent to TVA NTR lands (as indicated by a review of the TVA Natural Heritage database) are listed in Table 3-11. No additional natural areas are near Clear Creek and Fort Patrick Henry reservoirs.

Table 3-11. Natural Areas Within 3 Miles of TVA Northeastern Tributary Reservoirs Lands

Reservoir	Natural Area	Steward*	Distance to Nearest Point of Reservoir
Beaver Creek	Hickey Gap Road Ecologically Significant Site	Virginia Natural Heritage Program	2.3 miles east
Boone	Morrell Cave State Designated Natural Area	TDEC	0.5 mile southeast
	CNF	USFS	0.7 mile east
	Watauga River Bluffs The Nature Conservancy Preserve / Designated State Natural Area	The Nature Conservancy – Tenn./TDEC	1.6 miles south
South Holston	Overmountain Victory State Scenic Trail	NPS and states, other groups	0.8 mile northwest
	Middle Fork Holston River Megasite Ecologically Significant Site	Virginia Natural Heritage Program	1.5 miles north
	Holston River, South Fork (NRI stream)	NPS	1.0 mile above reservoir

Reservoir	Natural Area	Steward*	Distance to Nearest Point of Reservoir
Watauga	North Cherokee Wildlife Management Area (CNF)	TWRA	3.0 miles south
	Walnut Mountain (CNF) Ecologically Significant Site	USFS	2.8 miles south
	Doe River (NRI stream)	NPS	3.0 miles southwest
	Doe River Gorge Scenic Area (CNF)	USFS	3.0 miles southwest
	Pisgah National Forest	USFS	0.9 mile southeast
	Doe Branch Ditch Ecologically Significant Site	TDOT	0.8 mile northwest
Wilbur	Hunter Bog Registered State Natural Area	TDEC	3.0 miles northwest

*Ecologically significant sites are not actively managed; "steward" indicates the entity responsible for general management of the land.

3.11. Visual Resources

The physical, biological, and cultural features seen in the landscape give reservoir land its distinct visual character and sense of place. Varied combinations of these elements make the scenic resources of any portion of the reservoir identifiable and unique. Areas with the greatest scenic value such as islands, bluffs, wetlands, or steep forested ridges generally have the least capacity to absorb visual change without substantial devaluation. In the planning process, comparative scenic values of reservoir land were assessed to help identify areas for scenic conservation and scenic protection. The four broad visual characteristics listed below were evaluated. Two of these distinct but interrelated characteristics—viewing distance and human sensitivity—are commonly considered together as scenic visibility.

- Scenic attractiveness is the measure of outstanding or unique natural features, scenic variety, seasonal change, and strategic location.

- Scenic integrity is the measure of human modification and disturbance of the natural landscape.

- Viewing distance indicates scenic importance based on how far an area can be seen by observers and the degree of visible detail. Viewing distance is the measure of how far an area can be seen by observers and the degree of visible detail. It is ranked in one of three classifications from foreground to background. Figure 3-1 illustrates the viewing distance parameters.

    - The foreground distance is within 0.5 mile of the observer where details of objects are easily distinguished. Details are most significant in the immediate foreground from 0 to 300 feet.

    - Middleground is normally between 0.5 mile and 4 miles from the observer where objects may be distinguishable, but their details are weak and tend to merge into larger patterns.

- Background is the landscape seen beyond 4 miles where object details and colors are not normally discernible unless they are especially large, standing alone, or provide strong contrast.

- Human sensitivity is the expressed concern of people for the scenic value of the land under study. Concerns are derived or confirmed by public meetings and surveys. Sensitivity also includes considerations such as the number of viewers, frequency, and duration of views.

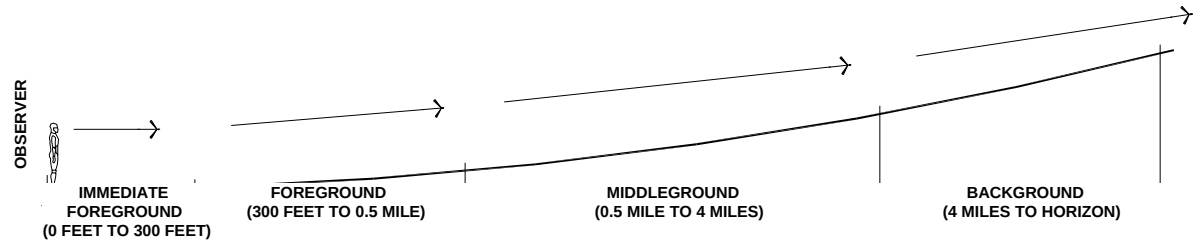

Figure 3-1. Viewing Distance

Where and how the reservoir landscape is viewed affects human perceptions of its aesthetic quality and sense of place. These impressions of the visual character can significantly influence how the scenic resources of public lands are appreciated, protected, and used.

The NTRs include islands, floodplains, secluded coves, and wetlands that are framed by high wooded ridges. Because the scenic features of the landscape are not limited by land boundaries, the attractive landscape character extends across public and private land alike. The natural elements together with the communities and other cultural development provide a scenic, rural countryside.

