CHAPTER 3

3. AFFECTED ENVIRONMENT

3.1. Regional Setting

The Watts Bar Dam drainage basin encompasses 17,310 square miles in Tennessee, North Carolina, and Virginia. It lies predominantly within two physiographic provinces: Ridge and Valley and Blue Ridge Mountains, often described as the Great Valley, with a small portion in the Cumberland Plateau. The geology of the Great Valley of East Tennessee consists of a system of sedimentary sandstones, shale, and limestone formations. This upper part of the Tennessee River Valley is underlain by folded and faulted Paleozoic rock formations. Most of the folds are compressed and many of them have been overturned, and thrust or reverse faults have developed along them often repeating and overlapping along each fault in a shingle-like structure (TVA 1949).

Watts Bar Reservoir is centrally located in the Appalachian Ridge and Valley physiographic province of mideast Tennessee (Fenneman 1938; Miller et al. 1966) and is within the Appalachian oak forest as described by Küchler (1966. The Ridge and Valley province, with elevations of up to 2,000 to 3,000 feet, consists of northeast-southwest trending valleys and streams. About 1,834 square miles of drainage lies within the watershed draining directly into Watts Bar Reservoir downstream of Fort Loudoun and Melton Hill dams.

Watts Bar Reservoir was impounded in 1942 by Watts Bar Dam, located at TRM 529.9. Watts Bar is a fairly large reservoir with 39,000 acres of surface area. The total length of the reservoir, including the Clinch River arm is about 96 miles; the shoreline length is 721 miles. The reservoir extends 72 miles up the Tennessee River to Fort Loudoun Dam and 63 miles up the Tennessee and Clinch rivers to Melton Hill Dam. It flows from the northeast through portions of four counties in Tennessee: Loudon, Roane, Meigs, and Rhea. The principal towns on Watts Bar Reservoir, Spring City, Kingston, Loudon, Rockwood, Lenoir City, Oak Ridge, and Harriman, all have water intakes or outfalls on the reservoir and access to commercial navigation. Rural populations are concentrated in the numerous long valleys between the forested ridges. Two major interstate highways meet just in the northeast of Watts Bar, and the reservoir is surrounded with several first-class railroads. State and federal highways connect the major communities with a large part of the eastern United States.

Besides Watts Bar Dam, TVA has major electric power-producing facilities on or near the reservoir at KIF on the Clinch River near Kingston, Tennessee, and at WBN near Watts Bar Dam. The USDOE has its Oak Ridge facilities on the upper reaches of Watts Bar Reservoir on the Clinch River. There are several barge terminals and industrial park areas near the larger communities and some concentrations of residential shoreline developments and marinas, but most of the Watts Bar Reservation shoreline can be typified as appearing forested and rural.

3.2. Terrestrial Ecology (Plant and Animal Communities)

Watts Bar Reservoir lies almost completely within the Central Ridge and Valley section of the ecological subregion referred to as the Eastern Broadleaf Forest (Oceanic) province (Bailey et al. 1994). A small portion of the upper Watts Bar Reservoir is part of the Cumberland Plateau. Küchler (1964) classifies the main vegetation type of the Central Ridge and Valley as Appalachian oak forest. The natural vegetation may consist of cold-deciduous broad-leaved

forest with evergreen needle-leaved trees (Bailey 1995). The main forest type is oak-pine, with blackjack oak, chestnut oak, post oak, scarlet oak, and southern red oak dominating drier sites and the moister sites dominated by white oak, southern red oak, and black oak. Shortleaf pine can form a major portion of the canopy. Other common trees that constitute a minor portion of the vegetation composition are black gum, several hickory species (bitternut, mockernut, pignut, and shagbark), loblolly pine, and sweetgum (Bailey 1995).

The Ridge and Valley province, with elevations of up to 2,000 to 3,000 feet, consists of northeast-southwest trending valleys on limestone bedrock and intervening ridges of more resistant sandstones (Martin et al. 1993). Analysis conducted by TVA for the SMI EIS (TVA 1998) found that tree cover comprised 64 percent of the vegetation within 25 feet of the shoreline and 59 percent of the vegetation between 25 feet and 100 feet from the shoreline. The next most common vegetation type along the Watts Bar shoreline was tree cover with grass understory comprising around 30 percent. This study also found that for two counties, Loudon and Meigs, which border portions of Watts Bar Reservoir, at least 20 percent of their forest area occurs within 0.25 mile of the reservoir shoreline.

The approximately 16,000 acres of TVA public land surrounding Watts Bar Reservoir can be broken into five broad community types: (1) forestland; (2) open/agricultural land; (3) shrub/brush land; (4) wetland/riparian/shallow overbank areas (flooded portion of reservoir outside the original riverbed area); and (5) residential/suburban habitats. Approximately 6,800 acres of this property was inventoried in 1994, see Table 3.2-1

Table 3.2-1. Vegetation Type of the 1994 Inventory

Vegetation Type	Acres	Percent of Total
Hardwoods	2,810	41.5
Softwoods (Pines)	2,208	32.5
Mixed-pines, Cedar, and Hardwood	1,593	23.5
Eastern Red Cedar	33	0.5
Open/Idle/Agriculture	127	2.0

1994 TVA Forest Inventory

Past land use has played a major role in creating the present mosaic of forest conditions. When TVA acquired properties around Watts Bar Reservoir, the land uses were typical of most other lands in the Tennessee Valley. There was primarily small subsistence farming on marginal land with row crop and pasture areas interspersed with woodlands. Many of these woodlands were grazed by livestock or burned regularly to promote the growth of annuals and other forage plants. Woodlots were also selectively harvested periodically to provide construction lumber, firewood, and other wood products with many of these areas being subject to severe soil erosion. Following purchase by TVA, much open land was either planted to loblolly or shortleaf pine by TVA or reverted naturally to Virginia pine, red cedar, hickory, and other hardwoods.

While a variety of hardwood types are present on TVA Watts Bar Reservoir lands, upland hardwood comprises the most significant portion of the stands. Typical species that occur in these stands include white oak, black oak, chestnut oak, southern red and scarlet oak, hickories, yellow poplar, red maple, and beech. Mixed pine/hardwood stands include several of these upland species in addition to sweetgum, sugar maple, white ash, chinkapin oak, and Virginia, white, shortleaf, and/or loblolly pines. Bottomland hardwoods comprise a relatively

small portion of the stands and are typically comprised of sweetgum, slippery and American elms, and various oaks including some large willow oaks in some areas. Pine stands are second to hardwoods in area coverage and are comprised of natural Virginia, shortleaf, and white pines and several hundreds of acres of planted loblolly pine. There are a variety of stand ages across the reservoir with the upland hardwood component comprising the majority of the older-age forest stands. Most mixed forest stands range in size from poles to large sawtimber and are a variety of age classes. There are some infrequent stands that could be small, isolated old-growth timber.

The once substantial pine stands on Watts Bar Reservoir land have undergone significant changes in recent years due to a major outbreak of southern pine bark beetles in the late 1990s. These insects decimated most all of the planted loblolly pine stands and infested the majority of mixed pine stands throughout the reservoir area. Aerial surveys conducted by TVA estimate that approximately 90 percent of the pine stands scattered around the reservoir have been impacted by the beetles with high mortality in some areas. As a result, there has been a substantial increase in reverting or shrub/brush habitat. Most of the beetle-impacted areas are slowly reverting back to mixtures of Virginia, loblolly, or shortleaf pine with various hardwoods, depending on the site, including yellow poplar, sweetgum, sassafras, winged elm, various oaks, and other common hardwood species. However, before the new tree cover becomes established, many of these areas will go through an herbaceous/shrubby reversion stage, which includes plants such as annual ragweed, lamb's quarters, spiny amaranth, panic grass, plume grass, sericea lespedeza, yellow crownbeard, tall ironweed, Canadian goldenrod, common blackberry, Japanese honeysuckle, and winged sumac.

Deciduous hardwood forests typically support the greatest diversity of wildlife (see Appendix D, Table D-1). Common mammals in this type include eastern gray squirrel, white-tailed deer, red bat, short-tailed shrew, and white-footed mouse. The bird community includes species present throughout the year, species that nest in the region and migrate to winter in the Caribbean and in Central and South America (often referred to as neotropical songbirds), and species that winter in the region. Common birds present throughout the year include eastern wild turkey, red-shouldered hawk, woodpeckers, blue jay, Carolina chickadee, tufted titmouse, and Carolina wren. Common neotropical songbirds include the yellow-billed cuckoo, wood thrush, red-eyed vireo, hooded and Kentucky warblers, and summer tanager. Wintering birds include the golden-crowned kinglet, winter wren, and yellow-rumped warbler. Among the common reptiles and amphibians found in deciduous forests are eastern box turtle, five-lined skink, black rat snake, dusky and slimy salamanders, American toad, and Cope's gray treefrog.

In recent years neotropical songbirds associated with interior forest habitats have been used as ecological indicators, and their population numbers have been used to detect environmental changes, monitor organic pollutants and radionuclide contamination, indicate changes in water quality, and indicate changes in prey stock (food webs) (Furness and Greenwood 1993). Many neotropical species have undergone significant population declines in recent years due to changes associated with their habitats (Robbins et al. 1989; DeGraaf and Rappole 1995). In order to determine a habitat's viability as interior forest, Temple and Cary (1988) developed a model that used 200 meters as the threshold distance to forest edge. In this methodology, interior-forest habitat requires at least a 200-meter buffer from any feature that breaks the tree cover, such as roads, rivers (reservoirs), or buildings. Using this criterion, Watts Bar Reservoir properties that support the greatest amount of interior forest habitat and/or potential for future interior habitat development include Parcels 7 and 8 (Fooshee Peninsula), Parcel 46 (Thief Neck Island), Parcels 142, 143, 145, 146 (former Clinch River Breeder Reactor site), and Parcels 297 and 298 (Lowe Branch area). There are no current population data on the

neotropical, area-sensitive bird species that are utilizing the habitats on portions of these parcels nor the exact acreage figure of qualifying interior forest. However, there has been some preliminary discussion with members of the Tennessee Ornithological Society and TWRA regarding the nomination and placement of some of these areas into the State of Tennessee's Important Bird Area designation program.

Coniferous or pine forests typically support fewer wildlife species than deciduous forests, and the number of species present increases with the proportion of deciduous trees present and the density of the understory shrub layer. Amphibians and reptiles commonly found in pine and mixed pine/cedar forests include eastern narrow mouth toad, eastern spadefoot toad, southern five-lined skink, and black racer. Birds commonly found in this type habitat include eastern wild turkey, blue jay, northern cardinal, American crow, sharp-shinned hawk, and a variety of woodpeckers. Edges along pine and cedar woodlands often provide habitat for mammals such as eastern cottontail rabbit, white-footed mouse, hispid cotton rat, and their associated predators. In many cases, the edges of these pine/cedar stands are dominated by more herbaceous/shrubby vegetation including several species of goldenrod, asters, bush clover, milkweed, broom-sage, wild oat grass, tick-trefoil, foxtail grass and winged sumac.

Shrub/brush and early successional habitats are widespread and common on Watts Bar Reservoir lands, especially since the southern pine bark beetle outbreak of the late 1990s. Beetle-devastated pine stands are reverting to these habitats throughout the reservoir to the benefit of wildlife that utilize these areas. Common amphibians and reptiles found in this habitat type include American toad, spring peeper, upland chorus frog, and common garter snake. Birds that nest in these habitats include eastern wild turkey, eastern towhee, brown thrasher, northern mockingbird, white-eyed vireo, field sparrow, song sparrow, eastern bluebird, common yellowthroat, and prairie warbler. Mammals seeking food and cover in these habitats include white-tailed deer, eastern mole, eastern cottontail rabbit, woodchuck, gray fox, and coyote.

Agricultural and grassland habitats are relatively uncommon on Watts Bar Reservoir properties comprising only a few hundred acres. Lands licensed to individual farmers by TVA are being farmed exclusively to grow hay forage crops for livestock. Most of these fields are planted to cool season grasses, predominantly Kentucky fescue with some orchard grass and clover and are mowed two to three times during the growing season for hay crops. Older fields that are more infrequently mowed support several coarse herbs and shrubs including annual ragweed, lamb's quarters, pigweed, panic grass, sericea lespedeza, tall ironweed, Canada goldenrod, common blackberry, northern dewberry, Japanese honeysuckle, and winged sumac. The frequently mowed open hayfield areas provide somewhat limited wildlife habitat. Bird species that use these areas include resident Canada geese, eastern bluebird, eastern meadowlark, American crow, American kestrel, and red-tailed hawk. Amphibians and reptiles utilizing these habitats, at least on a seasonal basis, include spring peeper, upland chorus frog, and eastern garter snake. Utilizing Breeding Bird Survey data from 1966 to 1992, Peterjohn et al. (1995) reported that birds of grasslands experienced the most significant and consistent declines throughout the Southeast. In an effort to offset this trend on a local landscape level, TVA partnered with the TWRA and agricultural licensees to plant and establish stands of native warm season grasses on portions of the Watts Dam Reservation (Parcel 3) over the last several years. To date, approximately 40 acres of mixed native grass stands have been successfully established. Grassland bird species, in particular northern bobwhite quail and grasshopper sparrows, have responded positively to this management effort.

Several birds on the USFWS list of "Birds of Conservation Concern" (USFWS 2002) occur on Watts Bar Reservoir lands. These species and their preferred habitats (Nicholson 1997) are the chuck-will's widow, whip-poor-will, wood thrush, and worm-eating warbler in upland forest;

Acadian flycatcher, Kentucky warbler, and Louisiana waterthrush along forested streams; prairie warbler in early successional scrub-shrub and sapling habitats; and the prothonotary warbler in forested wetlands. Watts Bar Reservoir lands provide regionally important habitats for most of these species.

Invasive terrestrial plant species typify disturbed, early successional vegetation throughout the Watts Bar Reservoir area. Several previously mentioned species such as Japanese honeysuckle and sericea lespedeza along with Chinese privet, multi-flora rose, kudzu, autumn olive, tree-of-heaven, nepalgrass, bush honeysuckle, and mimosa are widespread and common. Bottomlands, or periodically flooded narrow floodplain areas, are often dominated by Chinese privet and/or nepalgrass in the understory to the total exclusion of native flora. Many of these exotic invasive plant species are negatively affecting some of the uncommon natural plant communities scattered around Watts Bar Reservoir. TVA has taken action in previous years to chemically control some kudzu growth at specific sites and plans to expand this work on several areas in the future.

Riparian/shallow water/overbank habitats are widespread and common on Watts Bar Reservoir with its 771 shoreline miles and almost 29,000 acres of overbank. These shallow water/riparian habitats, coupled with a consistent fish forage base, provide excellent habitat for several fish-eating bird species. Great blue heron and black-crowned night-herons, along with a growing number of cattle egrets and double-crested cormorants, are common throughout the reservoir area with numerous nesting colonies being located on TVA-owned properties. Osprey, formerly listed as endangered in Tennessee, have consistently increased in numbers since the first successful nesting attempt in 1977. TWRA annually conducts a census of the active osprey nests and tallied around 120 nests during the 2004 nesting season.

Other wildlife utilizes the riparian and wetland habitats along the reservoir. Numerous other birds, including some neotropical migrant species such as prothonotary warbler, blue-gray gnatcatcher, and northern parula warbler, utilize these habitats. Some of the more common waterfowl species seen include mallards, American black ducks, hooded mergansers, resident Canada geese, and wood ducks. There are also other water/wading birds such as green herons, great egrets, pied-billed and horned grebes, and various tern and gull species. Common amphibians include green frog, narrow-mouth toad, and Fowler's toad while reptiles are represented by northern water snake, common snapping turtle, painted turtles, and red-eared sliders. Mammals that use these habitats include mink, muskrat, raccoon, and beaver.

3.3. Sensitive (Endangered and Threatened) Species

Sensitive species include any plant or animals listed under the ESA or similar state laws or regulations, as well as any species or community of species considered to be rare, uncommon, in need of management, or of special concern. The sensitive species in this section are those that are found in the area of Watts Bar Reservoir. The discussion of sensitive species is presented in three sections, namely, plants, terrestrial animals, and aquatic animals.

3.3.1. Plants

The rare plants known from the area surrounding Watts Bar Reservoir are found in many different types of terrestrial plant communities (Pyne and Shea 1994a). The major plant communities surrounding Watts Bar Reservoir include the following: forested bluffs and rocky slopes; mesic deciduous forests; moist woodlands; forested streamsides, seeps, and bogs; forest edges, roadsides, and fencerows; prairies, barrens, and open woodlands; marshes, wet

meadows, and open streamsides; and gravel bars and boulders in rivers and large streams. Each of these communities is described briefly below.

The Forested Bluff and Rocky Slope community is dominated by white pine and northern white cedar. Plants commonly found in the canopy layer are northern red oak and white oak. Plants commonly found in the understory are sassafras, serviceberry, leatherwood, and maple-leaf viburnum. This community contains the most rare plant species including the federally listed American hart's-tongue fern.

The Mesic Deciduous Forest typically has basswood, yellow buckeye, beech, tulip poplar, and sugar maple in the canopy layer and flowering dogwood, sourwood, umbrella magnolia, witch hazel, and striped maple in the understory.

The Moist Woodlands community includes cove slopes, ravines, valley floors, and floodplain forests. This community commonly contains river birch, green ash, sycamore, willow oak, and swamp chestnut oak.

The Forested Streamsides, Seeps, and Bogs community type is dominated by sycamore, box elder, basswood, sugar maple, and eastern hemlock.

Forest Edges, Roadsides, and Fencerows are typified by fast-growing, opportunistic vegetation and are often dominated by exotic woody vegetation such as Chinese privet, tree-of-heaven, mimosa, princess tree, and Japanese honeysuckle. Typical native vegetation includes eastern red cedar, blackgum, osage orange, and New Jersey tea.

Prairies, Barrens, and Open Woodlands typically have an abundance of grasses such as big blue steam and side oat gamma grass in addition to scattered trees such as eastern red cedar, post oak, and blackjack oak.

Marshes, Wet Meadows, and Open Streamsides are dominated by different species of grasses, sedges, and rushes. Small trees such as black willow, tag alder, button bush, and silky dogwood, as well as numerous fern species, are typical of this community type.

Gravel Bars and Boulders in Rivers and Large Streams are typically dominated by black willow, tag alder, button bush, and silky dogwood. Occasionally, two federally listed species, Virginia spirea and Cumberland rosemary, may occur in this community type.

Various sources were used to compile a list of sensitive plant species known to occur or to have suitable habitat on lands within or adjacent to Watts Bar Reservoir. These sources included the TVA Natural Heritage database, the 1988 Plan, the data for Watts Bar Reservoir from the SMI EIS (TVA 1998), the 2000 *Lower Watts Bar Management Unit Resource Management Plan and Final Environmental Assessment* (TVA 2000), as well as the University of Tennessee Herbarium database. Field inventories were done on Watts Bar in 1984 by Dr. Gene Wofford, of the University of Tennessee Herbarium, and in 1996 by Dr. Larry Pounds, a TVA contract botanist.

At present, no known populations of plants listed under the ESA as threatened or endangered occur on Watts Bar Reservoir lands. However four populations of Virginia spirea (*Spirea virginiana*) and one population of Cumberland rosemary (*Condridina verticillata*), both federally listed as threatened species, occur within 1 mile of the reservoir on the Emory River. In addition, there is a historical record of American hart's tongue fern (*Asplenium scolopendrium* var. *americanum*), a federally listed as threatened species, last observed in 1849 in a cave approximately 2 miles west of Caney Creek. There are 37 state-listed as threatened and

endangered species that occur in the vicinity of Watts Bar Reservoir, and 13 of these occur on TVA land. A listing of rare plant species and the community types in which they are found is provided in Table 3.3-1.

Spreading false-foxglove (*Aureolaria patula*). Thirty-four populations of false-foxglove (state-listed as threatened) have been reported on and around the Watts Bar Reservoir property. There is one population on the lower Watts Bar Reservoir property (TRMs 530-547) on Parcel 248. Five populations occur in the middle portion of the reservoir property between TRMs 544 and 573 on Parcels 61, 70, 81, 83, and 196. Six populations occur from the confluence of the Clinch River at TRM 568 to TRM 599 on Parcels 91 and 94. Four other populations occur in the area within Zone 1 (Non-TVA Shoreland), but are not associated with any parcel. Eleven populations occur in the upper part of the reservoir property (along the Clinch and Emory rivers) on Parcels 126, 148, 152, and 194. The remaining seven populations occur in Zone 1, and are not associated with any parcel. According to Kral (1983), this plant is a member of the figwort family, is a perennial herb, and is parasitic on the roots of oaks. It grows on steep, dry, partially shaded calcareous slopes above large streams and rivers. It is often found near water. False-foxglove is sensitive to the loss of overstory shading and does not tolerate competition from weedy vegetation. This species is sparsely distributed in a narrow range, with limited habitat (NatureServe 2007).

