Chapter 4

Description of Affected Environment

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4.1 Introduction to Affected Environment

The Description of Affected Environment consists of 24 individual sections that describe the existing conditions of the environmental resource areas evaluated in the ROS EIS. The specific resource areas were designed to reflect:

- Operating objectives of the TVA system (e.g., navigation and flood control);
- Issues raised during the scoping process (see Section 1.6); and,
- Topics that are typical for NEPA reviews (e.g., Prime Farmlands).

This introduction explains the common content and organization of the 24 resource area sections in Chapter 4, defines the reservoir and waterbody classifications that are used to describe existing resources, and describes the soils and geology that characterize the TVA region.

4.1.1 Organization of Resource-Specific Sections

The Affected Environment discussion for each resource area identifies the issues of concern used to measure potential impacts on the resource, the study area (or boundaries) for the analysis, the regulatory programs and TVA management activities that govern the resource area, and the existing conditions and future trends for the resource area. Table 4.1-01 lists the specific resource areas in the order they are presented in Chapter 4 and the main issues associated with each topic.

Key Issues

For each resource area, one or more key issues were identified that could measure whether a change in the existing reservoir operations policy would affect the resource and the amount of the effect associated with each policy alternative. Impacts measured for each issue were used to assess impacts on all aspects of the resource area.

Regulatory Programs and TVA Management Activities

Existing federal, state, and local regulations govern many of the specific resource areas. In addition, TVA implements ongoing programs to conserve resources. The relevant regulatory programs and TVA management activities are identified for each resource area. These laws and TVA's management actions were considered when assessing potential impacts of alternative reservoir operations policies.

Table 4.1-01 Resource Areas Included in the EIS and Focus of Discussion

Resource Area	Key Issues
4.2 Air Resources	Air quality (sulfur dioxide, ozone, nitrogen dioxide, particulate matter, carbon monoxide, and lead)
4.3 Climate	Greenhouse gases (emissions that are thought to be associated with global warming)
4.4 Water Quality	Reservoir and tailwater water quality conditions (residence time in a waterbody, thermal stratification, dissolved oxygen depletion, algal growth, sediment transport, and anoxic products)
4.5 Water Supply	Availability of water supplies, water supply delivery, and water treatment
4.6 Groundwater Resources	Groundwater levels and effects on groundwater use and wetland areas
4.7 Aquatic Resources	Biological conditions and diversity of species, sport and commercial fisheries
4.8 Wetlands	Wetland locations, types, and their ability to provide important functions
4.9 Aquatic Plants	Species abundance and composition
4.10 Terrestrial Ecology	Distribution of plant species in lowland and upland communities, and associated wildlife communities
4.11 Invasive Plants and Animals	Population abundance and spread of invasive and nuisance terrestrial and aquatic animals and terrestrial plants
4.12 Vector Control	Population abundance of permanent pool and floodwater mosquito species which are related to the potential transmission of vector-borne diseases
4.13 Threatened and Endangered Species	Occurrence patterns of federal-and state-protected species in aquatic habitats, along shoreline and lowland habitats, and along upland habitats
4.14 Managed Areas and Ecologically Significant Sites	Integrity of sites and viability of managing these areas for their intended use
4.15 Land Use	Rate of shoreline residential development and land use along shorelines
4.16 Shoreline Erosion	Rate of erosion of reservoir and tailwater shorelines
4.17 Prime Farmland	Rate of conversion or loss of important farmlands
4.18 Cultural Resources	Effects on archaeological sites or historic structures from shoreline erosion, shoreline development, and site exposure along shorelines
4.19 Visual Resources	Scenic attractiveness, landscape visibility, and scenic integrity

Table 4.1-01 Resource Areas Included in the EIS and Focus of Discussion (continued)