Land uses adjacent to the reservoirs include residential development, public parks, and sporadic industrial features. The reservoirs offer abundant water-recreation opportunities along with a variety of scenery. Most creek embayments are broadly open at the mouth, and some wind over a mile to their headwaters.

Among the scenic resources of each of the reservoirs, the water body itself is the most distinct and outstanding aesthetic feature. The horizontal surface provides visual balance and contrast to the islands and wooded hillsides. The reservoirs weave around ridges and bends, changing views periodically seen from the water. The reservoirs also link the other landscape features together. Views across the water are satisfying and peaceful to most observers.

Islands are another significant feature. The islands provide scenic accents and visual reference points throughout the reservoirs and serve as visual buffers for less desirable views. They also provide a pleasing foreground frame for the distant shoreline or background.

Other important scenic features include the secluded coves and steep, wooded ridges that occur around the reservoirs. The isolated coves with wooded shoreline provide relatively private locations for dispersed recreation activities. Significant elevation changes along

some stretches of shoreline provide a dramatic contrast to the surrounding reservoir and gently sloping countryside, particularly when they are viewed from background distances.

Most shorelines upstream of the dams appear natural. Slopes and ridgelines seen from the reservoirs are generally heavily vegetated with mature hardwood and evergreen trees and provide positive visual contrast to the reservoirs. There is usually little development in the foreground distances.

3.12. Water Quality

3.12.1. General Water Quality Characteristics

Water quality in the NTRs and their tailwaters is influenced by numerous factors including the size, geology, and land use conditions in upstream drainage areas, point and nonpoint discharges of pollutants, adjacent land use activities, and the operation of the reservoirs. The NTRs are located in two distinct ecoregions with different geological characteristics and land use patterns that affect water quality in the reservoirs.

Most of the South Fork Holston River watershed and a portion of the Watauga River watershed, downstream of Watauga and Wilbur dams, lie within the Ridge and Valley ecoregion, which is characterized by numerous ridges and valleys underlain by sedimentary rocks. The dissolution of the limestone and dolomite that underlie much of the valleys results in naturally high concentrations of dissolved minerals in the streams. The area has a relatively large population with substantial industrial development surrounding the Tri-Cities metropolitan area of Johnson City-Kingsport-Bristol in Tennessee and Virginia.

The Watauga River watershed upstream of Watauga and Wilbur dams and a portion of the South Fork Holston River watershed east of South Holston Reservoir lie within the SBRE. The SBRE is mostly forested because of the mountainous terrain and a large proportion of land within the national forest. The geology is primarily metamorphic and igneous rocks with minor areas of sedimentary geology. Because much of the province is underlain by rocks that are relatively insoluble and surface water drainage is rapid, streams draining this area generally contain relatively low concentrations of nutrients and dissolved minerals. The Watauga/Wilbur watershed contains the town of Mountain City, Tennessee, and the western portion of Boone, North Carolina. Parts of the basin are being developed for second homes and recreational areas. Although many of the headwater streams of the South Fork Holston River lie within the SBRE and the national forest, the geology and land use within the Ridge and Valley ecoregion are the predominant influences on overall water quality within the South Fork Holston River basin.

Impoundments convert typical riverine environments into lakelike conditions, thereby effecting change to many aspects of the aquatic environment such as water temperature, dissolved oxygen (DO), nutrient dynamics, algal productivity, and aquatic life in the reservoirs themselves and the rivers downstream. The length of time water is retained in a reservoir (i.e., residence time) is one of the primary mechanisms influencing these changes. Table 3-12 provides the average annual residence time and other physical characteristics of the NTRs.

The long residence time in South Holston and Watauga reservoirs (262 and 325 days, respectively), and to some extent Boone Reservoir (30 days), results in thermal stratification (i.e., the separation or layering of colder and warmer waters, with the colder, more dense water settling on the bottom) during summer in these reservoirs. Once stratification is established, oxygen in the deeper, colder waters is not replenished from the

air or from contact with the oxygen-rich surface water, and the natural process of decaying organic material results in low DO concentrations in the lower strata of the water column. The extent of oxygen depletion is related to the length of time a reservoir remains stratified and the amount of organic material present. The oxygen demand is increased by high nutrient loads (i.e., pollution) that carry in organic matter and/or result in increased algal growth. Residence time and the availability of nutrients and light play an important role in the growth of algae in the reservoirs.

Table 3-12. Physical and Operational Characteristics of Northeastern Tributary Reservoirs

Reservoir	Watershed	Hydrologic Unit Code	Drainage Area (square miles)	Mean Annual Flow (cubic feet per second)	Full Pool		Mean Depth* (feet)	Residence Time* (days)
					Area (acres)	Volume (1,000 acre-feet)		
Beaver Creek	South Fork Holston River	06010102	13.7	-	170**	5**	-	-
Clear Creek	South Fork Holston River	06010102	5.8	-	46	2.5	-	-
Boone	South Fork Holston River	06010102	1,840	2,441	4,310	189	44	30
Fort Patrick Henry	South Fork Holston River	06010102	1,903	2549	872	27	31	5
South Holston	South Fork Holston River	06010102	703	954	7,581	658	87	262
Watauga	Watauga River	06010203	468	688	6,430	569	89	325
Wilbur	Watauga River	06010203	471◆	730	72	0.7	10	0

- = Not applicable

* Mean depth and residence time are based on average, rather than full pool area and volume.

