

Chapter 7

Potential Mitigation Measures



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7.1. Introduction

The National Environmental Policy Act and its implementing regulations require that an EIS identify appropriate mitigation measures for the adverse impacts potentially resulting from a proposed action. Mitigation measures are actions that could be taken to avoid, offset, reduce, or compensate for adverse effects to the environment.

The purpose of this chapter is to describe the programmatic framework within which mitigation measures would be implemented and to identify and describe the mitigation measures that TVA may implement if the Preferred Alternative is implemented. After issuance of the FEIS, reviewing public comments on the FEIS, and a decision from the TVA Board, TVA will identify those mitigation measures to be implemented in its Record of Decision for this action.

Because the ROS is a programmatic action that takes place over a multi-state region covering the entire integrated reservoir system, TVA's mitigation approach also is appropriately scaled to a programmatic, reservoir-system level. TVA will rely heavily on its existing resource management programs to detect and track environmental changes that may occur and to implement identified mitigation measures.

This chapter is organized into three parts. Section 7.2 describes the need and context for a programmatic approach to mitigation. Section 7.3 presents an overview of TVA's management programs, which provide a framework for mitigation, monitoring, reporting, and enforcement. Section 7.4 describes the steps that TVA has taken during development of the Preferred Alternative to avoid and minimize environmental effects. That section also outlines the actions TVA may take to detect and track environmental changes and to mitigate adverse resource impacts if the Preferred Alternative is implemented.

7.2. Programmatic Approach to Mitigation

Mitigation for a policy action differs considerably from mitigation for a specific project. This is especially true for an operations policy that affects a large geographic area and the large number of waterbodies in the TVA reservoir system. In contrast with project-specific impacts, which may be readily delineated and quantified, some policy impacts can be diffuse, difficult to predict, may or may not occur as anticipated, and may develop over a long period of time. The prediction of environmental impacts, always an inexact science, is even more difficult for large-scale actions such as reservoir operations. Consequently, monitoring and an adaptive response can be important components of a programmatic mitigation plan.

MITIGATION

NEPA defines mitigation as actions taken to avoid, reduce the severity of, or eliminate an adverse impact. Mitigation can include:

- Avoiding impacts;
- Minimizing impacts by limiting the degree or magnitude of the action;
- Restoring or rehabilitating the affected environment;
- Reducing or eliminating impacts over time; and,
- Compensating by providing offsetting resources or environments.

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TVA's reservoir operations policy permits an adaptive response that has included substantial monitoring of environmental parameters, evaluation of ongoing environmental impacts, and mitigation of impacts. Under the Reservoir Release Improvement (RRI) Program, TVA has restored concentrations of DO in over 300 miles downstream of 16 projects. TVA has also established minimum flow requirements at 25 sites. Required structural modifications were completed in 1996, but ongoing operational aspects of the program could be modified to help mitigate low DO concentrations and flow problems in project releases.

In addition, the numerous statutes and implementing regulations that are presented in Chapter 4, Description of Affected Environment, can substantially affect the impacts relating to alternative reservoir operations policies. Chapter 5, Environmental Consequences of the Alternatives, provides the impact analysis and conclusions concerning compliance with these regulations and statutes; these are summarized in this chapter, as appropriate.

7.3. TVA Management Programs—Providing a Framework for Mitigation

TVA has developed numerous policies and programs to protect and enhance natural resources; these programs are the logical institutional framework for implementing mitigation actions. TVA presently manages and administers a wide variety of programs, initiatives, public outreach, and other individual measures designed to monitor, protect, maintain, and enhance the quality of the environment within the TVA reservoir system (Table 7.3-01). These activities range from monitoring programs such as the Vital Signs Reservoir Ecological Health Monitoring Program, to the development of reservoir land management plans and implementation of the Clean Water Initiative. As impacts are identified, existing TVA programs can be changed to better address substantive adverse impacts. Table 7.3-01 outlines a number of TVA program elements and activities relevant to monitoring and mitigation activities. These programs and activities were considered in the development of mitigation measures for the Preferred Alternative.