Resource Area	Key Issues
4.20 Dam Safety	Dam structure integrity associated with geology and seismicity, normal and design flood headwater levels, drawdown rates, and leakage
4.21 Navigation	Commodity movements by river barge on the Tennessee River, commodity movements along the Ohio River, and changes to mode of transportation (river vs. land) selected by shippers
4.22 Flood Control	Magnitude of flood flows, potential flood damage, and flood recovery
4.23 Power	The amount and timing of use of hydropower and non-hydropower generation, power system reliability, and the cost of power
4.24 Recreation	Public, commercial, and private recreation use
4.25 Social and Economic Resources	Regional economy as measured by population, employment, and economic activity from the economic drivers (navigation, power, water supply, property values, and recreation)

Study Area

The general project area is the Tennessee River Valley. The study area for each resource area was tailored to the distribution of the resource in the TVA region and the potential effects of the reservoir operation policy alternatives on the resource. For example, Water Quality focused on the waterbodies within the water control system—both reservoirs and tailwaters. Groundwater Resources defined the maximum zone of influence of reservoir surface water levels on groundwater resources near the reservoir. Cultural Resources focused on an area within 0.25 mile from reservoir shorelines to ensure that the analysis included direct and indirect impacts resulting from changes in the reservoir operations policy. Several resource areas also selected representative reservoirs to describe the Affected Environment for the entire water control system and resources within the TVA region. The impacts identified for representative reservoirs affect the entire water control system.

4.1.2 Reservoir and Waterbody Classifications

As described in Chapter 2, The Water Control System, each TVA reservoir falls into one of four general categories that are closely related to its characteristics, primary function, and operation in the reservoir system: mainstem storage, mainstem run-of-river, tributary storage, and tributary run-of-river. The location, size, and ranges in water levels of the reservoirs and tailwaters of the Tennessee River system—and the reservoir characteristics—are identified in Table 2.1-01 and in Appendix A.

Because the ecological and geographic characteristics of waterbodies were important to describe the Affected Environment for the specific resource areas and evaluate potential impacts from changes in the existing reservoir operations policy, an additional waterbody classification was developed. The ROS waterbody classification (presented in Figure 4.1-01 and in Table 4.1-02) identifies eight types of waterbodies, ranging from flowing mainstem reaches to warm tributary tailwaters. Each waterbody in the TVA system was defined as a "reach," extending from an upstream boundary to a downstream boundary, and was classified into one of the eight waterbody types. The eight categories reflect several important differences among the waterbodies, including geographic location (physiographic regions), whether the reaches were pooled or flowing, and thermal characteristics (warm, cool, or cold water).

Most resource areas use both the general reservoir system classification and the ROS waterbody classifications. In some cases, these classifications were further modified based on the need to describe the Affected Environment and potential impacts associated with a particular resource area. Each resource area provides the description and rationale for such modifications.

4.1.4 General Setting

Tennessee River Watershed

The Tennessee River watershed covers approximately 41,000 square miles. This area includes 129 counties within much of Tennessee and parts of Alabama, Kentucky, Georgia, Mississippi, North Carolina, and Virginia. The larger TVA Power Service Area covers 80,000 square miles and includes 201 counties in the same seven states (Figure 1.1-02).

The Tennessee River watershed begins with headwaters in the mountains of western Virginia and North Carolina, eastern Tennessee, and northern Georgia. At Knoxville, Tennessee, the Holston and French Broad Rivers join to form the Tennessee River, which then flows southwest through the state—gaining water from three other large tributaries: the Little Tennessee, Clinch, and Hiwassee Rivers. The Tennessee River eventually flows into Alabama, where it picks up another large tributary, the Elk River. At the northeast corner of Mississippi, the river turns north, re-crosses Tennessee—picking up the Duck River, and continues to Paducah, Kentucky, where it enters the Ohio River.

The total river elevation change from the maximum reservoir surface elevation at Watauga Dam (highest elevation on the system) to the minimum tailwater surface elevation at Kentucky Dam (lowest elevation on the system) is 1,675 feet in 828.6 river miles. The Tennessee, the main river, has a fall of 515 feet in 579.9 river miles from the top of the Fort Loudoun Dam gates to the minimum tailwater elevation at Kentucky Dam. The mainstem fall is gradual except in the Muscle Shoals area of Alabama, where a drop of 100 feet is found in a stretch of less than 20 miles (TVA 1990).