** Beaver Creek is a detention only reservoir with no permanent pool; at the emergency spillway crest, the temporary reservoir would cover 170 acres.

◆ Total drainage area of Wilbur Reservoir includes Watauga drainage area.

Boone, Fort Patrick Henry, South Holston, and Watauga are hydroelectric dams that withdraw water from the deeper, less oxygenated waters of the reservoir. The water released from these dams can create low-oxygen conditions downstream. To address tailwater oxygen concentrations and minimum-flow requirements, TVA established the Reservoir Releases Improvement Program in 1991. TVA has improved water quality below many of its dams by implementing minimum flows via turbine pulses and using a wide range of methods (e.g., turbine venting, oxygen injection, and aerating weirs) to improve DO concentrations. Minimum flows are maintained downstream of Boone and Fort Patrick Henry dams by venting the turbines (i.e., installing equipment that mixes air with water flowing over the turbines) in the Boone Dam. Turbine venting is also used to aerate water below Watauga and Wilbur dams. Minimum flow below the South Holston Dam is maintained by an aerating labyrinth weir and by periodically pulsing the turbines.

Wilbur Reservoir is a small hydroelectric project located on the Watauga River immediately downstream of TVA's Watauga Dam. There is very little useful storage behind Wilbur Dam, and it is generally operated in tandem with Watauga, except for maintaining pulsed and/or continuous minimum flows. The immediate watershed of Wilbur Reservoir (area between Watauga Dam and Wilbur Dam) is only about 3 square miles. Water quality in the reservoir is influenced primarily by the cold water releases from Watauga Dam.

Clear Creek and Beaver Creek dams are earthen dams with no facilities for power generation. They are essentially self-regulating by means of overflow structures. Beaver Creek is a detention reservoir with no permanent pool, meaning Beaver Creek is a free-flowing stream most of the time. At the emergency spillway crest (for large floods), the Beaver Creek Reservoir would temporarily cover 170 acres. Clear Creek Dam encompasses 46 acres at full pool and is surrounded by a public golf course.

3.12.2. Water Quality Monitoring

Water quality in TVA reservoirs is evaluated by several programs designed to monitor the chemical and biological conditions of the aquatic environment.

State-designated impaired waters. The states of Tennessee, Virginia, and North Carolina conduct water quality testing in accordance with requirements of the CWA. State assessment results are compiled biennially and reported to the public. The principal vehicles for this water quality assessment reporting are the states' 305(b) Reports and 303(d) Lists (North Carolina Department of Environment and Natural Resources 2007; TDEC 2008; Virginia Department of Environmental Quality 2008). These reports present how well waters support designated uses as well as likely causes and potential sources of impairment.

Many segments of the South Fork Holston and Watauga River systems are listed by the states as water-quality impaired under Section 303(d) of the CWA. Impaired waters have one or more properties that violate state water quality standards. They are considered impaired by pollution and not fully meeting designated uses, such as recreation (e.g., swimming and fishing), propagation of aquatic life, or water supply.

The state-designated impaired TVA reservoirs and tailwaters within the scope of this EIS include the reservoir tailwaters below Fort Patrick Henry and South Holston dams and the Boone, South Holston, and Watauga reservoirs (Appendix G, Tables G-2 through G-6). Reasons for the impaired designation in tailwaters include flow alteration, low DO concentrations, and/or thermal modification, with the source being the upstream impoundment. In the reservoirs, the reason for impairment is accumulated polychlorinated biphenyls (PCBs) and chlordane or mercury in fish tissue. Fish consumption advisories issued for Boone, South Holston, and Watauga reservoirs are discussed below. The principal sources of problems in reservoirs are the historical discharge of pollutants that have accumulated in sediment and fish flesh, plus atmospheric deposition of mercury.

State-designated impaired waters also include streams flowing into several of the reservoirs. The Tennessee, Virginia, and North Carolina water quality assessment reports list about 520 stream miles as impaired or partially impaired within the watersheds of the NTRs. The most common reasons for a stream to be impaired are the presence of elevated levels of bacteria, followed by loss of biological integrity and habitat loss. The most common sources of stream impairment are nonpoint source pollution from agriculture and urban runoff.

Fish consumption advisories. TVA maintains a program to examine contaminants in fish fillets from TVA reservoirs and their major tributary streams. TVA coordinates fish tissue studies in the Tennessee Valley with state agencies that are responsible for protecting public health and issuing a fish consumption advisory if warranted. TVA assists the states by collecting fish from TVA reservoirs and checking the tissue for metals, pesticides, PCBs, and other chemicals that could affect human health. Typically, channel catfish and largemouth bass are monitored.

