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Reminders:

In each numbered section of the chapter, the first mention of an alternative will be in bold print. Use of slashes between alternatives (e.g., Alternatives C2/D) means they are considered equal.

Ownership categories on 10,995 miles of TVA reservoir shoreline

- Flowage easement shoreland
- TVA-owned residential access shoreland
- TVA-owned-and-jointly-managed shoreland
- TVA-owned-and-managed shoreland

Alternative A - Limited TVA Role Along Open Shoreline and Additional Areas
Alternative B1 - Existing Guidelines Along Open Shoreline and Additional Areas (No Change/No Action)
Alternative B2 - Existing Guidelines Along Open Shoreline Only
Alternative C1 - Managed Development Along Open Shoreline and Additional Areas
Alternative C2 - Managed Development Along Open Shoreline Only
Alternative D - Minimum Disturbance Along Open Shoreline Only
Blended Alternative - Maintain and Gain Public Shoreline

Please see the Glossary in Chapter 5 for the meaning of unfamiliar words.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

Chapter 4 addresses the direct, indirect, and cumulative environmental impacts of the seven alternatives as they affect the 13 resource issues raised during public involvement. This chapter is organized by resource issues and provides the scientific, analytical, and technical basis for assessing the impacts on those resources. Measurement indicators were developed to gauge the effects of the alternatives on each resource.

Direct and indirect impacts are simply those impacts (also called *effects*) that occur in or near the proposed project area. These impacts also occur over time. The line between direct and indirect impacts is difficult to draw, so the following discussion combines both types of impacts. Direct and indirect impacts are those that would occur in or near TVA reservoirs and are caused by actions TVA would take. These projected impacts would occur within the 25-year SMI planning horizon.

Cumulative impacts occur when a TVA action has an incremental impact when analyzed in light of "past, present, and reasonably foreseeable future actions regardless" (CEQ Regulations, Section 1508.7) of who causes or is responsible for such actions. Cumulative impacts from TVA alternatives would occur when the proposed TVA activities combine with the effects of actions taken by others, including federal, state, and private entities.

4.2 Estimated Maximum Amount of Shoreline That Could Be Developed With Residential Alterations

In order to examine potential impacts of residential shoreline development on resource conditions, TVA had to project the maximum amount of shoreline that could be developed with future residential shoreline alterations. Indicators of the potential for notable increases in the level of residential shoreline development over the next 25 years include:

- Existing high levels of development on several reservoirs (Section 3.4.4),
- Population growth in counties along reservoirs (Section 3.16.2), and
- Increases in the number of permit applications (Section 1.1).

In forecasting future residential shoreline development scenarios, it was assumed that an increase in developed shoreline miles would likely correlate with the increasing trend in the number of shoreline alteration permits issued annually by TVA. Permits are increasing at the rate of 6 percent per year (Section 1.1). Using this rate of increase, it is projected that residential shoreline development could increase over 25 years from the 1994 level of 1,383 miles (Section 3.4) to 5,928 miles, or 54 percent of the total shoreline.

The growth rate of residential shoreline development would not only be influenced by TVA management practices but could also be heavily affected by a number of variables beyond TVA's control. Therefore, the actual rate of development could be greater or less than the projected 54 percent. Factors influencing the rate of development include:

- Availability of road access and utility services.
- Proximity of homesites to employment centers.
- Desirability and affordability of lakefront living.
- Urban expansion into areas that were once viewed as remote locations.
- Local zoning requirements.
- Migration of citizens to the Southeast.

Recognizing that a number of variables would influence the actual rate of development, TVA chose to examine three buildout scenarios. These scenarios were used as a framework for estimating the number of additional and total shoreline miles that could be developed Valleywide under each alternative *(Table 4.2-1)*. For each alternative, the number of additional miles potentially developed is the difference between the total number of miles impacted and the number of miles currently developed (1,383) with residential shoreline alterations. At the low end, TVA projects that 4,192 miles of shoreline, or 38 percent of the total shoreline, could be developed with residential shoreline alterations within the next 25 years.

Table 4.2-1. Estimated Maximum Amount of Shoreline Valleywide That Could Be Developed[1] With Residential Alterations, by Alternative.

Alternative	Total Miles of Shoreline That Could Be Developed	Total Percent of Shoreline That Could Be Developed	Existing Miles of Shoreline That Are Developed	Additional Miles of Shoreline That Could Be Developed	Additional Percent of Shoreline That Could Be Developed
A	6,893	63	1,383	5,510	50
B1	6,893	63	1,383	5,510	50
B2	4,192	38	1,383	2,809	25
C1	5,247	48	1,383	3,864	35
C2	4,192	38	1,383	2,809	25
D	4,192	38	1,383	2,809	25
Blended	4,192	38	1,383	2,809	25

[1]Within the next 25 years.

At the high end, TVA assumed that actual rate of growth could exceed the 54 percent development projection explained above and examined the effects of a 63 percent buildout scenario. Under this scenario, residential shoreline development could eventually affect another 50 percent of the shoreline, in addition to the 13 percent currently developed for residential use. At a 63 percent buildout level, 6,893 miles of shoreline could be developed with residential alterations. In addition, TVA examined the effects of a 48 percent buildout scenario. More information about these buildout scenarios and how they were developed is provided in Section 4.2.1.

It should be noted that these Valleywide buildout percentages (i.e., 38, 48, and 63) represent nothing more than TVA's estimate of the upper limit or maximum amount of development that could occur across the Tennessee Valley region over SMI's 25-year planning horizon under certain conditions. This does not mean that buildout necessarily would occur, because these percentages are not development goals or targets of the alternatives. These upper limits were needed for analysis purposes only and were used primarily to assess the environmental impacts that the alternatives could have on each of the 13 resources. The length of the planning period provides an opportunity to observe trends and adjust whatever policy is adopted to respond to these trends.

Because of physical and environmental constraints present on some sites; conservation features of **Alternatives C1, C2**, **D**, and the **Blended Alternative**; and other variables that influence development, it is possible that some of the shoreline with existing access rights will not be developed. The eventual buildout level will be influenced by these variables and the amount of additional development, if any, authorized by TVA.

4.2.1 38 Percent Buildout Scenario

Under **Alternatives B2, C2, D**, and the **Blended Alternative**, the amount of shoreline affected by residential shoreline alterations could increase from the present Valleywide level of 13 percent (Section 3.4) up to 38 percent over the next 25 years. Under these alternatives, TVA does not expect the Valleywide level of residential shoreline development to exceed 38 percent of the shoreline. The eventual level of buildout could possibly be less, as explained in the introduction to this section. At the 38 percent level, 4,192 shoreline miles could be developed. This is the total amount of shoreline currently within the flowage easement and TVA-owned residential access shoreland ownership categories (Section 1.4.5). Collectively, these are the shoreline areas where individual lakefront property owners generally now have access rights qualifying them to apply for Section 26a permits for docks and other water-use facilities. In the description of alternatives (Chapter 2), these shoreline areas are collectively referred to as *open* shoreline.

4.2.2 48 Percent Buildout Scenario

For the purpose of analyzing **Alternative C1**, TVA has estimated that residential shoreline development could affect up to 5,247 miles, or 48 percent of the total shoreline. In arriving at this estimate, TVA first assumed that all open residential shoreline (i.e., 4,192 miles or 38 percent) would be developed. Then, projected growth rates for each reservoir were applied to the number of undeveloped shoreline miles within certain ownership categories. The result was the number of additional miles that could be impacted by residential development under this scenario.

Growth rates for most reservoirs were published in the *Lake Improvement Plan* (TVA, 1990b). Reservoirs that were not included were treated as low-growth reservoirs.

Low Growth Projection. Five reservoirs had a low growth-rate projection (Fontana, Fort Patrick Henry, Nickajack, Normandy, and Ocoee Project). For these reservoirs, TVA assumed that up to 25 percent of the shoreline within the undeveloped TVA-owned-and-managed ownership category could be used for residential access and shoreline development.

Medium Growth Projection. Fourteen reservoirs had a medium growth-rate projection (Blue Ridge, Boone, Cherokee, Chickamauga, Douglas, Guntersville, Hiwassee, Kentucky, Norris, South Holston, Watauga, Watts Bar, Wheeler, and Wilson). For these reservoirs, TVA assumed that no more than 30 percent of the undeveloped shoreline within the TVA-owned-and-managed category would be used for residential shoreline alterations. In addition, TVA assumed that as much as 5 percent of the undeveloped shoreline in the TVA-owned-and-jointly-managed category could be converted to residential access for shoreline development.

High Growth Projection. Seven reservoirs had a high growth-rate projection (Chatuge, Fort Loudoun, Melton Hill, Nottely, Pickwick, Tellico, and Tims Ford). For these reservoirs, TVA assumed that 35 percent of the undeveloped shoreline within the TVA-owned-and-managed category and up to 10 percent of the undeveloped shoreline within the TVA-owned-and-jointly-managed category could be used for residential access and shoreline development.

4.2.3 63 Percent Buildout Scenario

For the purpose of analyzing **Alternatives A** and **B1**, TVA assumed that residential alterations would become the dominant shoreline use and could ultimately affect up to 6,893 miles or 63 percent of the total shoreline. For this scenario, TVA assumed that all open residential access shoreline (i.e., 4,192 miles or 38 percent) would be developed.

Low Growth Projection. For low-growth reservoirs, TVA assumed that up to 75 percent of the undeveloped TVA-owned-and-managed shoreland could be made available for residential access and shoreline development. In addition, TVA assumed that residential alterations along these shorelines could increase the pressure to convert up to 15 percent of the TVA-owned-and-jointly-managed category. It was assumed that demand would be greatest along transferred recreation areas, but that shorelines fronting areas transferred for natural resource management and industrial use could also receive some shoreline development pressure.

Medium Growth Projection. For medium-growth reservoirs, TVA assumed that up to 80 percent of the undeveloped TVA-owned-and-managed shoreland and 10 to 20 percent of the TVA-owned-and-jointly-managed category could be made available for residential access and shoreline development.

High Growth Projection. For high-growth reservoirs, TVA assumed that up to 85 percent of the undeveloped TVA-owned-and-managed shoreland and 15 to 25 percent of the TVA-owned-and-jointly-managed category could be made available for residential access and shoreline development.

4.3 Effects on Shoreline Vegetation

4.3.1 Introduction

Shoreline development results in the removal of some shoreline vegetation and alters the structure and species composition of the remaining vegetation. These impacts result from:

- Clearing for water-use facilities,
- Establishing lawns and other landscaping,
- Clearing vistas through shoreline forests, and
- Constructing access roads.

The magnitude of these impacts would vary among the alternatives. The impacts would also vary locally, depending on the type of vegetation present on tracts undergoing residential shoreline development.

4.3.2 Effects of the Alternatives

All alternatives would directly impact vegetation within the flowage easement and the TVA-owned residential access shoreland ownership categories. Alternatives A, B1, and C1 would also impact vegetation within the TVA-owned-and-managed and the TVA-owned-and-jointly-managed shoreland categories. In addition to impacting vegetation along the shoreline, residential development would also affect vegetation further inland. The average subdivision presently extends about one-fourth mile from the lakeshore (Section 3.4.5). Therefore, anticipated effects on forest area and tract size are considered within this zone. The rest of this section describes the impacts of each alternative, first on shoreline vegetation types within 25 feet of shoreline and then on forest area and tract size within one-fourth mile of the shoreline. It begins with Alternative B1, which most closely follows current guidelines.

Adoption of **Alternative B1** would result in continuation of the impacts to shoreline vegetation presently occurring from residential shoreline alterations. Anticipated changes to vegetation types within 25 feet of the shoreline *(Table 4.3-1*, *Figure 4.3-1)* would result from thinning and removal of forest cover from flowage easement shoreland, removal of forest understory and saplings from TVA-owned residential access shoreland, and establishment of lawns. These anticipated changes are based on the assumption that current proportions of vegetation types along undeveloped shoreline *(Table 3.5-1)* and along developed shoreline *(Table 3.5-2)* would remain constant.

The greatest changes to shoreline vegetation types would be a decrease of about 26 percent (1,829 miles) in shoreline dominated by forest and a doubling (increase of 1,943 miles) of shoreline dominated by the managed tree/grass vegetation type. The total length of wooded shoreline (sum of the forest, tree/grass, and tree/shrub types) would show little change (a decrease of 29 miles). The grass/forb vegetation type, which along developed shorelines is mostly mowed lawns, would increase by about 18 percent (114 miles). The impacts of these changes would be significant in agricultural and urban counties where shoreline forests make up a large proportion of the total forested land. An additional consequence would be an increase in the proportion of nonnative plant species along the shoreline.