Appalachian bug-bane (*Cimicifuga rubrifolia*). This species is listed as threatened by the state of Tennessee. Four populations of this member of the buttercup family have been found on Watts Bar Reservoir on Parcels 126, 128, 132, and 196. It is a perennial herb and is rare throughout its range. It typically occurs in cool, moist mixed hardwood forests between 890 to 1,575 feet elevation. However, plants have been found at elevations as high as 2,950 feet elevation. Approximately 50 occurrences are known for the species (NatureServe 2007).

Northern bush-honeysuckle (*Diervilla lonicera*). Two populations of this woody shrub were found growing on limestone cliffs of Watts Bar Reservoir on Parcels 126 and 196. A member of the honeysuckle family, this plant is listed as threatened at the state level. It grows in rocky woodlands often associated with limestone or sandstone bluffs (Kral 1983).

American barberry (*Berberis canadensis*). One population of this plant was found around TRM 593 within a Zone 1 area. This occurrence was determined to be a county record. Barberry is listed by the state as a species of special concern. The plant is a woody shrub about 1-7 feet tall (Radford et al. 1968). Collections at the University of Tennessee-Knoxville Herbarium suggest that the habitat consists of relatively open woodlands, because specimens have been made from wooded slopes, shale slopes, bluffs, terraces along river bluffs, and riverbanks. In the past, American barberry was distributed in open savannas and woodlands where habitat was maintained by fire. Fire suppression has significantly restricted its habitat to sites with shallow soil (e.g., glades and cliffs) or areas that experience periodic mowing or other canopy-clearing activities, such as transmission line or railroad/road rights-of-way, and riverbanks (NatureServe 2007).

Mountain bush-honeysuckle (*Diervilla rivularis*). One population of this state-listed as threatened species was found along Watts Bar Reservoir on Parcel 121. Mountain bush-honeysuckle occurs in damp woods and rocky banks and bluffs in full sun in disturbed areas (Wofford and Chester 2002). It is somewhat threatened by land use conversion, habitat fragmentation, and forest management practices (NatureServe 2007).

Table 3.3-1. Listed Plant Species by Community Type Known From or Potentially Occurring Adjacent (within 5 miles) of Watts Bar Reservoir

Plant		Status		Community[3]							
Common Name	Scientific Name	Federal[1]	State[2]	FBRS	MDF	MW	FSSB	FERF	PBOW	MWOS	GB
American barberry	*Berberis canadensis*		SPCO					X			
American ginseng	*Panax quiquefolius*		S-CE		X						
American hart's-tongue fern	*Asplenium scolopendrium* var. *americanum*	LT	END	X							
Appalachian bugbane	*Cimicifuga rubrifolia*		THR	X							
Barren's silky aster	*Aster pratensis*		THR						X		
Bay starvine	*Schisandra glabra*		THR				X				
Butternut	*Juglans cinerea*		THR			X					
Canada lily	*Lilium canadense*		THR					X		X	
Catfoot	*Gnaphalium helleri*		SPCO						X		
Cumberland rosemary	*Condridina verticillata*	LT	THR								X
Dwarf milkwort	*Polygala nana*		END	X							
Ear-leaf foxglove	*Agalinis auriculata*		END						X		
Fetter-bush	*Leucothoe racemosa*		THR							X	
Goldenseal	*Hydrastis canadensis*		S-CE		X						
Hairy sharp-scaled sedge	*Carex oxlepis* var. *pubescens*		SPCO	X		X					
Heavy-fruited sedge	*Carex gravida*		SPCO	X							
Large-flowered Barbara's-buttons	*Marshallia grandiflora*		END								X
Loesel's twayblade	*Liparis loeselii*		PT			X					
Mcdowell's sunflower	*Helianthus occidentalis*		SPCO						X		
Mountain bush-honeysuckle	*Diervilla rivularis*		THR	X							
Mountain honeysuckle	*Lonicera dioica*		SPCO	X							X
Northern bush-honeysuckle	*Diervilla lonicera*		THR	X							
Northern white cedar	*Thujja occidentalis*		SPCO	X							
Pale green orchid	*Platanthera flava* var. *herbiola*		THR			X					
Pink lady-slipper	*Cypripedium acaule*		E-CE			X					
Prairie goldenrod	*Solidago ptarmicoides*		END						X		
Pursh's wild-petunia	*Ruellia purshiana*		SPCO			X					
River bull rush	*Scirpus fluviatilis*		SPCO							X	
Shining ladies'-tresses	*Spiranthes lucida*		THR							X	
Short-head rush	*Juncus brachycephalus*		SPCO				X				
Slender blazing-star	*Liatris cylindracea*		THR						X		
Spreading false-foxglove	*Aureolaria patula*		THR	X							
Swamp lousewort	*Pedicularis lanceolata*		SPCO				X				
Tall larkspur	*Delphinium exaltatum*		END						X		
Three parted violet	*Viola tripartata*		SPCO			X					
Virginia spiraea	*Spiraea virginiana*	LT	END								X
Waterweed	*Elodea nuttallii*		SPCO							X	

[1] **LT**: Federally listed as threatened

[2] Status Codes:
- **END -** Endangered
- **THR -** Threatened
- **SPCO -** Special Concern
- **E-CE -** Endangered, Commercially exploited
- **S-CE -** Special Concern, Commercially exploited
- **PT -** Proposed Threatened

[3] Community Type Codes:
- **FBRS**: Forested bluff and rocky slope community
- **MDF -** Mesic deciduous forest
- **MW -** Moist woodlands
- **FSSB -** Forested streamsides, seeps, and bogs
- **FERF -** Forest edges, roadsides, and fencerows
- **PBOW -** Prairies, barrens, and open woodlands
- **MWOS -** Marshes, wet meadows, and open streamsides
- **GB -** Gravel bars and boulders in rives and large streams

Fetter-bush (*Leucothoe racemosa*). Fetter-bush is a state-listed threatened species and is member of the heath family. One population was found in 1984 growing on the shoreline of the upper Watts Bar Reservoir at TVA's KIF. According to Wofford and Chester (2002), this is a deciduous shrub that grows in wet woods, gravel bars, and on stream banks.

Canada lily (*Lilium canadense*). One population of Canada lily was found on the upper Watts Bar Reservoir growing across the river from Parcel 141. Three additional populations are known to occur within 5 miles of the reservoir. This state-listed as threatened species grows in sunny areas having acidic soil, such as bogs, meadows, low thickets, and balds. They have also been found growing in roadside ditches and along the edges of woods (Pyne and Shea 1994b).

Mountain honeysuckle (*Lonicera dioica*). A population of this state-listed species of special concern is located in the Sugar Grove HPA (Parcel 152) on the Clinch River. Mountain honeysuckle is infrequently found in open woods and riverbanks (Wofford and Chester 2002).

Large-flowered Barbara's buttons (*Marshallia grandiflora*). There is a historic record for this state-listed as endangered species from the Emory River of the upper Watts Bar Reservoir near Emory River Mile (ERM) 12. This plant is member of the Aster family. It is native to the Appalachians and is known from only 11 watersheds throughout its range. It occurs along flood-scoured banks of large, high-gradient rivers in the central Appalachians. This species is also reported from rocky lakeshores, creek banks, bluffs, and floodplains. It tends to occur in moist to wet sandy soil, in sandy/cobbly alluvium, or in bedrock crevices along rivers (NatureServe 2007). According to Pyne and Shea (1994b), in Tennessee, Cumberland Rosemary, a federally listed as threatened species, is often associated with and found near large-flowered Barbara's buttons.

Pursh's wild petunia (*Ruellia purshiana*). This perennial herb is state-listed as special concern. One population was found growing in Zone 1 within 500 feet of the Clinch River at Clinch River Mile (CRM) 22.5. Weakley (2004) lists the habitat as dry woodlands, forest, and glades especially over magnesium, iron, and calcium-rich rocks.

Northern white cedar (*Thuja occidentalis*). A member of the cedar family, this tree is state-listed as special concern. It is a conifer with a narrow, almost columnar crown. On upland sites, northern white cedar grows primarily in calcium-rich soils and clays and shallow loam overlying broken limestone (NatureServe 2007). On Watts Bar Reservoir, there is one historical population occurring in an area of limestone cliffs with seepage areas above the Emory River between ERMs 11 and 12. Recently, two populations of northern white cedar were found on Parcel 181A on the Emory River at ERMs 6.2 and 8.8

Shinning ladies tresses (*Spiranthes lucida*). Shinning ladies tresses, a state-listed as threatened orchid is primarily found in disturbed areas where the water supply is plentiful, such as open areas along creek banks, wet meadows, marshes, lakeshores, and sandbars of streams. According to Pyne and Shea (1994a) the plant is small and easily overlooked. One population was found on upper Watts Bar Reservoir near Parcel 148.

Bay starvine (*Schisandra glabra*). This state-listed as threatened woody vine has a widespread range but with only a small number of known secure populations. It is highly threatened by competition from exotic invasive plants (particularly Japanese honeysuckle), land use conversion and habitat fragmentation (NatureServe 2007). Prior to its discovery in

the Whites Creek Parcel 233, it was known only from three counties along the Mississippi River in southwestern Tennessee.

3.3.2. Terrestrial Animals

The various plant communities on Watts Bar Reservoir provide suitable habitat for a variety of federally and state-listed terrestrial animals. These diverse communities include pine forests, mixed hardwood/conifer forests, upland and riparian hardwood forests, wetlands, and early successional and agricultural lands. Forest stands consist of a mixture of hardwoods and pine; however, recent infestations of southern pine bark beetle have greatly reduced numbers of pine stands in the vicinity. In addition to distinctive vegetated communities, many features such as streams, caves, rock outcrops, and sinkholes found on Watts Bar Reservoir lands provide unique habitats for rare species of wildlife. Although large stands of contiguous forest exist on Watts Bar Reservoir lands, large portions of reservoir lands have been developed, primarily for housing developments. This has resulted in fragmentation of many of these plant communities.

The TVA Natural Heritage database was queried to identify federally and state-listed terrestrial animals as well as sensitive ecological areas (e.g., caves and heron colonies) from the four counties surrounding Watts Bar Reservoir. Fourteen sensitive terrestrial animal species, 24 caves, and 22 heron colonies were identified (see Table 3.3-2). Two terrestrial animals are federally listed, and the remaining 12 species are listed by the state of Tennessee.

Table 3.3-2. Listed Terrestrial Animals Known to Occur in Loudon, Meigs, Rhea, and Roane Counties, Tennessee

Common Name	Scientific Name	Federal Status	State Status
Amphibians			
Eastern hellbender	*Cryptobranchus alleganiensis alleganiensis*	-	In Need of Management
Four-toed salamander	*Hemidactylium scutatum*	-	In Need of Management
Tennessee cave salamander	*Gyrinophilus palleucus*	-	Threatened
Birds			
Bachman's sparrow	*Aimophila aestivalis*	-	Endangered
Bald eagle	*Haliaeetus leucocephalus*	Threatened	In Need of Management
Barn owl	*Tyto alba*	-	In Need of Management
Least bittern	*Ixobrychus exilis*	-	In Need of Management
Sharp-shinned hawk	*Accipiter striatus*	-	In Need of Management
Mammals			
Eastern small-footed bat	*Myotis leibii*	-	In Need of Management
Gray bat	*Myotis grisescens*	Endangered	Endangered
Southeastern shrew	*Sorex longirostris*	-	In Need of Management
Southern bog lemming	*Synaptomys cooperi*	-	In Need of Management
Reptiles			
Eastern slender glass lizard	*Ophisaurus attenuatus longicaudus*	-	In Need of Management
Northern pine snake	*Pituophis melanoleucus melanoleucus*	-	Threatened

The eastern hellbender (*Cryptobranchus alleganiensis alleganiensis)* is found in large and midsize, fast-flowing, rocky rivers at elevations below 2,500 feet (Petranka 1998). Eastern hellbenders have been documented within the Clinch River and Little Tennessee River watersheds. Suitable habitat for this species exists on many parcels within the Watts Bar Reservoir vicinity.

The four-toed salamander (*Hemidactylium scutatum)* occurs in forested swamps, bogs, vernal pools, and other fish-free habitats, especially those with mossy banks. This salamander has been reported from Roane County. Suitable habitat for four-toed salamanders exists within wetlands in Parcels 36 and 111. Additional habitat exists on Parcel 193.

The Tennessee cave salamander (*Gyrinophilus palleucus)* is found in several cave systems in the region. This species has been documented from a cave approximately 800 feet from TVA land on Watts Bar Reservoir. Caves containing aquatic systems near Marble Bluff provide suitable habitat for this species.

The Bachman's sparrow (*Aimophila aestivalis*) is found in grassy openings in mature pine forests, but this bird species has also been recorded in old-field habitats. Populations are documented for Rhea and Roane counties. Suitable habitat for Bachman's sparrows is limited and scattered throughout Watts Bar Reservoir lands. The species may be found in Parcels 3, 295, 297, 298, and 299 near Watts Bar Dam.

Bald eagles (*Haliaeetus leucocephalus*) prefer to nest and roost in large, middle-aged and mature tracts of deciduous forest on Watts Bar Reservoir lands. Although their populations continue to increase in the Tennessee River Valley, nesting bald eagles remain uncommon in east Tennessee. Five bald eagle nests are currently known to occur on Watts Bar Reservoir. Suitable bald eagle nesting habitat is found throughout the project area. Bald eagles regularly roost at various sites along the reservoir during winter months. The largest of these roosts are found in the Paint Rock Wildlife Refuge, Whites Creek embayment, and Thiefneck Island.

Barn owls (*Tyto alba*) roost and nest in caves, hollow trees, barns, and silos. They forage over open landscape such as abandoned farmland, but also in urban habitat such as vacant lots, cemeteries, and parks (Nicholson 1997). The species has been reported from Rhea County and TVA KIF. Suitable habitat for this species is limited and scattered throughout the Watts Bar Reservoir.

Least bitterns (*Ixobrychus exilis*) inhabit marshes with tall, emergent vegetation bordering open water up to a meter or more deep (Weller 1961). The species has been reported from Meigs County. Suitable habitat for least bitterns can be found within some embayments of the Watts Bar Reservoir. Many of these sites are shallow enough to allow the growth of emergent herbaceous and woody vegetation preferred by this species.

Osprey (*Pandion haliaetus*) is currently not listed at the state or federal levels; however, the species is tracked by TVA. Ospreys nest in trees, on power line structures, artificial nest platforms, channel markers, and other structures in or near open water. In recent years, osprey populations have increased in Tennessee. Watts Bar Reservoir has one of the largest populations of nesting osprey in the Tennessee River Valley. There are numerous osprey nests throughout Paint Rock Wildlife Refuge.

Sharp-shinned hawks (*Accipiter striatus*) nest within coniferous and mixed woodlands. The species has been reported from Roane County. Suitable habitat for sharp-shinned hawks occurs within mixed forests found scattered throughout the Watts Bar Reservoir. Although no active nests have been reported, the species has been observed in the area.

Eastern small-footed bats (*Myotis leibii*) roost in crevices in caves, mine tunnels, expansion joints beneath highway bridges, and in buildings (Linzey 1998). There is one documented record for this species from Rhea County. Forested bluffs in the vicinity of Watts Bar Reservoir provide suitable habitat for this species.

Gray bats (*Myotis grisescens*) roost in caves and forage over open water habitats. They have been reported from six caves within the vicinity of Watts Bar Reservoir. Only one of these caves is located on Watts Bar Reservoir land. Results of recent surveys at this cave indicate that gray bats roost at this site on a transitional basis during spring and fall migration.

Indiana bats (*Myotis sodalis*) have not been reported from the vicinity of Watts Bar Reservoir. This species roosts in caves during the winter, and form summer roosts under the bark of living and dead trees. Indiana bats favor mature deciduous forests having open midstories with an abundance of trees with exfoliating bark. Suitable habitat for the species exists in the Watts Bar Reservoir lands.

Southeastern shrews (*Sorex longirostris*) are found in a variety of habitats across Tennessee including moist forests and wetlands. Numerous southeastern shrew records are documented in the vicinity of the Clinch River within the Watts Bar Reservoir area. Suitable habitat for this species exists on most parcels.

Southern bog lemmings (*Synaptomys cooperi*) are found in wet pastures, grassy openings in woods, clear-cuts, power line rights-of-way, and similar habitat. One population of southern bog lemming is known from Rhea County. Suitable habitat for this species exists on several parcels.

Eastern slender glass lizards (*Ophisaurus attenuatus longicaudus*) are found in dry grassland and open woodland habitats. Suitable habitat for glass lizards is found scattered throughout the Watts Bar Reservoir. The upper end of Whites Creek (Parcel 233) contains areas of extensive sandy soils, which are ideal for this species.

Northern pine snakes (*Pituophis melanoleucus melanoleucus*) inhabit sandy pine forests, dry ridges, and hillsides. They have also been found in thickets dominated by Virginia pine, mountain laurel, and rhododendron. There is one historical record for this species from Rhea County. Suitable habitat is found scattered throughout the Watts Bar Reservoir.

Caves represent very specialized habitats and a significant number of federally and state-listed species exist within caves. Cave habitats are utilized year-around, as roosting and maternity sites by several state- and federally listed species of bats. The state-listed Allegheny wood rat (*Neotoma magister*), Tennessee cave salamander, and barn owl are also found in caves. According to a review of the TVA Natural Heritage database, six caves are recorded along the reservoir and 24 caves are reported from the four-county area. Two caves are located on TVA Watts Bar Reservoir land.

Heron colonies are colonial nesting sites used by migratory wading birds. Several species of birds, often in large numbers, nest in these colonies. Birds occupying these sites are sensitive to disturbance, especially during the nesting season.

According to a review of the TVA Natural Heritage database, 22 heron colonies are recorded along the reservoir. A majority of these colonies are within Zone 3 (Sensitive Resource Management) and Zone 4 (Natural Resource Conservation). Most of these colonies contain only great blue herons (*Ardea herodius*), but some are known to contain small colonies of black-crowned night-herons (*Nycticorax nycticorax*) and double-crested cormorants (*Phalacrocorax auritus*). Cattle egrets (*Bubulcus ibis*) are nesting on a small island south of Half Moon Island and on a small island in the Clinch River near the KIF peninsula.

The establishment of heron colonies on Watts Bar Reservoir is significant. Great blue heron populations in Tennessee underwent declines in the late 1960s and early 1970s (Nicholson 1997). Recently, heron colonies have increased dramatically throughout the Tennessee River watershed. The establishment of these new colonies suggests that Watts Bar Reservoir may provide suitable nesting habitat for other species of wading birds that are considered uncommon in Tennessee.

3.3.3. Aquatic Animals

A review of data from the TVA Natural Heritage database indicated that there are several rare and sensitive aquatic animal species found in Watts Bar Reservoir or in its tributaries in Loudon, Meigs, Rhea, and Roane counties. The official status of those species listed at the state and federal levels is provided in Table 3.3-3.

Table 3.3-3. State- and Federally Listed Aquatic Animal Species Reported From Watts Bar Reservoir and its Tributaries, and Recent Status of Those Species in and Around Watts Bar Reservoir

Common Name	Scientific Name	Federal Status	State Status[1]	Recently Found in Study Area?
Fish				
Tangerine darter	*Percina aurantiaca*	-	NMGT	Yes
Blue sucker	*Cycleptus elongates*	-	THR	Yes
Flame chub	*Hemitremia flammea*	-	NMGT	Yes
Snail darter	*Percina tanasi*	THR	THR	Yes
Spotfin chub	*Cyprinella monacha*	THR	THR	Yes
Tennessee dace	*Phoxinus tennesseensis*	-	NMGT	Yes
Mussels				
Pink mucket	*Lampsilis abrupta*	END	END	Yes
Alabama lampmussel	*Lampsilis virescens*	END	END	No
Rough pigtoe	*Pleurobema plenum*	END	END	Yes
Dromedary pearlymussel	*Dromus dromas*	END	END	No
Fanshell	*Cyprogenia stegaria*	END	END	Yes

Common Name	Scientific Name	Federal Status	State Status[1]	Recently Found in Study Area?
Pyramid pigtoe	*Pleurobema rubrum*	-	NMGT	Yes
Fine-rayed pigtoe	*Fusconaia cuneolus*	END	END	No
Purple bean	*Villosa perpurpurea*	END	END	No
Orange-foot pimpleback	*Plethobasus cooperianus*	END	END	Yes
Snails				
Anthony's river snail	*Athearnia anthonyi*	END	END	No

[1] Status Codes: END = Endangered; THR = Threatened; NMGT = Deemed In Need of Management by the TWRA

Fish - The state- and federally listed spotfin chub (*Cyprinella monacha*) and state-listed Tennessee dace (*Phoxinus tennesseensis*) do not occur in Watts Bar Reservoir, but are found in tributary streams on non-TVA lands allocated as Zone 1 (Non-TVA Shoreland).