The State of Tennessee has issued a precautionary advisory for the consumption of catfish and carp from Boone Reservoir because of PCB and chlordane contamination. A precautionary advisory also has been issued by the State of Tennessee for the consumption of largemouth bass from South Holston Reservoir and largemouth and channel catfish from Watauga Reservoir because of elevated mercury concentrations. A precautionary advisory means that pregnant women, nursing mothers, and children should not eat the fish species named. All others should limit consumption of the named species to one meal per month. The Commonwealth of Virginia has issued an advisory to not consume carp or largemouth and smallmouth bass from Beaver Creek (Beaver Creek Dam downstream to the Virginia/Tennessee state line) because of PCB contamination. Virginia also advises that people not consume more than two meals per month of carp or northeastern hogsucker from Wolf Creek (Route 670 near Abingdon downstream to Route 75 near Green Spring).

Swimming advisories. The states evaluate water quality by performing and evaluating bacteriological (*Escherichia coli*) monitoring. When test results warrant, the states issue water contact advisories. Currently, there are no state advisories against swimming in the NTRs.

Reservoir ecological health. Since 1990, TVA has implemented the Reservoir Ecological Health Monitoring Program to determine reservoir health as compared to other reservoirs in the TVA system, to provide data for comparing future water quality conditions, and as a screening program to target needs for more detailed studies (TVA 2006b). As a part of this program, TVA developed a reservoir ecological health scoring system to aid in data evaluation and communication of monitoring results to the public. The ecological health scoring system is based upon the following five indicators, which are typically measured in the reservoir forebay area (a short distance upstream of the dam) and one or more areas farther upstream:

1. DO is necessary in respiration of most aquatic organisms. Ideally, a reservoir has enough DO throughout the water column available to fish, insects, and zooplankton (microscopic aquatic animals) for respiration. Concentrations of DO in a reservoir both control and are controlled by many physical, chemical, and biological processes (e.g., photosynthesis, respiration, oxidation-reduction reactions, bacterial decomposition, temperature) that determine the assimilative capacity of a reservoir. Assimilative capacity is a water body's ability to receive wastewaters or other materials requiring oxygen for decomposition without deleterious effects and without damage to aquatic life. If concentrations are low enough and/or low levels are sustained long enough, it can adversely affect the health and diversity of aquatic organisms. DO levels are expressed in terms of milligrams/liter.

2. Chlorophyll, a surrogate measure for the amount of algae (phytoplankton) in the water, is important because it provides insights into the level of primary productivity (basic level of the food web) within a water body and can provide a measure of

nutrient enrichment. Although some level of phytoplankton production is essential to maintain a healthy aquatic community, as concentrations increase, uses can be affected differently. For example, fisheries such as largemouth bass in southeastern reservoirs can be enhanced as phytoplankton concentrations increase to relatively high levels. However, elevated phytoplankton concentrations are a concern because adverse ecological and use impacts could occur, such as reduced water clarity, more frequent algal blooms, higher oxygen demands and lower DO concentrations, increased periods of anoxic conditions and resultant anoxic byproducts (i.e., ammonia, sulfide, and dissolved manganese), more frequent water treatment problems, and higher water treatment cost.

3. Sediment quality is a measure of the amount of PCBs, pesticides, and metals in sediment on the bottom of the reservoir. Sediments at the bottoms of reservoirs serve as a repository for a variety of materials, especially chemicals that have a low solubility in water. If contaminated, bottom sediments can have adverse impacts on bottom fauna and can often be long-term sources of toxic substances to the aquatic environment. They may impact wildlife and humans through the consumption of contaminated food or water or through direct contact. These impacts may occur even though the water above the sediments meets water quality criteria. Thus, examination of reservoir sediments is useful to determine if toxic chemicals are present and if chemical composition is changing through time.

4. Benthic macroinvertebrates (large bottom-dwelling invertebrates such as worms, snails, mussels, and crayfish) are included in aquatic monitoring programs because of their importance to the aquatic food chain, and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Data analyses that are indicative of water quality include richness of taxa (i.e., diversity of various groups of animals and plants), relative abundance of organisms tolerant or intolerant of poor water quality, and proportions of samples with no organisms present.

5. Fish are included because they are important to the aquatic food chain and because they have a long life cycle that allows them to reflect water quality conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons. Ratings are based primarily on fish community structure and function using a metric known as the Reservoir Fish Assemblage Index (RFAI). Also considered in the rating is the percentage of the sample represented by omnivores (organisms that eat plants and animals) and insectivores (insect eaters), overall number of fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc.

Each indicator is evaluated separately and assigned a rating of “good,” “fair,” or “poor.” Individual ratings are combined into a single, composite score for each reservoir, termed the Reservoir Ecological Health Rating.

Reservoir Ecological Health Ratings reported between 1994 and 2007 are summarized in Table 3-13 and provided in detail in Appendix G, Tables G-7 and G-8.