Forest area within one-fourth mile of the shoreline would decrease by about 10 percent (21,800 acres). This decrease is extrapolated from the data presented in Section 3.5.3 (excluding Kentucky Reservoir) and assumes the present proportions of forest cover on developed and undeveloped lands would remain constant. The decrease in tract size of contiguous blocks of forest within one-fourth mile of shoreline would be the greatest of any alternative and equal to that expected under Alternative A. However, based on available information, quantifying this change is not possible. Impacts to both

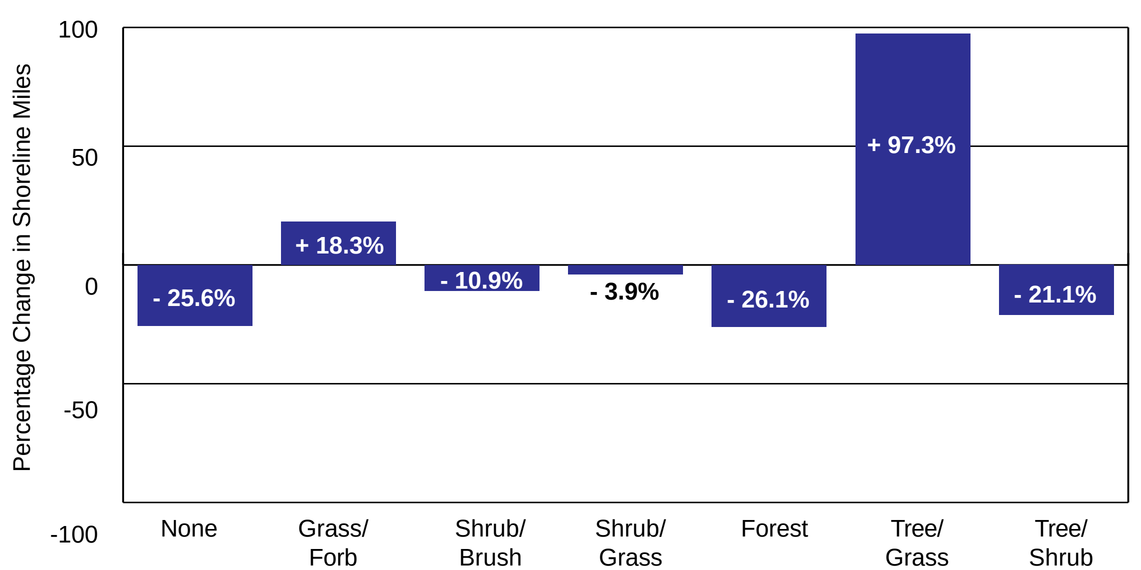
Table 4.3-1. Approximate Miles and Percent of Reservoir Shoreline With Different Vegetation Types Within 25 Feet of Shoreline at the Current Level of Development and Projected Changes at Buildout[1] Under the Various Alternatives.[2]

Vegetation Type	Current Conditions	Alternative A	B1	B2	C1	C2	D	Blended
None	239.8 1.9%	-69.5 -29.0%	-61.4 -25.6%	-31.5 -13.1%	-63.5 -26.5%	-34.4 -14.3%	-34.4 -14.3%	-34.4 -14.3%
Grass/Forb	622.5 6.0%	+190.7 +30.6%	+113.8 +18.3%	+39.5 +6.3%	-66.3 -10.6%	-13.8 -2.2%	-13.8 -2.2%	-13.8 -2.2%
Shrub/ Brush	80.6 0.7%	-1.1 -1.3%	-8.8 -10.9%	-3.2 -4.0%	-15.6 -19.4%	-6.7 -8.3%	-6.7 -8.3%	-6.7 -8.3%
Shrub/ Grass	382.4 3.5%	+26.0 +6.8%	-14.8 -3.9%	-12.8 -3.3%	-76.9 -20.1%	-40.3 -10.5%	-40.3 -10.5%	-40.3 -10.5%
Forest	7001.1 57.9%	-1850.3 -26.4%	-1829.4 -26.1%	-908.6 -13.0%	-253.2 -3.6%	-323.2 -4.6%	-100.5 -1.4%	-242.0 -3.5%
Tree/Grass	1996.5 24.3%	+1835.4 +91.9%	+1942.5 +97.3%	+1023.3 +51.3%	+682.3 +34.2%	+559.8 +28.0%	+337.0 +16.9%	+478.5 +24.0%
Tree/Shrub	672.1 5.7%	-131.2 -19.5%	-141.9 -21.1%	-106.7 -15.9%	-206.8 -30.8%	-141.4 -21.0%	-141.4 -21.0%	-141.4 -21.0%

[1]Within the next 25 years.

[2]Determined by applying the percentages listed in *Tables 3.5-1* and *3.5-2* for the sample of six reservoirs to the whole reservoir system.

Figure 4.3-1. Anticipated Changes[1] in Vegetation Types Within 25 Feet of the Shoreline Under Alternative B1.

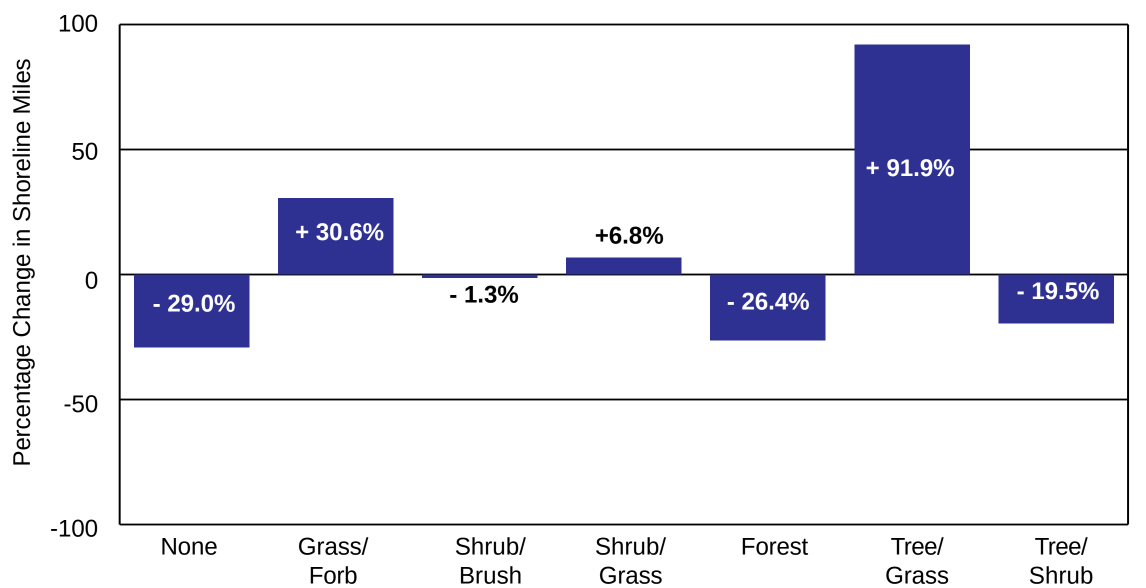


[1]Within the next 25 years.

forest area and tract size result from clearing for house sites, establishment of lawns, and construction of access roads. Although some of these decreases would likely occur independently, residential shoreline development would affect the timing and location of these changes. Impacts to both forest area and tract size under Alternative B1 would be significant in agricultural and urban counties where shoreline forests make up a large proportion of the total forested land.

Adoption of **Alternative A** would result in the greatest impacts to shoreline vegetation, and most of the developed shoreline would eventually resemble current, developed flowage easement shoreland. These impacts would be significant, especially in agricultural and urban counties where shoreline forests make up a large proportion of the total forested land. Anticipated changes to vegetation types within 25 feet of the shoreline *(Table 4.3-1, Figure 4.3-2)* would include the conversion of about a quarter of the shoreline in the forest type to the tree/grass type (which would almost double in length) and a 31 percent (191 miles) increase in the grass/forb type. The total length of wooded shoreline (sum of the forest, tree/grass, and tree/shrub types) would decrease by about 146 miles. The increase in the proportion of nonnative plant species would be greatest under this alternative.

Figure 4.3-2. Anticipated Changes[1] in Vegetation Types Within 25 Feet of the Shoreline Under Alternative A.



[1]Within the next 25 years.

Under Alternative A, there would generally be no restrictions on vegetation clearing within flowage easement or TVA-owned residential access shorelands. Therefore, the decrease in forest area within one-fourth mile of the shoreline would be somewhat greater than the 10 percent (21,800 acres) predicted under Alternative B1. The decrease in tract size of contiguous blocks of forest within one-fourth mile of the shoreline would be the greatest of any alternative and equal to that expected under Alternative B1.

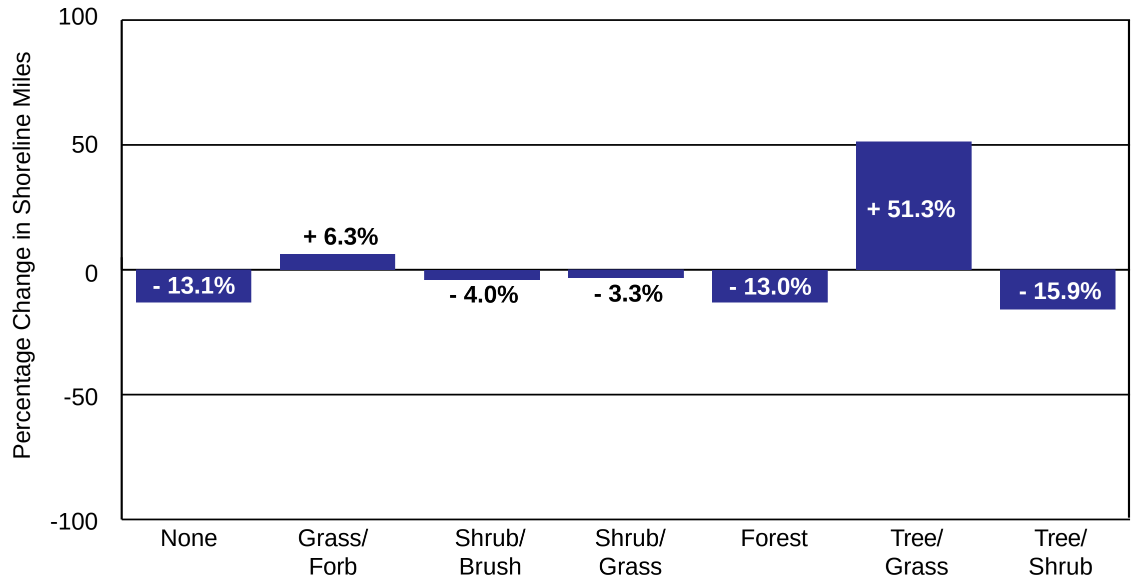
Adoption of **Alternative B2** would result in impacts similar to those of Alternative B1, but over a smaller area. The greatest anticipated change to vegetation types within 25 feet of the shoreline *(Table 4.3-1, Figure 4.3-3)* would be an increase of about 51 percent (1,023 miles) in the managed tree/grass category. Forests within 25 feet of shoreline would decrease by 13 percent (909 miles), and the total length of wooded shoreline (sum of the forest, tree/grass, and tree/shrub types) would show very little change.

Alternative B2 would result in about a 6 percent decrease in forest area within one-fourth mile of the shoreline. The tract size of contiguous blocks of forests would undergo a moderate decrease.

Alternative C1 would result in reduced impacts to shoreline vegetation compared to Alternatives A, B1, and B2. Impacts from development of TVA-owned shoreline would be substantially reduced, compared to those resulting from development of flowage easement shoreland and backlying private lands. Active vegetation management would be limited to understory removal within the vegetation management corridor, and the rest of the TVA-owned residential access shoreland would remain forested or eventually revert to forest. Projected changes in vegetation types within 25 feet of the shoreline *(Table 4.3-1)* are based on the following assumptions:

- Adjacent landowners would maintain the widest possible vegetation management corridors (i.e., along 20 percent, or 220 miles, of TVA-owned residential access shoreland that is now undeveloped).
- Future developed flowage easement shoreland would resemble that which is currently developed.

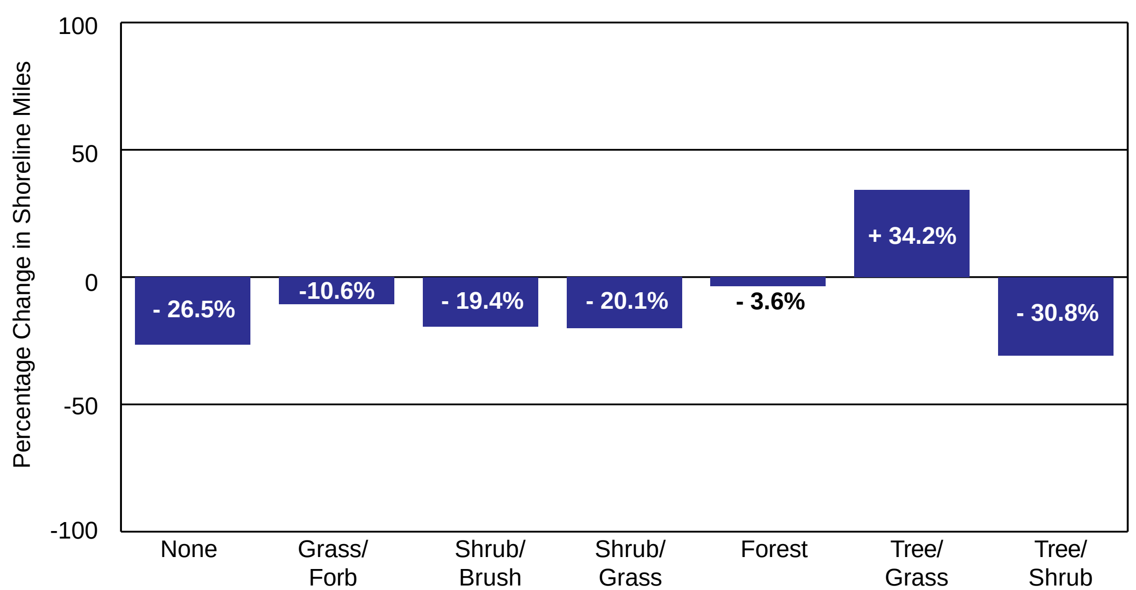
Figure 4.3-3. Anticipated Changes[1] in Vegetation Types Within 25 Feet of the Shoreline Under Alternative B2.



[1]Within the next 25 years.

Assuming that virtually all of the additional shorelands opened for residential shoreline development would eventually be forested, Alternative C1 would result in about a 4 percent (253 miles) reduction in the forest vegetation type within 25 feet of the shoreline *(Table 4.3-1, Figure 4.3-4).* However, the total length of wooded shoreline (sum of the forest, tree/grass, and tree/shrub types) would increase by 222 miles. This is due to a 34 percent (682 miles) increase in the tree/grass type which offsets decreases in the forest and tree/shrub types.

Figure 4.3-4. Anticipated Changes[1] in Vegetation Types Within 25 Feet of the Shoreline Under Alternative C1.