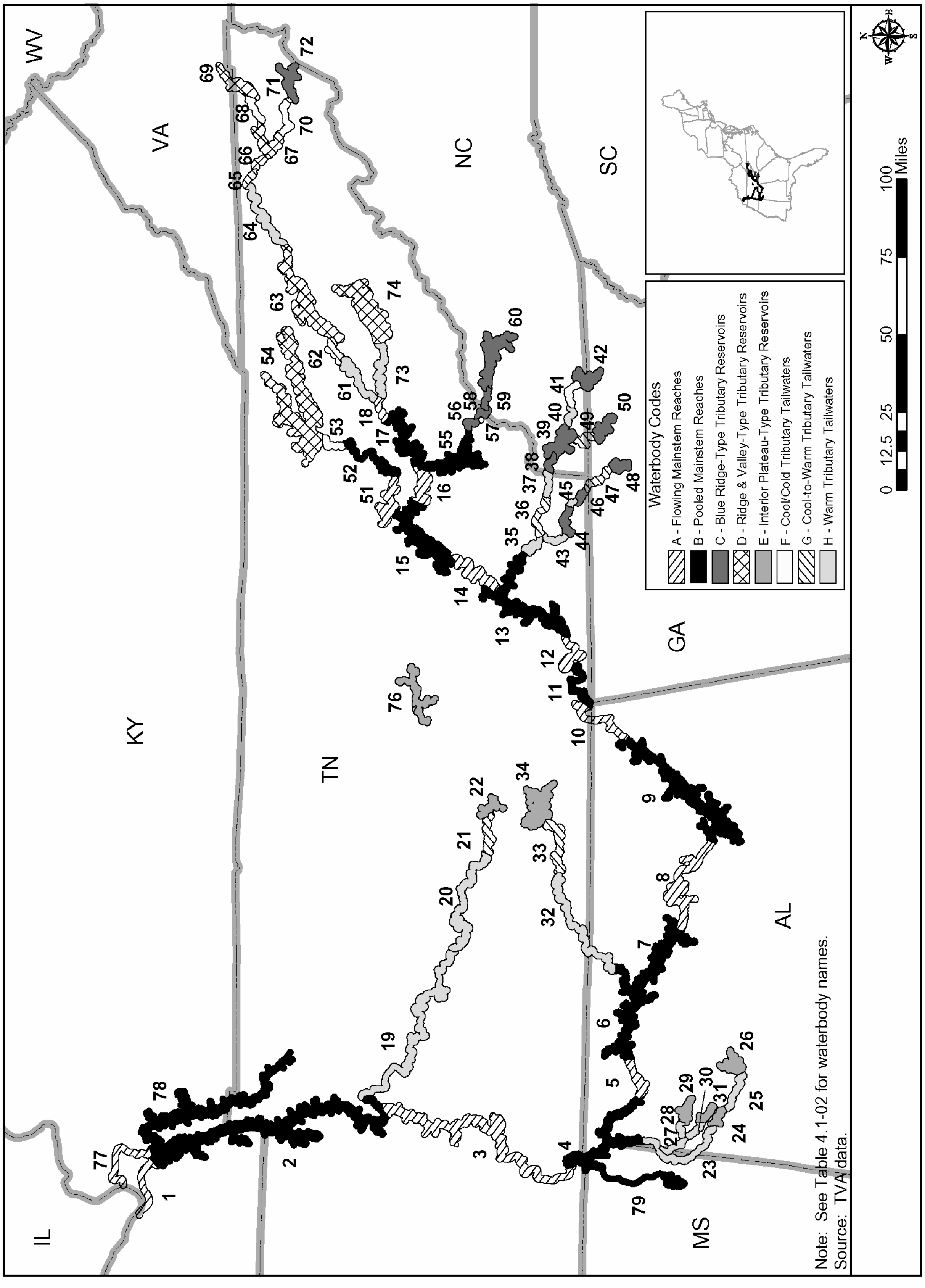

Figure 4.1-01 Reservoir Operations Study Waterbodies

Table 4.1-02 ROS Waterbodies Classifications

A—Flowing Mainstem Reaches (11 Reaches)	Reach Length (stream miles)
1. Kentucky tailwater	22.4
3. Pickwick tailwater	95.9
5. Wilson tailwater	14.4
8. Guntersville tailwater	38.3
10. Nickajack tailwater	22.7
12. Chickamauga tailwater	39.9
14. Watts Bar tailwater	23.9
16. Fort Loudoun tailwater	26.3
18. Fort Loudoun [Inflow]	11.2
51. Clinch River to Melton Hill Dam	18.6
77. Cumberland R.—Barkley Dam tailwater	30.6
Total miles	**344.2**
B—Pooled Mainstem Reaches (12 Reaches)	
2. Kentucky Reservoir to Duck River	88.4
4. Pickwick Reservoir to Colbert	38.3
6. Wilson Reservoir	15.5
7. Wheeler Reservoir to Limestone Creek	35.8
9. Guntersville Reservoir to Scottsboro	53.0
11. Nickajack Reservoir to Raccoon Mountain	21.3
13. Chickamauga Reservoir to Gillespie Bend	35.0
15. Watts Bar Reservoir to Paint Rock Creek	46.1
17. Fort Loudoun Reservoir to Peter Blow Bend	38.7
52. Melton Hill Reservoir to Clinton (Route 61)	43.2
55. Tellico Reservoir to Chilhowee Dam	33.2
78. Barkley Reservoir to Cumberland City	73.4
Total miles	**521.9**
C—Blue Ridge-Type Tributary Reservoirs (12 Reaches)	
38. Apalachia Reservoir	9.8
39. Hiwassee Reservoir to 19/64 bridge	21.0
42. Chatuge Reservoir	12.6