Table 7.3-01 TVA Program Elements and Activities Relevant to Mitigation

TVA Program or Activity	TVA Programs and Activities Relevant to Mitigation Strategies
<p>Section 26a permitting process – Requires obtaining TVA approval before putting obstructions on or along Tennessee River system</p>	<ul style="list-style-type: none"> • This process addresses construction, maintenance, and operation of facilities and activities on, over, or along the Tennessee River and its tributaries. This includes residential shoreline structures, non-navigable houseboats, and intakes and outfalls. • TVA Watershed Teams are responsible for implementation of Section 26a. • Permit recipients are required to follow the construction procedures and environmental protection measures specified. • For non-routine projects or actions, Environmental Assessments (EAs) or Environmental Impact Statements (EISs) are completed in addition to the Section 26a permitting process.
<p>Reservoir Land Management Planning – Defines allowable areas for residential, commercial, and industrial shoreline development on TVA property</p>	<ul style="list-style-type: none"> • Land Management Plans (LMPs) are approved by the TVA Board of Directors and implemented by the Watershed Teams. • Each LMP includes provisions for shoreline management, land use, protection, and monitoring. The whole reservoir is considered in the plan. • Each LMP is developed with extensive interagency and public review.
<p>Reservoir Release Improvement Program – TVA's Program, completed in 1996, to improve dissolved oxygen (DO) and increase water levels in tailwaters from minimum flows</p>	<ul style="list-style-type: none"> • TVA uses a wide range of methods to improve DO concentrations. In some cases, more than one approach is necessary to reach oxygen targets (6 milligrams per liter of water in cold-water tailwaters, and 4 milligrams per liter in warm-water tailwaters), which include turbine venting, surface water pumps, oxygen injection systems, aerating weirs, and air compressors and blowers. • TVA uses three different technologies to maintain minimum water level in the riverbed below tributary dams, including turbine pulsing, weirs, and small hydroelectric units.

Table 7.3-01 TVA Program Elements and Activities Relevant to Mitigation (continued)

TVA Program or Activity	TVA Programs and Activities Relevant to Mitigation Strategies
<p>Vital Signs Reservoir Ecological Health Monitoring Program – TVA’s program to systematically monitor the ecological condition of its reservoirs</p>	<ul style="list-style-type: none"> • This monitoring program provides the necessary information from five key indicators (chlorophyll-a, DO, fish assemblage, benthic macroinvertebrates, and sediment contaminants) to evaluate conditions in reservoirs and to target detailed assessment studies if significant problems are found. In addition, this information establishes a baseline for comparing future water quality conditions in TVA’s reservoirs. • TVA monitors ecological conditions at 69 sites on 31 reservoirs. Each site was monitored initially for 4 to 5 consecutive years to establish baseline data. Monitoring continues on an every-other-year basis unless a substantial change in the ecological health score occurs during a 2-year cycle. If that occurs, the site is monitored the next year to confirm that the change was not temporary. Roughly half the sites are sampled each year on an alternating basis. • In 1999, TVA began physical and chemical water quality monitoring annually on 32 reservoirs at 59 locations. Physical and chemical water quality monitoring is conducted monthly from April through September on mainstem reservoirs and from April through October on tributary reservoirs. Sampling includes temperature, DO, pH, and conductivity profiles; and photic zone composite samples for chlorophyll and nutrients (Total P, NH₃, NO_x, organic N, TKN, TSS, and TOC). • TVA performs biological sampling (fish and/or benthic macroinvertebrates) of tailwaters for 18 tailwaters at 47 sites. Reservoir fish and benthic assemblages are sampled once in late fall/early winter. The condition of these biological communities is evaluated using multi-metric indices. Sediment samples are collected in July or August of each year and analyzed for PCBs, pesticides, and metal contaminants. The monitoring program is based on sampling protocols following EPA Level III fish and Level III benthic bioassessment protocols.
<p>Shoreline Management Policy – A comprehensive management policy developed out of the Shoreline Management Initiative that controls residential development along TVA reservoir shorelines</p>	<ul style="list-style-type: none"> • TVA Watershed Teams are responsible for implementation of the Shoreline Management Policy. • The goal is to balance shoreline development, recreation use, and resource conservation needs. • Under this policy, a Residential Access Shoreland Inventory is being conducted, which includes an ongoing baseline inventory of resource conditions along TVA-owned residential access shoreland and flowage easement shoreland. Residential shoreline is placed into at least three categories: shoreline protection, residential mitigation, and managed residential. • New construction of residential water use facilities on waterbodies is limited to 1,000 square feet. • Shorelands not open for residential development can be opened only if offset by closing other shorelands that are open to residential development (a maintain-and-gain policy). • A 50-foot shoreline management zone (or greenbelt) is retained on TVA land that adjoins newly developed residential areas where practicable.