Likewise, the remaining four fish species are primarily found in the tributary streams allocated as flowage areas. However, they are wide-ranging and are known to use the margins and embayment areas of the reservoir, although this is not their preferred habitat. Snail darter (*Percina tanasi*) larvae drift downstream from tributary streams into reservoirs, and as the young develop they migrate back upstream into tributary streams. Snail darters are also found below Watts Bar Dam in the tailwater.

Mollusks - Five protected mollusk species have been reported from Watts Bar Reservoir and its tributaries, but have not been found in the study area within the last 30 years. These include the Alabama lampmussel (*Lampsilis virescens*), dromedary pearlymussel (*Dromus dromas*), fine-rayed pigtoe (*Fusconaia cuneolus*), purple bean (*Villosa perpurpurea*), and Anthony's river snail (*Athearnia anthonyi*). These species were prevalent before the impoundment of the reservoir (in 1942) and have likely been extirpated because of the loss of suitable habitat.

Four endangered mussel species have been observed relatively recently in Watts Bar Reservoir in the tailwaters of the upstream dams (Fort Loudoun and Melton Hill). These include the pink mucket (*Lampsilis abrupta*), rough pigtoe (*Pleurobema plenum*), fanshell (*Cyprogenia stegaria)*, and the orange-foot pimpleback (*Plethobasus cooperianus*). These mussels are found within the waters of Watts Bar Reservoir, but not in tributary steams including TVA lands associated with the proposed land plan.

Six mussel species occur just downstream of Watts Bar Dam in the tailwater. These include the four mussel species mentioned to occur in the reservoir, as well as the state- and federally listed as endangered dromedary pearlymussel (*Dromus dromas*), and the state-listed in need of management pyramid pigtoe (*Pleurobema rubrum*).

3.4. Managed Areas and Sensitive Ecological Sites

Managed areas and ecologically sensitive sites are lands set aside for a particular management objective or lands that are known to contain sensitive biological, cultural, or scenic resources. Such areas and sites within the seven-state TVA region are identified and recorded in the TVA Natural Heritage database. Managed areas and ecologically

sensitive sites are typically established and managed to achieve one or more of the following objectives.

Species/Habitat Protection for places with endangered or threatened plants or animals, unique natural habitats, or habitats for valued fish or wildlife populations. Examples include national and state wildlife refuges, mussel sanctuaries, TVA's HPAs, refuges operated by nongovernmental agencies, and identified but unprotected ecologically significant sites.

Recreation areas, such as parks, picnic areas, camping areas, trails, greenways, and other sites managed for outdoor recreation or open space, such as national parks, national recreation trails, scout camps, and county and municipal parks.

Resource Production/Harvest on lands managed for production of forest products or for hunting or fishing, such as national forests, state game lands, and fish hatcheries.

Scientific/Educational Resources on lands protected for scientific research and education, including biosphere reserves, TVA's ecological study areas (ECSAs), environmental education areas, and research parks.

Cultural Resources protection, such as lands with human-made resources of interest, including military reservations, state historic areas, and state archaeological areas.

Visual/Aesthetic Resources areas with exceptional scenic qualities or views, such as TVA's small wild areas (SWAs), national and state scenic trails, wildlife observation areas (WOAs), and wild and scenic rivers.

Most managed areas and ecologically significant sites have multiple management objectives. If management objectives cannot be met, the integrity of the area may be lost or compromised.

The managed areas and ecologically significant sites addressed in this section have been established by various agencies for numerous and often overlapping objectives. Federal agencies manage areas according to agency policy. TVA, for example, manages SWAs, HPAs, and ECSAs. Federal lands, such as national wildlife refuges and several national forests, are managed with public funds by various agencies within the U.S. Department of the Interior and the U.S. Department of Agriculture, in accordance with applicable laws and regulations.

State laws and regulations permit state agencies, commissions, departments, and divisions to establish and manage a variety of public sanctuaries, parks and forests, and wildlife management areas (WMAs), such as the Watts Bar and Oak Ridge WMAs. City and county governments, through their parks and recreation divisions or their equivalent, serve to provide passive recreational opportunities for the public through management of municipal parks, watersheds, and picnic areas. Various nongovernmental organizations often use private donations to purchase and maintain lands for protection of sensitive resources and passive recreational activities. Some lands, such as Browder Woods, are privately owned.

For this study, managed areas and ecologically significant sites within and in the vicinity of Watts Bar Reservation were identified using the TVA Natural Heritage database and the Land Plan allocation maps. Fifteen TVA managed areas and 17 areas managed by other local, state, or federal agencies are currently located on Watts Bar Reservation. A change

in the number of TVA-managed areas is proposed with this Land Plan and includes the removal of five HPAs and one ECSA and the addition of a new HPA.

These areas are described below.

3.4.1. TVA Small Wild Areas (SWAs)

Two SWAs are located on the Watts Bar Reservation. SWAs are designated areas that have exceptional natural, scenic, or aesthetic qualities and are suitable for low-impact public use.

Fooshee TVA SWA (Parcel 8) is located at TRMs 538.4 to 537.7 on the left-descending shoreline. This 141-acre area on the east side of a large peninsula boasts a dry ridge forest of large white oaks and shagbark hickories. Brown Hollow, on the western edge of the area, is a moist forest of beeches and maples with a ground cover of ferns and wildflowers. The peninsula provides habitat for wintering bald eagles and numerous other migratory birds, offering visitors a unique wildlife viewing opportunity. An unmarked path and several logging roads create a network of trails that extend onto adjacent TVA lands. TVA, in cooperation with the National Wild Turkey Federation, manages these adjacent lands to enhance habitat for wild turkeys and other wildlife. The majority of the SWA and adjacent lands are open for hunting during statewide seasons. The area is accessible by both car and boat. The trail starts in a developed campground where 55 sites are available for overnight visits. A day use area features a beach, playground, picnic pavilions, and a boat ramp.

Whites Creek TVA SWA (Parcel 238) is located on Whites Creek at Miles 2.5 to 2.0 on the right-descending shoreline. This 171-acre area is composed of dry sawback ridgetops with stands of pine and chestnut oak. Moist coves of beech and maples can be found at lower elevations. This area is noted for spring wildflower displays including trout lily, doll's eyes, and wild ginger. An adjacent TWRA boat ramp provides access to the area. This ramp also marks the beginning of a 3-mile loop trail. The proposed 87.5-acre addition to Whites Creek TVA SWA (Parcel 237) is located on Whites Creek at approximately Miles 3.75 to 2.75 on the right-descending shoreline. The TWRA boat ramp area (Parcel 12-26) and proposed new trail would connect these two areas.

3.4.2. TVA Ecological Study Areas (ECSAs)

ECSAs are areas designated for use for ecological research or environmental education. One ECSA is currently located on the reservation. The upper reaches of Thiefneck Island, approximately 254 acres, was designated a TVA ECSA in the 1988 Land Plan. Until recently, the island was used for several years by Roane State Community College for environmental education and research. Because the college is no longer interested in studying the ecology of the island, it is proposed that the ESA designation be removed from this area with this Land Plan. The island is proposed to remain a Zone 3 designation.

3.4.3. TVA Habitat Protection Areas (HPAs)

Twelve HPAs are located on Watts Bar Reservation. HPAs are established to protect populations of species that have been identified as either endangered or threatened in the state in which they occur or by the USFWS. Unusual or exemplary biological communities or geological features also can receive protection. Activities that could damage the ecological quality of these areas are deterred.

It is proposed that the HPA designation for five of these 12 areas be removed because the animals being protected (e.g., ospreys and great blue herons) on these lands are no longer present and/or their populations have rebounded such that this extra form of management and protection is no longer warranted. These areas include Blue Springs Peninsula TVA HPA, Fooshee Bend Islands TVA HPA, Johnson Bend Islands TVA HPA, Long Island TVA HPA, and Riley Creek Islands TVA HPA.

Along with the remaining seven TVA HPAs, one new TVA HPA is proposed; these areas are described below.

Marney Bluff TVA HPA (Parcel 65) is located at TRMs 565.0 to 564.5 on the left-descending shoreline. This site consists of bluff terrain and is one of three site locations in Tennessee that provides habitat for the state-threatened northern bush honeysuckle (*Diervilla lonicera*). The brittle stems of this plant make it susceptible to trampling and breakage.

Marble Bluff TVA HPA (Parcel 91*)* is located at TRMs 577.7 to 578.5 on the left-descending shoreline. This 12-acre narrow tract has a high limestone bluff that provides habitat for spreading false-foxglove (*Aureolaria patula*), which is a state-listed as threatened plant species. This site also contains Marble Bluff Cave that supports a summer colony of federally listed gray bats *(Myotis grisescens)* and possibly state-listed Tennessee cave salamanders *(Gyrinophilus palluecus).*

Polecat Creek Slopes TVA HPA (Parcel 94) is located at TRMs 579.5 to 579.0 on the left-descending shoreline. This 11-acre site provides habitat for spreading false-foxglove, a state-listed as threatened plant species.

Grassy Creek TVA HPA (Parcel 146) is located on Grassy Creek at CRM 14.5 on the right-descending shoreline. This 99-acre tract, with a proposed 166 additional acres, provides habitat for spreading false-foxglove, Appalachian bugbane (*Cimicifuga rubifolia*), and shining ladies'-tresses (*Spiranthes lucida*), all state-listed as threatened species. This area also contains habitat for the state-listed eastern small-footed bat (*Myotis leibii*).

Sugar Grove TVA HPA (Parcel 152) is located on Emory River at ERMs 1.4 to 0.0 on the left-descending shoreline. This 4-acre area provides habitat for spreading false-foxglove and mountain honeysuckle (*Lonicera dioica*).

Rayburn Bridge TVA HPA (Parcel 194), located on the Clinch River at CRMs 2.5 to 2.2 on the right-descending bank, is an 8-acre site under the bridges of Interstate-40 and U.S. Highway 70. It provides habitat for spreading false-foxglove.

Stowe Bluff TVA HPA (Parcel 196) is located on the Clinch River at CRMs 1.7 to 1.0 on the right-descending shoreline. This 11-acre site provides habitat for Appalachian bugbane, northern bush honeysuckle, and spreading false-foxglove.

Whites Creek Alluvial Deposit Forest TVA Proposed HPA (Parcel 233) is located on 27.2 acres of the most upper end of Parcel 233 (total 80.5 miles) on Whites Creek at Whites Creek Miles 4.0 to 5.5 on the left-descending shoreline. This newly proposed HPA is a result of the recent discovery of a significant rare plant species, the bay starvine *(Schisandra glabra)*, which is listed as threatened by the state of Tennessee. The survey also found that the overall vegetation of the site is rare in the Ridge and Valley area and

more characteristic of Cumberland Plateau ravines and gorges. A more detailed description of the HPA can be found in the parcel descriptions section.

3.4.4. Wildlife Management Areas (WMAs), Wildlife Refuges, and Wildlife Observation Areas (WOAs)

Two WMAs, two wildlife refuges, and one WOA are on the reservoir. The TWRA manages WMAs for hunting and trapping and manages refuges primarily to support migratory and resident waterfowl and other birds, although some hunting is allowed. WOAs provide areas specifically designated for public viewing and photographing of wildlife.

Watts Bar State WMA consists of two units, the Thiefneck Island Unit (Parcel 46) and the Long Island Unit (Parcel 78), and several unnamed tracts scattered throughout the reservation (parcels or portions of Parcels 7, 35, 50, 72, 75, 227, 254, 276, and 286). The Watts Bar State WMA totals almost 3,900 acres. The Thiefneck Island Unit is located on Thiefneck Island at TRMs 556 to 551 in midchannel. It is one of two WMA units on Watts Bar Reservoir. TWRA Region III manages approximately 80 acres on the northern tip of Thiefneck Island. To enhance wildlife, TWRA annually plants small grain crops on approximately 20 acres. Hunting is allowed on the entire island, with special restrictions on the manner and means of harvest. The Long Island Unit is located on Long Island between TRMs 571 and 572.2 in midchannel. TWRA Region III administers hunting in this area according to statewide and some special hunting seasons. Small and big game and waterfowl hunting opportunities include squirrel, raccoon, opossum, northern bobwhite quail, eastern cottontail rabbit, American woodcock, Wilson's snipe, mourning dove, and white-tailed deer. Trapping also is allowed on this unit except during duck season.

Paint Rock State Wildlife Refuge (Parcel 88) is located at TRMs 575.8 to 573.8 on the left- and right-descending shorelines, in midchannel, and includes embayments on several creeks. The refuge is managed by TWRA Region III to attract and support migratory and resident waterfowl, osprey, bald eagles, sandhill cranes, and numerous other wading birds. Beaver, raccoon, white-tailed deer, and other mammals also inhabit the area. During a winter closure period, public access is limited. TWRA opens this 1,600-acre area (which includes both the land acreage of Parcel 88 and water acreage) to early Canada goose and wood duck/teal hunts.

Kingston Fossil Plant WOA (Parcel 190) is situated near the confluence of the Clinch and Emory rivers from ERMs 3.0 to 1.9 on the right-descending shoreline. KIF's ash settling ponds provide habitat for a wide variety of shorebirds, wading birds, and waterfowl. It is managed by TVA in cooperation with TWRA.

Kingston Refuge is located on the Clinch River at CRMs 4.4 to 2.5 and on the Emory River at ERMs 2.0 to 0.0 on the right-descending shoreline. Although the refuge encompasses the entire 1,260-acre KIF site, TWRA only actively manages a 300-acre area on the peninsula between the rivers. TWRA regulations create a refuge for migrating waterfowl; however, limited hunting opportunities exist. The refuge also is a popular area for bird watchers where the brown-headed nuthatch is a species of particular interest.

Oak Ridge State WMA, located at CRMs 18.8 to 14.5 on the right-descending shoreline, is a 37,000-acre area primarily on the Oak Ridge Reservation and adjacent USDOE lands. TWRA administers special shotgun, muzzleloader, and archery deer hunts. Boat access is limited in the section of the WMA adjacent to the Clinch River. The WMA includes some of the adjacent TVA lands at the former Clinch River Breeder Reactor site.

3.4.5. Parks

Seven municipal or county parks are on the reservation.

Meigs County Park (Parcel 5), located at TRMs 531.5 to 530.5 on the left-descending shoreline, is a 249-acre park managed by Meigs County under a recreation easement from TVA. The park features tennis courts, playgrounds, ball fields, an informal camping area and a natural boat ramp for lake access.

Steekee Creek Park (Parcel 99) is located between TRMs 592 and 591 on the left-descending shoreline. TVA granted an easement to the city of Loudon for this municipal park.

Southwest Point Park (portion of Parcel 121) is located at TRMs 568.4 to 568.2 on the right-descending shoreline at the junction of the Clinch and Tennessee Rivers. Atop a hill overlooking Watts Bar Reservoir, Fort Southwest Point is the only fort in the state of Tennessee reconstructed on its original foundation. Completed sections of the fort, dating from 1792, include barracks, a blockhouse, and 250 feet of palisade wall. A separate building houses a welcome center and museum, which are open from late March to mid-December. In addition to the fort, the 30-acre park includes several ball fields, a track, picnic tables, and a pavilion. A walking trail around the base of the fort connects other waterfront areas in the city of Kingston to the park. Visitors can access the area from the water via a boat ramp located on this trail. This site was transferred to the City of Kingston by TVA after archaeological studies were completed in cooperation with TDEC. The site is listed on the NRHP.

Kingston City Park (portion of Parcel 121) is located at CRM 2.5 on the left-descending shoreline. This municipal park has been a popular gathering place for the community of Kingston since its transfer from TVA in 1958. Fishing tournaments and boat races are two of the many recreational activities at the park, which features floating boat docks, boat ramps, a pier, a roped-off swimming area, sand volleyball court, and playground equipment. Picnicking along the riverbank is an especially popular activity here. Visitors also can enjoy observing bird life, including osprey, gulls, wading birds, and waterfowl, from one of the many benches provided along a waterfront walking trail. This trail, used extensively by the public, begins at the adjacent Byrd Field, passes through Kingston City Park and extends for nearly 2.75 miles to Southwest Point Park.

Roane County Park (fronted by Parcel 201) is located at TRM 562.3 at Caney Creek. In 1961, TVA transferred this 183-acre area, spanning two peninsulas, to Roane County for public recreation use. The large peninsula offers many recreational opportunities including a marina, campground, tennis courts, swimming beach, picnic pavilion, ball fields, other amenities, and an extensive trail system. The smaller peninsula, with a more rugged terrain, is undeveloped. However, a primitive walking trail offers hikers the opportunity to enjoy the abundant wildflower display in the spring.

City of Rockwood Park (Parcel 219) is located at TRM 553 on King Creek. This area, roughly 69 acres of open fields with some wooded areas, was transferred by TVA to the City of Rockwood in 1951. The city park provides a boat ramp, sheltered picnic tables, and restroom facilities. Also known as Tom Fuller Memorial Park, it was named for Rockwood prominent citizen and doctor, Tom Fuller. The park has become a popular area for lake access.

Spring City Park (Parcel 270 and fronted by Parcel 277) is located on the Piney River at approximately Piney River Mile 5.5 on two sites. TVA granted an easement to the town of Spring City for public recreation on Parcel 270 and transferred property to Spring City, which is fronted by Parcel 277, also for public recreation. This site includes the Spring City Boat Dock.

3.4.6. Other Managed Areas

Three protection planning sites (PPSs), two potential national natural landmarks (PNNLs), and one biosphere reserve are on or adjacent to the reservation. PPSs are compiled by the Tennessee Protection Planning Committee, a cooperative effort of government land managers and private individuals knowledgeable about the biota of the state. The National Natural Landmark (NNL) Program was established in the 1970s by the U.S. National Park Service to identify nationally significant examples of ecologically pristine or near pristine landscapes. PNNL tracts, while meeting the criteria for listing, have not to date been registered as NNLs. Biosphere reserves are areas of terrestrial and coastal ecosystems that are internationally recognized within the framework of the United Nations Education, Scientific, and Cultural Organization Man and the Biosphere Program.

Berry Cave PPS is adjacent to Marble Bluff HPA (Parcel 91) and approximately 0.25 mile west of the reservoir at TRM 578.5 on the left-descending shoreline. The cave at this site is home to the Tennessee cave salamander (*Gyrinophilus palleucus*).

Browder Woods PPS and PNNL is located approximately 0.45 mile north of the reservoir at TRM 597.0 on the right-descending shoreline. This privately owned site contains approximately 300 rolling acres of second growth white oak forest, a rare remnant of the white oak forest that was once widespread in the Great Valley.

Crowder Cemetery Cedar Barrens PPS is located on the Clinch River at CRMs 12.9 to 12.4 on the left-descending shoreline. It extends southwest from the river. This 258-acre tract was designated a PPS by the Tennessee Protection Planning Committee. The cedar barrens at one time contained a number of rare plants including cylindric blazing star (*Liatris cylindracea*), goldenrod (*Solidago ptamicoides*), tall larkspur *(Delphinium exaltatum*), and earleaf foxglove (*Agalinis auriculata*). Recent ground disturbance has likely reduced the number of rare plants found in this area to two: the goldenrod and a state-listed special concern species, the naked-steam sunflower (*Helianthus occidentalis)*. This area was once a part of the Oak Ridge Reservation.

Oak Ridge Reservation is adjacent to the reservoir and is located on the Clinch River at CRM 23.2 to CRM 18.9. It excludes the former Clinch River Breeder Reactor site. USDOE manages this 34,000-acre area, which is used variously for manufacture, laboratory research, managed forest, and ecosystem process research.

Oak Ridge National Environmental Research Park Biosphere Reserve is an area adjacent to the reservoir and contains many natural areas, sensitive sites, and research plots. This area contains approximately 20,000 acres and is within the boundaries of the Oak Ridge Reservation. The park is used as an outdoor laboratory for studying present and future environmental consequences from energy-related issues. It provides protected land for the use of education and research in environmental sciences. Managed by the Oak Ridge National Laboratory for the USDOE, it is located on the Clinch River at CRMs 21.0 to 18.9 and on Melton Hill Reservoir at CRMs 33.2 to 23.0 on the right-descending shoreline.