44. Parksville Reservoir to Ocoee #2 Dam	12.3
46. Ocoee #3 Reservoir	6.4

Table 4.1-02 ROS Waterbodies Classifications (continued)

C—Blue Ridge-Type Tributary Reservoirs (continued)	Reach Length (stream miles)
48. Blue Ridge Reservoir	12.0
50. Notteley Reservoir	17.5
56. Chilhowee to Calderwood Powerhouse	8.8
58. Calderwood Dam to Cheoah Dam	7.8
59. Cheoah Dam to Fontana Dam	9.6
60. Fontana Reservoir	28.8
72. Watauga Reservoir	16.3
Total miles	**162.9**
D—Ridge and Valley-Type Tributary Reservoirs (6 Reaches)	
54. Norris Reservoir	72.2
63. Cherokee Reservoir to John Sevier	54.4
66. Fort Patrick Henry Reservoir	10.4
67. Boone Reservoir	17.4
69. South Fork Holston Reservoir	24.8
74. Douglas Reservoir	44.2
Total miles	**223.4**
E—Interior Plateau-Type Tributary Reservoirs (7 Reaches)	
22. Normandy Reservoir	17.8
24. Bear Creek Reservoir	15.9
26. Upper Bear Reservoir	16.4
29. Cedar Creek Reservoir	16.0
31. Little Bear Creek Reservoir	11.1
34. Tims Ford Reservoir	35.2
76. Great Falls Reservoir	19.4
Total miles	**131.8**
F—Cool/Cold Tributary Tailwaters (6 Reaches)	
41. Mission Dam to Chatuge Dam	14.9
53. Norris Dam tailwater	13.5
57. Calderwood powerhouse to dam	1.2
68. South Fork Holston Dam tailwater	13.8
70. Watauga River—Boone to Wilbur	18.2
71. Wilbur Reservoir	2.7
Total miles	**64.3**