Table 7.3-01 TVA Program Elements and Activities Relevant to Mitigation (continued)

TVA Program or Activity	TVA Programs and Activities Relevant to Mitigation Strategies
<p>Shoreline Management Policy (continued)</p>	<ul style="list-style-type: none"> Vegetation Management Plans are required for new developments under this policy and are designed to improve or enhance the vegetative cover of the property. Use of native vegetation is encouraged. Best management practices for the construction of docks, management of vegetation, stabilization of shoreline erosion, and other shoreline alterations are promoted to protect water quality.
<p>Shoreline Treatment Program – A program for rating the condition of shorelines within TVA reservoirs and identifying those to be restored through stabilization and revegetation</p>	<ul style="list-style-type: none"> TVA has conducted Shoreline Condition Assessments on all TVA reservoir shorelines. These assessments rate the shoreline conditions based on two parameters: erosion condition and vegetation condition. Shorelines are rated as good, fair, or poor based on the combined score for the two parameters. Each year, TVA selects 35 to 40 sites (approximately 8 miles of reservoir shoreline) that are rated as poor to be restored through stabilization and revegetation. The shoreline rating criteria, used to rank potential sites in order of treatment priority, provides a higher rating to those sites where archaeological resources are threatened, all other criteria being equal.
<p>Hydro Automation Program – A TVA Program to automate the control of TVA's hydropower generating units</p>	<ul style="list-style-type: none"> The Hydro Automation Program will link a majority of all 109 units to a centralized computer system so turbines can be managed individually on a system-wide scale.
<p>TVA's Natural Areas Programs – TVA's cooperative management of publicly owned lands with significant natural features.</p>	<ul style="list-style-type: none"> In managing the publicly owned land in and around its facilities and reservoirs, TVA has developed a land use designation system under which 82 sites on 10,700 acres have been classified as TVA natural areas. The sites are identified as habitat protection areas, small wild areas, ecological study areas, or wildlife observation areas. Their management includes restrictions on activities that might endanger significant natural features.
<p>Natural Heritage Project – TVA's project to inventory and monitor sensitive natural resources, including protected species, geological features, natural areas, and other sensitive natural resources</p>	<ul style="list-style-type: none"> In cooperation with other federal, state, and non-governmental organizations, TVA identifies, monitors, and assists in protecting threatened and endangered species and environmentally sensitive sites. In addition, it maintains databases of these protected species, geological features, natural areas, and other sensitive natural resources. The Natural Heritage Project staff also uses this information to provide environmental input on TVA activities that range from transmission line construction to economic development. TVA and the U.S. Fish and Wildlife Service routinely share information on the location of listed species.
<p>Riparian Restoration – Activities to protect and restore riparian vegetation</p>	<ul style="list-style-type: none"> Riparian restoration is designed to help owners of streambank or shoreline properties create landscaping plans that not only enhance their property but also protect water resources. The program identifies ways of using trees and other vegetation to help reduce erosion by holding soil in place, protect water quality by filtering sediments and pollutants, provide wildlife habitat and cover for fish, and enhance scenic beauty along the water's edge.