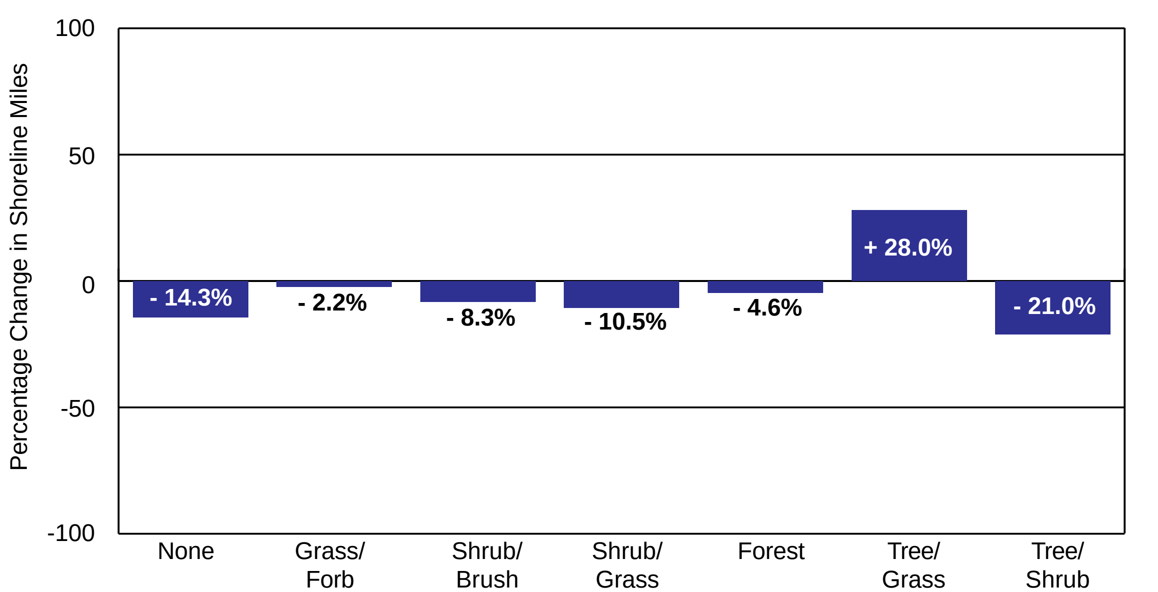


[1]Within the next 25 years.

Because much of the reforestation would likely be limited to TVA property, the proportion of forest and the tract size of contiguous blocks of forest within one-fourth mile of the shoreline would decrease to levels between those of Alternatives B1 and B2. Forest area would decrease about 7 to 8 percent. The proportion of nonnative plant species would likely increase within vegetation management corridors, as well as in adjacent unmanaged areas. The overall increase in nonnative plants would be greater than under Alternatives C2 and D and less than under the other alternatives.

Alternative C2 would result in about a 5 percent (323 miles) decrease in the length of forested shoreline *(Table 4.3-1, Figure 4.3-5)*. This prediction is based on the same assumptions about vegetation management corridors and flowage easement shorelands as described for Alternative C1. The reduction in forested shoreline would be slightly greater than under Alternative C1 because no additional shoreland would be opened for development under Alternative C2. As a result, clearing of flowage easement shoreland would offset reforestation of other shoreland more than under Alternative C1. The tree/grass category would increase by 28 percent (560 miles) and the tree/shrub category would decrease by 21 percent (141 miles). The total length of wooded shoreline (sum of the forest, tree/grass, and tree/shrub types) would increase by 95 miles due to reforestation. The increase in nonnative plant species would be less than under Alternatives A, B1, B2, or C1.

Figure 4.3-5. Anticipated Changes[1] in Vegetation Types Within 25 Feet of the Shoreline Under Alternative C2.



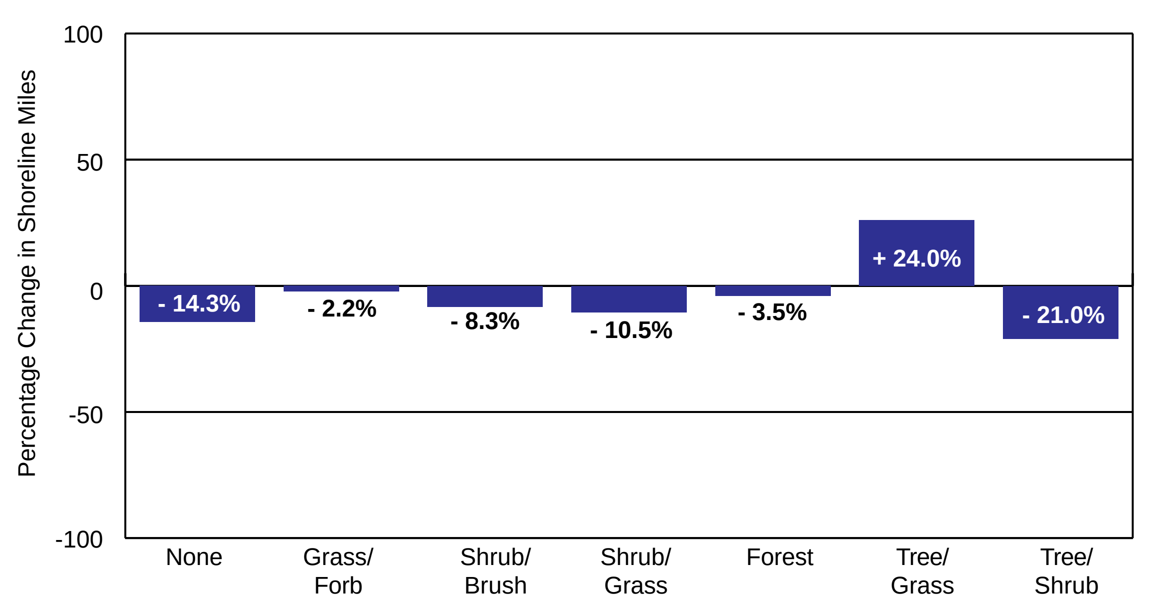
[1]Within the next 25 years.

Forest area within one-fourth mile of shoreline would decrease slightly less than under Alternative B2, and tract size of contiguous blocks of forest would decrease less than that predicted for the Blended Alternative. These decreases would be second lowest of all alternatives.

The **Blended Alternative** would result in the second lowest level of impacts to shoreline vegetation; overall, the impacts would not differ greatly from those resulting from Alternative C2. For purposes of describing these impacts, it was assumed that homeowners would maintain a 20-foot cleared access/visual corridor through a forested 25-foot-deep SMZ on TVA-owned residential access shoreland. Clearing of poison ivy and other plants specified by TVA and pruning of low tree limbs would be allowed in the SMZ. Selective thinning of trees less than 3 inches in diameter, clearing of certain understory plants, and pruning of low tree limbs would be allowed on TVA lands beyond the SMZ.

As with Alternatives C1, C2, and D, areas along newly developed TVA-owned shoreline and within 25 feet of the water in the grass/forb or shrub-dominated vegetation types would eventually become forested. The access/visual corridor would most likely have a grassy understory and partial-to-closed forest canopy. The understory in parts of the SMZ would be open because of the removal of specified understory plants and pruning of low tree limbs. The increase in shoreline forest, however, would be offset by development of flowage easement shoreland. The net result would be a decrease in the forest vegetation type of about 4 percent (242 miles) and a 24 percent (479 miles) increase in the tree/grass vegetation type within 25 feet of the shoreline *(Table 4.3-1, Figure 4.3-6)*. The total length of wooded shoreline would increase slightly (1 percent).

Figure 4.3-6. Anticipated Changes[1] in Vegetation Types Within 25 Feet of the Shoreline Under the Blended Alternative.



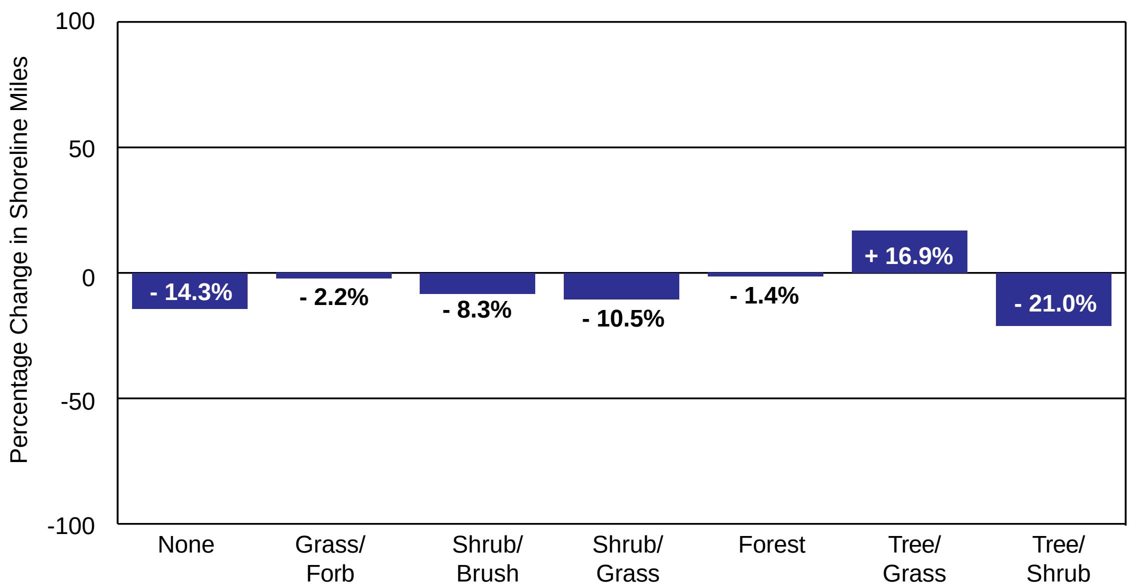
[1]Within the next 25 years.

Under the Blended Alternative, TVA-owned residential access shoreland outside of the 25-foot-deep SMZ would eventually resemble the shoreland under Alternatives B1 or B2. Forest area within one-fourth mile of the shoreline would decrease by about 5 to 6 percent. The tract size of contiguous blocks of forests would undergo a moderate decrease to a level between that of Alternatives C2 and B2. Understory clearing would encourage the invasion of exotic species, as with Alternatives B1 and B2. It would also inhibit tree reproduction, contributing to the long-term loss of forest cover.

Alternative D would result in the lowest level of impacts to shoreline vegetation. Areas along newly developed TVA-owned shoreline in the grass/forb or shrub-dominated vegetation types would eventually become forested, and the 6-foot-wide access paths would have little impact on vegetation. The increase in shoreline forest, however, would be offset by development of flowage easement shoreland. The net result would be a small (1 percent, 101 miles) decrease in forest within 25 feet of the shoreline *(Table 4.3-1, Figure 4.3-7)*. The tree/grass vegetation type would increase 17 percent (337 miles) and the tree/shrub type would decrease 21 percent (141 miles).

Under Alternative D, most reforestation would likely be limited to the immediate shoreline. Therefore, the proportion of forest and the tract size of contiguous blocks of forest within one-fourth mile of the shoreline would continue to decrease. These decreases, however, would be slightly less than those predicted for Alternative C2 and the least of all the alternatives. This alternative would result in the lowest level of impacts from nonnative plants.

Figure 4.3-7. Anticipated Changes[1] in Vegetation Types Within 25 Feet of the Shoreline Under Alternative D.



[1]Within the next 25 years.

Summary of Impacts to Vegetation

Under most of these alternatives, the anticipated residential shoreline alterations would result in significant impacts to vegetation. Residential development, however, is only one of several uses impacting shoreline vegetation. Other uses include industrial development, public and commercial recreational development, forest management, and agricultural practices. Industrial and recreational development can greatly impact vegetation, although these impacts usually occur on relatively short stretches of shoreline.

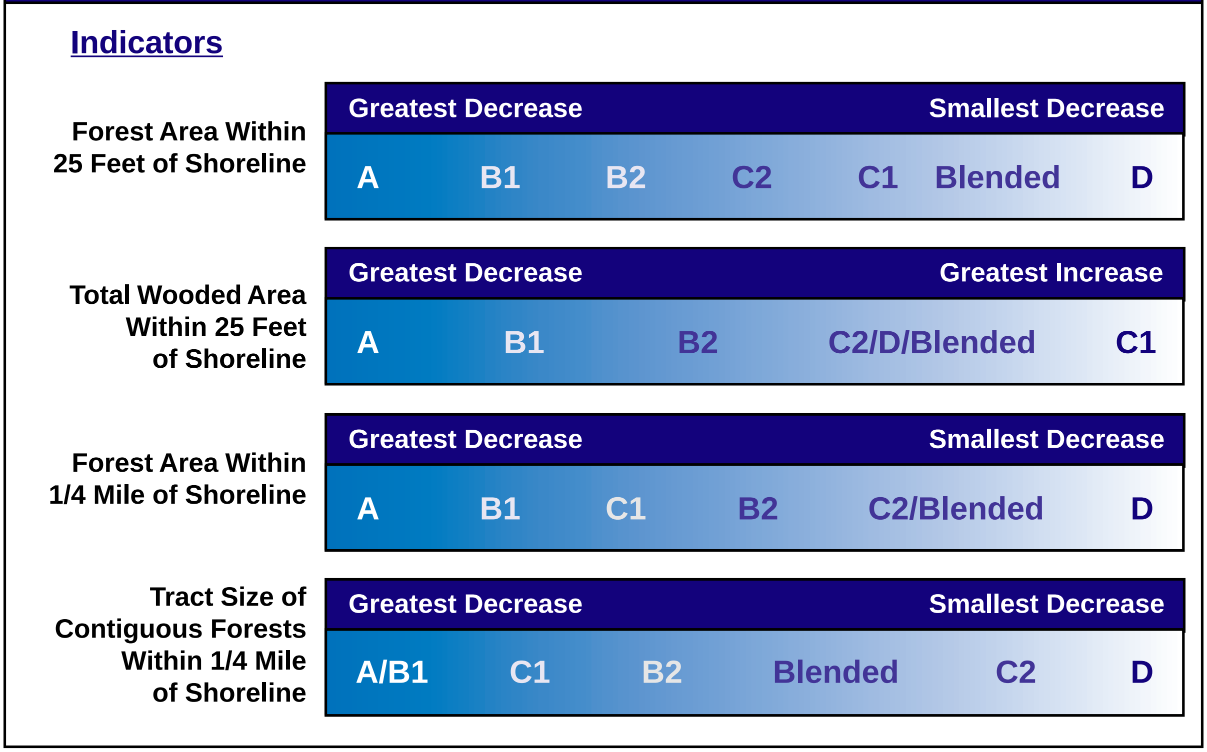
Forest management and agricultural practices both occur along extensive stretches of shoreline. Less than 1 percent of TVA-owned lands, however, are annually affected by forest management activities. Forest management generally does not result in long-term changes to shoreline vegetation, aside from sometimes changing the tree species present or from the intentional reforestation of open areas. Impacts to shoreline vegetation from agricultural practices have decreased as the area of farmland has declined and shoreline buffer strips have been established along sections of TVA-owned shoreland leased to private farmers.