Table 4.1-02 ROS Waterbodies Classifications (continued)

G—Cool-to-Warm Tributary Tailwaters (7 Reaches)	Reach Length (stream miles)
21. Duck River—Shelbyville to Normandy	27.2
33. Elk River—Fayetteville to Tims Ford	43.5
36. Hiwassee River—Ocoee River to Powerhouse	18.4
47. Blue Ridge tailwater	17.4
49. Nottely River to Nottely Dam	14.6
62. Holston River Nance Ferry—Cherokee Dam	19.0
65. Fort Patrick Henry Dam tailwater	8.2
Total miles	**148.3**
H—Warm Tributary Tailwaters (7 Reaches)	
19. Duck River to Columbia	123.5
20. Duck River—Columbia to Shelbyville	87.9
23. Bear Creek to Bear Creek Dam	60.4
25. Upper Bear tailwater	24.0
27. Cedar Creek to Little Bear Creek	14.9
28. Cedar Creek Reservoir tailwater	8.3
30. Little Bear Creek to dam	11.5
32. Elk River—to Fayetteville	73.8
35. Hiwassee River to Ocoee River mouth	15.9
37. Hiwassee River—Apalachia cut-off reach	13.2
40. Mission Dam tailwater	14.3
43. Ocoee River—mouth to Parksville Dam	11.9
45. Ocoee #2 Reservoir to Ocoee #3 Dam	5.0
61. Holston River to Nance Ferry	33.3
64. Holston River—John Sevier to North Fork	35.5
73. French Broad River to Douglas Dam	32.3
75. Caney Fork—Great Falls Dam tailwater	0.8
Total miles	**566.5**

Note:

The numbers that precede reach names correspond to the locations of each waterbody on Figure 4.1-01.

Source: TVA source data 2002.

The eastern half of the Tennessee Valley includes the slopes of the Blue Ridge and Great Smoky Mountains, where an abundant growth of timber covers the ground. The western half of the Valley is less rugged, with substantial areas of flat or rolling land occurring in middle Tennessee and along the western edge.

Physiography, Soils, and Geology

Reservoirs and the associated tailwaters of the Tennessee River Valley span six physiographic regions, including the Highland Rim, Coastal Plain, Cumberland Plateau, Blue Ridge, Central Basin, and Valley and Ridge (Figure 4.1-02). Thirty-nine percent of the TVA region is in the Highland Rim, and 40 percent in the Coastal Plain.

The geology and soils associated with the physiographic regions for each of the TVA reservoirs in the scope of this study were determined in previous studies (Eckel et al. 1940, TVA 1949, Sapp and Emplaincourt 1975, Fenneman 1938, Redmond and Scott 1996, Clark and Zisa 1976, Springer and Elder 1980) (see Table 4.1-03).

The eastern portion of the Tennessee River watershed is located in the Blue Ridge (Unaka Mountains) and the Valley and Ridge Physiographic Regions. The headwaters of the Tennessee River originate in the rugged Unaka Mountains in North Carolina and eastern Tennessee. This region has undergone multiple orogenic (mountain-building) events and is underlain by folded and faulted complexes of igneous, metamorphic or sedimentary rocks dating from the Precambrian and Paleozoic Eras. The soils of the Blue Ridge Physiographic Region consist of highly weatherable material. The depth of soil varies from 1 to 3 feet at higher elevations and from to 3 to 7 feet on the lower side slopes. The valleys contain a variety of soils and are generally productive. Soil depths of the Valley and Ridge Physiographic Region range from shallow over shales and sandstones to very deep over the dolomitic limestone. The upland soils are primarily highly leached, and strongly acid with low fertility. Because of the variable landscape, soils properties vary over short distances, resulting in small patches of productive land intermixed with average land or large tracts of rough land.