3.4.7. Nationwide Rivers Inventory-Listed Streams

The Nationwide Rivers Inventory (NRI) listing by the National Park Service was used to identify NRI-listed streams in the vicinity of the reservation; three such river segments were identified and are described below. Approximately 3,400 free-flowing river segments in the United States are listed on the NRI, which were so designated for their nationally significant natural or cultural values.

Emory River, from the upper reaches of Watts Bar Reservoir near ERM 14 at the Roane County line to ERM 25 a mile below the Nemo Bridge, is listed on the NRI. The National Park Service recognizes this 11-mile segment for its scenic, recreational, geologic, and fish and wildlife values. It is noted as a scenic pastoral stream that flows through an impressive gorge area. It also supports game fishery. The segment ERMs 25 to 27 is a designated component of the National Wild and Scenic Rivers System. The Emory River meets the Obed River, Tennessee's only designated National Wild and Scenic River, at ERM 27.

Little Tennessee River, from Little Tennessee River Mile 1.0 above Tellico Dam to Little Tennessee River Mile 33.0 at Chilhowee Dam, is listed on the NRI. The National Park Service recognizes this 32-mile segment for its scenic, recreational, geologic, fish and wildlife, historic, and cultural values. It is noted as critical habitat for the federally listed snail darter (*Percina tanasi*), offers excellent fishing and floating opportunities, and has 180 recorded archaeological sites.

Piney Creek, from Piney Creek River Mile 9.0 at the confluence with Little Piney Creek 3 miles north of Watts Bar Reservoir at Spring City to Piney Creek River Mile 32.0 at the headwaters near the Bledsoe County line, is listed on the NRI. The National Park Service recognizes this 23-mile segment for its scenic, recreational, and geologic values. It is noted as one of the most wild, scenic, and clear streams in Tennessee. It features adjacent waterfalls and affords sections of exciting creek run.

3.5. Water Quality and Shoreline

Watts Bar is a main stem Tennessee River reservoir with an average annual discharge of about 27,000 cubic feet per second (cfs), average water residence time of 18 days, and a winter drawdown of about 6 feet from the summer pool level. Only 1,834 square miles of total 17,310 miles of the watershed drains directly into Watts Bar Reservoir. Most of the water entering Watts Bar Reservoir (86 percent) comes from outside the immediate drainage area. The Tennessee and Little Tennessee rivers (i.e., discharge from Fort Loudoun Dam, 18,200 cfs) account for approximately 67 percent of the flow into the reservoir. The Clinch River (i.e., discharge from Melton Hill Dam, 5,000 cfs) accounts for about 19 percent of the flow into the reservoir. The remaining 14 percent is contributed by local inflows.

There are five major tributaries, greater than 100-square-mile drainage area, that make up the majority of the local inflow to Watts Bar Reservoir: Poplar Creek (136-square-mile drainage area) joins the Clinch River at CRM 12; the Emory River (865-square-mile drainage area) joins the Clinch River at CRM 4, near the city of Kingston; Whites Creek (138-square-mile drainage area) joins the Tennessee River at TRM 545; and the Piney River (137-square-mile drainage area) enters the Tennessee River at TRM 532, near Spring City. The Little Tennessee River (2,630-square-mile drainage area) joins the Tennessee River at TRM 601 below Tellico Dam, but very little water is discharged through Tellico Dam. Instead, it is routed through a navigation canal to Fort Loudoun Reservoir and is controlled primarily by Fort Loudoun Dam and Navigation Lock.

Hydrologic unit codes (HUCs) are cataloging units assigned to each watershed by the U.S. Geological Survey for the purpose of assessment and management activities. HUCs are standard units used by most state and federal agencies to reference for scientific study, sampling, and impact analysis. They are important to water quality efforts as they define land areas that drain to a specific stream. HUCs are based on watershed size ranging from 2-digit regional watershed codes (major rivers) to 12-digit cataloging units (creeks and streams) that represent the smaller subwatersheds. The 1,834-square-mile local Watts Bar Reservoir watershed is comprised of three regional cataloging units: 06010201 for the Watts Bar Reservoir; 06010208 for the Emory and Obed river system; and portions of 06010207 for the Clinch River tributaries that are part of Watts Bar Reservoir. This immediate drainage area contains a total of 31 smaller, 11-digit subwatersheds. Land uses can contribute positively or negatively to the water quality of the stream in that drainage basin. These smaller units of study can be used to determine causes and sources of water pollution and develop plans and projects to improve conditions.

3.5.1. General Water Quality Characteristics

The water quality in Watts Bar Reservoir is affected by many factors such as from TVA public land along the reservoir and from land use practices throughout the reservoir's drainage area. Most of the water entering Watts Bar Reservoir originates outside the immediate watershed, so the overall water quality characteristics of the reservoir are strongly affected by waters outside of local watershed. The water quality characteristics of the embayments are, however, more apt to exhibit a response to pollutant loadings and changes in land use within the local area than the main river region.

Watts Bar is considered a productive (eutrophic) reservoir with an average chlorophyll concentration for the growing season (April through September, 1998-2004) of about 15 milligrams per cubic meter (mg/m^3) in the main channel, with embayments ranging from 10 to 35 mg/m^3 (TVA 2004a). Summertime thermal stratification does occur but is generally limited to the downstream reach of the reservoir (TRMs 530 to 545) or embayments where velocity is sufficiently reduced to limit mixing of the water column, diminishing reaeration and causing lower dissolved oxygen (DO) concentrations in the bottom waters. TVA has installed aeration equipment to add oxygen to the deep water above Watts Bar Dam and to improve conditions immediately downstream. The upstream reach above TRM 565 is essentially riverine and typically does not experience thermal stratification. Algal productivity is suppressed due to greater concentration of suspended sediment and limited time in the photic zone (the area of the water column where light is sufficient for photosynthesis) for growth. The middle reach of the reservoir (TRMs 545 to 565) is termed the transition zone. This segment of the river has a greater volume and a longer residence time than the upper reach, and water quality is more influenced by internal processes. Velocity is reduced in this reach, suspended sediment begins to settle from the water column, and algae remain in the photic zone for longer periods. This allows increased photosynthesis and results in higher algal productivity (i.e., higher chlorophyll concentrations). This reach of the reservoir typically experiences only weak thermal stratification except during low-flow conditions.

3.5.2. TVA Water Quality Monitoring and Results

As part of the Reservoir Vital Signs Monitoring Program initiated by TVA in 1990, Watts Bar Reservoir has been monitored for physical and chemical characteristics of waters, sediment contaminants, benthic macroinvertebrates (bottom-dwelling animals such as worms, mollusks insects, and snails living in or on the sediments) and fish community assemblage. Five key indicators (DO, chlorophyll, fish, bottom life, and sediment contaminants) are

monitored and contribute to a final rating that describes the "health" and integrity of an aquatic ecosystem. TVA monitors two locations on Watts Bar Reservoir for physical and chemical characteristics, and sediment contaminants. The forebay region (the deep, still waters near the dam) is sampled at TRM 532.5. The midreservoir region (or transition zone) is sampled at TRM 560.8, downstream of the confluence of the Clinch and Tennessee rivers. Other components of the monitoring program include monitoring of toxic contaminants in fish flesh to determine their suitability for consumption and sampling of bacteriological concentrations at recreational areas to evaluate their suitability for water contact recreation (TVA 2004b).

The overall Reservoir Ecological Health rating for Watts Bar Reservoir was fair in 2004. Ratings declined from good to poor between 1994 and 2002. This was driven mostly by declining scores for chlorophyll and DO (see Table 3.5-1). In reservoirs such as Watts Bar, which have short water residence time (the amount of time required to replace the reservoirs' volume of water with "new" water), DO and chlorophyll can be strongly influenced by reservoir flow. The drought-like condition across the Valley from mid-1998 to mid-2002 led to lower flows, thereby allowing for more stagnant conditions and lower DO concentration in bottom waters. The improved rainfall and runoff in 2003 and 2004 greatly improved DO. However, chlorophyll concentrations have continued to show a trend of increasing concentrations (Figure 3.5-1 and 3.5-2) between 1994 and 2002, with substantial increases at TRM 560.8. These high chlorophyll concentrations have caused the water quality ratings to decrease. Analysis of the total phosphorus data also indicates a trend of increasing concentrations at TRM 560.8. Nitrogen concentrations have been more variable and exhibit no strong trend over time.

Table 3.5-1. Watts Bar Reservoir Water Quality Ratings, Reservoir Vital Signs Monitoring Data

	Monitoring Years					
	1994	**1996**	**1998**	**2000**	**2002**	**2004**
Watts Bar Forebay						
Dissolved Oxygen	Fair	Good	Good	Poor	Poor	Good
Chlorophyll	Fair	Poor	Poor	Poor	Poor	Poor
Sediment	Fair	Fair	Fair	Fair	Fair	Good
Watts Bar Midreservoir						
Dissolved Oxygen	Good	Good	Good	Good	Good	Good
Chlorophyll	Good	Poor	Poor	Poor	Poor	Poor
Sediment	Fair	Fair	Fair	Fair	Fair	Fair

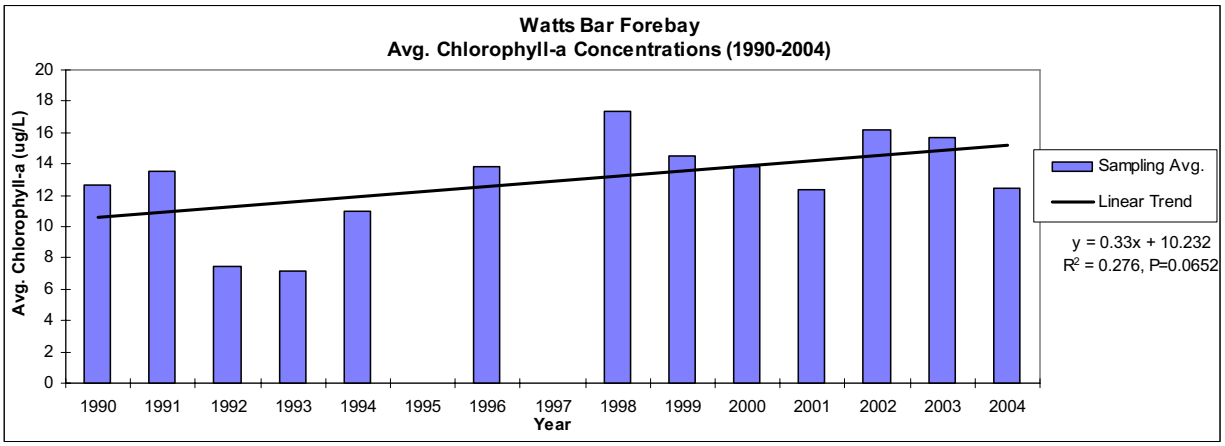

Figure 3.5-1. Trend in Chlorophyll-a Concentrations in Watts Bar Reservoir Forebay (TRM 532.5)

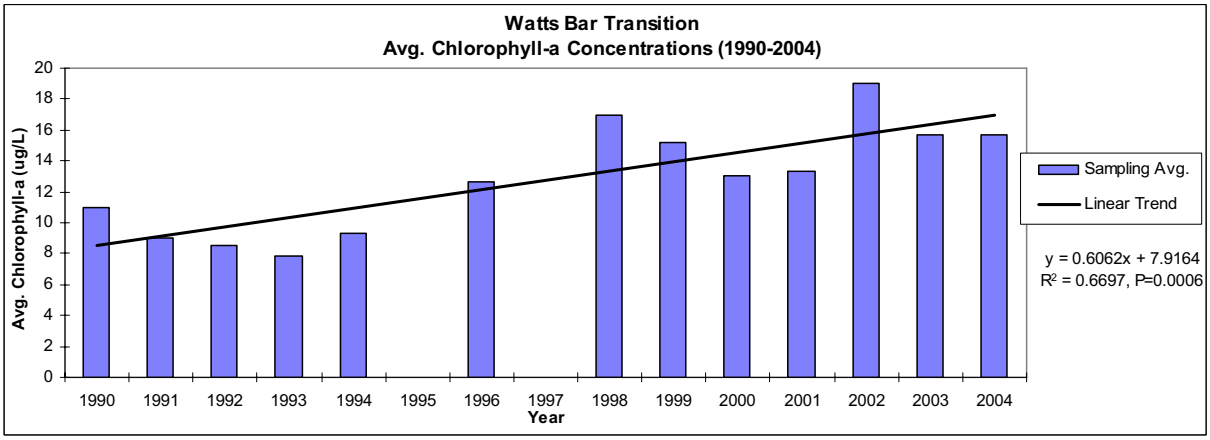

Figure 3.5-2. Trend in Chlorophyll-a Concentrations in Watts Bar Reservoir Transition Zone (TRM 560.8)

Sediment quality rated good at the forebay and fair at the transition due to elevated arsenic levels. The sediment quality ratings have varied from good to fair (1991-2003) with a greater frequency of occurrence of organic chemicals (mainly polychlorinated biphenyls [PCBs] and chlordane) in recent years. PCBs and chlordane were not detected in 2004. The presence or absence of these chemicals is probably more due to sampling variability rather than an actual increase because of their historical, rather than current use. These chemicals are no longer manufactured because they have been linked to a variety of health concerns. Chlordane was mainly used to control termites. PCBs were commonly used in a variety of commercial products, including adhesives, hydraulic systems, transformers, electric motors, and other electrical equipment, as well as during past operations of the USDOE's Oak Ridge Reservation.

Institutional controls (warning signs, fish consumption advisories, and monitoring) are in place to reduce health and environmental risk. USDOE is required to take appropriate actions if a sediment-disturbing activity would threaten human health or the environment. The land planning process will not affect the established procedure for reviewing projects

and proposals that may result in sediment disturbance. TVA participates in the WBWG along with the USACE, the USDOE, TDEC, and the USEPA. The primary purpose of this working group is to review projects that have the potential to disturb contaminated or potentially contaminated sediments resulting from past operations at the Oak Ridge Reservation.

The state of Tennessee has issued several fish consumption advisories for Watts Bar Reservoir because of PCB contamination. Striped bass, catfish, and striped bass-white bass hybrids caught in the Tennessee River portion of the reservoir should not be eaten. Additionally, no fish caught in the Poplar Creek Embayment should be eaten due to PCB and mercury contamination.

There is a precautionary advisory for largemouth bass, white bass, sauger, carp, and smallmouth buffalo caught in the Tennessee River portion of the reservoir and catfish and sauger caught in the Clinch River arm. A precautionary advisory means pregnant women, nursing mothers, and children should not consume the fish species named, and all other individuals should limit their consumption to no more than one meal per month.

PCB concentrations have declined in fish tissue samples from Watts Bar and neighboring Fort Loudoun and Tellico reservoirs in recent years. To better understand the issue of PCB contamination, TVA coordinates with state agencies to sample these reservoirs annually.

There are no state advisories against swimming in Watts Bar Reservoir. Escherichia coli (E. coli) bacteria levels were tested in samples collected on and around the reservoir in 2006. The following sites were within the state of Tennessee's guidelines for water contact: Watts Bar Dam recreation area beach, Rhea Harbor beach, Wolf Creek informal camping area swim site on Peninsula, Fooshee Pass day use area beach, Hornsby Hollow Campground beach, Red Cloud Campground beach, Eden on Lake beach, Brigadoon Resort beach, Whites Creek public access area canoe access site, Lakeside Resort beach, Arrowhead Resort beach, Whites Creek boat ramp, Bayside Marina beach, Roane County Park beach, Caney Creek informal swim site, Boy Scouts of America Camp Buck Toms swim site, Crab Orchard Creek canoe access site and KIF boat ramp.

Several sites exceeded the single-sample maximum at least one time. Some of the elevated E. coli concentrations found at these sites may be related to documented waterfowl presence or collection following a rainfall event. These sites were Whites Creek public access area, Arrowhead Resort beach, Roane County Park beach, Caney Creek informal swim site, Crab Orchard Creek canoe access site, and KIF boat ramp.

In addition, Riley Creek day use area beach and Riley Creek Campground beach, exceeded the geometric mean (geometric mean of all 10 samples) and the single-sample maximum 5 of 10 sampling events.

The State of Tennessee 303(d) List is a compilation of the streams and lakes in Tennessee that are "water quality limited" or are expected to exceed water quality standards in the next two years and need additional pollution controls. The assessment of Tennessee's waters was based on a water quality evaluation that took place during 2005 and early 2006 (TDEC 2006).

Water quality limited streams are those that have one or more properties that violate water quality standards. They are considered impaired by pollution and not fully meeting designated uses (TDEC 2006). Of the 31 smaller, 11-digit watersheds, or HUCs, that make up the local Watts Bar Reservoir watershed, there are 19 that have impaired stream

segments. The impaired segment, corresponding hydrologic unit and cause and source of impairment are listed in Appendix D, Table D-3.

3.6. Aquatic Ecology

Aquatic habitat in the littoral (near shore) zone is greatly influenced by underwater topography and back-lying land use. Underwater topography at Watts Bar Reservoir varies from moderately steep, with scattered small bluffs near the river channel, to typically shallow embayments, coves, and areas further from the river channel and tributary stream channels. Undeveloped shoreline is mostly wooded, so fallen trees and brush provide woody cover in those areas. Woody habitat is usually reduced on TVA and non-TVA lands where back-lying property is largely residential or agricultural.

As part of the data collection effort for the SMI EIS, a survey was conducted on four representative TVA reservoirs by TVA to arrive at a shoreline aquatic habitat index (SAHI) score that would indicate the quality of aquatic habitat conditions adjacent to various land uses. Although Watts Bar was not chosen as one of the four reservoirs, nearby Fort Loudoun was included in the surveys. Scoring parameters (metrics) included seven physical habitat parameters (i.e., riparian zone condition, amount of canopy cover, bank stability, substrate composition, amount of cover, habitat diversity, and degree of slope) important to Tennessee Valley reservoir resident sport fish populations, which rely heavily on shoreline areas for reproductive success, juvenile development, and/or adult feeding. Field methods and the SAHI rationale are described in Appendix G of the SMI EIS (TVA 1998). The overall average SAHI score extrapolated for all TVA reservoirs was 24.3 (of a possible 35), which indicates generally “fair” shoreline aquatic habitat within the reservoirs. Average SAHI scores are higher adjacent to lands currently allocated for natural and wildlife uses and cultural/public use/open area uses, compared to shorelines adjacent to all other allocated uses.

Rock is an important constituent of littoral aquatic habitat over much of the reservoir, either in the form of bedrock outcrops or a mixture of rubble and cobble on steeper shorelines or gravel along shallower shorelines. Substrate and available aquatic habitat in coves and embayments also typically correspond to shoreline topography and vegetation. In areas characterized by residential development, habitat includes man-made features such as shoreline stabilization structures (e.g., seawalls or riprap) and docks. Some aquatic habitats, such as fallen trees, are less numerous in residential areas.

TVA began a program to systematically monitor the ecological conditions of its reservoirs in 1990. Previously, reservoir studies had been confined to assessments to meet specific needs as they arose. Reservoir (and stream) monitoring programs were combined with TVA’s fish tissue and bacteriological studies to form an integrated Vital Signs Monitoring Program. The following descriptions of Watts Bar Reservoir’s existing condition are based primarily on results from this program. Due to sampling methodology and rating criteria changes, only data collected since 1994 are presented.

3.6.1. Benthic Community

Benthic macroinvertebrate (e.g., lake bottom dwelling, readily visible, aquatic worms, snails, crayfish, and mussels) samples were taken in four areas of Watts Bar Reservoir during even numbered years beginning in 1994, as part of TVA’s Reservoir Vital Signs Monitoring Program. Areas sampled included the forebay (area of the reservoir nearest the dam) at TRM 531.0, a midreservoir transition station at TRM 560.8, and inflows in both the

Tennessee River at TRM 600 and the Clinch River at CRM 19. Forebay sampling was moved to TRM 532.5 in 2000. Bottom dwellers 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. Sampling and data analysis were based on seven parameters (eight parameters prior to 1995) that indicate species diversity, abundance of selected species that are indicative of good (and poor) water quality, total abundance of all species except those indicative of poor water quality, and proportion of samples with no organisms present. Collection methods and rating criteria were different prior to 1994, so those results are not compared directly to samples taken using current methods and therefore are not presented in this document.