Table 3-13. Typical Ratings for Dissolved Oxygen, Chlorophyll, and Sediment in the Northeastern Tributary Reservoirs Monitored as Part of the Reservoir Ecological Health Monitoring Program, 1991-2007

Indicator	Boone			Fort Patrick Henry	South Holston		Watauga	
	Forebay	Transition Zone*	Transition Zone**	Forebay	Forebay	Transition zone	Forebay	Transition Zone
Dissolved Oxygen	G/F/P	P	G	G	P	P	G/F	F/P
Chlorophyll	G/F/P	P	P	P	G	G→ G/F/P	G	G
Sediment	F	F	P→F	G/F	G/F	G/F	G/F	F

* South Fork Holston River
**Watauga River
Rating codes: *G = Good; F = Fair; P = Poor; more than one rating code (e.g., G/F) for an indicator means that ratings have fluctuated generally between the rating categories shown; an arrow (→) between rating codes signifies that the indicator has exhibited a trend toward either improved or lower ratings.*

Boone, Fort Patrick Henry, South Holston, and Watauga reservoirs are monitored under TVA's Reservoir Ecological Health Monitoring Program. Wilbur, Clear Creek, and Beaver Creek reservoirs are not included in this monitoring program due to the small size and operational characteristics of these reservoirs as described in Section 3.12.1 above.

Boone, Fort Patrick Henry, and South Holston often receive "poor" ecological health scores, primarily caused by low DO concentrations, elevated chlorophyll concentrations, and a benthic macroinvertebrate (e.g., mollusks) community comprised mostly of organisms indicative of poor water quality conditions. Watauga Reservoir usually scores "good" or at the high end of the "fair" range. DO concentrations in Watauga are not as severely depressed, and chlorophyll concentrations are lower than those found on other reservoirs. Two factors contribute to better water quality conditions in Watauga: (1) relatively less development in the surrounding area and (2) the nutrient-poor soils characteristic of the SBRE (as opposed to the nutrient rich soils surrounding the other reservoirs in the Ridge and Valley ecoregion). Detailed results of ecological health monitoring for each reservoir are provided in the individual RLMPs (Volumes II-VI).

3.12.3. Water Supply

The quality of source water can have a direct impact on water treatment cost and how the water ultimately is used. Quality of source water may also determine the maximum amount of pollution from both point and nonpoint sources that a water body can assimilate without violating state water quality standards. Numerous municipal water suppliers and industries utilize surface water from the NTRs and their supporting watersheds as their primary source of raw water. In 2005, the average daily surface water demand among these users was 31.5 millions of gallons per day (MGD) (Table 3-14).

Wastewater permits are issued by the states under the National Pollutant Discharge Elimination System (NPDES) program. Based on these permits, the 2005 average daily wastewater discharge for all seven NTRs was about 30 MGD (Table 3-14).

Table 3-14. Average Daily Municipal and Industrial Water Intake From and Wastewater Discharge to Northeastern Tributary Reservoirs in 2005

Reservoir*	Municipal Water Intake (MGD)	Industrial Water Intake (MGD)	NPDES-permitted Wastewater Discharge (MGD)
Beaver Creek	0	0	0
Clear Creek	0	0	0
Boone	19.3	0.1	21.7
Fort Patrick Henry	0	0	1.3
South Holston	8.9	0	5.4
Watauga	3.1	0.1	1.6
Wilbur	0	0	0

Source: TVA's 2005 Water Use database
*Includes intake from watersheds supporting each reservoir

3.13. Aquatic Ecology

Aquatic life in the NTRs is influenced by some of the same physical and chemical factors associated with water quality, such as adjacent land uses and reservoir operations, discussed in Section 3.12 above. The Tennessee River and all major tributaries, including the rivers and streams in the NTRs area, have been affected by impoundments and point and nonpoint sources of pollution. As a result, the larger river fish faunas have extremely fragmented distributions and several known species have disappeared (Etnier and Starnes 1993).

In reservoirs, aquatic habitat in the littoral (i.e., near shore) zone is greatly influenced by back-lying land use and topography. In areas characterized by residential development, habitat includes man-made features such as riprap banks, seawalls, and docks. Undeveloped shoreline typically is wooded; therefore, trees and brush provide woody cover in those areas. Shoreline topography varies from moderately deep with stretches of bluff along the main channels to typically shallow in embayments and coves. Due to the lack of natural underwater structure (e.g., submerged trees), rock is an important component of underwater habitat. Rock habitat includes, but is not limited to, bedrock outcrops, a mixture of rubble and cobble, or gravel along main channel shorelines. Cove substrate is typically soil and gravel with scattered cobble. Structure provides protection from predators, shade to cool the water temperature in the shallow littoral zone, spawning habitat, and places for food organisms to live and grow. Algae and other organisms (including bacteria, zooplankton, and aquatic insects), which are important fish foods, use physical and biological structure as growth substrates.