The Tennessee River flows southwest from the Valley and Ridge Physiographic Region into the Cumberland Plateau Physiographic Region. This region consists of a high tableland that is underlain by nearly flat-lying sedimentary rocks of Paleozoic age. The Plateau is highly dissected by streams and rivers, forming valleys with moderate to high relief. Because limestone underlies portions of this region, karst (an irregular limestone region with sinks, underground streams, and caverns) landscapes and extensive cave systems have developed. The Cumberland Plateau is bounded on the west and east by escarpments. The terrain is gently rolling to hilly highland with deeply cut gorges.

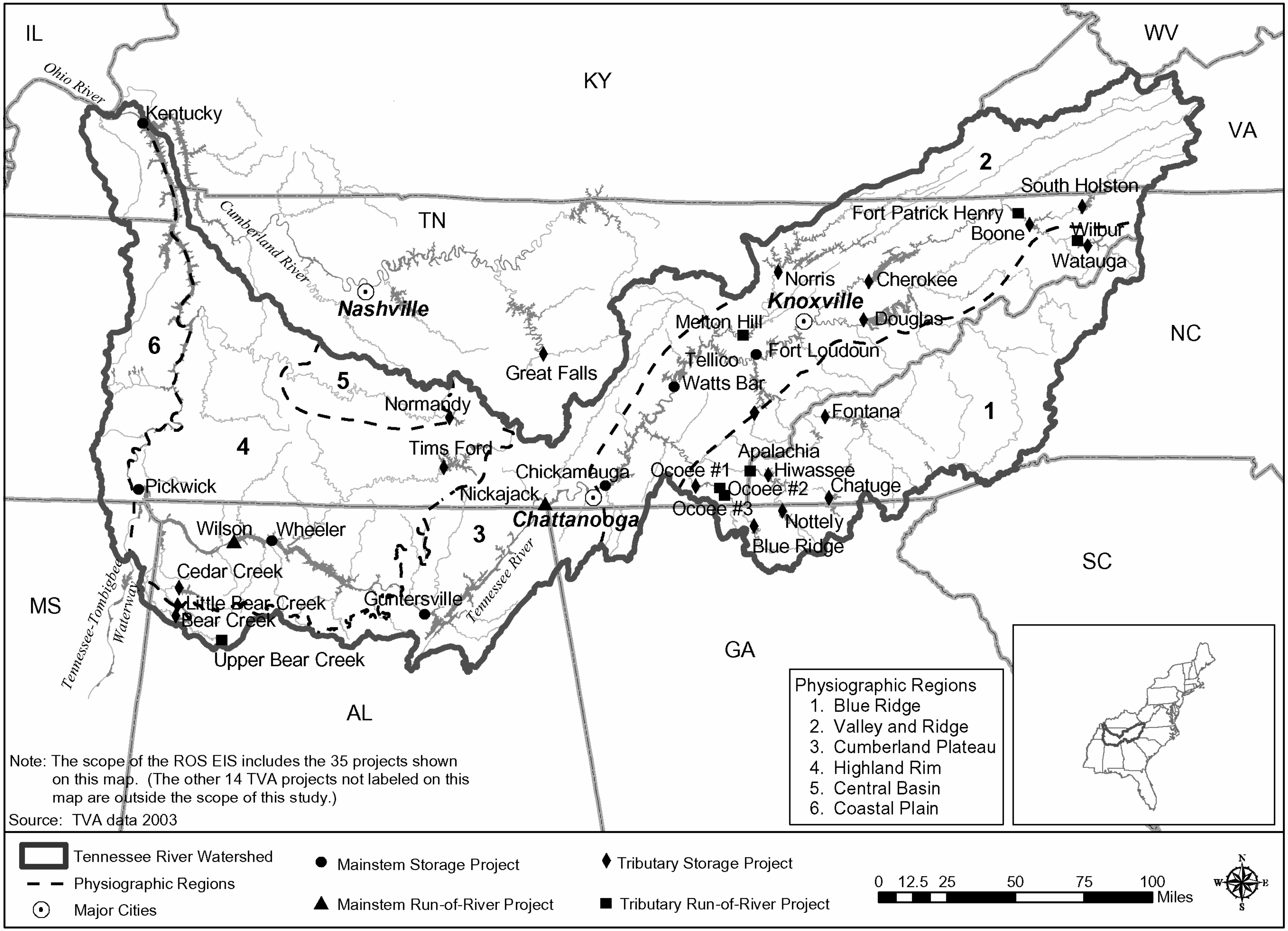

Figure 4.1-02 Physiographic Regions within the Tennessee River Watershed

Table 4.1-03 Physiographic Regions of the Tennessee Valley

Physiographic Region	Topography	Bedrock Geology	Geologic Structure
Blue Ridge Mountains	Rugged terrain, heavily forested slopes, rushing streams, and waterfalls	Metamorphic and igneous rocks, minor sedimentary rocks of Precambrian and Paleozoic Age	Complex structure closely folded and faulted
Valley and Ridge	Narrow parallel ridges and broader intervening valleys of northeast-southwest trend	Highly deformed but non-metamorphosed sedimentary rocks of Paleozoic Age	Thrust faults and folds; resistant sandstone cap ridge tops; less resistant carbonate rocks valleys
Cumberland Plateau	Northern portion maturely dissected mountainous and rugged; southern region plateau submaturely dissected, youthful valleys	Paleozoic Age sandstones and shales	Rocks nearly horizontal, some folding in the eastern region; faults rare
Highland Rim	Bench separating central basin and the Cumberland Plateau; gently rolling uplands	Paleozoic Age limestones, shales and sandstones	Simple structure, strata dip gently away to form central basin
Central Basin	Broad irregularly shaped basin, solution features and erosional knobs	Paleozoic Age limestones and shales	Eroded structural dome; bedrock dipping radically outward; faults rare
Coastal Plain	Flat-lying region of low relief (300 feet or less) with low-gradient streams in broad, flat valleys	Late Mesozoic and Cenozoic Age clastic sedimentary rocks overlying Paleozoic Age sedimentary rocks; recent sediments composed of alluvial sands and loess	Formations horizontally layered, with gentle dip to embayment; folds and faults rare