The cumulative impacts to shoreline vegetation would be similar to these direct effects. Shoreline development, as well as development of backlying lands, would continue over the next 25 years and would gradually change the amount and composition of shoreline vegetation. These impacts, both direct and cumulative, would be significant under all alternatives because of the large area affected.

4.3.3 Relative Impacts of the Alternatives

The relative impacts to shoreline vegetation under the seven alternatives are shown in *Figure 4.3-8*.

***Figure 4.3-8. Relative Impacts of the Alternatives on Shoreline Vegetation.*[1]**



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.4 <u>Effects on Wildlife</u>

4.4.1 <u>Introduction</u>

The various alternatives would impact wildlife populations through:

- Changes in the species composition and structure of shoreline vegetation.
- Increases in forest fragmentation and edge effects.
- Increased human activity along shorelines.
- Effects on lands managed for natural resources conservation.
- Increased populations of predatory mammals.

From a cumulative impacts perspective, fragmentation of wildlife habitat is a serious problem. Fragmentation results when a large expanse of relatively uniform habitat is transformed into one or more smaller remnants. Its effects on animals vary with the habitat requirements of the species under consideration. In eastern North America, fragmentation effects are best known for birds. Many birds require contiguous areas of forest of up to a few hundred acres or more (Robbins et al., 1989). A large proportion of these area-sensitive species are neotropical migrants, many of which have declining population trends. Forest fragmentation has been identified as a cause of these population declines (Askins et al., 1990; Robinson et al., 1995).

Although many of the contiguous forested tracts along TVA's shoreline are too small (Section 3.5.3) to support all of the potentially occurring species, a number of large shoreline tracts do exist, especially within the TVA-owned-and-managed and the TVA-owned-and-jointly-managed shoreland categories. As described in Section 4.3, residential shoreline development would decrease the size of contiguous forested tracts. This increase in fragmentation would have an effect on many wildlife species.

The value of shoreline forests in supporting diverse wildlife populations also increases with their width (Keller et al., 1993). Relatively narrow shoreline forests, however, can serve as corridors connecting larger forested tracts. These corridors may be important at a landscape scale by providing a means for species to move between forested tracts, increasing both the number of wildlife species present and the viability of their populations (Saunders and Hobbs, 1991). Residential shoreline development could eliminate forested shoreline corridors and indirectly impact wildlife populations of larger, remaining forested tracts.

An edge is the junction of two different habitats, such as forest and lawn. Many species are adapted to edges, and increasing edge has been a traditional wildlife management objective. The number of species present within an edge tends to be higher than within adjacent areas of homogeneous habitats (Yahner, 1988). Increasing forest edge, however, can adversely impact many species, especially those requiring large contiguous tracts of forest or other habitats. Many predators concentrate their activities along edges, and the rate of parasitism of bird nests by brown-headed cowbirds is highest near edges. These effects can extend several hundred feet into the forest (Wilcove, 1985), reducing its suitability for area-sensitive species and contributing to the adverse impacts of forest fragmentation.

Residential shoreline development can have other effects on wildlife populations. Friesen et al. (1995) found that bird populations in forested tracts decreased as the density of houses within 110 yards of the forested tracts increased. The most pronounced decrease was in neotropical migrant birds, and the effect of housing density was greater than the effect of forest tract size on bird populations.

A likely reason for this effect on forest birds is the increase in local populations of predatory mammals, both those kept as pets (e.g., house cats and dogs) and native species such as raccoons. Cats and dogs frequently kill small mammals and ground-dwelling birds and can depress their populations in suburban areas (Churcher and Lawton, 1989). Dogs prey on several animals and frequently chase deer. Raccoons are an omnivorous species and a frequent nest predator whose local numbers may increase in the presence of accessible garbage cans and bird feeders. The impacts of these predators would likely occur under all alternatives. Their magnitude would increase with the density of development, the number of unrestrained cats, and the availability of food sources for raccoons. None of these factors are directly addressed by the alternatives, although they could be locally significant.

4.4.2 Effects of the Alternatives

For each alternative, this section first describes the effects on forest wildlife populations, and then the effects on wintering waterfowl habitat.

Alternative A would result in the greatest impacts to wildlife, especially waterfowl and wildlife species inhabiting forests. At the maximum 63 percent buildout, removal of the understory from about 1,850 miles of shoreline forest *(Table 4.3-1)* would reduce habitat required by several species such as the wood thrush and Kentucky warbler. The 191-mile increase in shoreline dominated by lawns would impact forest wildlife by increasing local populations of brown-headed cowbirds, a nest parasite on several forest-inhabiting birds. Removal of forest understory and clearing for lawns would also eliminate many shoreline forested corridors, resulting in cumulative impacts.

Forest wildlife populations would be further impacted by the reduction in forest area (greater than 10 percent) within one-fourth mile of the shoreline and by the decrease in the average size of contiguous forested tracts. Because of the compounding effects of forest fragmentation and edge effects, impacts to forest wildlife populations would be cumulative and greater than those resulting solely from the reduction in forest area. Populations of several species requiring large tracts of forest, as well as several birds that are vulnerable to cowbird parasitism, are declining in the region, and this alternative would contribute to the decline. Impacts to wildlife from loss of forest habitat would be most significant in counties where shoreline forest makes up a large proportion of the total forested land, while the impacts from increased cowbird populations would be most significant in heavily forested counties.

Alternative A would result in regionally significant impacts to waterfowl populations. Resident Canada geese would benefit from the increase in shoreline lawns, which provide attractive feeding areas when mowed to the water's edge. However, these geese are presently a nuisance on some reservoirs. Residential shoreline development would also eliminate some areas presently suitable for goose hunting (the primary method of controlling their increasing population). The increase in goose habitat and reduced population control would likely result in more widespread conflicts between geese and humans.

Impacts to other waterfowl species would generally be negative and result from removal of shoreline vegetation, impacts to shoreline wetlands, and the increased human presence along the shoreline. The proportion of wintering waterfowl habitat in the moderate and high suitability classes *(Figure 3.6-1)* would be reduced by at least half. This direct effect on dabbling duck populations would be compounded by impacts to waterfowl refuges and management areas. These impacts would come from residential development of adjoining land in addition to portions of the management areas. Also, potential cumulative impacts would likely be significant because of the location of the reservoirs along the migration routes of several species.

A few species besides Canada geese would benefit from Alternative A. The extensive residential shoreline development would increase habitat for species such as the raccoon, American robin, northern mockingbird, song sparrow, and house finch, which are adapted to suburban habitats. A few species using scattered shoreline trees, such as the eastern kingbird and common grackle, would also benefit. Currently, populations of most of these species are relatively stable or increasing in the region.

Alternative B1 would have slightly less impact on forest wildlife populations than Alternative A because of shoreline vegetation management constraints on TVA-owned shorelands. Much of the understory would be removed from about 1,829 miles of shoreline forest. The number of shoreline miles in the tree/grass vegetation type would almost double. These changes would affect species requiring forest understory such as the wood thrush and Kentucky warbler. Shoreline in the grass/forb category would increase by about 114 miles due to clearing for lawns. Removal of forest understory and clearing for lawns would also eliminate many shoreline forested corridors, resulting in cumulative impacts.

Effects on forest wildlife habitat within one-fourth mile of the shoreline would be similar to those of Alternative A. The combined effects on shoreline forests, forest area, and forest tract size would be most significant in counties where shoreline forest makes up a large proportion of the total forested land, while the impacts from increased cowbird populations would be most significant in heavily forested counties.

The impacts to wintering waterfowl habitat resulting from Alternative B1 would be similar to those from Alternative A. The proportion of wintering waterfowl habitat in the moderate and high suitability classes would decrease by about half. Impacts to existing waterfowl refuges and management areas would be significant. Also, potential cumulative impacts would likely be significant. The increase in resident Canada goose populations, as well as other species using suburban habitats, would be slightly less than under Alternative A.

Alternative B2 would result in lower impacts to forest wildlife populations than Alternative B1, because fewer shoreline miles would be developed *(Table 4.2-1)*. Site-specific impacts would be similar. Much of the understory would be removed from 909 miles of forested shoreline, and about 6 percent of the forest area within one-fourth mile of the shoreline would be cleared. These decreases may not have significant regional impacts on forest wildlife. However, they would have locally significant impacts, both direct and cumulative, in counties where shoreline forests make up a large proportion of the total forested land. These impacts also would be significant on reservoirs where a high proportion of the shoreline is currently available for residential access, such as Beech River Project, Boone, Chatuge, Douglas, Fort Loudoun, and Wilson *(Table 1.4-1).*

The adverse impacts of Alternative B2 on most waterfowl would occur from shoreline clearing, impacts to wetlands, and increased human disturbance. Wintering waterfowl habitat in the moderate and high suitability classes would decrease by about 25 percent, which would be locally significant. As with Alternatives A and B1, resident Canada geese would benefit from the increase in lawns adjacent to the shoreline.

Alternative C1 would result in lower impacts to wildlife than Alternatives A and B1 and would have somewhat greater impacts than Alternative B2. Most impacts to forest wildlife populations would occur on backlying portions of residential developments and along flowage easement shorelands. Because more shoreline could be developed, the amount of forest lost within one-fourth mile of the shoreline would likely be about 7 to 8 percent, somewhat greater than under Alternative B2. Forest tract size would also decrease, although the maintenance of more wooded shoreline would slightly reduce this effect. Except for flowage easement shorelands, a forested strip would remain or gradually develop along most of the other newly developed shorelands. Although this forested strip would have a high proportion of edge, its net effects to forest wildlife would be beneficial. Overall impacts to forest wildlife populations would be locally important in the few counties with a high proportion of flowage easement shorelands and where shoreline forests make up a large proportion of the total forest area.

Wintering waterfowl habitat in the moderate and high suitability classes would decrease by about 25 percent. It would be locally significant in a few flowage easement shoreland areas. The maintenance of a wooded shoreline along other residential shorelands and the process for selecting additional developable lands (Section 2.5.1) would reduce impacts elsewhere. The increase in resident Canada geese would be less than Alternatives A, B1, and B2, and limited to flowage easement shorelands.

The **Blended Alternative** would result in the third lowest level of impacts to wildlife populations. Impacts to forest wildlife populations would be greatest along flowage easement shorelands and backlying private lands. The reduction in forest area within one-fourth mile of shoreline would be slightly less than Alternative B2. On TVA-owned residential access shorelands, the 25-foot SMZ and protection of overstory trees would reduce impacts from forest fragmentation. Much of the shoreland, however, would have limited value to forest wildlife because of the allowable removal of understory vegetation. As with Alternative B2, this could result in locally significant impacts to forest wildlife.

Wintering waterfowl habitat in the moderate and high suitability classes would decrease to a level between those resulting from Alternative C2 (20 percent decrease) and Alternative D (15 percent decrease). This decrease would be concentrated along flowage easement shorelands, where impacts would be locally significant. On TVA-owned residential access shorelands, maintenance of the SMZ would reduce effects on waterfowl from human disturbance. The increase in resident Canada geese would be similar to that resulting from Alternatives C1, C2, and D.

Alternative C2 would result in the second lowest level of impacts to wildlife, and these impacts would be greatest along flowage easement shorelands and backlying lands. The reduction in forest area and forest tract size within one-fourth mile of the shoreline would likely be somewhat less than the 6 percent predicted under Alternative B2. Except for flowage easement shorelands, a forested strip would remain or gradually develop along most of the other newly developed shorelands. Although this forested strip would have a high proportion of edge, its net effects to forest wildlife would be beneficial. Overall impacts to forest wildlife populations would be locally important in the few counties with a high proportion of flowage easement shorelands and where shoreline forests make up a large proportion of the total forest area.

Wintering waterfowl habitat in the moderate and high suitability classes would decrease by about 20 percent. As with Alternative C1, it would be locally significant in a few flowage easement shoreland areas. The increase in resident Canada geese would be similar to that resulting from Alternative C1.

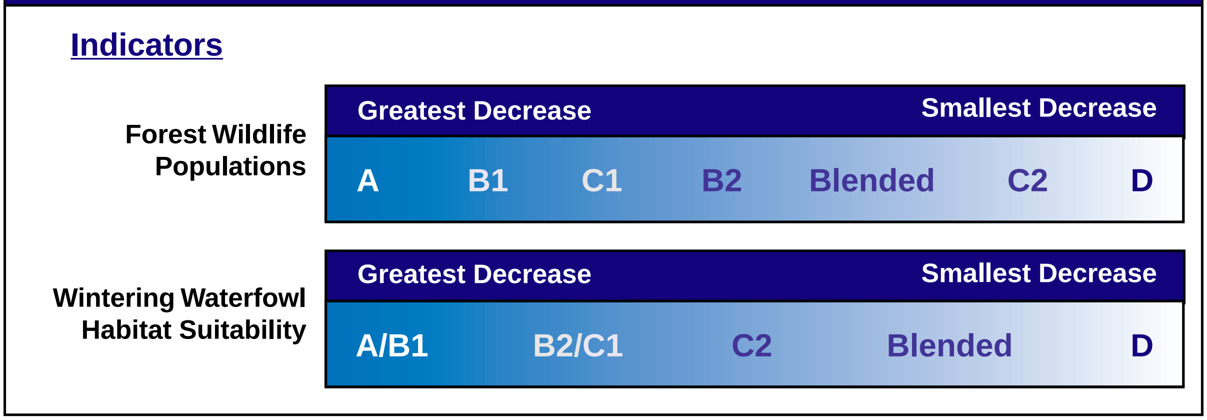
Alternative D would result in the lowest level of impacts to wildlife populations. The major impact would be to forest wildlife and would result from the reduction in forest area and forest tract size caused by residential development on backlying property. The amount of forest lost within one-fourth mile of the shoreline would likely be somewhat less than the 6 percent decrease predicted under Alternative B2. The length of wooded shoreline would increase, and portions of this wooded shoreline would serve as wildlife corridors connecting larger forested areas. However, much of this forested shoreline would have a high proportion of edge, reducing its suitability for some forest wildlife species. Overall impacts to forest wildlife populations would be locally important in the few counties with a high proportion of flowage easement shorelands and where shoreline forests make up a large proportion of the total forest area.