Impoundment favors growth of aquatic species that are tolerant of lakelike conditions, and disfavors groups of aquatic species adapted to river conditions. Deep tributary reservoirs often undergo thermal stratification (layering) during summer, when the colder, less oxygenated water settles on the bottom. Therefore, water discharged into the Boone, Fort Patrick Henry, South Holston, and Watauga/Wilbur tailwaters can be very cold and have low DO content, impairing water quality and resulting in less diverse aquatic communities. Recent projects (e.g., turbine venting, oxygen injection, and installation of weir dams) designed to aerate dam discharges in the tailwaters of Boone, Fort Patrick Henry, South

Holston, Wilbur, and Watauga reservoirs have increased DO levels to mimic more natural riverlike conditions.

On the other hand, releases of very cold water from the lower depths of Fort Patrick Henry, South Holston, and Wilbur dams support well-established, year-round trout fisheries in the tailwaters. These downstream areas generally have habitats and food bases that can support large carrying capacities and allow trout to grow larger than they normally do elsewhere. These tailwaters are typically stocked by TWRA with fingerlings in the early spring and adult fish (catchables) throughout the summer. Adults supplement the catch during peak angling season, and by fall, fingerlings have begun to enter these fisheries. Recruitment of natural reproduction (mostly by brown trout) contributes substantially to the fishery in the South Holston tailwater and, to a lesser extent, in the Wilbur tailwater (Watauga River), which supports a 16-mile fishery for rainbow and brown trout before it enters Boone Reservoir (Habera et al. 2003a; 2003b). Brook trout fingerlings were added to the Wilbur tailwater stocking program in 2001. Watauga tailwater receives just over 200,000 trout annually, most of which are rainbow trout.

Aquatic ecological conditions in streams and reservoirs are monitored under a number of TVA programs. Conditions in Beaver Creek and Clear Creek reservoirs are evaluated using results of Index of Biotic Integrity (IBI) (Karr 1981) and benthic macroinvertebrate sampling conducted below the respective dams. Data from monitored streams are compared to benchmarks from relatively unimpacted streams as a measure of ecological impact. Analysis of benthic macroinvertebrates (Ephemeroptera, Plecoptera, Trichoptera [EPT] score) also provides a measure of water quality and ultimately, the health of the stream. Between 1995 and 2007, IBI scores for Beaver and Clear creeks indicate fair to very poor conditions, and EPT scores indicate primarily fair conditions, ranging from poor to good. The Beaver Creek and Clear Creek RLMP (Volume II) provides additional details about the results of these monitoring programs.

Aquatic ecological conditions in the larger reservoirs have been monitored using the Reservoir Vital Signs Monitoring Program (RVSMP), which focuses on (1) physical and chemical characteristics of waters; (2) physical and chemical characteristics of sediments; (3) benthic macroinvertebrate community sampling; and (4) fish assemblage sampling. The RVSMP includes evaluation of fish community structure and function using an analysis tool known as the RFAI (McDonough and Hickman 1999). Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number or fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, and deformities. The RVSMP also includes evaluation of benthic macroinvertebrate communities based upon seven parameters that indicate species diversity, abundance of selected species that are indicative of good (or poor) water quality, total abundance of selected species, and proportion of samples with no organisms present.

Biennial RFAI and benthic macroinvertebrate scores recorded between 1999 and 2007 indicate fish assemblage scores are typically fair on Boone, fair to poor on Fort Patrick Henry, and fair to good on South Holston and Watauga reservoirs. Benthic scores are typically poor on Boone and South Holston reservoirs and fair to poor on Fort Patrick Henry and Watauga reservoirs.

Additionally, the Sport Fishing Index (SFI; Hickman 2000) is designed to measure sport fishing quality for various species in Tennessee and Cumberland Valley reservoirs. The SFI is based on the results of fish population sampling by TVA and state resource agencies and, when available, results of angler success as measured by state resource agencies

(i.e., bass tournament results and creel surveys). The SFI score ranges from a high of 60 (excellent) to a low of 20 (very poor). On Boone and South Holston reservoirs, SFI scores measured for five species ranged between 25 and 36 and were typically similar to or greater than the Valleywide average. On Watauga Reservoir, SFI scores measured for five species ranged between 24 and 48 and were typically similar to or greater than the Valleywide average. On Fort Patrick Henry Reservoir, SFI scores measured for three species ranged from 28 to 35 and were similar to the Valleywide average. Detailed results of RFAI, benthic macroinvertebrate sampling, and the SFI monitoring are provided in the individual RLMPs.