Table 7.3-01 TVA Program Elements and Activities Relevant to Mitigation (continued)

TVA Program or Activity	TVA Programs and Activities Relevant to Mitigation Strategies
<p>Cultural Resources Management – TVA’s program to manage cultural and archaeological resources</p>	<ul style="list-style-type: none"> • Cultural resources management includes various actions to address requirements of the National Historic Preservation Act and the Archaeological Resource Protection Act. • Archaeological resources in need of treatment/protection are identified from data obtained during archaeological surveys of reservoir shorelines and TVA reservoir lands, and through additional field evaluations of site conditions. The most critically impaired sites are submitted to the Shoreline Treatment Program for consideration in that program’s rating process. For each site selected for treatment, consultation is conducted with the appropriate State Historic Preservation Office and other stakeholders, such as Indian tribes.
<p>Clean Water Initiative – A program started in 1992 as a result of the Lake Improvement Plan; TVA partnerships with community residents, businesses, and government agencies to promote watershed protection</p>	<ul style="list-style-type: none"> • TVA’s Watershed Teams are responsible for carrying out the program. They focus on improving water quality and shoreline conditions. Among other accomplishments, these community coalitions: <ul style="list-style-type: none"> —Monitor stream and aquatic community conditions; —Institute agricultural and urban management practices that reduce water pollution; —Treat eroded land and stabilized streambanks; —Plant vegetation and installed structures intended to improve aquatic habitat; and, —Collect waste and litter from streambanks and shores.

7.4. Potential Impacts and Mitigation for the Preferred Alternative

Mitigation follows a sequence of avoiding impacts; minimizing impacts by limiting the degree or magnitude of the action; and then, if needed, restoring or rehabilitating the affected environment, reducing or eliminating impacts over time, or compensating by providing offsetting resources or environments. Monitoring is often included to verify anticipated outcomes or identify unanticipated impacts. TVA has implemented the first steps of this mitigation process by avoiding and minimizing potential impacts in the design of its reservoir operations policy alternatives and especially in the formulation of the Preferred Alternative.

In developing the Preferred Alternative, TVA combined the desirable features of the alternatives identified in the DEIS to create a more feasible, publicly responsive preferred alternative. Through detailed analysis in this FEIS, TVA has determined that most changes under the Preferred Alternative would result in beneficial to slightly adverse impacts. The Preferred Alternative would result in a few types of effects, however, that would cause adverse impacts on the environment.

7.4.1 Avoidance and Minimization in the Preferred Alternative

The Preferred Alternative was formulated purposefully to avoid or reduce the adverse impacts associated with the action alternatives presented in the DEIS, especially the substantially adverse impacts related to flood damages, water quality, power costs, aquatic resources, wetlands, and migratory waterfowl and shorebirds. The elements of the Preferred Alternative that were added or modified specifically to avoid or minimize potential adverse impacts include the following:

- Except for the Base Case, detailed analyses indicated that all of the alternatives evaluated in the DEIS would result in unacceptable increases in the risk of flooding at critical locations in the Tennessee Valley. To address this issue, operating guides and regulating zones for individual projects were modified so that there would be no increase in flood damages for flood events with a frequency of 500 years or less.
- Most of the alternatives that included extension of summer pools further into summer and fall than under the Base Case would result in longer residence time of water in the reservoirs and consequent adverse or substantially adverse impacts on water quality. The Preferred Alternative focuses on achieving certain flows from the reservoirs from June 1 through Labor Day. Consequently, impacts on water quality would be only slightly adverse and variable among the reservoirs under the Preferred Alternative. However, some of these variable impacts could be adverse and may justify mitigation. This balancing of additional recreation benefits with water quality impacts is also important for aquatic resources, because water quality is a major factor that influences the health of fisheries and the quality of aquatic habitat.