Wintering waterfowl habitat in the moderate and high suitability classes would decrease by about 15 percent. This reduction would be concentrated along flowage easement shorelands, where impacts would be locally important. The increase in resident Canada geese would be similar to that resulting from Alternatives C1, C2, and the Blended Alternative.

4.4.3 Relative Impacts of the Alternatives

The relative impacts to wildlife under the seven alternatives are shown in *Figure 4.4-1*.

Figure 4.4-1. Relative Impacts of the Alternatives on Wildlife.[1]



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.5 Effects on Endangered and Threatened Species

4.5.1 Introduction

Under all alternatives, TVA will continue to comply with the Endangered Species Act of 1973, as amended. All proposed residential shoreline development activities on TVA property and on flowage easement shorelands will be reviewed to determine their potential impacts on endangered or threatened species. Proposals that would likely jeopardize the continued existence of listed species would not be approved. As a result of this review process, direct impacts to the listed terrestrial species, to the Alabama cavefish, and to the spring pygmy sunfish would not occur.

All but 2 of the 17 listed aquatic species occur downstream from dams or in unimpounded stream reaches upstream from reservoirs (Section 3.7). Those occurring upstream from reservoirs would not be affected by the alternatives. Species occurring in tailwater areas potentially could be affected by siltation or other water quality impacts resulting from residential shoreline development. However, because impacts to water quality in tailwater areas are expected to be insignificant (Section 4.10), no effects on listed species in these habitats are anticipated.

Under all alternatives, TVA expects to complete inventories for listed species on flowage easement and TVA-owned residential access shorelands within one year of publication of the SMI Record of Decision. These inventories will be updated and shoreline classifications reevaluated as necessary.

4.5.2 Effects of the Alternatives

Under **Alternatives C1, C2, D,** and the **Blended Alternative,** the presence of federally listed species and high priority state-listed species would be a criterion for including a shoreline segment in the Shoreline Protection category (Sections 2.5.1, 2.6, 2.7.1, 2.8.1, and Appendix C). Then, TVA would manage this protected shoreline as necessary to maintain and recover populations of endangered or threatened species. TVA would also use its education and incentive programs (Sections 2.5.2, 2.7, and 2.8.5) to encourage owners of flowage easement shoreland to protect listed species populations. The shoreline categorization system would not be applied under **Alternatives A, B1,** and **B2**.

Current populations of listed species on reservoir shorelands will be protected from the direct impacts of permitted development activities under all alternatives. Indirect and cumulative impacts to listed species, however, could occur as additional shorelands are developed. These impacts could result, for example, from the loss of foraging habitat for wide-ranging species such as the gray bat and bald eagle.

The development of additional shorelands could also result in the loss of potentially suitable, but presently unoccupied, habitat, thereby inhibiting recovery opportunities for listed species. For example, the populations of some listed species, such as the bald eagle, will likely continue their recovery and expand into previously unoccupied but presently suitable habitat. The recovery of such listed species would be affected if little suitable habitat were present to support their increasing populations. Additional species, many of them currently candidate or special concern species, are also likely to be listed as endangered or threatened in the future. Some of these species would likely occur in locations or habitats not identified by previous shoreline surveys.

TVA is unable to identify the threshold at which cumulative impacts would begin to have an effect on listed species. However, cumulative impacts would be greatest under Alternatives A/B1, which would open large areas to development with minimal or no restrictions on vegetation management and soil disturbance. The level of potential impacts under Alternative B2 would be less than Alternative A/B1 followed by Alternative C1, and Alternatives C2/Blended Alternative. Cumulative impacts would be least under Alternative D, which would maintain much of the predevelopment character of shoreline habitats. All of the alternatives using the shoreline categorization system (Alternatives C1, C2, D, and the Blended Alternative) would result in fewer incremental and cumulative impacts, and consequently improved protection of listed species, than would Alternatives A, B1, and B2.

The threshold at which cumulative impacts would occur is also likely to vary between reservoirs. Variables that would influence cumulative impact thresholds include:

- Present use by endangered or threatened species.
- Amount of potential habitat for listed species.
- Present amount of development.
- Amount of shorelands potentially developable under the different alternatives.

All of these factors would be considered in the development of reservoir-specific management plans (Sections 2.5.1, 2.6, 2.7.1, and 2.8.1). TVA would also work with the USF&WS and state conservation agencies during the planning process. If the planning process indicates a “may affect” situation would occur, TVA would consult with the USF&WS on the need for additional protective measures. Through the adoption of a policy that improves protection for potential habitat of listed species, TVA believes that Alternatives C1, C2, D, and the Blended Alternative would result in enhanced protection and recovery of listed species on reservoir shorelands.

4.5.3 <u>Relative Impacts of the Alternatives</u>

The relative impacts to endangered and threatened species under the seven alternatives are shown in *Figure 4.5-1*.

Figure 4.5-1. Relative Impacts of the Alternatives on Endangered and Threatened Species.[1]

Indicator	Greatest Potential				Lowest Potential
Potential Habitat Loss from Indirect and Cumulative Effects	A/B1	B2	C1	C2/Blended	D

[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.6 Effects on Soils

4.6.1 Introduction

Manipulation of vegetative cover is the most important variable when analyzing effects of the alternatives on the potential for soil erosion. In fact, undisturbed forested watersheds are the generally accepted benchmark of water quality. Adequate shoreline vegetation, such as mature forest, shrubs, grass/forb, or a mixture, works to prevent soil erosion in a number of ways. For example,

- Vegetative cover reduces the force of raindrops, which can remove soil particles and initiate the erosion process.
- Vegetation also slows water runoff, thus reducing the amount of soil dislodged.
- The roots of vegetation form channels in the soil, which improve soil permeability and water infiltration rates. As a result, less water is available for runoff.
- The residue or organic matter from dead vegetation improves soil structure and, therefore, the absorption capability of soils.
- And finally, the root systems of vegetation bind soil particles together, making soil more resistant to erosion.

A healthy stand of woody and herbaceous vegetation around a riparian zone of a reservoir is often referred to as the *shoreline management zone* or SMZ. The SMZ not only minimizes erosion, but also provides the following benefits:

- SMZs are often crucial to protection and enhancement of water resources (Welsch, 1991).
- SMZs are extremely complex ecosystems that help provide food and optimum habitat for shoreline communities.
- SMZs are useful in mitigating or filtering nonpoint source pollution, including sediments, nutrients, pesticides, animal wastes, and other substances that can enter the reservoir as a component of runoff.
- These zones provide shade, which optimizes light and temperature conditions for aquatic plants and animals.
- SMZs also provide organic matter needed to maintain biological diversity in the reservoir.

O'Laughlin and Belt (1995) proposed functional approaches to riparian zone design. Muncy (1992) outlined minimum SMZ widths based on slope of adjacent lands and type of stream or water body. Schueler (1995) outlined vegetation importance, design widths, and buffer education approaches.

4.6.2 Shoreland Soil Erosion

Under **Alternative A**, the potential for shoreland soil erosion would be the greatest. In reviewing permit applications for shoreline alterations, the principal focus would be to ensure minimal impacts to navigation, flood control, and power generation. Sensitive natural resources, such as cultural resources, endangered and threatened species, and wetlands would also be protected. However, there would be no limitations on clearing or manipulation of vegetative cover, except as necessary to protect sensitive resources.

As of 1994, 1,383 miles, or 13 percent of total reservoir shoreline (10,995 miles), had been developed with residential shoreline alterations (see *Table 3.4-1*). Under Alternative A, residential shoreline development could occur on an additional 5,510 miles within 25 years (see *Table 4.2-1*). A wide range of alterations to the shoreline and adjacent SMZ would likely occur at this rate of development. Vegetative cover manipulation, including tree and shrub clearing, understory removal, and mowing, would typically be unlimited, and only sensitive areas would be protected.

On backlying lands, soil-disturbing activities such as road construction and clearing for houses would increase dramatically. Consequently, the potential for shoreland soil erosion would increase substantially. During the construction phase of house and road building, a large amount of sediment would be available for transport due to the lack of vegetative cover. The potential for erosion would fall off somewhat as roads were paved and lawns were established. However, the increased velocity of surface water runoff associated with paved roads would contribute to the erosion potential. Unlimited manipulation of the SMZ would also contribute to this potential, while providing its own source of erosion and sedimentation.

SMI participants expressed concern about wave action from boating and its effects on shoreland soil erosion and bank stability (Section 1.10.7). The wakes associated with recreational and commercial boating are a leading contributor to the erosion problem, and establishment of no-wake zones has often been suggested as a way to reduce these erosive effects. However, the role of establishing and enforcing regulations that could reduce the impact boating has on erosion is a state responsibility. It is questionable whether regulations such as no-wake zones could be implemented and enforced on a large enough scale to have a positive cumulative impact. Therefore, the SMZ would also play a critical role in reducing the harmful effects of wave action on the shoreland. Consequently, erosion impacts on shoreland soils from wave action would be greatest under Alternative A.

Under **Alternative B1**, soil erosion potential would be less than under Alternative A. As with Alternative A, up to 5,510 additional shoreline miles could potentially be opened for residential shoreline development, resulting in significant soil-disturbing activities. Likewise, an SMZ would not be required under this alternative, and mowing and soil-disturbing activities, such as grading, would not be prohibited.

However, the erosion potential would be diminished somewhat by restrictions placed on tree- and shrub-cutting and management of woody understory. Removal of trees and understory would be limited to vegetation less than 3 inches in diameter at ground level. These vegetation management restrictions should result in enough tree canopy and soil-holding root systems to effectively reduce soil erosion compared to Alternative A. For the same reasons, shoreland erosion impacts from wave action would be less than those projected under Alternative A.

Under **Alternative B2**, soil erosion potential would be less than under Alternatives A and B1. Under Alternative B2, residential shoreline development would likely occur on an additional 2,809 miles, and this substantial decrease in shoreline miles potentially developed would reduce the risk of soil erosion, since less soil would be available for transport. However, the potential for shoreland erosion would still be moderately high because of the lack of an SMZ requirement. The types of impacts resulting from this alternative would be comparable to Alternative B1; however, potential cumulative impacts (including the effects of wave action) resulting from Alternative B2 would be reduced significantly.

Under **Alternative C1**, soil erosion potential would be less than under Alternative B2. Residential shoreline development could potentially occur on up to 3,864 additional miles, which is lower than Alternatives A and B1, but higher than Alternative B2. Comparatively, however, this alternative would have a lower potential for shoreland erosion than Alternatives A, B1, or B2 because of the adoption of shoreline development standards (see Section 2.5.2). Under this alternative, a 100-foot-wide SMZ would be maintained where possible. A property owner with a lot at least 100 feet wide would be allowed to establish a vegetation management corridor across TVA land. Manipulation of vegetative cover (i.e., removal of trees up to 5 inches in diameter) and soil-disturbing activities within the SMZ would be limited to the vegetation management corridor. The remainder of the SMZ would be left undisturbed, and potential for shoreland erosion would be greatly reduced for the reasons given in Section 4.6.1. Erosion at the shoreline (i.e., from wave action) would also be reduced due to the soil-holding capabilities of established woody and herbaceous vegetation.

Under the **Blended Alternative**, vegetation removal would increase somewhat when compared to Alternative C2. Like Alternative C2, residential shoreline development would potentially affect up to 38 percent of the shoreline, compared with 48 percent under Alternative C1. When both of these factors are considered, TVA estimates that the potential for soil erosion under the Blended Alternative would fall somewhere between that expected for Alternatives C1 and C2. Under this alternative, a 25-foot SMZ would be maintained on TVA land. At 25 feet, the SMZ is at the minimum depth required to meet water quality objectives, help prevent erosion, and provide aquatic habitat. The vegetation management guidelines in the Blended Alternative are similar to recommendations by Welsch (1991). This author proposes the use of a three-tiered streamside management zone consisting of 15 to 20 feet of undisturbed forest (Zone 1), 60 to 75 feet of managed forest (Zone 2), and a runoff control zone (Zone 3). Welsch recommends grassing or lawn establishment only within Zone 3, and he suggests that this zone be located at least 75 feet from the shoreline. A similar approach is recommended by the Natural Resources Conservation Service and by the Center for Watershed Protection (Schueler, 1995), which recommends a 25-foot-deep streamside zone.

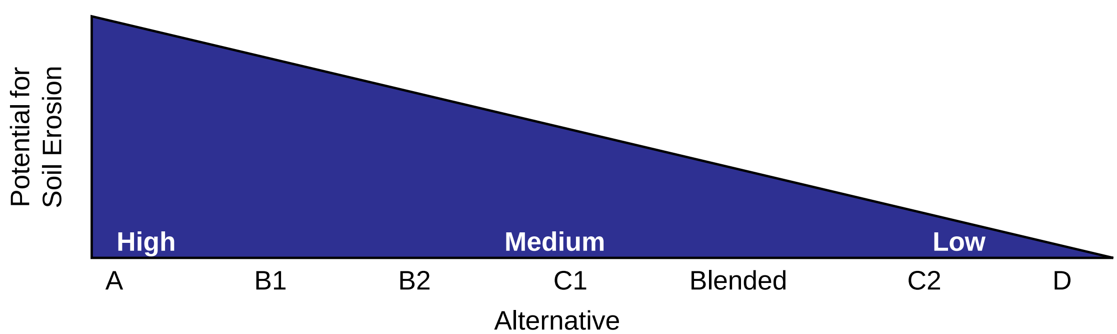
The 25-foot SMZ would be required for new homesites that develop next to forested TVA public land with outstanding access rights. TVA would work with adjacent homeowners to encourage the planting of native trees, shrubs, and plants in those areas where the TVA land is not forested. The SMZ would not be required on private land or on TVA land where permitted shoreline development and lawns now exist. As noted in Section 2.8 of the FEIS, TVA would continue to allow mowing of established lawns. In contrast to Alternatives C1 and C2 (which would allow no vegetation disturbance in the SMZ other than that required for clearing the access corridor), the Blended Alternative would provide for clearing of specified plants — such as poison ivy, Japanese honeysuckle, and kudzu — within the 25-foot-deep zone and elsewhere on TVA land. The Blended Alternative would adopt existing tree-cutting guidelines on the portion of TVA property that is located outside the SMZ. Permits would be required for the thinning of select trees and other vegetation under 3 inches in diameter at ground level. Pruning of side limbs on trees would also be allowed in the SMZ and elsewhere on TVA land.