3.14. Air Quality

NAAQS have been established to protect the public health and welfare with respect to six pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. An area where any air quality standard is violated may be designated as a nonattainment area for that pollutant, and emissions of that pollutant from new or expanding sources are carefully controlled. On March 12, 2008, the USEPA significantly strengthened its NAAQS for ground-level ozone. USEPA is revising the 8-hour primary ozone standard designed to protect public health to a level of 0.075 parts per million (ppm). The previous standard set in 1997 was 0.084 ppm. In addition to tightening the primary standard, USEPA is also strengthening the secondary 8-hour standard for ozone to the level of 0.075 ppm. The secondary standard is designed specifically to protect sensitive plants from damage caused by ozone exposure throughout the growing season. States were to have made recommendations to USEPA no later than March 2009 for areas to be designated attainment, nonattainment, and unclassifiable. USEPA will issue final designations no later than March 2010 unless there is insufficient information to make these designation decisions, in which case USEPA will issue designations by March 2011. Under these tightened ozone standards, some of the counties in which the NTRs are located are likely to be designated nonattainment for ozone. USEPA tightened the primary fine particulate standard in December 2006 and designated additional nonattainment areas in December 2008, though none of the counties covered by the NTRLMP were designated as nonattainment for fine particulate matter. All of the counties containing the NTRs are currently in attainment of each of the NAAQS standards.

Prevention of significant deterioration (PSD) regulations are used to limit air pollutant emissions from new or expanding sources. Under these regulations, some national parks and wilderness areas are designated PSD Class I air quality areas and are specially protected. There are four Class I areas within 62 miles of the NTRs, including Linville Gorge Wilderness, the Great Smoky Mountains National Park, Shining Rock Wilderness, and Joyce Kilmer/Slickrock Wilderness. The closest Class I area, Linville Gorge, is located approximately 30 miles southeast of Watauga Reservoir.

3.15. Noise

Along the NTRs, sources of noise include industrial development, power generation facilities, substations, developed recreation sites, and traffic. Noise-related effects of lands planning in the NTRs were evaluated qualitatively based upon the number of acres allocated to each zone and based upon the assumption that the potential to generate noise is greatest with industrial land uses, is moderate with developed recreation uses, and is least with conservation land uses.

3.16. Socioeconomics

3.16.1. Population and Economy

Human population in the counties where the NTRs are located is estimated to be about 421,000, as of 2008 (Table 3-15). In every county in the area, population grew more slowly than in the nation and the state between 1980 and 2008, while the independent city of Bristol, Virginia, lost population. Projections and current trends suggest that the population of this area will reach about 450,000 by the year 2020. Washington County, Tennessee, is projected to grow slightly faster than the nation, although more slowly than the state. Otherwise, the area is projected to grow more slowly than the nation.

Overall, the rural population share in the area is about the same as the Tennessee average, which is somewhat higher than the national average as well as the Virginia average. However, two counties—Johnson, Tennessee, and Washington, Virginia—are considerably more rural than the area as a whole.

Table 3-15. Population Around the Northeastern Tributary Reservoirs

Area	1980	2000	Estimate 2008	Projection 2020	Percent Increase, 1980-2008	Projected Percent Increase, 2008-2020	Percent Rural, 2000
Carter Co., Tenn.	50,205	56,742	59,492	63,657	18.5	7.0	40.3
Johnson Co., Tenn.	13,745	17,499	18,112	19,655	31.8	8.5	83.2
Sullivan Co., Tenn.	143,968	153,048	153,900	161,390	6.9	4.9	26.6
Washington Co., Tenn.	88,755	107,198	118,639	133,790	33.7	12.8	32.6
Washington Co., Va.	46,487	51,103	53,038	54,138	14.1	2.1	69.7
Bristol City, Va.	19,042	17,367	17,424	17,078	-8.5	-2.0	0.9
Total	**362,202**	**402,957**	**420,605**	**449,708**	**16.1**	**6.9**	**36.9**
Tennessee	4,591,023	5,689,283	6,214,888	7,195,375	35.4	15.8	36.4
Virginia	5,346,797	7,078,515	7,769,089	8,917,396	45.3	14.8	27.0
U.S. (000)	226,545.8	281,421.9	304,059.7	341,387.0	34.2	12.3	21.0

Sources: Historical data and U.S. projection from U.S. Census Bureau, http://www.census.gov.

Projections for Tennessee: Tennessee Advisory Commission on Intergovernmental Relations and The University of Tennessee, Center for Business and Economic Research, *Population Projections for the State of Tennessee 2005 to 2025,* http://cber.bus.utk.edu/.

Projections for Virginia: Virginia Employment Commission, http://www.vawc.virginia.gov/gsipub/.

Total employment in 2007 was almost 246,000 in the area counties (Table 3-16). Both farming and manufacturing account for a larger share of jobs than in the state and the nation. Farm employment accounted for 3.1 percent of all jobs in the area, slightly higher than the Tennessee share of 2.5 percent and almost twice the national share of 1.6 percent. Johnson County is more dependent on farming, which accounts for 11.3 percent of all jobs in the county. Manufacturing is especially important in Sullivan County and in Washington County/Bristol City, Virginia.