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- Habitat quality in many tailwaters would be maintained by ensuring that minimum flow commitments and DO targets in the Lake Improvement Plan would continue to be met. In addition, TVA would provide seasonal releases into the Apalachia Bypass to enhance aquatic habitat in that river reach.
- Most of the alternatives that extended summer pool levels could result in substantial adverse effects on wetlands. Under the Preferred Alternative, pools would be maintained at levels more similar to the Base Case than other policy alternatives. Although adverse impacts on wetland extent, distribution, and habitat connectivity would be reduced compared to most other policy alternatives, adverse impacts may still occur.
- No changes would be made in the operating guide curves for Kentucky Reservoir. This would substantially reduce the potential for adverse effects on flats habitats, interference with the operation and integrity of managed areas, and impacts on adjacent forested wetlands that could occur under alternatives that extend summer pool levels further into summer and fall.

7.4.2 Mitigation for the Preferred Alternative

The Preferred Alternative does not avoid all potential impacts on environmental resources; some adverse impacts could still occur. In particular, implementation of the Preferred Alternative could result in slightly adverse to adverse impacts on certain wetland types and locations, water quality and aquatic resources in some reservoirs, and other resource areas. In some cases, the extent of the impacts may vary from year to year—depending on the reservoir, annual rainfall conditions, and other factors.

Potential mitigation measures for TVA's Preferred Alternative are identified in Table 7.4-01 for adverse impacts on water quality, aquatic resources, and vector (mosquito) control. These mitigation measures are based on incremental impacts compared to the Base Case and are scaled to resource importance and extent as well as to the severity of the potential impact. For each mitigation measure proposed, TVA has provided a description of the need for the mitigation; the mitigation measure or monitoring activity; and the anticipated result in terms of follow-up activities for resource management, protection, enhancement, or replacement.

Table 7.4-01 Mitigation for Potential Adverse Impacts Associated with the Preferred Alternative

Need	Description	Results and Follow-Up Activities
<p>Water quality and aquatic resources could be adversely affected at some locations. If analysis or monitoring indicates that dissolved oxygen (DO) concentrations are declining below DO target levels, increase TVA aeration efforts (see Table 7.4-02).</p>	<p>Upgrade aeration equipment and operations at appropriate locations as necessary to meet the DO target levels established by the Lake Improvement Plan (see Appendix A, Table A-05.) This could include increased oxygenation, upgrading existing equipment, or installing additional equipment. Such measures shall be initiated and completed within 1 year at Watts Bar, and within 3 years at other locations where established targets are not being met.</p>	<p>Share information about enhanced aeration efforts with interested agencies.</p> <p>Continue monitoring to determine whether efforts are successful. If DO targets cannot be maintained, investigate additional mitigation approaches with interested agencies.</p>
<p>Holding mainstem reservoir levels up longer could increase the number of days that reservoir mosquito breeding habitat exists. Mitigate if this is confirmed through monitoring (see Table 7.4-02).</p>	<p>Extend the duration of reservoir level fluctuations for mosquito control, consistent with holding mainstem reservoir levels up longer.</p>	<p>Continue to monitor mosquito levels. If extending the duration of the fluctuations does not offset the increase in reservoir mosquitoes, investigate other mitigation methods—including additional changes in fluctuation efforts.</p>

7.4.3 Mitigation and Monitoring

Given the inherent uncertainties with any environmental analyses, monitoring should be conducted before a substantial investment is made in mitigation—not only to avoid wasting money but also to ensure that the appropriate mitigation is used at the most important locations. A mix of monitoring and adaptive response is an important component of TVA’s programmatic mitigation plan. Tables 7.4-02 and 7.4-03 describe the activities that could be taken to verify TVA’s projection of impacts for a number of important resource areas.

Tables 7.4-02 and 7.4-03 identify those activities that could be undertaken to mitigate adverse impacts that could not be avoided in the formulation of the Preferred Alternative. Activities that could be taken to address other resource areas are also identified.