In some cases, vegetation alone will not curb erosion, and other solutions such as riprap must be used. Many comments were received from landowners who are using these "hard" solutions, and TVA appreciates their past and continuing efforts to minimize erosion on both private and public land. Under the Blended Alternative, TVA would demonstrate biostabilization techniques and would provide technical assistance, when requested, about which erosion control method is best suited for a particular site. Applicants could choose between biostabilization, riprap, and gabions, or some combination of these approaches.

Under **Alternative C2**, shoreland soil erosion potential would be less than under Alternative C1 and the Blended Alternative. Development standards that limit the manipulation of vegetative cover and establish SMZs would be the same as those described for Alternative C1. However, residential shoreline alterations would potentially occur on up to 2,809 additional miles of shoreline, compared to 3,864 miles under Alternative C1.

Under **Alternative D**, shoreland soil erosion potential would be the lowest. TVA would seek to minimize disturbance of existing shorelands by maximizing preservation of natural resources and scenic values. More protective standards for shoreline alterations would be used. All TVA-owned residential access shoreland would be set aside as SMZs. Access to the lake would be limited to a 6-foot-wide pathway. Manipulation of vegetation (i.e., mowing and removal of trees and shrubs) and soil-disturbing activities would also be limited to the 6-foot pathway. As with Alternative C2, residential shoreline alterations would potentially occur on up to 2,809 additional miles of shoreline. The potential for soil erosion would be minimized through standards governing removal of vegetative cover within the SMZ. The effects on shoreland soils from wave action would also be greatly reduced under this alternative. *Figure 4.6-1* illustrates the effect of the range of alternatives on soil erosion potential.

Figure 4.6-1. Range of Soil Erosion Potential by Alternative.[1]



[1]Within the next 25 years.

4.6.3 Shoreline Bank Stability

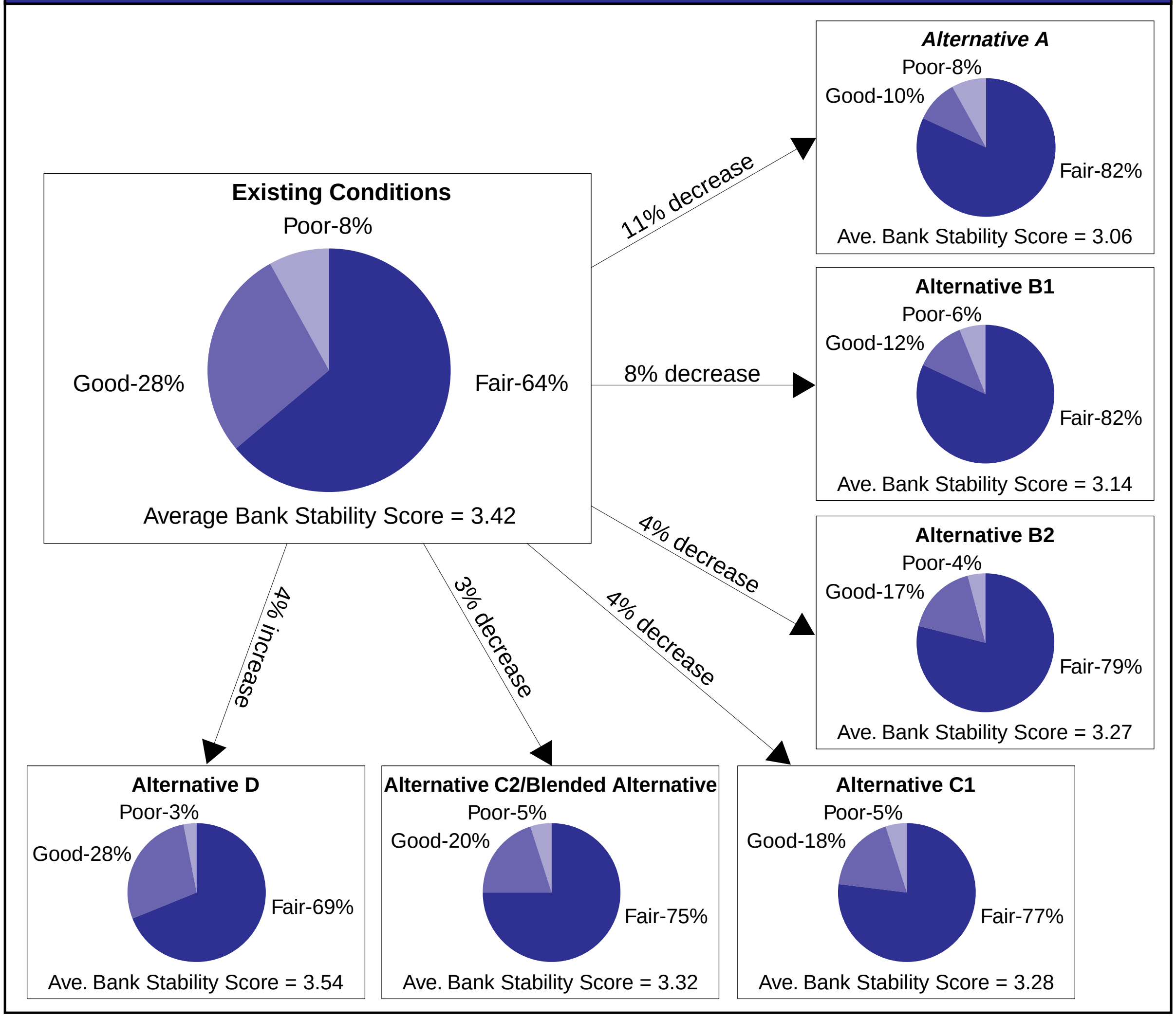
In addition to shoreland soil erosion impacts, shoreline bank stability as it relates to water quality and aquatic habitat was also analyzed. Erosion and sedimentation impacts on water quality and aquatic habitat from residential shoreline development comprise one of the measurements of the SAHI (Section 3.11.4 and Appendix G). Index values were derived from field data collected on four representative TVA reservoirs. When the erosion values for different shoreland uses under each buildout scenario were factored into a model of the entire TVA reservoir system, cumulative impacts varied across the alternatives *(Figure 4.6-2).*

All alternatives, except **Alternative D**, would result in some degradation of shoreline bank stability. This deterioration would result in a lower proportion of shoreline area with “good” bank stability and a larger area with "fair" bank stability. All alternatives, except **Alternative A**, would slightly reduce the areas currently classified with “poor” bank stability. The most severe decline in shoreline bank stability would be under Alternative A. **Alternative B1** would result in a slightly less adverse impact to shoreline bank stability than Alternative A, followed by **Alternatives B2, C1,** and **Alternative C2/Blended Alternative**. Alternative D improves bank stability over existing conditions.

4.6.4 Relative Impacts of the Alternatives

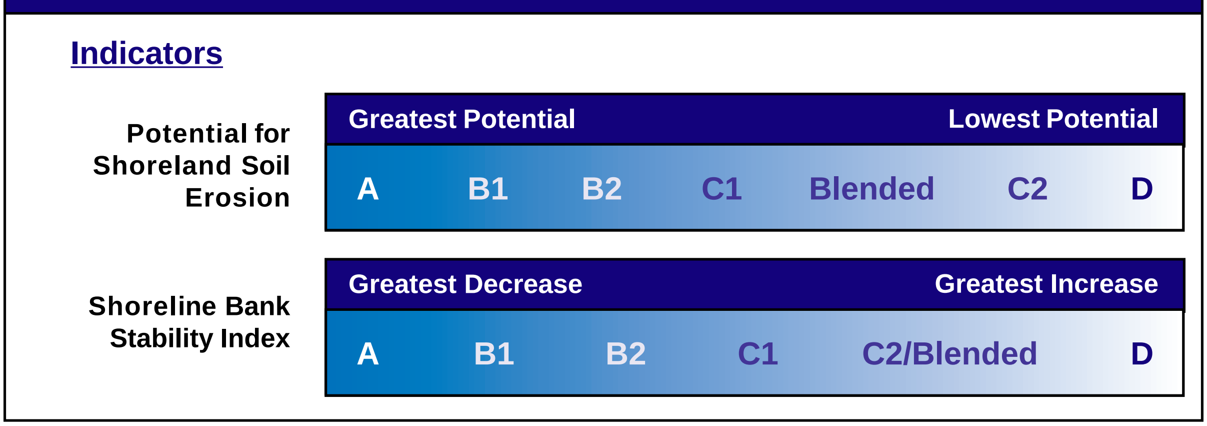
The relative impacts to soil erosion under the seven alternatives are shown in *Figure 4.6-3*.

Figure 4.6-2. Cumulative Impacts[1] of SMI Alternatives on Shoreline Bank Stability.



[1]Within the next 25 years.

Figure 4.6-3. Relative Impacts of the Alternatives on Soils.[1]



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.7 Effects on Wetlands

4.7.1 Introduction

Wetlands are highly productive, biologically diverse ecosystems that frequently occur along TVA reservoir shorelines. In addition to providing habitat for fish and wildlife, wetlands also help control shoreline erosion, improve water quality, and provide recreational opportunities for a variety of lake users.

Under any of the alternatives, TVA would continue to comply with Executive Order 11990 (Protection of Wetlands). Additionally, in accordance with TVA's environmental review procedures,

> TVA takes such actions as may be necessary to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands (TVA, 1983b).

Under these procedures and Executive Order 11990 (Protection of Wetlands), TVA reviews its proposed actions, including requests for uses of shoreline properties adjacent to residential areas, and identifies potential wetlands impacts. In situations where wetlands impacts could occur, TVA develops strategies for minimizing those effects to the extent practicable. For projects that TVA proposes to undertake itself, it would also comply with the Clean Water Act and other applicable legislation.

This assessment of potential impacts to wetlands functions and values is based on a model developed for six representative reservoirs, where acres and types of wetlands *(Table 3.9-1)* occurring within specific shoreline zones (*Figure 3.9-1)* were tabulated.

4.7.2 Effects of the Alternatives

Adoption of **Alternative A** would result in the greatest adverse impacts to shoreline wetlands. Since most wetlands surrounding TVA reservoirs occur on presently undeveloped land, increased residential shoreline alterations on up to 63 percent of the shoreline *(Table 4.2-1)* would result in substantial losses of remaining wetlands functions and values.

Under Alternative A, direct impacts would likely result from some owners of adjacent residential properties removing wetlands vegetation that occurs between the winter pool elevation and maximum shoreline contour. Additionally, nutrients and contaminants entering the reservoir from adjacent residential development would reduce the capabilities of shoreline wetlands for improving water quality (Section 4.10). Furthermore, expanded bank stabilization activities would disturb the substrate and alter the hydrology of shoreline wetlands.

Indirectly, wetlands and associated functions and values occurring on adjacent private lands would be substantially reduced over time. Increased human activity within and near wetlands would reduce biological diversity, as well. Such indirect effects would be most substantial at the local scale, especially in areas of the eastern Valley where TVA's shoreline wetlands provide the majority of the remaining wetlands associated functions and values.

Adoption of Alternative A would also result in the greatest cumulative impacts to wetlands functions (erosion and pollution control and wildlife habitat) and values (recreation, water quality, and aesthetics). This would result primarily from a case-by-case approach of addressing compliance issues associated with Executive Order 11990. Executive order compliance measures for minimizing impacts would protect some key wetlands areas; however, minimization (as opposed to avoidance) would still result in cumulative reductions of current functions and values. This assessment reflects the findings of Holland et al. (1995) regarding impacts of urbanization on wetlands in the vicinity of Portland, Oregon. This study confirmed that wetlands losses continue, despite increased wetlands regulation (e.g., Clean Water Act of 1977 and Oregon's 1985 Removal-F.11 Law) and awareness of the importance of wetlands.

Adoption of **Alternative B1** or **B2** would lead to continued direct, indirect, and cumulative impacts to wetlands from future residential shoreline development. Permit applications for private water-use facilities would continue to be reviewed individually. Under TVA's existing guidelines, progress has been made in slowing the rate of loss of shoreline wetlands. However, considering the increasing number of permit requests, cumulative wetlands impacts would likely increase over time. Additionally, Alternatives B1 and B2 would allow for expanded land- and water-based alterations, resulting in indirect impacts to various wetlands functions and values. Under Alternative B1, substantially more shoreland could be developed for residential shoreline alterations. Consequently, the potential loss of wetlands functions and values would be greater under Alternative B1 than Alternative B2.

Alternatives C1, C2, and the **Blended Alternative** would result in significant reductions in wetlands impacts over time. For these alternatives, wetlands would be protected by applying a shoreline categorization system (Sections 2.5.1, 2.6, 2.7.1, 2.8.1, and Appendix C). Using this approach, significant areas of shoreline wetlands would be identified and protected from future residential shoreline alterations. This would better protect the natural and beneficial functions and values of wetlands.

For Alternatives C1, C2, and the Blended Alternative, only wetlands providing limited functions or values (e.g., very narrow fringe wetlands or those supporting minimal plant diversity) could be allocated for managed development. Residential shoreline development affecting these areas would be approved consistent with prescribed standards for minimizing potential impacts to lower quality wetlands. These standards would be included as conditions to shoreline permits that would be established with owners of adjacent residential properties. TVA would also develop education materials providing information on how property owners could minimize indirect impacts to shoreline wetlands. Additionally, TVA would provide technical assistance that could involve wetlands restoration or creation, especially along severely eroding shorelines. As with Alternatives B2, C2 and D, the Blended Alternative would result in residential shoreline alterations on up to 38 percent of the shoreline Valleywide.