As shown in Table 3.6-1, the benthic community in Watts Bar Reservoir rated from poor to excellent in comparison to other run-of-the-river reservoirs. The midreservoir station had the best overall benthic community, rating fair or better each year. In 2004, the benthic community rated excellent at this station. Otherwise throughout Watts Bar Reservoir, benthic communities rated generally poor, although there may be an improving trend since 2002.

Table 3.6-1. Benthic Community Ratings, Vital Signs Monitoring Data

	Monitoring Years					
Station	**1994**	**1996**	**1998**	**2000**	**2002**	**2004**
Forebay	Poor	Very Poor	Poor	Poor	Poor	Fair
Midreservoir	Good	Fair	Fair	Fair	Fair	Excellent
Inflow (Tennessee River)	Poor	Poor	Poor	Poor	Poor	Fair
Inflow (Clinch River)	Poor	Poor	Poor	Poor	Fair	Fair

3.6.2. Fish Community

The Reservoir Vital Signs Monitoring Program included fish sampling at Watts Bar Reservoir in even numbered years from 1994 through 2004. The electrofishing and gill netting sampling stations correspond to those described for benthic sampling.

Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle that allows them to reflect conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons. Monitoring results for each sampling station are analyzed to arrive at a Reservoir Fish Assemblage Index rating, which is based primarily on fish community structure and function. Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc. (TVA 1997).

The vital stations fish community monitoring results are shown in Table 3.6-2. These data compare Watts Bar to other run-of-the-river reservoirs. With only two exceptions since 1994, fish communities have rated ‘good’ in Watts Bar Reservoir. This indicates a consistently well-balanced fish assemblage over time. In 2004 sampling, overall species diversity was good, as were the diversity of top carnivores, and the low incidence of anomalies. Lower ratings were seen in percent tolerant individuals and percent of omnivores.

Table 3.6-2. Fish Community Ratings, Vital Signs Monitoring Data

Station	Monitoring Years					
	1994	1996	1998	2000	2002	2004
Forebay	good	good	good	good	fair	good
Midreservoir	good	good	good	good	fair	good
Inflow (Tennessee River)	good	good	good	good	good	good
Inflow (Clinch River)	good	good	fair	good	good	fair

A total of 43 fish species was collected in TVA's most recent fish collections at Watts Bar Reservoir in the fall of 2004. More abundant species in the overall sample were gizzard shad, bluegill, redear sunfish, largemouth bass, and freshwater drum.

TWRA creel data indicate that bluegill is the species caught in highest numbers, with largemouth bass trailing closely behind (TWRA 2002). Black bass are, however, the most sought after group of fish by Watts Bar anglers, as nearly 330,000 hours were spent in pursuit of them in 2000. This was nearly one-half of all the estimated fishing pressure for Watts Bar that year. Other species caught in considerable numbers include black crappie, white bass, white crappie, smallmouth bass, and sauger.

In 1995, TDEC recommended that the public not consume catfish and striped bass, as well as limiting consumption of largemouth bass from the lower Watts Bar Reservoir. Similar advisories associated with PCBs are in effect for other east Tennessee reservoirs, including Fort Loudoun, Tellico, and Melton Hill—all of which are upstream from Watts Bar (USDOE 1995). Currently, TDEC advises the public to not consume catfish, striped bass, and hybrid striped bass from Watts Bar Reservoir, with precautionary advisories on eating white bass, sauger, carp, smallmouth buffalo, and largemouth bass (TDEC 2002).

3.7. Wetlands and Floodplains

Floodplains and most wetlands by their nature can occur on the same TVA property, that is, lowland areas next to water courses, and are included together in a single section of the EIS as a convenience to readers. Both wetlands and floodplains are important to the function of TVA's management of the Tennessee River including Watts Bar Reservoir lands. The occurrence of wetlands and floodplains can influence the management of TVA property and the activities that can take place there.

3.7.1. Wetlands

Wetlands are defined by TVA Environmental Review Procedures (TVA 1983) as: "Those areas inundated by surface or groundwater with a frequency sufficient to support, and under normal circumstance, 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 typically transitional ecosystems between terrestrial and aquatic communities. Watts Bar Reservoir is located in the Ridge and Valley physiographic province. Wetlands in this region are typically associated with low-lying, poorly drained areas, or linear in feature and associated with the floodplain areas of streams, rivers, and in the case of the Watts Bar project, the reservoir. In the Watts Bar project area, wetlands represent a small percentage

of the landscape relative to uplands, mainly due to the geology of the region (Hefner et al. 1994).

Watts Bar Reservoir wetlands were identified and classified using the USFWS National Wetlands Inventory (NWI) mapping conventions and the system developed by Cowardin et al. (1979).

Wetlands occurring in Watts Bar Reservoir and its tributaries are in the Palustrine system (P), and the forested (FO), scrub-shrub (SS), emergent (EM), and aquatic bed (AB) subsystems. In the forested and scrub-shrub wetlands, the vegetation class is "broad-leaved deciduous," which is designated by the number 1. In the emergent wetlands, the vegetation class is "persistent," designated by the number 1, and "nonpersistent," designated by the number 2. The term "persistent" refers to herbaceous vegetation with aboveground parts that persist through the nongrowing season, such as, for example, the dry remains of cattail and sedges. "Nonpersistent" vegetation dies back completely to ground level during the nongrowing season. The hydrologic regimes in these wetlands were judged to include temporarily flooded (A), and seasonally flooded (C), although it is possible that other hydrologic regimes, such as saturated (B) and semipermanently flooded (F) occur.

The functions of wetlands associated with Watts Bar Reservoir include shoreline stabilization, retention of sediments, removal or transformation of contaminants, nutrient cycling, provision of fish and wildlife habitat, and provision of plant species and community diversity. A brief description of wetland functions follows:

Shoreline stabilization: The roots of trees, shrubs, and herbaceous vegetation, and the organic litter layer on the ground help to stabilize the shoreline soil against erosion that could result from boat wakes and storm runoff. This function is important throughout the reservoir, but it is particularly important to preserve in those areas along the main shoreline that are subject to wave action from boat wakes and increased runoff from developed areas.

Retention of sediments: Vegetation and the litter layer in the wetlands aid in the removal and retention of eroded soil and particulates that wash toward the reservoir from adjacent upland areas and in tributary streams. This function is particularly important to preserve in those areas in which surrounding land uses could result in increased erosion and runoff, including farming operations and land development.

Retention and transformation of contaminants and nutrients: Contaminants and nutrients in dissolved and particulate form can be carried into the reservoir in storm runoff. Potential contaminants could include fertilizers and pesticides from agricultural, residential, and urban areas, excess nutrients and pathogenic bacteria from animal waste and septic system leachate, and oil and grease from roads and watercraft. Through various chemical, biological, and physical means in wetland soils, these contaminants and nutrients can be sequestered, transformed into other chemical form, or assimilated by plants.

Nutrient cycling: Nutrients are contributed to the system internally in leaf litter, plant debris, and animal waste and remains. These nutrients are cycled internally and either taken up by plants in the wetland or exported out of the wetland.

Provision of fish and wildlife habitat: Wetlands provide habitat for a large number of mammal, bird, amphibian, reptile, fish, and invertebrate species. Wetlands are essential

habitat for migratory and nesting waterfowl, and many shorebird and songbird species. Many species are wetland dependent for a part or all of their life cycle. Other species may not use the wetlands directly, but are dependent on wetlands as a source of carbon and energy. An example of this would be aquatic invertebrates that use the organic material exported from wetlands.

Provision of plant species and community diversity: Wetland plant communities consist primarily of species that can grow under low-oxygen, saturated-soil conditions. Although some of the species can grow outside of wetlands, most cannot grow in dry situations. The destruction of wetlands results in local removal of commonly occurring species from the landscape, and thus, over time, can lead to a reduction in the amount of plant, community, and landscape diversity in the local area or region.

Flood flow alteration: Important functions of riverine wetlands are those associated with flood flow alteration. These functions include short- and long- term storage of flood waters and energy reduction. This function is also important for another wetland function, the export of organic carbon. Plant and other organic material produced in the wetland are exported out of the wetland to downstream consumers during flood events.

General trends in wetland loss in the Southeast and in Tennessee indicate that palustrine forested wetlands have suffered a net loss in acreage over the last 10 years, primarily due to transportation impacts, the continued growth of urban/suburban development associated with continued population growth, and to a lesser degree, agriculture (Heffner et al. 1994). Prior to impoundment, the Tennessee River system had extensive areas of forested wetlands that were lost as dams were constructed and these floodplain areas were covered by water. Depending upon topography, forested wetlands have developed over time in the riparian and floodplain zones now affected by reservoir operations. Emergent and scrub-shrub wetlands have also developed in the embayments and mouths of tributary streams as they enter the reservoir. These wetlands, located on TVA parcels along Watts Bar Reservoir and its tributaries, are part of the overall resource assessment for this plan.

Wetland types and extent

Some fieldwork was conducted for the purposes of this plan. However, existing data sets were used to estimate the extent and types of wetlands located in the study area. These various data sets are described below.

Reservoir Operations Study (ROS): Data analysis conducted for TVA's 2004 ROS provided acreage figures for wetland types at the reservoir level. This analysis was conducted using USFWS NWI data. A geographic information system (GIS) analysis was performed on these data, and then wetland loss or gain trends, as described in Dahl (2000), were applied to the figures to estimate current acreage.

Shoreline Management Inventory (SMIN); The SMIN wetlands data are comprised of field surveyed wetlands mapped and entered into a GIS. These data provide wetland acreage, as well as mapped locations of extremely small linear wetland areas. SMI coverage does not include aquatic bed wetlands or flats. These data include mixed habitat types, e.g., forested/scrub-shrub and scrub-shrub/emergent wetlands.

Field Surveys: Field surveys were conducted on a limited number of wetlands determined by TVA biologists to be especially unique or of high ecological value. These wetlands are located on Zone 3 (Sensitive Resource Management), Zone 4 (Natural Resource Conservation), Zone 6 (Recreation) and Zone 7 (Shoreline Access) parcels.

Analysis of these data sets indicates forested wetlands are the most common wetland type on Watts Bar Reservoir. Emergent and scrub-shrub wetlands are less common; however, Watts Bar is unique in that it supports areas with a mix of habitat types. Emergent and scrub-shrub wetlands are often found associated with larger areas of forested wetlands, along the shoreline gradient, and in embayments across the reservoir.

Aquatic bed habitats, those areas with rooted vascular plants, are very limited on Watts Bar. There are a few shallow areas that support spiny-leaf naiad (an exotic species); aquatic bed areas were more extensive in the 1980s and very early 1990s (primarily comprised of Eurasian water milfoil). High water flows and other factors (David Webb, TVA, personal communication) in the mid-1990s eliminated most of the aquatic bed (milfoil) habitats.

While small areas of wetlands are located along the shoreline throughout the reservoir, especially significant areas of wetlands occur in the embayments associated with Hines Creek, Whites Creek, Muddy Creek, Greasy Run Creek, and Wolf Creek. Other particularly important wetland areas are located in parcels located along the Little Emory River, in the Swan Pond and Clinch River Breeder Reactor area, and on various forested islands in the main stem of the river.

Palustrine emergent and scrub-shrub wetlands are less common and are commonly found at the head of embayments of the smaller tributary streams as they enter the reservoir. There are significant areas of emergent and scrub-shrub wetlands found in the embayments of Greasy Run Creek, Hines Creek, and Grassy Creek.

Typical plant species that comprise wetlands in the study area include red maple, sycamore, green ash, willow oak, sweetgum, box-elder, alder, river birch, rose mallow, buttonbush, silky dogwood, soft rush, smartweed, cattail, *Scirpus* spp., and rice cutgrass. Reed canary grass, an exotic species, is becoming increasingly more common, especially in the Tennessee arm of the river upstream from Kingston.

Based on field surveys designed to assess especially unique wetland areas on Watts Bar, there are 12 areas of wetlands located on portions of Zone 7 (Shoreline Access) parcels that were determined to be of very high quality. This assessment was made using a version (TVARAM) of the *Ohio Rapid Assessment Method* (version 5.0) specific to the TVA region. The assessment was developed to assess wetland condition/ecological significance. Using the TVARAM, 10 of these wetlands scored as Category 3 wetlands, which includes wetlands of very high quality and wetlands that are of concern regionally and/or statewide, such as wetlands that provide habitat for threatened or endangered species. Two wetlands on these Zone 7 parcels scored as Category 2 wetlands, which are described as moderate-quality wetlands. These areas are listed below in Table 3.7-1.

Table 3.7-1. Wetland Types on Zone 7 Parcels

Parcel Number[1]	Wetland Type[2]	TVA RAM Score/Category[3]	Allocation
160	PFO/PEM/PSS/flats	90/Category 3	Zone 7
36	PEM/PFO/PSS/flats	84/Category 3	Zone 7
265	Flats/PSS/PEM/PFO	78.5/Category 3	Zone 7
267	PFO/PSS/PEM/flats	74.5/Category 3	Zone 7
269	PFO/PSS/PEM/flats	76/Category 3	Zone 7
102	PFO/PSS/PEM/flats	62/Category 2	Zone 7
109	Flats/PSS/PFO/PEM	55.5/Category 2	Zone 7
112	PEM/PSS/flats	55/Category 2	Zone 7
128	PFO/PEM/PSS	71.5/Category 3	Zone 7
157	PFO/PEM/PSS/flats	64/Category 2	Zone 7
111	PFO/PEM/PSS/flats	82.5/Category 3	Zone 7
234	PEM/PSS/PFO/flats	73/Category 3	Zone 7

[1]Wetlands occupy portions of these parcels; acreages are listed in Table B-1.
[2]P – palustrine; EM – emergent; SS - scrub-shrub; FO – forested; Cowardin 1979; order of wetland class is based on the dominant class in descending order of prevalence.
[3]TVARAM scoring methodology provides a maximum score of 100 points. Wetlands scoring between 67-100 are classified as Category 3 wetlands; wetlands scoring between 35-67 are Category 2 wetlands, and wetlands scoring below 35 are Category 1 wetlands.

Other significant wetlands were surveyed prior to the development of TVARAM; while these areas were not scored using TVARAM, they were assessed using a habitat assessment method that indicated they were of especially high quality. These wetlands are listed in Table 3.7-2.

Table 3.7-2. Watts Bar Parcels With Significant Wetlands

Parcel/Location[1]	Wetland Type[2]	Ecological Significance/Sensitivity[3]	Allocation
103/Hines Creek	PFO	High	Zone 3
268/Muddy Creek	PFO	High	Zone 3
160/Little Emory River	PFO/PSS/PEM	High	Zone 7
183/Swan Pond	PFO	High	Zone 6
185	PFO	High	Zone 4
188	PFO	High	Zone 3
281/Wolf Creek	PFO	Average	Zone 3
169	PFO	Average	Zone 4
166	PFO	Average	Zone 3
233/Whites Creek	PFO	Average	Zone 3

[1] Wetlands occupy portions of these parcels.
[2] P – palustrine; EM – emergent; SS - scrub-shrub; FO – forested; Cowardin 1979; order of wetland class is based on the dominant class in descending order of prevalence.
[3] The rapid assessment methodology used rated the ecological significance/sensitivity of the wetlands as High/Average/Low.

As stated in Section 2, this Land Plan includes two action alternatives that differ in the land use zone category assigned to certain parcels (Tables 2.1-3 and 2.2-1). A description of each of these parcels is presented below.

Parcels 5, 9, 44, 47, 80, 120-123, 12-55, 218, 257, 294-299: Based on NWI maps, SMIN data, and information from the previous 1988 Plan, these parcels contain no significant areas of wetlands. These parcels, however, may contain some small, scattered scrub-shrub and emergent areas on shoreline portions of some of these parcels.

Parcel 10: NWI maps indicate a small forested wetland occurs in an embayment associated with this parcel.

Parcels 142-148: NWI data as well as SMIN data indicate there are extensive areas of wetlands associated with these parcels. A mix of habitat types occurs in this area, and there are areas of forested wetlands along the shoreline of Parcel 144 and 145, as well as emergent and scrub-shrub wetlands in the Grassy Creek embayment. There are also forested wetlands within Parcel 146, the Grassy Creek HPA.

Parcel 153: SMIN data indicate nine small wetlands occur on this parcel. A linear strip of forested wetlands occurs along the shoreline at the northern end of the parcel. The remaining wetlands are a mix of emergent and scrub-shrub wetlands located along the shoreline at the southern end of the parcel.

Parcel 230: SMIN data indicate four areas of emergent wetlands occur along the shoreline in coves on this parcel.

3.7.2. 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"

The EO is not intended to prohibit floodplain development in all cases, but rather to create a consistent government policy against such development under most circumstances. It applies to all federal agencies that: acquire, manage, or dispose of federal lands and facilities; undertake, finance, or assist construction and improvements; and conduct activities and programs affecting land use, including planning, regulating, and licensing. The EO requires that agencies avoid the 100-year floodplain unless it is the only practicable alternative.

The 100-year floodplain on Watts Bar Reservoir is the area that would be inundated by the 100-year flood. There are two main water courses in Watts Bar Reservoir, the Tennessee River and the Clinch River. The 100-year flood elevations for the Tennessee River vary from elevation 746.5 feet mean sea level (msl) at Watts Bar Dam (TRM 529.9) to elevation 760.0 feet msl at the upper end of Watts Bar Reservoir at TRM 602.3 (downstream of Fort Loudoun Dam). A tabulation of the 100-year flood elevations is included in Appendix D, Table D-5. For the Clinch River, the 100-year flood elevations vary from elevation 747.1 feet msl at the mouth (CRM 0.0) to elevation 755.3 feet msl at the upper end of Watts Bar Reservoir at CRM 23.1 (downstream of Melton Hill Dam). A tabulation of the 100-year flood elevations is included in Appendix D, Table D-4.

The flood risk profile (FRP) elevations for the Tennessee River vary from elevation 747.0 feet msl at Watts Bar Dam to elevation 769.3 feet msl at the upper end of Watts Bar Reservoir at TRM 602.3. A tabulation of the FRP elevations is included in Appendix D, Table D-5. For the Clinch River, the FRP elevations vary from elevation 748.4 feet msl at the mouth to elevation 759.2 feet msl at the upper end of Watts Bar Reservoir at CRM 23.1. The FRP elevations are based on the 500-year flood and are used to control flood damageable development for TVA projects and on TVA Lands. A tabulation of the FRP elevations is included in Appendix D, Table D-4.

3.8. Land Use and Prime Farmland

3.8.1. Land Use

Of the original 1.27 million acres of land purchased for TVA reservoir construction, 37 percent (470,000 acres) is retained land under water, 23 percent (293,000 acres) is retained reservoir land, and 40 percent (506,000 acres) has been sold or transferred. Most of the transferred land (342,000 acres) was acquired by state and federal agencies for recreation and resource management. The sold land (160,000 acres) was acquired by various private individuals and corporations for development, and 4,000 acres were sold with restrictions for commercial recreation, group camps, or private clubs.

When TVA acquired properties around Watts Bar Reservoir, the land uses were primarily small subsistence farming on marginal land with row crop and pasture areas interspersed with woodlands. Following purchase by TVA, much open land was either planted in pine or reverted naturally to pine and/or hardwoods. Now the TVA public land surrounding Watts Bar Reservoir can be broken into five broad community types: forestland, open/agricultural land, shrub/brush land, wetland/riparian/shallow overbank areas, and residential/suburban habitats. Agricultural and grassland habitats are relatively uncommon on Watts Bar Reservoir properties comprising only a few hundred acres.

Since the completion of Watts Bar Reservoir, TVA has sold or transferred over 35 percent of the original land base (9,000 acres) to private, state, or federal ownership for economic development and recreation, and to private ownership. TVA land comprises only about 11 percent of the land within 0.25 mile of Watts Bar Reservoir (see Table 3.8-1), 54 percent of the land around Watts Bar has been or currently is being developed, and 35 percent of the land is available for development.

Table 3.8-1. Comparison TVA Planned Land and Private Land Within 0.25 Mile of Watts Bar Reservoir

	Acres	Percent of Watts Bar Reservoir Land
TVA Reservoir Lands (1988 Plan)	7,411	11
Existing Development (Urban Growth Initiative)*	35,251	54
Planned Growth (Urban Growth Initiative)*	22,468	35
Total Land	65,130	100

*Tennessee State Urban Growth Initiative Data

Currently, TVA owns and manages 16,200 acres of land and 721 miles of shoreline on Watts Bar Reservoir. The Watts Bar Reservoir flows from the northeast to southwest

through Loudon, Meigs, Rhea, and Roane Counties in east Tennessee, which are distinctly rural in description. The principal towns on the reservoir are Spring City, Kingston, Loudon, Rockwood, Lenoir City, Oak Ridge, and Harriman. Rural populations are concentrated in the numerous long valleys between the forested ridges. There are several barge terminals and industrial park areas near the larger communities, and some concentrations of residential shoreline developments and marinas. However, most of the Watts Bar Reservoir shoreline can be typified as appearing forested and rural. Of the 721 miles of shoreline on Watts Bar, 340 miles (47 percent) are available for Shoreline Access, which includes current development.