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Table 7.4-02 Monitoring for Potential Adverse Impacts Associated with the Preferred Alternative

Need	Description	Results and Follow-Up Activities
<p>Decreases in concentrations of dissolved oxygen (DO) are predicted in water released from some mainstem and tributary dams due to increase in volumes of water with low DO concentrations in the reservoirs. This could adversely affect water quality and aquatic resources.</p>	<p>Continue existing monitoring activities under the Reservoir Release Improvement and Vital Signs Reservoir Ecological Health monitoring programs to look for water quality and ecological changes. Conduct additional DO and temperature sampling at selected tailwater locations as determined by Vital Signs monitoring.</p>	<p>Share data with other interested agencies.</p> <p>If DO concentrations lower than the established targets are observed, mitigate appropriately (see Table 7.4-01).</p>
<p>Holding mainstem reservoir levels up longer could increase the number of days that reservoir mosquito breeding habitat exists.</p>	<p>Continue existing monitoring activities throughout the extended time the mainstem reservoir levels are held up.</p>	<p>Share data with interested agencies.</p> <p>If reservoir mosquito nuisance levels increase, mitigate appropriately (see Table 7.4-01).</p>

Table 7.4-03 Monitoring for Other Resource Areas

Need	Description	Results and Follow-Up Activities
The rate of erosion on reservoir shorelines could increase, further affecting sensitive cultural resource sites.	Continue monitoring sensitive cultural resource sites along the shoreline.	If the rate of shoreline erosion at sensitive cultural resource sites increases, increase stabilization efforts commensurate with the rate of increase.
One population of the endangered green pitcher plant on Chatuge Reservoir could be affected by changes in the local hydrology. Detailed hydrologic studies have not been conducted at this site.	Work with the landowner, the U.S. Fish and Wildlife Service, and other interested agencies to conduct a hydrologic study to determine whether the changes in reservoir levels would affect this population. The study and results are to be completed within 1 year. Then, periodically monitor the status of green pitcher plant populations around Chatuge Reservoir and share data with interested agencies.	If results of the study indicate that changes resulting from implementation of the Preferred Alternative are likely to adversely affect the green pitcher plant, take appropriate action to avoid or mitigate those adverse effects.
The results of the Reservoir Operations Study indicate that there is a need to develop a Drought Management Plan for the Tennessee River system.	Work with state and federal agencies in a cooperative manner to develop a Drought Management Plan within a reasonable period of time. This plan would be implemented during extreme drought conditions.	Suspend the reservoir operations policy during severe drought to allow implementation of the Drought Management Plan.
The availability of water would generally increase during the growing season. This could cause slight shifts in the extents and distributions of wetlands and wetland types. The changes in the timing of the presence of water could adversely affect flats, scrub/shrub, and forested wetlands. There could be a slight decrease in wetland functions overall.	Develop a monitoring program to determine whether extended pool levels cause shifts of wetland plant communities. Perform monitoring activities on a 3- to 5-year basis for 15 years to establish effects.	If substantial shifts of wetland plant communities occur, take appropriate action to mitigate adverse effects.

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Table 7.4-03 Monitoring for Other Resource Areas (continued)

Need	Description	Results and Follow-Up Activities
<p>The results of the Reservoir Operations Study indicate that there is a need for more cooperative efforts to determine habitat requirements and potential enhancements for shorebirds.</p>	<p>Work with state and federal agencies in a cooperative manner to determine habitat requirements and opportunities for enhancements to shorebirds. This will include better identification of information gaps and cataloguing the federal and state programs that address these habitats and species.</p>	<p>Share data with other interested agencies and investigate with other agencies actions that could be taken to enhance these habitats and species.</p>
<p>The results of the Reservoir Operations Study indicate that there is a need for more cooperative efforts to determine habitat requirements and potential enhancements for important sport fish.</p>	<p>Work with state and federal agencies in a cooperative manner to determine habitat requirements and opportunities for enhancements to sports fish. This will include better identification of information gaps and cataloguing the federal and state programs that address these habitats and species.</p>	<p>Share data with other interested agencies and investigate with other agencies actions that could be taken to enhance these habitats and species.</p>