Due to the wetlands protection provisions associated with the shoreline categorization system, anticipated differences in direct wetlands impacts between Alternatives C1, C2, and the Blended Alternative would not be substantial. However, there is a greater likelihood for indirect impacts associated with Alternative C1, since more shoreline could be opened for residential access and shoreline development. These indirect impacts would result in shoreline wetlands with significantly reduced functions (e.g., nutrient/contaminant sequestration) and more limited values (e.g., wildlife observation and aesthetics). Under Alternatives C1, C2, and the Blended Alternative, the rate of wetland loss would be reduced, and wetlands impacts from residential shoreline development are less likely be regionally significant compared to Alternatives A, B1, and B2.

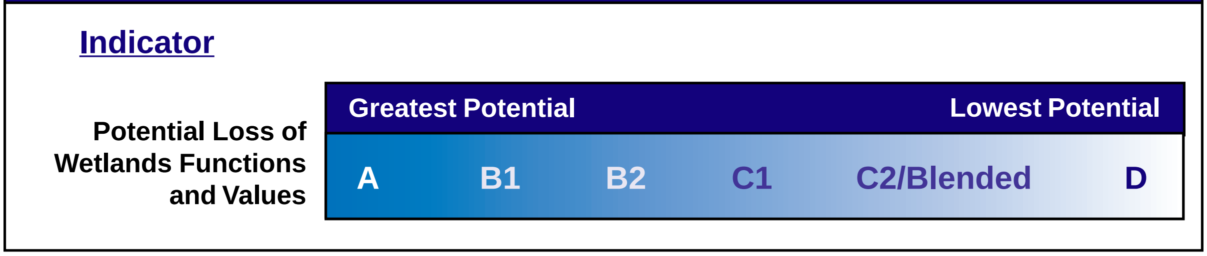
Clearly, **Alternative D** would provide the highest level of protection for beneficial wetlands functions and values. As with Alternatives C1 and C2/Blended Alternative, this alternative would implement a shoreline categorization system, provide for development and distribution of educational materials, and allow for TVA technical assistance in treating eroding shorelines. Furthermore, Alternative D would reduce impacts by limiting the width of vegetation management corridors to the minimum necessary for access (i.e., 6-foot-wide pathways). Because of this, much of the remaining "predevelopment" characteristics of the shoreline (including wetlands) would be maintained.

Despite the impact minimization provisions of Executive Order 11990, impacts to wetlands functions and values would increase as the miles of residential shoreline development increase. Though difficult to quantify on a site-specific or reservoir basis, these impacts could be cumulatively significant. The capability for wetlands impact avoidance afforded by a shoreline categorization system, as provided for in Alternatives C1, C2, the Blended Alternative, and Alternative D, would better protect wetlands functions and values.

4.7.3 Relative Impacts of the Alternatives

The relative impacts to wetlands under the seven alternatives are shown in *Figure 4.7-1*.

Figure 4.7-1. Relative Impacts of the Alternatives on Wetlands.[1]



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.8 Effects on Floodplains/Flood Control

4.8.1 Introduction

Under any of the seven alternatives, TVA will apply criteria contained in Executive Order 11988 (Floodplain Management) during its review of all projects. Executive Order 11988 directs federal agencies to use their authority to avoid (to the extent possible):

- Long-term and short-term adverse impacts associated with the occupancy and modification of floodplains and
- Direct and/or indirect support of floodplain development wherever there is a practicable alternative.

For activities involving TVA lands, a floodplain review is conducted to ensure that the proposed activity is consistent with Executive Order 11988 and TVA's flood damage reduction objectives. Regardless of the alternative implemented, compliance with Executive Order 11988 should prevent an increase in flood damage associated with new residential shoreline alterations and ensure that the reservoir system can be operated for flood control benefits. Under Executive Order 11988, actions with no practicable alternative can proceed, provided adverse impacts are minimized. Adverse impacts to shoreline alterations would be minimized by designing and constructing these alterations to withstand flooding with minimum damage and by using the least amount of fill possible to complete the project. However, residential shoreline alterations could negatively impact natural and beneficial floodplain values (i.e., water quality, wildlife and plant resources, cultural resources, etc.). Potential impacts to natural and beneficial floodplain values are directly related to the amount of shoreland available for development. The use of development standards would help to minimize these impacts.

Shoreline development could also result in increased sedimentation in the reservoirs, which could cause a loss of lake flood control and/or power storage capacity. One source of sediment would be from erosion occurring during construction of the developing areas (Section 4.6.2). In many instances, however, sedimentation would be deposited in the reservoir below the lower limits of flood control and power storage. Therefore, the potential loss of flood control and power storage should be negligible under any of the alternatives.

4.8.2 Effects of the Alternatives

Under **Alternative A**, an additional 50 percent of the shoreline could potentially be developed over the next 25 years *(Table 4.2-1),* and there would be no development standards. Therefore, this alternative would result in significant direct and cumulative impacts to natural and beneficial floodplain values. Many of the values associated with undeveloped floodplains would be lost.

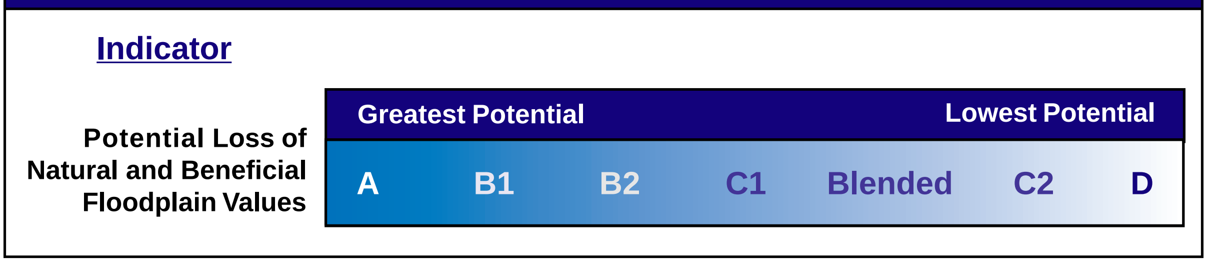
Under **Alternative B1**, adverse impacts to natural and beneficial floodplain values would be less than those expected under Alternative A, because TVA would utilize existing permitting practices to control development (Appendix A). Under **Alternative B2**, direct and cumulative adverse impacts to natural and beneficial floodplain values would be less than those expected under Alternative B1, because fewer miles of shoreline would be developed.

Under **Alternatives C1**, the **Blended Alternative**, **C2**, and **D**, direct and cumulative adverse impacts to natural and beneficial floodplain values should be significantly less than those anticipated under Alternatives A, B1, and B2 because of the use of shoreline development standards (Sections 2.5.2, 2.6, 2.7.2, 2.8.3 and Appendixes D, E, and F) and a shoreline categorization system (Sections 2.5.1, 2.6, 2.7.1, 2.8.1, and Appendix C). Under the Blended Alternative, residential shoreline development could potentially affect up to 38 percent of the shoreline at buildout, compared with 48 percent under Alternative C1. Although development and vegetation management standards would be more stringent under Alternative C1, the additional development possible under this alternative would likely result in greater impacts to floodplains than the Blended Alternative. Alternative C2 and the Blended Alternative would likely result in the same amount of shoreline developed over the next 25 years. Under Alternative C2, impacts would be less than those projected under the Blended Alternative, because more stringent development and vegetation management standards would be implemented. Alternative D would provide the highest level of protection for natural and beneficial floodplain values, because more protective shoreline development standards would be applied.

4.8.3 Relative Impacts of the Alternatives

The relative impacts to floodplains under the seven alternatives are shown in *Figure 4.8-1*.

Figure 4.8-1. Relative Impacts of the Alternatives on Floodplains.[1]



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.9 Effects on Aquatic Habitat

4.9.1 Introduction

Reservoir shoreline areas are extremely important to many sport, commercial, and prey fish species. These regions provide necessary spawning and nursery areas for species such as black bass, crappie, catfish, buffalo-fish, shad, sunfish, minnows, and shiners. Shoreline areas also provide cover for fish and habitats for aquatic invertebrates, which are a food source for other fish species.

Shoreline development can significantly modify the physical characteristics of adjacent fish and aquatic invertebrate habitats, which can result in dramatic changes in the quality of the fish community (Christensen et al., 1996). One of the most detrimental effects of shoreline development is the removal of riparian zone vegetation. Removal of this vegetation can result in loss of fish cover and shade, which in turn elevates surface water temperatures. Also, fish-spawning habitat, such as gravel and woody cover, can be rendered unsuitable by excessive siltation and erosion, which can occur when riparian vegetation is cleared.

Other shoreline development activities include placement of retaining walls or riprap (to stabilize the shoreline), dredging, construction of docks and piers, and clearing of the drawdown zone adjacent to the shoreline (i.e., removal of stumps, brush, logs, boulders, etc.). Some of these modifications result in the degradation of some fish and aquatic invertebrate habitats. However, other changes could actually enhance the habitat of some species.

Riprap Placement

Placement of riprap to stabilize shorelines can result in both positive and negative impacts, depending upon site-specific factors (i.e., type and amount of preexisting cover, slope, soil types, etc.). Riprap does help to reduce erosion, thereby limiting siltation of spawning areas. Additionally, riprap provides spawning areas for catfish and cover for sport fish and their prey, especially in locations where other types of cover are lacking. However, use of riprap often results in only one habitat type, which can decrease species diversity in a given area (Benson, 1980). Indiscriminate placement of riprap can cover or replace gravel and woody habitats which are important spawning and nursery habitats for many fish species.

Dredging

Dredging usually results in negative impacts to aquatic communities, especially when large areas are involved. In addition to substrate removal of shallow, fish-spawning habitat, areas adjacent to the dredged site are often subjected to excessive siltation (Ebert, 1993). However, in a few special situations (i.e., large flats with no deep pockets or lanes), limited dredging (a narrow boat lane) can provide additional cover (i.e., deeper water and access lanes) for fish using spawning flats.

Dock and Pier Construction

Construction of docks and piers, while having short-term negative impacts, can increase fish habitat. Fixed docks and piers, especially those with pilings driven into the substrate, provide shade and cover for fish and aquatic invertebrates (White, 1975). Floating piers provide shade, but only limited cover for fish. However, construction of docks and piers often includes clearing of adjacent riparian vegetation, which results in habitat degradation.

Clearing of Drawdown Zone

Shoreline development often results in other shoreline disturbances, such as clearing stumps, brush, logs, and boulders from the drawdown zone. These activities can result in a significant loss of prime fish and aquatic invertebrate habitat (Cobb and Kaufman, 1993; Hickman, 1975; Marzolf, 1978). On the other hand, aquatic habitat can be enhanced with habitat improvements such as anchored brush piles, rock aggregations, log cribs, and/or other forms of cover.

4.9.2 Representation of Alternatives Using Existing Land Uses

Using the SAHI described in Appendix G, TVA addressed anticipated impacts of the SMI alternatives on associated fish and aquatic invertebrate habitats. This analysis is based on the assumption that shoreline disturbance anticipated under each alternative was accurately represented by some of the land use and vegetation type designations observed during the shoreline soil erosion investigations (Section 3.8.9 and Appendix K).

Existing residential development with grass or grass/forb vegetation types (i.e., “mowed to water’s edge with no trees”) was used to represent **Alternative A**. **Alternatives B1** and **B2** were represented by existing residential development with tree/grass or tree/shrub vegetation types. **Alternatives C1, C2,** and the **Blended Alternative** were best represented by “undeveloped land” with tree, tree/grass, or tree/shrub vegetation types. These areas were used due to a lack of existing residential development indicative of these alternatives (i.e., cleared access corridors approximately 20 feet wide). Forested land was used to represent **Alternative D** (i.e., only a 6-foot pathway to the water).

4.9.3 Effects of the Alternatives

Cumulative effects of nonresidential activities on aquatic habitats would be regionally insignificant. Over the next 25 years, it is estimated that a maximum of 1 percent of additional shoreline could be developed for recreation and 2.2 percent for industrial use. These percentages are especially low when measured against all aquatic habitats in the TVA region, both for TVA lands and on other streams and lakes. However, at the reservoir level and on a case-by-case basis, they could be locally significant. Almost all shoreline-related impacts are anticipated from increases in residential shoreline development, ranging from 25 to 50 percent of the shoreline *(Table 4.2-1).*

During construction of shoreline facilities, the aquatic environment would be directly impacted by siltation and aquatic habitat removal. Habitat elimination would occur through dredging, clearing of the drawdown zone, use of riprap or retaining walls, and placement of docks or piers. Indirect effects to the aquatic environment include potential for increased siltation and water quality degradation due to road construction and associated runoff contamination. These effects are expected to be minimal on both the local and regional scale. Direct and indirect impacts on the aquatic environment were determined by comparing SAHI scores. These scores were based on projections of all land use types (including industrial, recreational, and residential shoreline development) under each SMI alternative.

Varying changes in the physical quality of aquatic habitat in TVA reservoirs are anticipated under the SMI alternatives. As of 1994, 13 percent of reservoir shoreline had been developed with residential shoreline alterations. Under **Alternative A**, residential shoreline development could potentially occur on up to 63 percent of the shoreline over the next 25 years *(Table 4.2-1)*. Potentially 50 percent of existing undeveloped areas could experience a change in quality of available shoreline aquatic habitat. Undeveloped areas include forest land, land previously used for agriculture or pasture land, and informal recreational areas.

Under Alternative A, the average SAHI score is projected to decline from 24.3 under existing conditions to 18.4 at buildout *(Figure 4.9-1)*. Under this alternative, 73 percent of all shoreline aquatic habitat is projected to be fair, 26 percent poor, and 1 percent good.

Under **Alternative B1**, TVA's existing permitting guidelines would be used, but the amount of shoreline potentially developed would be the same as Alternative A. Under this alternative, the average SAHI score is projected to decline to 20.2, with 81 percent of the shoreline aquatic habitat predicted to be fair, 15 percent poor, and 4 percent good. Under **Alternative B2**, up to 38 percent of the shoreline could be developed at buildout, and the SAHI score is projected to be 22.1. Under this alternative, 81 percent of the shoreline aquatic habitat would be fair, 7 percent poor, and 12 percent good.