Currently, there are over 17,000 acres of platted residential property adjacent to Watts Bar Reservoir public lands, which is 1,000 acres greater than the total amount of TVA public land being planned on the reservoir. It is estimated that approximately a little more than half of the platted area has already been converted to residential housing with complete conversion of most of these areas anticipated.

Other large tracts of land in the immediate vicinity include the USDOE Oak Ridge facilities on the upper reaches of Watts Bar Reservoir on the Clinch River. The Oak Ridge State WMA, totaling 37,000 acres is primarily on the Oak Ridge Reservation and adjacent USDOE lands. USDOE manages the Oak Ridge Reservation, which is approximately 34,000 acres (excluding the former Clinch River Breeder Reactor site). Of those 34,000 acres, 20,000 acres are defined as the Oak Ridge National Environmental Research Park Biosphere Reserve. These USDOE lands total 71,000 acres adjacent to TVA public lands on Watts Bar Reservoir. Large tracts of privately owned lands in the immediate area include Browder Woods, approximately 300 rolling acres of second-growth white oak forest and Crowder Cemetery Cedar Barrens, a 258-acre tract containing rare plants (see Managed Areas, Section 3.4).

There are over 26.3 million acres of land in the state of Tennessee. Only 976,014 acres or 3.7 percent of the land base is in public ownership (State of Tennessee 2003). TVA owns approximately 165,440 acres (0.6 percent) of the land in Tennessee, which is 17 percent of the public lands in the state. From 1992 to 1997, the state of Tennessee ranked 14th in the percentage of agricultural land converted to developed uses with 212,500 acres or 2 percent of agricultural land being converted to developed land, for an average annual rate of 42,500 acres. Additionally, 405,100 acres of rural land was converted to developed uses, with an average annual rate of 81,020 acres (Farmland Information Center 2004).

TVA had a pilot study prepared on Land Evaluation (CH2M Hill 2005) that was based on the 2005 Plan, to evaluate the usefulness of using land value methods for TVA land plans and to provide information to support the ongoing Land Plan. The study provided ‘Highest and Best Land Use Analysis’ for the May 2005 Plan, considering the proposed allocation changes and also ‘Ecological Services and Human Use Valuation’ for the most important TVA ecological and recreation property on the reservoir. The report confirmed the relative impact of the former alternatives on ecological, recreational, and real estate values, and recommended a blended or hybrid alterative to optimize the land values under current marketing conditions. Results of an accompanying market analysis indicated limited opportunities for commercial and industrial development opportunities for the Meigs, Rhea, and Roane counties area, and that much of the residential development market was saturated by several ongoing large-scale and long-term projects.

TVA Land Policy: The TVA Board of Directors approved a final Land Policy, in November 2006 (see Appendix A), which protects and preserves undeveloped public lands managed

by TVA. The new Land Policy reflects both TVA business operations and public stakeholder expectations. TVA recognizes the public value in the remaining reservoir lands and that TVA should continue to provide for the public use and enjoyment of the reservoir system. Uses of TVA reservoir lands should be in the overall greatest public interest. The significant directives of the Land Policy pertaining to reservoir lands are:

- TVA will continue to develop reservoir land management plans with substantial public input and approval from the TVA Board.

- Public lands managed by TVA will not be allocated or sold for residential or retail.

- TVA will consider disposing of reservoir lands for industrial purposes or other businesses, if the property is located in an existing industrial park or the land is designated for such purposes in a reservoir land management plan. Preference will be given to businesses that require water access.

- TVA will consider leasing and granting easements over public lands for commercial recreation or public recreation purposes, if the property is allocated for that use in a reservoir land management plan.

- TVA will consider deed modifications pertaining to flowage rights no longer needed for river operation purposes. TVA would consider modifications that would open the land affected to public recreational access or, in the case of land already open to the public, continue such access. TVA will not remove or modify other deed restrictions for the purpose of facilitating residential development.

Interim Use: Although TVA reservoir land is designated for specific uses by allocation to one of the land use zones, often these plans are designed to take time to implement. During this time (sometimes years) the land is available for informal public recreation use (hiking, hunting, camping, etc.), wildlife and other natural resource management, and agriculture where no permanent changes or obligations occur that detract from its planned purpose but a temporary usefulness can be sustained. Likewise, by their design, some land allocation zones encourage temporary or utilization uses in the management of natural resources, such as dam reservation maintenance, wildlife plots, or WMAs.

There are currently about 17 agricultural licenses for land on 30 parcels totaling about 469 acres of TVA public land on Watts Bar Reservoir (Table D-17, Appendix D), which all expire on December 31, 2008. TVA considers use of TVA public land for agriculture to be a short-term use but provides agriculture licenses under certain circumstances where they are compatible with TVA land management goals or are the best use of the land. Agricultural licenses can be compatible with Zones 2, 3, 4, 5, 6, and 7. An example is utilizing hay crops as an effective way to manage open fields for certain wildlife species, archaeological sites, and reduce maintenance costs for mowing areas of land on recreation and industrial sites. Lands licensed to individual farmers by TVA are largely being farmed to grow hay forage crops for livestock. Even though Parcel 187 is licensed for row crops, it may be used for hay.

Land Use Agreements: Land use agreements such as licenses, leases, and easements are implemented by TVA to authorize activities or landrights on TVA land to support TVA's various programmatic plans and goals. These include road and utility easements, industrial sites, water treatment facilities, marinas, public recreation areas, and WMAs.

TVA project operations on Watts Bar Reservoir include the Watts Bar Dam Reservation, KIF, TVA maintenance facilities, and navigation safety harbors and landings. Although technically downstream of the Watts Bar Dam, WBN, which is immediately adjacent to the dam reservation, is included in this Land Plan. TVA provides the use of public land to public agencies and utilities when in the public interest. Most often these are land use agreements for utility or road rights-of-way, sites for industrial use, public works projects (water intakes), dewatering/pump stations, and community maintenance facilities. The existing land use agreements for Watts Bar Reservoir are summarized in Table 3.8-2, along with the number of currently approved land use agreements as well as the number that were approved in 1988. Between 1988 and 2004, there was an increase of 88 new agreements for 603 acres of TVA public land. Since 2004, there has been a net increase of 15 land agreements.

Table 3.8-2. Number of Land Use Agreements by Category Existing in 1988 and 2004

Land Use Agreement Categories	1988		2004	
	No. of Agreements	Acres	No. of Agreements	Acres
Highways/Roads	49	409	50	430
Railroad Easements	7	9	17	9
Industrial				
Barge Terminals	N/A	N/A	3	11
Industrial Sites	8	1,259	10	1,274
Project Operations				
Maintenance Facility	1	<1	1	<1
Pump Station/Dewatering	5	1	6	1
Recreation	161	3,150	191	3,518
Sufferance Agreements	1	<1	6	<1
Wastewater Treatment	1	1	2	186
Wildlife Management Areas	2	1,900	3	1,900
Utilities				
Electric	8	7	13	8
Gas	2	1	8	3
Sewer	23	8	25	8
Telephone	15	7	20	7
Water	10	22	13	22
Total	**272**	**6,774**	**360**	**7,377**

Currently, TVA has several long-term land use agreements with other federal, state, and local government agencies for WMAs and refuges and city and county parks. TWRA has long-term land use agreements in Roane County for approximately 1,900 acres of TVA public land for two state refuges and one WMA totaling almost 3,900 acres. Kingston Fossil Plant WOA (Parcel 190), approximately 300 acres, is managed by TVA in cooperation with TWRA. Two SWAs are located on Watts Bar Reservoir, totaling about 350 acres; these are managed for low-impact public use because of their exceptional natural, scenic, or aesthetic qualities. Seven HPAs, approximately 155 acres, have been established to protect populations of endangered or threatened species, unusual or exemplary biological communities, or unique geological features. Seven municipal or county parks totaling approximately 600 acres are located on TVA reservoir lands. In total, about 7,100 acres

are managed for natural resource conservation or sensitive resource protection on TVA public land on Watts Bar Reservoir.

There are about 20 commercial marinas on Watts Bar Reservoir. Most of these marinas adjoin TVA property and are under a license agreement that conveys the landrights for commercial recreation. Some marinas are located on former TVA property transferred to a city or county for recreation purposes. The remaining marinas reside on former TVA property sold specifically for recreation development. See Recreation, Section 3.11, for more detailed information.

3.8.2. Prime Farmland

Prime farmland has the best combination of soil physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. This land can be cropland, pastureland, rangeland, forestland, or other land not urban nor water. The conversion of farmland and prime farmland soils to industrial and other nonagricultural uses essentially precludes farming the land in the foreseeable future. Creation of the 1981 Farmland Protection Policy Act addressed this issue and set guidelines that require all federal agencies to evaluate impacts to farmland prior to permanently converting to a nonagriculture land use. The act requires that Form AD 1006, “Farmland Conversion Impact Rating,” be completed by federal agencies with assistance from the Natural Resource Conservation Service before an action is taken.

The geographic extent of the Watts Bar Reservoir reaches Loudon, Meigs, Rhea, and Roane counties. Agriculture census data show that in the last 15 years, except for Meigs County, acreage in county farms has increased by an average of about 8 percent while the value of agricultural products sold has increased in all counties, ranging from 8.6 percent in Meigs County to 105 percent for Rhea County (Table 3.8-3). These four counties have a total of 125,964 acres of land with soil properties to be classified as prime farmland ranging from 14.1 percent of Roane County to 21.2 percent of Meigs County (Table 3.8-4).

Table 3.8-3. Change in Farm Size and Value of Agricultural Products From 1987 to 2002 in Counties Adjacent to the Watts Bar Reservoir

County	1987	1992	1997	2002	Percent Change in 15 Years
Acres in farms					
Loudon	77,665	73,654	73,976	82,656	6.4
Meigs	54,949	56,253	48,977	48,918	-11.0
Rhea	55,956	52,462	56,049	60,762	8.6
Roane	58,739	52,433	53,110	63,378	7.9
Market value of agricultural products sold ($1,000)					
Loudon	31,486	38,546	45,067	50,628	60.8
Meigs	5,195	5,039	4,783	5,642	8.6
Rhea	8,687	7,908	7,575	17,809	105.0
Roane	4,377	4,825	5,771	5,660	29.3

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

Table 3.8-4. Acreage of Farmland in the Counties Adjacent to the Watts Bar Reservoir

County	Total Land in County*	Farm Size in 2002**	Farmland in County**	Total Prime Farmland*	Prime Farmland in County*
	Acres	Acres	Percent	Acres	Percent
Loudon	151,323	82,656	54.6	23,459	15.5
Meigs	122,240	48,918	40.0	25,905	21.2
Rhea	214,400	60,762	28.3	42,304	19.7
Roane	243,200	63,378	26.1	34,296	14.1
Total	731,163	255,714	35.0	125,964	17.2

Source: *TVA 2004
**U.S. Department of Agriculture, Agriculture Census, http://agcensus.mannlib.cornell.edu/

About 3,000 acres of prime farmland soils occur in 216 parcels of the over 300 land parcels of the Land Plan, 14 percent (407 acres) are currently used for agriculture (see Table 3.8-5). These soils have formed in local alluvium located on the floodplains of the river and smaller streams in the area. A list of prime farmland soils and their combined acreage within each county are found in Table D-10, Appendix D.

Little land would be disturbed by activities in Zones 3 and 4 and so prime farmland soils would be protected. Land allocated to Zones 2, 5, 6, and 7 would potentially have soil disturbance activities and impacts to prime farmland soils. Farmland statistics by zone and parcel are in Tables D-10 to D-15, Appendix D).

Table 3.8-5. Number of Parcels, Acreage of Prime Farmland (greater than 1 acre) and Agricultural Land Use for all Parcels Allocated in Each Zone

Zone	Number of Parcels	Total Acres	Prime Farmland Acreage*	Percent Prime Farmland	Acres used for Agriculture**	Acres of Prime Farmland used for Agriculture
2	9	1,922	230	30	259	109
3	39	3,118	898	62	122	69
4	48	3,858	636	41	221	92
5	12	1,544	257	36	98	26
6	41	1,720	278	47	76	34
7	67	2,023	701	39	188	77
Total	216	14,185	3,000	21	964	407

Source: *National Resources Conservation Service, U.S. Department of Agriculture Soil Surveys
** National Land Cover Database

Historically, TVA understands the value of farmland and has continued to license about 469 acres of its public lands for use as agriculture. Currently, there are 30 parcels with existing licenses (Table D-17, Appendix D) ranging in size from 159 acres to 0.1 acre.

3.9. Cultural Resources

For at least 12,000 years, the Tennessee River and the Little Tennessee River Valley have been an area for human occupation, which became more intense through succeeding

cultural periods. In the upper east Tennessee area, archaeological investigations have demonstrated that Tennessee and the eastern Ridge and Valley Region were the setting for each one of these cultural/temporal traditions, from the Paleo-Indian (12,000-8000 B.C.), the Archaic (8000-1200 B.C.), the Woodland (1200 B.C.-1000 A.D.), the Mississippian (1000-1500 A.D.), to the Protohistoric-Contact Period (1500-1750 A.D.). Prehistoric archaeological stages are based on changing settlement patterns. Smaller time periods, known as "phases" are represented by distinctive sets of artifact remains. In addition, historic era cultural traditions have included the Cherokee (1700 A.D.-present), European and African-American (1750 A.D.-present) occupations.

The Paleo-Indian Period (12,000-8000 B.C.) represents the documented first human occupation of the area. The settlement and land use pattern of this period were dominated by highly mobile bands of hunters and gatherers. The subsequent Archaic Period (8000-1200 B.C.) represents a continuation of the hunter-gatherer lifestyle. Through time, there is increasing social complexity and the appearance of horticulture late in the period. The settlement pattern during this period is characterized by spring and summer campsites. Increased social complexity, reliance on horticulture and agriculture, and the introduction of ceramic technology characterize the Woodland Period (1200 B.C.-1000 A.D.). The increased importance of horticulture is associated with a less mobile lifestyle as suggested by semipermanent structures. The Mississippian Period (1000 -1500 A.D.), the last prehistoric period in east Tennessee, is associated with the pinnacle of social complexity in the southeastern United States. This period is characterized by permanent settlements, maize agriculture, and chiefdom-level societies.

The Archaic through Mississippian periods have been intensively investigated in east Tennessee (Chapman 1973, 1975, 1977, 1978, 1979a, 1979b, 1981; Cridlebaugh 1981; Kimball 1985; Polhemus 1979 Davis 1990; Guthe and Bistline 1981). In addition, it is widely known historically that many settlements along the Little Tennessee River were Overhill Cherokee villages (Timberlake 1927; Bartram 1995). Many archaeological investigations in the 1960s and 1970s focused on the Cherokee occupation of the area (Schroedl 1985; Baden 1983; Russ and Chapman 1984). All of these investigations have provided additional details about the changing environments, shifting subsistence strategies and settlement patterns, and variations in the cultural material associated with each major stage.

As previously mentioned, Watts Bar Reservoir is located in four Tennessee counties (Roane, Rhea, Meigs and Loudon). In 1792, John Sevier established Fort Southwest Point at the convergence of the Tennessee and Clinch rivers to protect white settlers traveling west. Roane County was established in 1801 at the juncture of the Tennessee, Clinch, and Emory rivers. The town of Kingston was chosen as the county seat in 1807 (Hall 1998). Rhea County was established in 1807, from a portion of Roane County. The new county was situated in a valley between the Tennessee River and Cumberland Plateau. Though enlarged in 1817, parts of the county were lost in the formation of Hamilton County in 1817 and Meigs County in 1836 (Broyles 1998). Meigs County was established in 1836 from Rhea County. The county is bounded on the west by the Tennessee River, and the lower Hiwassee River crosses through the southern portion of the county. The county contains fertile bottomland and ample timber, as well a vein of iron core (Toplovich 1998). When Tennessee voted on secession in June 1861, the majority of these counties sided with the Confederacy. No major Civil War battles were fought in these counties, but there were massive troop movements through the area. Industrialization developed slowly after the Civil War. Loudon County was established on June 2, 1870, from portions of Roane, Monroe, and Blount counties. Loudon County lies on both sides of the Tennessee River

and extends north to the Clinch River. The Little Tennessee River also passes through the county. Settlements were made on the north banks of the Tennessee and the Little Tennessee before 1800 (Spence 1998). TVA brought changes to the area with the construction of a reservoir network along the Tennessee and Little Tennessee River Valley (Chickamauga in 1940, Watts Bar in 1942, Fort Loudoun in 1943, and Tellico in 1979). TVA's construction of Sequoyah and Watts Bar nuclear plants south and north of the county in the 1970s added residential growth.

The NHPA of 1966 and the Archaeological Resources Protection Act (ARPA) of 1979 address the protection of significant archaeological resources and the preservation of historic properties located on TVA lands or affected by TVA undertakings. A historic property is defined under 36 CFR Part 800.16 (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."

In response to this federal legislation, TVA conducts inventories of its lands to identify historic properties. The area of potential effect (APE) as defined in 36 CFR Part 800.16 (d) is "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist." For the action proposed, APE is approximately 16,200 acres of land that TVA retained or previously committed to specific land uses and other non-TVA lands that may be affected by a TVA undertaking.

In September 2004, TVA consulted with the Tennessee State Historic Preservation Officer (SHPO) and appropriate affiliated Native American Indian tribes for this project. The comments are attached in Appendix D. Based on these comments, a programmatic agreement (PA) was executed between TVA, the Tennessee SHPO, and the Advisory Council on Historic Preservation to address a phased compliance survey strategy and potential adverse effects to historic properties.

3.9.1. Archaeological Resources

The Watts Bar Reservoir area has been the focus of archaeological research since the early 19th century. The earliest description of prehistoric Native American culture within the Watts Bar study area comes from John Haywood (1823, 1959) who described the mounds of the Bell and DeArmond sites as they were seen in the early 1800s. It was not until the 1930s and 1940s during the extensive Works Progress Authority projects in preparation of the Chickamauga and Watts Bar reservoirs that extensive survey and excavations were undertaken (Ahlman 2000). Three major archaeological surveys and numerous small-scale surveys have been completed on TVA land along Watts Bar Reservoir. In the early 1940s, prior to TVA's inundation of Watts Bar Reservoir, archaeological investigations (including site recording and in some cases excavation) were conducted in the flood zone. To address land management concerns for the 1988 Plan, TVA contracted with the University of Tennessee to conduct an archaeological survey in 1986. Later in the 1990s, the University of Tennessee surveyed an additional 6,861 acres of TVA fee-owned lands (only 2,211 acres are within the 16,200 acres considered in the Land Plan) and 6 miles of shoreline on the Watts Bar Reservoir. The last large-scale survey (Ahlman 2000) was conducted by means of a pedestrian survey and systematic shovel testing from existing humus to culturally sterile subsoil. The soil matrix was screened through a 0.25-inch wire mesh screen. Crew members walked the areas in 20-meter transects and excavated shovel test pits on 20-meter centers along each transect in zones of low slope and/or high site probability.

Existing data were reviewed during this assessment and over 700 archaeological resources have been identified within and along the Watts Bar Reservoir. Prehistoric components and sites dating from the Paleo-Indian through Mississippian periods were recorded, and historic archaeological sites were associated with the 19th to 20th century habitation of the area.

3.9.2. Historic Structures

Initially, European settlement in the early 19th century developed into an agricultural economy with farmsteads and small towns. Transportation networks revolved along the Tennessee River. 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 area. 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 Watts Bar Reservoir (1939-1942) resulted in further significant changes of the region. The acquisition of land for the Watts Bar Reservoir by TVA resulted in the removal of most structures and other man-made features on these TVA lands. Very few structures remained, though many historic structures do remain on adjacent non-TVA lands. Historic structures (and other man-made features) remain from all these historical periods. The earliest settlements tended to be on the waterways, and many of these were lost to TVA's reservoir development. Also, the richest farmlands and the most prosperous farms and plantations were located on the river bottoms. Many of these were also lost.

A major historic structures' survey was done for the 1988 Plan. This was conducted by TVA Cultural Resources staff and included sites on TVA lands and on adjacent non-TVA lands. This survey identified 17 structures listed on the NRHP and 25 eligible for listing, 150 historic structures and/or historic districts of which many are probably eligible for listing, and 171 that are no longer eligible for listing.