Table 3-16. Employment in the Counties Around the Northeastern Tributary Reservoirs in 2007

Area	Total Employ-ment	Percent of Total Employment				
		Farm	Manufac-turing	Retail Trade	Govern-ment	Other
Carter Co., Tenn.	21,338	3.3	6.7	14.1	12.0	63.9
Johnson Co., Tenn.	6,931	11.3	10.0	11.2	16.1	51.4
Sullivan Co., Tenn.	94,307	1.6	14.7	12.1	8.5	63.2
Washington Co., Tenn.	80,051	2.9	9.2	11.8	16.0	60.1
Washington Co. + Bristol City, Va.	43,140	5.2	14.3	13.0	12.5	54.9
Total	**245,767**	**3.1**	**12.0**	**12.3**	**12.2**	**60.4**
Tennessee	3,746,010	2.5	10.5	11.2	12.0	63.8
Virginia	4,936,137	1.1	5.9	10.6	17.5	64.9
U.S. (000)	180,943.8	1.6	8.0	10.7	13.4	66.3

Source: U.S. Bureau of Economic Analysis, Regional Economic Accounts, http://www.bea.gov/regional/reis/.

The unemployment rate in the area in 2008 was 5.6 percent, slightly lower than the national and Tennessee rates, although notably higher than the Virginia rate (Table 3-17). The highest rate, 8.4 percent, was in Johnson County, followed by Carter County at 6.4 percent. The rates in the rest of the area were below the national and Tennessee levels, although higher than the Virginia rate.

Table 3-17. Unemployment and Income in the Counties Surrounding the Northeastern Tributary Reservoirs in 2007

Area	Unemployment Rate (2008)	Per Capita Personal Income (2007)	
		($)	Percent of U.S.
Carter Co., Tenn.	6.4	23,987	62
Johnson Co., Tenn.	8.4	20,785	54
Sullivan Co., Tenn.	5.2	32,141	83
Washington Co., Tenn.	5.5	30,516	79
Washington Co. + Bristol City, Va.	5.2	29,907	77
Total	**5.6**	**29,664**	**77**
Tennessee	6.4	33,395	86
Virginia	4.0	41,727	108
U.S. (000)	5.8	38,615	100

Source: U.S. Bureau of Economic Analysis, Regional Economic Accounts, http://www.bea.gov/regional/reis/.

The NTRs are located in a relatively low-income area (Table 3-17). All of the counties in the area have per capita personal income levels below the state and national averages. Johnson County is the poorest county, with per capita income only 54 percent of the national average. Carter County, the second-lowest, is 62 percent of the national average. The remaining counties have average income between 77 and 83 percent of the national average, which is still below, but much closer to, the Tennessee average.

3.16.2. Environmental Justice

The population of the area is predominantly non-Hispanic white, with a minority population average of 5.9 percent (Table 3-18). The minority population share ranges from 3.9 percent in Washington County, Virginia, to 8.4 percent in Washington County, Tennessee and 9.4 percent in the independent city of Bristol, Virginia. These shares are very low in comparison to the state and national averages.

Table 3-18. Minority Population in the Counties Around the Northeastern Tributary Reservoirs, 2008

Area	Total Population	Nonwhite Population	White Hispanic Population	Total Minority Population	Percent Minority Population
Carter Co., Tenn.	59,492	2,053	737	2,790	4.7
Johnson Co., Tenn.	18,112	732	176	908	5.0
Sullivan Co., Tenn.	153,900	5,939	1,515	7,454	4.8
Washington Co., Tenn.	118,639	7,407	2,564	9,971	8.4
Washington Co., Va.	53,038	1,532	532	2,064	3.9
Bristol City, Va.	17,424	1,422	223	1,645	9.4
Total	**420,605**	**19,085**	**5,747**	**24,832**	**5.9**
Tennessee	6,214,888	1,219,860	204,512	1,424,372	22.9
Virginia	7,769,089	2,095,176	472,488	2,567,664	33.0
U.S.	304,059,724	61,420,482	43,147,784	104,568,266	34.4

Source: U.S. Census Bureau, http://www.census.gov/popest/race.html

Overall, poverty levels are slightly higher than the State of Tennessee average and well above the Virginia and national averages (Table 3-19). The average share of persons below poverty level in the area in 2007 was 16.7 percent, somewhat higher than the 15.8 percent average for Tennessee. The national average is lower at 13.0 percent and the Virginia average much lower at 9.9 percent. Johnson County has the highest poverty level, at 21.9 percent, followed by Carter County at 20.1 percent. The remaining levels range from 14.8 percent in Washington County, Virginia, to 18.3 percent in the independent city of Bristol, Virginia.

Table 3-19. Persons Below Poverty Level in the Counties Around the Northeastern Tributary Reservoirs, 2007

Area	Persons Below Poverty Level (Number)	Persons Below Poverty Level (Percent)
Carter Co., Tenn.	11,244	20.1
Johnson Co., Tenn.	3,568	21.9
Sullivan Co., Tenn.	22,627	15.0
Washington Co., Tenn.	19,469	17.3
Washington Co., Va.	7,589	14.8
Bristol City, Va.	3,098	18.3
Total	**67,595**	**16.7**
Tennessee	945,263	15.8
Virginia	739,135	9.9
U.S.	38,052,247	13.0

Source: U.S. Census Bureau, http://www.census.gov/hhes/www/poverty/poverty.html