Sources: Luther 1995, Moore 1999, and Miller 1994.

From the Cumberland Plateau, the Tennessee River flows northwest through the Highland Rim Physiographic Region. This region consists of a highly dissected flat-lying tableland that is underlain by nearly flat-lying Paleozoic age limestone. Due to the presence of limestone, an extensive karst plain has developed, with numerous sinkholes, disappearing streams, and cave systems (Bingham and Helton 1999). The hill slope soils were formed from limestone and have clayey and cherty subsoils. The more level areas and hill caps have soils formed from thin loess (windblown material) and limestone residuum. The soils are highly leached and strongly acid with low fertility—except near the Kentucky–Tennessee border.

The Central Basin Physiographic Region is within the Highland Rim. The Central Basin is one of the smaller physiographic regions of the Tennessee Valley watershed and includes parts of the Duck River and Cumberland River drainages. The Basin is underlain by upwarped Paleozoic age limestone that has been eroded to form a basin surrounded by the Highland Rim. The inner portion of the Basin is relatively flat lying with low relief, and is bordered by large hills and ridges along its outer edge. Due to the weathering and erosion of the underlying limestone, karst topography is present in this region.

From the Highland Rim, the Tennessee River flows north through the Coastal Plain Physiographic Region. The portion of this region that lies within the Tennessee Valley is almost entirely west or southwest of the Tennessee River and includes the drainages of the Beech River and Bear Creek. The relief within this area is generally low; consequently, stream gradients are very low—their valleys are broad and flat and filled with thick accumulations of alluvium. The rocks exposed in the Gulf Coastal Plain are all unconsolidated sediments, with Paleozoic rocks underlying the whole area at great depth. The soils of the Coastal Plain Physiographic Region are highly leached, low in fertility, and strongly acid. Quality cropland is found mainly on the bottoms and terraces. Control of erosion is of major concern, as evidenced by deep gullies that are common on some hillsides.