Only a small portion of these identified historic structures have the potential to be affected by the proposed allocations of the alternatives. The only eligible historic structures on TVA lands are the Watts Bar Fossil Plant; the Watts Bar Dam, Locks, and Power House; and a number of remaining dwellings from the original construction village (now Watts Bar Resort).

3.10. Navigation

Watts Bar Reservoir is one of the impoundments that make the commercially navigable, Tennessee River System possible. This approximately 650-mile system connects Knoxville, Tennessee, at the upper end with Paducah, Kentucky, at the confluence of the Tennessee and the Ohio rivers and provides for year-round navigation the length of the Tennessee River, with an additional 150 miles of navigable tributaries. The Tennessee River system is in turn part of the interconnected National Inland Waterway System that links much of the eastern half of the United States by water transportation, with coastal and Great Lakes links to the rest of the world.

Watts Bar Reservoir is bounded by three dams with navigation locks. Watts Bar Lock and Dam, at TRM 529.9, marks the southern (downstream) boundary of the reservoir and Fort

Loudoun Lock and Dam defines the upstream limits of the reservoir at TRM 602.3. In addition, Watts Bar Reservoir extends into two navigable tributaries of the Tennessee River: the Emory River, navigable for 12 miles to the town of Harriman and the Clinch River. While the Clinch is navigable for 62 miles to the town of Clinton, Melton Hill Lock and Dam at CRM 23.1 marks the furthest extent of Watts Bar Reservoir on the Clinch River.

In 2005, the most recent year for which there is comprehensive commodity data, over 1.2 million tons of commercial cargo moved on Watts Bar Reservoir (USACE 2006a). Over 800 thousand tons of this traffic either originated or terminated at the four active commercial barge terminals located on Watts Bar Reservoir. The average tow size on Watts Bar Reservoir in 2005 was 4.5 barges with a total of 233 barge tows (USACE 2006a). Commodities transported include grains and grain products, iron and steel, minerals, asphalt, sand, salt, and fertilizers.

The economic impact of commercial waterway transportation is typically measured in terms of the transportation savings (or shipper savings) that accrue to the area's economy as a result of using barge transportation over other modes. Shipper savings from commercial waterway traffic originating or terminating on Watts Bar Reservoir in 2005 was $7.7 million. The average shipper savings benefit to the area for the period 2001 to 2005 was just under $9 million annually.

To support commercial waterway traffic, TVA and the U.S. Coast Guard (USCG) maintain a number of navigation aids either on the water or along the shoreline. These include main channel and secondary channel buoys; mooring cells, dolphins, and buoys; dayboards (navigation signs) and lighted beacons; and shoreline signs for safety harbors, landings, and secondary channels. A safety harbor is a cove or embayment off the main channel into which a tow may pull in high flow, inclement weather conditions, or an emergency; a safety landing marks a place on the shoreline of the main channel where a tow may tie off in a weather or operations emergency.

Navigation aids also support recreational boat traffic, as do the locks at Watts Bar and Fort Loudoun dams (Melton Hill Lock was closed to all but essential traffic in August 2003 due to an electrical system failure in the mechanism that fills and empties the lock chamber). While it is impossible to know the actual number of recreational vessels on Watts Bar Reservoir at any one time, several indicators may provide useful information. For example, in 2006, 1,849 recreational vessels locked through at Watts Bar Lock, and 1,928 recreational vessels locked through at Fort Loudoun Lock (USACE 2006b).

TVA's comprehensive ROS final environmental impact statement (FEIS) recreation field study (TVA 2004b) indicated that in 2002, there were about 1.9 million visitor days to Watts Bar Reservoir. Eight hundred seventy-four thousand visitor days (46 percent) were attributed to use of commercial facilities for access to Watts Bar Reservoir, 702 thousand (37 percent) accessed from private residences, and 313 thousand (17 percent) from public facilities. A subsequent internal TVA inventory of recreation facilities showed that, in 2004, there were 50 paved boat ramps on Watts Bar Reservoir and about 1,500 boat docking slips at area marinas, with an additional 238 out-of-water storage slips. The inventory also found that there were 16 facilities on Watts Bar Reservoir where one could rent boats or personal watercraft in 2002 (TVA 2005b).

3.11. Recreation

Developed recreation and informal recreation are the major components of recreation on TVA lands. Developed recreation on TVA lands is described as Zone 6 in the Land Plan (see Table 2.1-3). It consists of public property suitable and capable to support the following: for-profit commercial water-based facilities available to the public for a fee (Commercial Recreation), recreation facilities provided by a nonprofit public agency (Public Recreation), and narrow strips on the reservoir (Water Access). Informal recreation is usually as a component of Zone 4, Natural Resource Conservation, where land is maintained for hunting, fishing, hiking, picnicking, and viewing. Therefore, land allocated for Zone 6 is actively managed primarily for developed recreation, while informal recreation is a more passive opportunistic component of Zone 4. Recreation impacts are assessed for both Zones 4 and 6. Also, additional recreation facilities (such as picnic areas, beaches, and boat ramps) are sometimes located on TVA Project Operation lands (Zone 2).

Watts Bar Reservoir encompasses 37,385 surface acres at full summer pool. The reservoir receives an estimated 1.9 million recreation user days per year, according to the TVA ROS FEIS (TVA 2004b). Of the total 1.9 million visitor days, approximately 313 thousand gained access to the reservoir through public use areas, 702 thousand through private residential areas, and 874 thousand through commercial use areas.

The types of recreation opportunities that can be provided on the public lands and waters of Watts Bar Reservoir, i.e., day hiking, wildlife viewing, developed camping, picnicking, swimming, biking, hunting, fishing, and boating, continue to be high-growth recreation activities and/or those activities with high participation rates (Cordell et al. 2004). In 1988, TVA directly operated recreation facilities such as campgrounds, day use areas, and boat ramps on Parcels 4, 10, 22, 74, and 266. However, TVA has currently leased three of the five parcels to private operators, closed one, and is in the process of leasing the fifth. The Watts Bar Dam Reservation is available for use, and TVA provides access to undeveloped lands for informal recreation use.

The 2004 ROS FEIS (TVA 2004b) focused on water-based recreation and did not account for people using land-based recreation such as trails, visitor overlooks, driving for pleasure, hunting, etc. The undeveloped lands around Watts Bar Reservoir support many of these types of activities. Although these types of uses are not quantified, these uses are extensive based on the visual impacts of foot paths, bare soils, litter, and other indicators. Some of the important Zone 4 Parcels on Watts Bar Reservoir that support dispersed, informal wild land recreation include Parcels 7, 24, 46, 237, 227, 254, 285, 286, and 283. Considerable logging has occurred on Parcels 297, 298, and 299 as a result of damage from the southern pine bark beetles. However, the size of these three parcels (145, 34, 423 acres, respectively) makes them important wild land informal recreation parcels.

Through the November 2006 Land Policy, the TVA Board of Directors directed a survey be completed of TVA land designated for Developed Recreation use (Zone 6) in reservoir land management plans. TVA determined whether the properties previously designated in the 1988 Plan remained suitable for recreational use and whether a continued need exists to use the property for recreational purposes. This assessment examined the anticipated demand for reservoir recreation activities, percentage of total shoreline open for residential development, and Water Reservoir Opportunity Spectrum (WROS) boating capacity coefficients.

Anticipated Demand for Reservoir Recreation Activities: The estimated demand for activities specifically dealing with recreation opportunities provided by lands and waters

managed by TVA are described in Table 3.11-1. Demand for public boat access, campgrounds, other developed opportunities, and informal opportunities are in high demand, while demand for marinas and lodging are in medium demand.

Table 3.11-1. Demand for Recreation Opportunities on Watts Bar Reservoir

Opportunity	Demand High/Medium/Low
Public boat access	High
Commercial marinas	Medium
Campgrounds	High
Lodging in support of reservoir recreation tourism	Medium
Developed land-based opportunities	High
Informal, dispersed land-based opportunities	High

Percentage of Total Shoreline Open for Residential Development: Of the 721 miles of shoreline on Watts Bar Reservoir, 47 percent (340 miles) is open for private residential dock access according to TVA's SMP. A little less than about half (22 Percent of the total) of the open shoreline has been developed or planned for residential development, leaving about half (25 Percent of the total) of the open land currently undeveloped (see Table 3.11-2).

Table 3.11-2. Current Shoreline Use

Watts Bar Reservoir Shoreline	Miles of Shoreline	Percent of Total Shoreline
Total Shoreline	721	100
Total open SMP shoreline	340	47
Current shoreline developed/permitted	159	22
Open shoreline remaining (not developed or permitted)	181	25

WROS Boating Capacity Coefficients: WROS (Hass et al. 2004) defines the setting available to achieve a particular recreation experience. The WROS is broken down into six opportunity classes from the greatest impact to the least (Urban, Suburban, Rural Developed, Rural Natural, Semi Primitive, and Primitive) based on the way people experience their natural surroundings, in particular a body of water (see Table 3.11-3). Research shows that people not only seek to participate in recreation activities, but they also seek specific settings in order to enjoy a given experience and its benefits. In WROS, settings, experience, and benefits are listed as components of a recreation opportunity. Several attributes are used to categorize the reservoir. Physical attributes include degree of development, degree of resource modification, and distance to development on the water. Managerial attributes include the degree of public or commercial access facilities and degree of management presence. Social attributes include the degree of visitor

concentration or presence, degree of nonrecreational use, and the degree of diverse recreation activities.

Table 3.11-3. WROS Opportunity Classes as a Function of Density

Opportunity Class	Density (Acres per Boat)
Urban	1-10
Suburban	10-20
Rural Developed	20-50
Rural Natural	50-110
Semi Primitive	110-480
Primitive	480-3,200

Two management zones were identified and defined by the recreation assessment for Watts Bar Reservoir and a WROS opportunity class calculated and assigned for each. Most of Watts Bar Reservoir was designated as Suburban and the Clinch River arm of the reservoir, upstream of CRM 9 was designated as Rural Developed.

Boating units were identified by unit access analysis. That is, all access points on the reservoir were tallied, and an assumption of the percentages of boats that would use the reservoir at different times of the season/week (for each type of access point) was compiled in a matrix to determine the WROS opportunity class.

Based on boating units ranging from 75 acres per boating unit (one marina boat slip or one private dock or one parking place at a public boat ramp) for summer weekday to 44 acres per boating unit on peak summer holidays with an average summer weekend day of 36 acres per boating unit (Table 3.11-4), the upper Clinch River section of Watts Bar Reservoir was assigned a WROS opportunity class of Rural Developed or 20 to 50 acres per Boat (Table 3.11-3).

Table 3.11-4. WROS Opportunity Class Calculation for Clinch River

Zone Rural Developed	Average Summer Weekday	Average Summer Weekend day	Peak Summer Holiday
Estimated boating units in use	16	33	44
Surface acres per boating unit	75	36	27

Likewise, the majority of Watts Bar Reservoir was assigned a Suburban Opportunity class (10 to 20 acres per boat) based on the calculated boating units (Table 3.11-5) with an average summer weekend day of 11 acres per boating unit.

Table 3.11-5. WROS Opportunity Class Calculation for Main Watts Bar

Zone Suburban	Average Summer Weekday	Average Summer Weekend day	Peak Summer Holiday
Estimated boating units in use	1,727	3,296	4,473
Surface acres per boating unit	21	11	8

Between 1999 and 2005, over 90,000 Americans (3,300 in the Tennessee Valley) age 16 and over were interviewed (U.S. Forest Service 2006) for the National Survey on Recreation and the Environment. Respondents were asked about their participation in approximately 80 specific outdoor recreation activities. This report provides an up-to-date review and analysis for the outdoor recreation demand, participation rates, and trend data for the target study region of the counties surrounding the Watts Bar Reservoir area and for the United States (Table 3.11-6). A subset of activities was chosen based on compatible uses of TVA managed lands.

Table 3.11-6. National Survey on Recreation and Environment for the Watts Bar Reservoir Area

Recreation Category	Percent of People Participating in Watts Bar Clinch Watershed Area	Percent of People Participating in United States
Public Boat Access		
Boating (any type)	39	36.9
Motor Boating	33.7	24.8
Freshwater Fishing	43.3	30
Personal Watercraft Use	11.3	9.6
Canoeing	7.4	9.9
Kayaking	2.2	3.9
Sailing	0.8	5.2
Commercial Marinas		
Motor Boating	33.7	24.8
Campgrounds		
Developed Camping	27.3	26.6
Developed Land-Base Opportunities		
Walking for Pleasure	75.4	82.6
Family Gathering	75.2	74.3
Picnicking	60.2	54.2
Swimming in Lakes and Streams	42	41.9
Visiting a Beach	24.8	43
Freshwater Fishing	43.3	30

Recreation Category	Percent of People Participating in Watts Bar Clinch Watershed Area	Percent of People Participating in United States
Informal, Dispersed Land-Based Opportunities		
Visiting a Wilderness or Primitive Area	39.8	33.1
Day Hiking	28.5	32.8
Primitive Camping	14.5	16.2
Mountain Biking	18.7	20.7
Backpacking	10.7	10.3
Hunting (any type)	18.5	11.6
Orienteering	5.6	1.8
Visit Other Waterside (besides beach)	31.5	25.6
View/Photograph Natural Scenery	64	60.8
View/Photograph Wildlife	48.8	45.3
View/Photograph Birds	28.7	32.7
Gather Mushrooms, Berries, etc.	35.6	28.6

The above comparison indicates that recreation in the Watts Bar area is similar to the rest of the U. S., except that participation in freshwater fishing from a public boat launching ramp and from a land-base structure are greater in the Watts Bar Reservoir compared to the national average. In addition, motor boating from a public boat launching ramp and a commercial marina are participated more in the Watts Bar watershed area as compared to the national average.

3.11.1. Developed Recreation

Watts Bar Reservoir has a number of commercial, public, and quasi-public recreation facilities that provide developed recreation opportunities (see Table 3.11-7). An existing recreation inventory database was created in 2003 and updated in 2006 that details the types of developed recreation facilities available to meet recreation needs for users of Watts Bar Reservoir (see Table D-6). The database is a current inventory of recreation facilities and services available on each reservoir and includes the following categories of water-based areas:

Public - TVA, other federal, state, and county/municipal facilities operated for nonprofit,

Private - private commercial areas operated for-profit, noncommercial areas for members/residents only

Quasi-public - areas serving members of nonprofit organizations

The focus of the inventory was on areas directly bordering the reservoir shoreline. Information collected included basic attribute data, such as area type, contact list, location information, and facilities encompassing a wide range of accommodations typically offered at water-oriented outdoor recreation operations.

Only those recreation areas with some level of facility development and evidence of maintenance were included. By these criteria, undeveloped lands managed by TVA or

other public agencies were excluded. Informal recreation facilities on TVA lands are considered separately.

Table 3.11-7. Recreation Facilities on Watts Bar Reservoir

Facility Type	Commercial	Public
Wet Slips	1,447	0
Dry Slips	238	0
Campsites with electrical hookups	744	0
Campsites without electricity	78	0
Paved boat ramps	21	30
Parking spaces	1,574	693
Picnic tables	87	298
Picnic pavilions	5	20

There are 67 developed recreation areas on Watts Bar Reservoir (see Table C-6). Twenty-six of them are commercial recreation areas operated by private entities, most of which are resorts or marinas that offer such facilities as boat slips, boat rentals, swimming beaches, picnic areas, supply store, restaurant, camping, rooms and cabins, and other recreation facilities. Likewise, there are 37 public recreation areas that may have facilities such as launching ramps, picnic tables, swimming beaches, trails, playgrounds, or other facilities. And, there are four quasi-public recreation areas such as summer camps for churches and scouts.

3.11.2. Informal Recreation

Informal recreation has historically been an important recreation opportunity on Watts Bar Reservoir. Lands allocated for informal recreation are managed to accommodate activities such as hunting, hiking, biking, bird watching, photography, primitive camping, bank fishing, and picnicking, etc. Informal recreation is actively managed on 41 parcels allocated for Zone 4 or equivalent categories but can occur on most TVA-managed lands where development has not taken place. Data collected by the National Survey on Recreation and the Environment for informal, dispersed land-based opportunities in the Tennessee Valley watershed indicate above average participation in many of these activities.

In 2005, TVA introduced the Informal Recreation Analysis Tool (Guerry 2005) to measure the amount and extent of ecological impact associated with recreation activities. This is an ongoing effort to identify and measure said impacts on all TVA lands. In addition to assessing ecological damage, this tool gives managers a spatial component in which to quantify the number and location of active informal recreation areas that are on a given reservoir. To date, approximately 20 percent of the TVA lands on Watts Bar Reservoir have been assessed (*TVA Informal Recreation Technical Report*, TVA 2006; *TVA Informal Recreation Technical Report*, TVA 2007b). Although this data set is incomplete, initial findings suggest that Watts Bar Reservoir receives a large amount of informal recreation use. Table 3.11-8 is a summation of the informal areas (with the number of sites for each area) that have been identified to date.

Table 3.11-8. Informal Recreation Areas Identified on Watts Bar Reservoir

Recreation Area	Parcel Number	Number of Sites
Bayside	41	1
Kembro, Pine, and Woodland Islands	291	2
Unnamed - Mound Island	286	1
Toestring Branch	262	1
Doc Smith 1	286	1
Doc Smith 2	286	2
Unnamed	276	1
Wolf Creek Parcel	285	4
Goat Island	7	5
Hornsby Hollow	24	2
Red Cloud 1	306	1
Red Cloud 2	306	1
Pearl Harbor	30	1
Eagle Furnace	233	1
Fingers	224	4
Half Moon	227	4
Snoopy Head	35	2
Thiefneck	46	6
Whites Creek	237	1
Total		**41**

3.12. Visual Resources

Watts Bar Reservoir extends from Watts Bar Dam at the head of the Chickamauga pool to Fort Loudoun Dam near Lenoir City, Tennessee, and lies in a region of the Tennessee River Valley noted for a wide variety of scenic resources. Watts Bar provides 721 miles of shoreline and over 39,000 acres of water surface. The reservoir and floodplain areas include attractive islands, rock bluffs, secluded coves, wetlands, and agricultural land, which are framed by high wooded ridges. Since the scenic features of the ridge and valley landscape are not limited by property boundaries, the attractive landscape character extends across TVA public and private land alike. The natural elements together with the communities and other cultural development provide a scenic, relatively harmonious, rural countryside.

Land uses adjacent to the Watts Bar Reservoir are similar to other mainstream reservoirs. They include industrial areas and TVA facilities (WBN, KIF, and Watts Bar Hydro Plant) as well as state and local parks, WMAs, commercial recreation facilities, and an ever-growing assortment of residential development. The reservoir offers abundant water-recreation opportunities along with a variety of scenery. Most creek embayments are broadly open at the mouth, and some wind several miles to their headwaters.

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 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. Four broad visual characteristics 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.

- 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 0.5-4.0 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 4.0 miles where object details and colors are not normally discernible unless they are especially large, standing alone, or provide strong contrast. Figure 3.12-1 illustrates the viewing distance parameters.

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.

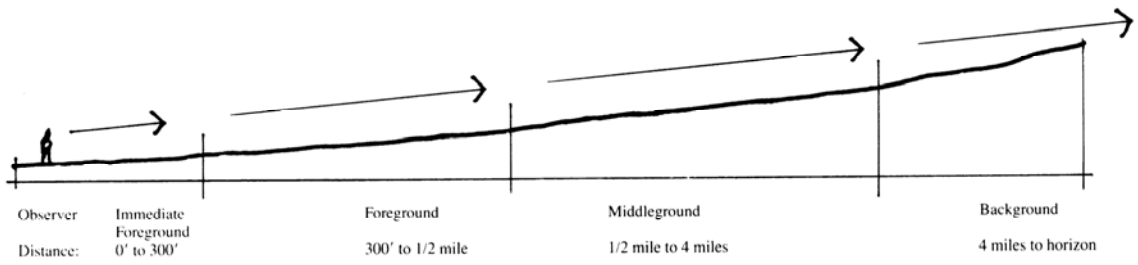

Figure 3.12-1. Viewing Distance

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.

3.12.1. Environmental Setting of Watts Bar Reservoir

Among the scenic resources of Watts Bar Reservoir, the water body itself is the most distinct and outstanding aesthetic feature. The horizontal surface provides visual balance and contrast to the islands, bluffs, and wooded hillsides. The reservoir provides harmony

and creates mystery as it weaves around the ridges and bends, constantly changing views seen from the water. It also provides unity, serving as a visual ribbon that links the other landscape features together. Views across the water provide a tranquil sense of place that is satisfying and peaceful to most observers.

Islands are another significant visual feature. Numerous notable islands and a number of minor islands have been identified. The islands provide scenic accents and visual reference points throughout the reservoir and serve as visual buffers for less desirable views. They also provide a pleasing foreground frame for the distant shoreline or background. Limestone bluffs are distinct scenic elements that occur along a few sections of the main river channel. The sheer rock faces rise from the water with steep, wooded, bluff-like ridges rising several hundred feet more above them. The bluffs provide attractive vertical accents and a natural contrast of colors that can be seen from the distant middleground.

Other important scenic features include the tranquil, secluded coves and steep, wooded ridges that occur around the reservoir. The isolated coves with wooded shoreline provide peaceful and relatively private locations for overnight boat anchorage although shallow waters limit the use of some. Steep slopes along the shoreline rise mostly undisturbed to wooded skylines. Some ridge tops reach more than 300 feet above the water. The significant elevation changes provide a dramatic contrast to the surrounding reservoir and gently sloping countryside, particularly when they are viewed from background distances.

Watts Bar Dam (TRM 530) is 112 feet high and stretches 2,960 feet across the Tennessee River. The dam skirts the base of a steep, rocky bluff that forms the right abutment of the dam. A flat floodplain stretches for a distance of approximately 750 feet from the left riverbank to the base of a low bluff that rises about 50 feet in the 300 foot length and then slopes gently toward the top of the east abutment (TVA 1949).

The shoreline upstream from the dam is naturally appearing and includes several attractive coves. Vegetative patterns are interrupted by transmission lines on each bank above the dam. Meigs County Park can be seen intermittently from the cove at Peak-Hornsby Cemetery. Numerous homes along adjacent bluffs and ridges can be seen in the foreground and middleground from the water for approximately 5 miles, beginning at Watts Bar Dam.

The embayment along Piney River at Wolf Creek and Muddy Creek (TRM 533) ranges from approximately 0.5 mile wide to over 1.5 miles wide at the confluence of the three streams. This embayment includes public use areas at Rhea Springs Recreation Area and Spring City Park, a sewage disposal plant, and numerous residential and commercial areas. Visual clutter in the embayment is interspersed with unaltered landscapes, particularly along the east side of Wolf Creek. Duck Island, the largest island within the embayment, has a vegetative buffer along the shoreline with an interior that is used mainly for agriculture to benefit wildlife. Scenic attractiveness in the area is common. Scenic integrity is low to moderate.

The main channel of Watts Bar Reservoir continues east between Goat Island, north of Fooshee Peninsula and Iron Hill Island. Fooshee Peninsula features Fooshee SWA and Fooshee Public Use Area and offers outstanding views of the reservoir. Goat Island is dominated by pine forest along the shoreline and mature hardwoods on the interior, while Iron Hill Island is characterized by the number of occurring wetlands along the shoreline. Scenic attractiveness is common. Scenic integrity is moderate.

Continuing north, from TRM 540 near Rowden Branch and Hornsby Hollow Recreation Area, several islands can be seen in the foreground from the reservoir. These islands provide visual contrast and buffers of shoreline development at Rowden Branch as seen from the main river channel. Near TRM 551 is Thiefneck Island, the site of the Fooshee Pass Public Use Area. Visible features along the shoreline include a number of wetland areas. The island is heavily vegetated with some peaks rising over 240 feet above the water surface. Residential development on adjacent shorelines is sparse compared to other areas on Watts Bar Reservoir.

At TRM 558, several islands and a peninsula can be seen in the foreground and middleground distances. These islands are used mainly for wildlife management. Wetland areas are prevalent along the shorelines, and the remainder of the islands is heavily vegetated, providing visual contrast to shoreline development along this section of the reservoir. Near TRM 562, Caney Creek enters Watts Bar Reservoir. From the confluence of Caney Creek and Watts Bar Reservoir, New Hope Road Bridge can be seen in the foreground. Farther upstream, human alterations include water use facilities and Roane County Park.

The next 6 miles upstream (TRMs 562 to 568) to the confluence of Tennessee and Clinch Rivers, views of the shoreline include subdivisions and homes with their associated docks and water use facilities. Views include occasional passing highway traffic in the foreground and middleground. Several ridgelines rise approximately 300 feet in the background with development visible on some slopes. The visual congestion along this area is generally viewed in the foreground; therefore, scenic attractiveness is minimal and scenic integrity is low. When viewed from greater distance across the reservoir, details become weaker and scenic value improves.

The main channel bends to the southeast, and a wide range of landforms in the middleground and background provide visual relief from human alteration along the shoreline and back-lying land. These landforms include ridges ranging from 100 to 200 feet in height and valleys accentuated by natural vegetative patterns. Islands along the channel, particularly those larger than 5 acres, provide visual buffers of shoreline development. Riley Creek Recreation area is located on the right bank near TRM 570, approximately 1 mile west of Long Island.

Upstream of Long Island near Smith Creek embayment, the main reservoir narrows to a riverine character. Shoreline development is sparse, and heavy vegetation covers the naturally appearing slopes. The channel becomes again broadly horizontal near Huffine Island and Paint Rock WMA. Wide shoreline areas are accentuated by sparse vegetation, and gently sloping topography is used mainly for farmland. Embayments enter the main channel on each side of the reservoir and are mainly unaltered by human activity. Scenic attractiveness is common. Scenic integrity is moderate.

At TRM 577, moderate development can be seen on the left bank from the water. Views of development along the right bank are less discernible due to broad bands of vegetation along the shoreline. At TRM 583, residential development becomes increasingly heavy and is a focal point in the landscape. Visual clutter along the shoreline is relieved intermittently for recreation users in the water by Matlock Island (TRM 583.5) and Sweetwater Island (TRM 584.5).

3.12.2. Environmental Setting of the Clinch River Segment of Watts Bar Reservoir

The Clinch River segment of Watts Bar Reservoir enters the Tennessee River part of Watts Bar Reservoir at approximately TRM 568 (CRM 0) just downstream of the city of Kingston. This section of the Clinch River is characterized by dense residential development along the shoreline. At approximately CRM 2.5, the Interstate-40 and U.S. Highway 70 bridges crossing the Clinch River are viewed in the foreground distance, and KIF is viewed in the middleground. Views of KIF are mainly of the smokestacks and broadly horizontal industrial facilities. Scenic attractiveness is minimal. Depending upon viewer location, scenic integrity is low to very low.

At CRM 5, the industrial setting of KIF transitions to sparse residential development on the right and left banks. This riverine setting is less altered with the exception of occasional private water use facilities seen along the shoreline. From CRMs 5 to 11, landscape character ranges from light residential and open space to natural woodlands. Several scenic coves are seen along this section of the Clinch River with high ridges in the background, retaining moderate scenic integrity.

At approximately CRM 11, industrial facilities at the USDOE East Tennessee Technology Park (former K-25 Plant) come into view on the left bank. Numerous transmission lines, industrial facilities, and broadly horizontal buildings combine to create a concentration of mixed shoreline development. The results are extensive visual congestion, adverse contrast, and very low scenic integrity. Upstream, at CRM 14, the former Clinch River Breeder Reactor site is on the left bank. From the reservoir, this site appears mainly undisturbed due to extensively retained shoreline buffers. However, the site has been greatly altered through vegetative removal and earthwork operations. Beyond the former Clinch River Breeder Reactor site, at CRMs 19 to 21, the landscape on the right bank becomes predominately agriculture, while the left bank appears unaltered and is heavily wooded. Jones Island, one of the largest islands along this portion of the reservoir, is naturally appearing and has excellent scenic value.

3.12.3. Environmental Setting of the Emory River Segment of Watts Bar Reservoir

The Emory River segment of Watts Bar Reservoir begins just beyond CRM 4 east of KIF. The KIF environmental setting was previously discussed in Section 3.12.2. At ERM 2, northeast of KIF, the shoreline character becomes mainly light residential interspersed with tracts of undisturbed woodlands and agriculture lands. At ERM 5 the main body of water turns west toward Harriman, and the Little Emory River tributary enters from the north at this point.

The Little Emory River tributary at the mouth of the Emory River is a riverine setting punctuated by sparse residential development on each bank. To the east, Pine Ridge rises over 300 feet and provides visual contrast to the lower-lying shoreline areas. Residential development becomes more concentrated near Harvey Hannah Highway to the north. Water use facilities and boat ramps become more prevalent in the landscape in this area, and there is a reduction in visual integrity. This portion of the Watts Bar Reservoir terminates near Bitter Creek Highway.

The Emory Creek section of the Watts Bar Reservoir continues from ERM 5 and traverses west through rural countryside. From the water, this section of river is naturally appearing due to the wide vegetative buffers along the shoreline. Brief views of residential areas and altered landscapes can be seen periodically, particularly within small coves along the river. At ERM 7, the natural landscape transitions from open space to heavy residential at TRM

10 east of Harriman. Automobiles, as well as myriad transmission and utility lines, are frequently seen along local roads. Taller buildings to the north become focal points in the landscape. This portion of the Watts Bar Reservoir terminates near William Hampton Browder Bridge on U.S. Highway 27.

3.13. Socioeconomic and Environmental Justice

3.13.1. Socioeconomics

Both social and economic values and activities pertaining to the Watts Bar Reservoir area are derived primarily from the local communities and their livelihoods. Meigs, Loudon, Rhea, and Roane counties are decidedly rural in description with several locally important towns or small cities. The important overall socioeconomic conditions that could be impacted by the Land Plan include population, size of the labor force, types of jobs, unemployment levels, and income levels. Within the general subject of socioeconomic conditions is the specific subject of environmental justice, which relates to the amount and any concentrations of the population that is in poverty or is a racial or ethnic minority.

Population: The four counties in the Watts Bar Reservoir area had a population of 130,482 in 2000, an increase of 17.7 percent since 1990 (see Tables 3.13-1 and 3.13-2). This was a faster growth rate than in either the state or the nation, in contrast to the previous decade in which the area grew much more slowly than the state and the nation. Estimates for 2006 indicate that the population of the area has grown an additional 7.2 percent since 2000. This remains a faster rate than either the state or the nation. Meigs County, the smallest of the four counties in the area, had the fastest growth rate between 1990 and 2000, but Loudon County is estimated to have had the highest growth rate between 2000 and 2006. Roane County, the largest of the four, had the slowest growth rate after a loss of population between 1980 and 1990 and is estimated to have had the slowest growth rate between 2000 and 2006. All four counties grew much faster from 1990 to 2000 than in the previous decade, but the growth rates since 2000 have been slower than from 1990 to 2000. Projections indicate that the area will continue to have faster population growth than either the state or the nation for the next several years and decades, but that the growth rate will not be as fast as it is now.

Table 3.13-1. Population and Population Projections, 1980-2020

	1980	1990	2000	2006 (Estimate)	2010	2020
Loudon County	28,553	31,255	39,086	44,566	48,208	57,953
Meigs County	7,431	8,033	11,086	11,698	13,579	17,343
Rhea County	24,235	24,344	28,400	30,347	31,607	35,018
Roane County	48,425	47,227	51,910	53,293	54,484	57,677
Area Total	108,644	110,859	130,482	139,904	147,878	167,991
Tennessee	4,591,023	4,877,185	5,689,283	6,038,803	6,425,969	7,195,375
United States (000)	226,542.2	248,709.9	281,421.9	299,398.5	308,936.0	335,805

Source: Historical data from U.S. Census Bureau, Census of Population 1980, 1990, and 2000; state and county projections from 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,* December 2003; U. S. projections from U.S. Census Bureau, "U.S. Interim Projections by Age, Sex, Race, and Hispanic Origin," March 2004.

Table 3.13-2. Percent Change in Population

	1980-1990	1990-2000	2000-2006	2000-2010	2010-2020	1980-2020
Loudon County	9.5	25.1	14.0	23.3	20.2	103.0
Meigs County	8.1	38.0	5.5	22.5	27.7	133.4
Rhea County	0.4	16.7	6.9	11.3	10.8	44.5
Roane County	- 2.5	9.9	2.7	5.0	5.9	19.1
Area Total	2.0	17.7	7.2	13.6	13.6	54.6
Tennessee	6.2	16.7	6.1	12.0	12.0	56.7
United States	9.8	13.2	6.4	9.8	8.7	48.2

These counties are decidedly rural in distribution of population. The largest city in the four counties is Lenoir City (Loudon County) with about 7,700 residents. All counties have from almost 60 percent (Roane) to almost 90 percent (Meigs) of their population outside incorporated cities or towns.

Labor Force and Unemployment: In 2006, the civilian labor force of the area was 67,220, as shown in Table 3.13-3. Of these, 3,570 were unemployed on average during the year, yielding an unemployment rate of 5.3 percent. This rate was higher than both the state and the national rates.

Table 3.13-3. Labor Force Data, Residents of Watts Bar Reservoir Area, 2006

	Civilian Labor Force	Unemployed	Unemployment Rate (Percent)
Loudon County	22,350	990	4.4
Meigs County	4,840	330	6.8
Rhea County	13,400	820	6.1
Roane County	26,630	1,430	5.4
Area Total	67,220	3,570	5.3
Tennessee	2,990,220	154,600	5.2
United States (000)	151,428	7,001	4.6

Source: Tennessee Department of Employment Security

Employment: The area is more dependent on manufacturing, farming, and government employment than either the state or the nation (Table 3.13-5). Farm employment accounted for 4.8 percent of the total in 2005, notably higher than the state average of 2.7 percent and the national average of 1.7 percent. Both Loudon and Meigs counties have relatively high farm employment, while Rhea and Roane counties have farm employment shares more like the state average. Manufacturing employment is especially dominant in Rhea County, at 31.7 percent of the total, compared to 11.7 percent in the state and 8.5 percent nationally. It is also relatively high in Loudon County, 16.8 percent of the total, and slightly higher than the state in Meigs County, at 12.9 percent. Government employment is higher than both the state and national averages in Rhea and Roane counties. All other types of employment, conversely, are lower in the area than in the state or nation, though in Meigs and Roane counties, this category is relatively close to the state and national percentages.

Table 3.13-4. Employment, 2005

	Total	Farm	Manufacturing	Government	Other
Loudon County	18,721	1,324	3,153	2,166	12,078
Meigs County	5,766	406	741	471	4,148
Rhea County	14,851	511	4,711	2,463	7,166
Roane County	21,420	646	1,601	4,248	14,925
Area Total	60,758	2,887	10,206	9,348	38,317
Tennessee	3,630,959	98,051	424,041	438,664	2,670,203
United States (000)	174,249.6	2,914.0	14,860.9	23,837.0	132,637.7

Note: Includes full- and part-time employment, proprietors and wage and salary employees
Source: U.S. Bureau of Economic Analysis, Regional Economic Information System

Table 3.13-5. Percent Distribution of Employment, 2005

	Total	Farm	Manufacturing	Government	Other
Loudon County	100.0	7.1	16.8	11.6	64.5
Meigs County	100.0	7.0	12.9	8.2	71.9
Rhea County	100.0	3.4	31.7	16.6	48.3
Roane County	100.0	3.0	7.5	19.8	69.7
Area Total	100.0	4.8	16.8	15.4	63.1
Tennessee	100.0	2.7	11.7	12.1	73.5
United States	100.0	1.7	8.5	13.7	76.1

Occupation Patterns: Another way to compare the employment in the area with state and national employment patterns is by type of occupation, which to a certain extent cuts across the broad categories described above. Table 3.13-6 shows that in 2000 the area had fewer of its workers in the management, professional, and related occupations, as well as in sales and office occupations than does either the state or the nation. This pattern holds for all of the four counties in the area. Conversely, all four counties had relatively more workers in the construction, extraction, and maintenance occupations and in production, transportation, and material moving occupations than the state or the nation. The share of workers in service occupations is similar to the state, but smaller than the national average. Farming, fishing, and forestry occupations accounted for only a small share in any of the counties, but the share was higher than the state and national averages except in Roane County.

Table 3.13-6. Occupation of Workers (Percent Distribution), 2000

Occupation Class	Loudon	Meigs	Rhea	Roane	Area Total	State	U.S.
Management, Professional, and Related	25.6	16.6	18.5	26.7	23.8	29.5	33.6
Service	13.3	12.9	13.3	14.4	13.7	13.7	14.9
Sales and Office	25.3	19.4	20.4	22.4	22.7	26.1	26.7
Farming, Fishing, and Forestry	0.9	1.7	1.1	0.5	0.8	0.6	0.7
Construction, extraction, and maintenance	12.2	15.2	11.9	13.3	12.8	10.3	9.4
Production, transportation, and material moving	22.7	34.2	34.8	22.7	26.2	19.9	14.6

Source: U.S. Census Bureau, Census of Population 2000

Income: Per capita personal income in all four of the area counties is lower than the state and national averages (Table 3.13-7). Loudon County had the highest level in 2005 at $30,538, almost 89 percent of the national average. Meigs County had the lowest level at $22,206, a little more than 64 percent of the national average. The area as a whole averaged 78.4 percent of the national average in 2005.

Table 3.13-7. Per Capita Personal Income

	1995	Percent of U.S. in 1995	2005	Percent of U.S. in 2005
Loudon County	20,395	88.4	30,538	88.6
Meigs County	14,679	63.6	22,206	64.4
Rhea County	16,228	70.3	22,757	66.0
Roane County	18,905	81.9	27,584	80.0
Area Total	18,419	79.8	27,015	78.4
Tennessee	21,174	91.8	30,969	89.8
United States (000)	23,076	100.0	34,471	100.0

Source: U.S. Bureau of Economic Analysis, Regional Economic Information System.

3.13.2. Environmental Justice

Environmental justice is concerned with the possibility of disproportionate impacts to minority and low-income populations in the area. The minority population in the Watts Bar Reservoir area is small, 5.7 percent of the total in 2005, which is well below the state average of 22.1 percent and the national average of 33.1 percent (Table 3.13-8). Within the four counties in the area, the minority population ranges from 3.2 percent of the total in Meigs County to 6.2 percent in Loudon County. The estimated poverty rate in the area in 2004 was 14.1 percent, slightly lower than the state rate of 15.0 percent, but higher than the national average of 12.7 percent. Among the counties in the area, poverty rates range from 11.1 percent in Loudon County to 17.5 percent in Meigs County.

Table 3.13-8. Minority Population, 2005, and Poverty, 2004

	Population	Minority Population			Poverty
	Total	Nonwhite	White Hispanic	Percent Minority	Percent Below Poverty Level
Loudon County	43,387	1,194	1,507	6.2	11.1
Meigs County	11,657	298	74	3.2	17.5
Rhea County	29,918	1,170	635	6.0	16.2
Roane County	52,889	2,517	445	5.6	14.7
Area Total	137,851	5,179	2,661	5.7	14.1
Tennessee	5,962,959	1,153,315	164,831	22.1	15.0
United States	296,410,404	58,555,450	39,488,517	33.1	12.7

Source: U.S. Census Bureau, Estimates of the Population by Race and Hispanic or Latino Origin for the United States of America; July 1, 2005, and CC-ESR2005-6RACE; U.S. Census Bureau, Small Area Income and Poverty Estimates, December 2004

3.14. Air Quality

National Ambient Air Quality Standards establish safe concentration limits in the outside air for six pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. These standards are designed to protect public health and welfare. An area where any air quality standard is violated is designated as a nonattainment area for that pollutant, and emissions of that pollutant from new or expanding sources are carefully controlled. Except for ozone and particulate matter, all counties that surround Watts Bar Reservoir and their surrounding counties are currently in attainment. In July 1997, USEPA promulgated new, more restrictive standards for ozone and fine particulate matter ($PM_{2.5}$). These new standards include an 8-hour standard for ozone and 24-hour and annual standards for $PM_{2.5}$. The 24-hour standard was further raised in October/September 2006. USEPA has begun implementation of these new standards, and issued final designations for 8-hour ozone in April 2004 and for $PM_{2.5}$ in January 2005. Nonattainment counties for 8-hour ozone concentrations include Loudon and Meigs among the Watts Bar Reservoir lands counties. Other nonattainment counties that are adjacent to the Watts Bar Reservoir lands counties are Knox and Blount adjacent to Loudon, Anderson adjacent to Roane, and Hamilton adjacent to Meigs. The $PM_{2.5}$ nonattainment designations include Loudon County and part of Roane County and the nearby counties of Anderson, Blount, Knox, and Hamilton.

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. The closest PSD Class I area is the Great Smoky Mountains National Park to the east and southeast from Watts Bar Reservoir. The shortest distance to the nearest border of the park is from the upper end of the reservoir close to Fort Loudoun Dam and is about 20 miles.