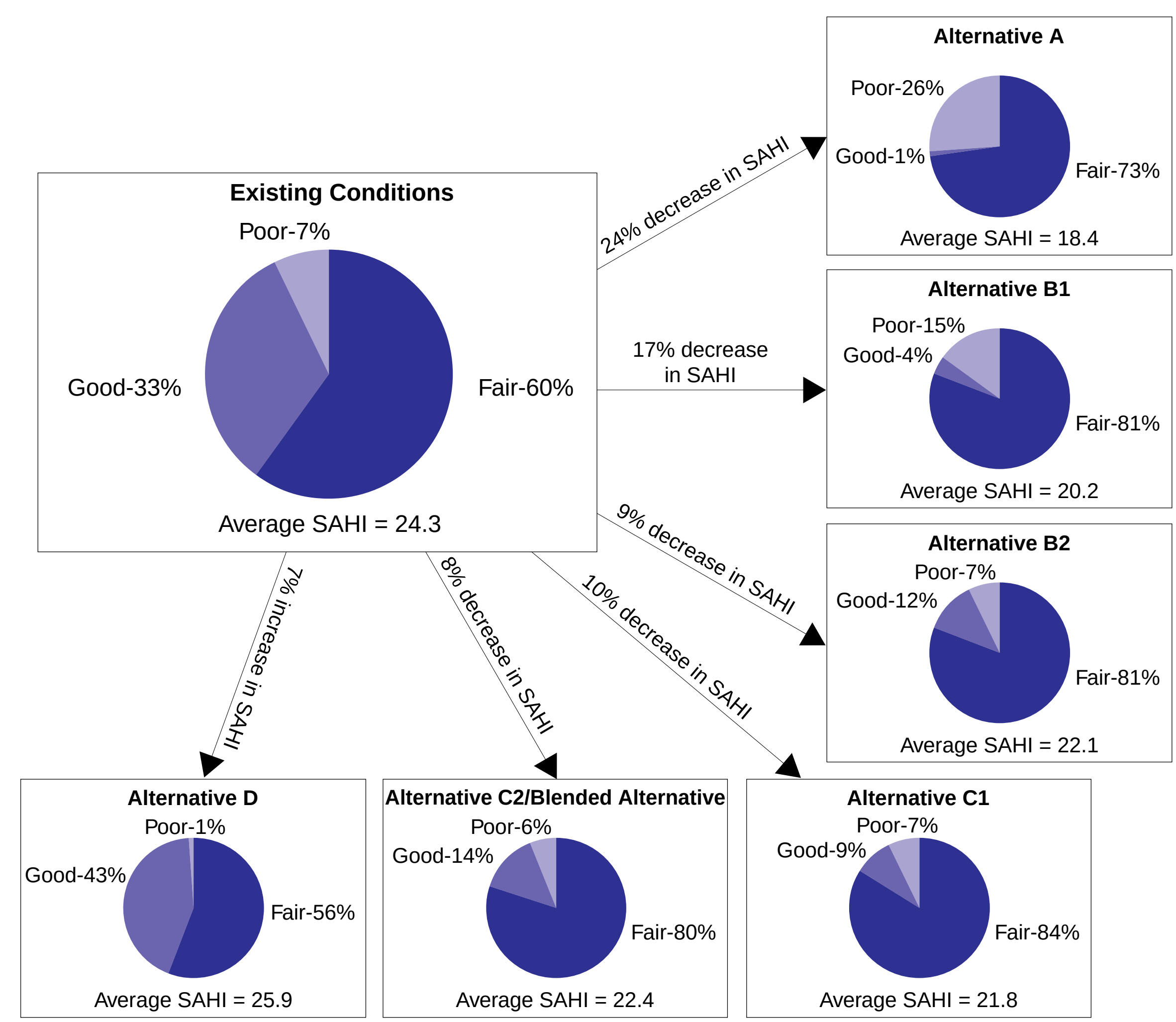
Under **Alternative C1**, the average SAHI score is projected to be 21.8. Shoreline development standards would have a positive impact on aquatic habitat quality, but this score is slightly lower than that anticipated for Alternative B2, because additional shoreline (i.e., 10 percent) could be opened for residential access and shoreline development. Under Alternative C1, 84 percent of shoreline aquatic habitat would be fair, 7 percent poor, and 9 percent good.

Under **Alternative C2** and the **Blended Alternative**, it is anticipated that impacts to aquatic habitat would be similar. Both alternatives could result in residential shoreline development on up to 38 percent of the shoreline at buildout.

Under the Blended Alternative, the SMZ would be left relatively undisturbed and maintained in a forested condition for 25 feet, compared with 100 feet proposed under Alternative C2. The depth of the SMZ proposed for the Blended Alternative, however, would be sufficient to limit adverse impacts to the adjacent aquatic habitat. The SAHI score for Alternative C2/Blended Alternative is projected to be 22.4. Under these alternatives, 80 percent of the shoreline aquatic habitat would be fair, 6 percent poor, and 14 percent good.

Under **Alternative D**, the SAHI score is projected to be 25.9. This slight improvement over existing conditions would be a result of some land changing from agricultural or undeveloped uses to forested SMZs with only a 6-foot pathway for water access. Most shoreline aquatic habitat is projected to be either fair (56 percent) or good (43 percent), with only 1 percent rating poor.

Figure 4.9-1. Comparison of Shoreline Aquatic Habitat Index (SAHI) Ratings for Existing Conditions and Each of the Seven SMI Alternatives.[1]



[1]Within the next 25 years.

In general, habitat quality (as measured by the SAHI) declines under the various SMI alternatives as the management of residential shoreline development decreases. However, projected average SAHI scores remained in the fair category (scores of 17-26) for all alternatives at maximum buildout.

It is apparent from the land use/aquatic habitat surveys of the four representative reservoirs that residential shoreline development generally results in degradation of existing aquatic habitat. These impacts could be mitigated. Incentives could be made available to property owners adjacent to TVA reservoir lands, encouraging installation of beneficial structures, such as brush piles, spawning benches, log cribs, and/or planting of native vegetation (willows, button bush, pondweed, etc.). A 26a permit would be required, and established TVA fish attractor installation guidelines would have to be followed. These incentives could increase the amount of high quality habitat, especially in areas where habitat diversity is limited. However, it is impossible to project what percentage of landowners would participate.

Responses of near-shore biological communities to various levels of impact on aquatic habitat from the SMI alternatives are difficult to predict. Considerable research has been conducted on the importance of diversity and amount of habitat for fish. However, the threshold where populations begin to suffer if habitat continues to deteriorate is unknown. The potential to reach this threshold would be highest under Alternatives A and B1, where development of up to 63 percent of the shoreline could result in adverse aquatic habitat impacts. Limits on the amount of residential shoreline development and adoption of management standards would minimize the potential to reach threshold levels and subsequent negative impacts to the resident fish community.

4.9.4 Relative Impacts of the Alternatives

The relative impacts to aquatic habitat under the seven alternatives are shown in *Figure 4.9-2*.

Figure 4.9-2. Relative Impacts of the Alternatives on Aquatic Habitat.[1]

Indicator

Indicator	Greatest Decrease					Greatest Increase
Comparison of SAHI[2] Scores	A	B1	C1	B2	C2/Blended	D

[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

[2]The SAHI or Shoreline Aquatic Habitat Index measures seven conditions important to healthy sport fish populations: cover, substrate, bank stability, canopy cover, forested buffer strips, diversity of habitat, and amount of dredging.

4.10 Effects on Water Quality

4.10.1 Introduction

USEPA reports to Congress on Section 319 of the Clean Water Act (USEPA, 1989, 1992) stated that siltation and nutrients are the pollutants most responsible for nonpoint source impacts to the nation's surface waters. Residential shoreline development and construction on backlying properties generate both sediment and nutrients which, without proper land use practices, are ultimately carried into reservoirs.

During residential shoreline development, penetrable spaces, which include vegetated and open forested areas, are converted to land uses that usually increase impenetrable surfaces. Natural vegetative cover is stripped from the land, and cut-and-fill activities that enhance the development potential of the land occur. As development increases, there are usually corresponding increases in the volume and rapidity of runoff during storm events.

Direct and indirect effects on water quality from shoreline and associated development accrue during three time phases:

- During initial land disturbance of an area for residential shoreline development, some degree of increased soil erosion and associated reservoir turbidity and siltation may occur, even with the use of best management practices.
- During construction of individual residences on backlying properties, an increase in runoff-related turbidity and siltation may occur. Soil, along with sediment-bound and dissolved nutrients, is mobilized and carried into the reservoir.
- In the third phase, lawns are developed and maintained, and runoff containing fertilizer, herbicides, and pesticides begins and continues indefinitely.

Concurrently, sewage systems begin operation and individual septic systems fill. As shoreline areas develop, nutrients are added, and if septic systems fail, fecal coliform is contributed to the embayment or reservoir.

As noted in Chapter 3, some localized sediments in the river bottoms of the Tennessee River Valley are contaminated with PCBs, DDT, chlordane, dioxin, and/or mercury. However, only a very small percentage of this sediment in the TVA river/reservoir system is contaminated to the point of concern. It is possible that dredging or other sediment-disturbing activities such as construction of water-use facilities in these localized areas could suspend contaminated sediments. This could result in a redistribution of sediment, possibly diluting contaminant concentrations, or it could make contaminants available for transport into aquatic life or to human exposure, depending upon the contaminant involved and ambient water quality conditions. Whenever Section 26a and/or land use permits are required, TVA would ensure pollutant resuspension does not occur or is mitigated to acceptable levels.

4.10.2 Nutrient Enrichment

For each alternative, the amount of an added nutrient (total phosphorus, expressed as mg/L) was examined, using a TVA reservoir-specific nutrient model and land use-specific nutrient export coefficients (Reckhow et al., 1980). The potential for embayment- and reservoir-wide effects was investigated for both tributary and mainstream reservoirs because of differences in shape and depth, water movement, nutrient loading, and responses to nutrient concentrations.

Total phosphorus was chosen as an indicator of general nutrient additions to TVA reservoirs because:

- Phosphorus often limits biological productivity in reservoirs of the Tennessee River Valley.
- Phosphorus is the most critical nutrient for biological productivity added to water bodies in the Tennessee River Valley from nonpoint sources, such as residential shoreline development. In this analysis, the terms *nutrient* and *total phosphorus* are used interchangeably.
- Although nitrogen is an important nutrient in the dynamics of reservoir ecosystems, it is typically in abundance in the Tennessee River basin and is neither the controlling factor for biological communities nor the nutrient source creating nuisance water quality problems.

All alternatives would produce some incremental increase in nutrient levels of TVA reservoirs at buildout. Regardless of the method of sewage treatment, relative nutrient contributions among the alternatives were dependent upon the percentage of developed miles and density of development at buildout, distance of backlying development from the shoreline, individual reservoir characteristics, and whether managed development standards (e.g., SMZs) were included.

For phosphorus concentrations, there is a threshold at which impacts on aquatic communities or undesirable water quality effects are more likely to occur. There is also reasonable agreement that total phosphorus (nutrient) levels in excess of 0.02 mg/L probably indicate some degree of excessive algal growth in lakes. This threshold likely represents a reasonable lower limit for eutrophic conditions. For TVA reservoirs, threshold nutrient levels for development of undesirable water quality conditions are uncertain but could be as low as 0.020 to 0.025 mg/L of total phosphorus (Placke, 1983).

Addition of 0.02 mg/L of total phosphorus to a water body can substantially increase the potential for undesirable effects to water quality (i.e., excessive algal growth) and biological communities. Deviations as small as 0.01 mg/L of total phosphorus may be sufficient (Placke, 1983) to produce changes in aquatic communities.

Embayments

Embayment water quality and aquatic communities are much more sensitive to nutrient additions from residential shoreline development than entire reservoirs because:

- Embayment water volumes available to dilute nutrients are less than those of entire reservoirs.
- Embayments retain water longer (low flushing rates) and are relatively isolated from the flow in reservoir main channels.
- Embayments are typically shallower.
- Embayments are usually more heavily developed.

Under **Alternatives A, B1,** and **B2**, water quality of particular embayments of both mainstream and tributary reservoirs could experience adverse cumulative effects from added nutrients. **Alternatives C1, C2,** the **Blended Alternative,** and **Alternative D** would be much less likely to produce such effects, and in embayments of both mainstream and tributary reservoirs, the impacts on water quality from these alternatives would be essentially the same.

Mainstream Reservoirs. In general, embayments along mainstream reservoirs appear to be slightly less sensitive to nutrient additions from residential development of the shoreline and backlying areas. Under Alternatives A, B1, and B2, nutrients would approach levels necessary to produce notable embayment eutrophication and associated water quality problems *(Figure 4.10-1)*. Under Alternatives C1, C2, the Blended Alternative, and Alternative D, the inclusion of SMZs combined with fewer miles of shoreline developed would likely constrain additional phosphorus concentrations in most mainstream embayments. Under all of the alternatives, phosphorus concentrations would not likely reach a level that would cause eutrophication-related water quality problems, even in conjunction with other nutrient sources.

Tributary Reservoirs. Under Alternatives A, B1, and B2, residential development of the shoreline and backlying areas would result in nutrient contributions in excess of 0.02 mg/L and increase eutrophication of tributary reservoir embayments to problem levels *(Figure 4.10-2).* The result would be greater incidences of high algal production and reduced desirability of the area for water-based recreation. For all alternatives, nutrient additions would approach, and in some cases exceed, 0.01 mg/L and thus produce changes in aquatic communities of tributary reservoir embayments. Water quality and aquatic community responses would be highly site-specific and would need to be evaluated as part of the environmental review process during the preparation of reservoir-specific land use plans.

Reservoir-Wide and Basin-Wide Effects

In assessing cumulative impacts on water quality, both residential and nonresidential sources of pollution were considered. Under any of the alternatives, TVA concluded that the overall cumulative impact would be insignificant at the reservoir and river basin level. None of the alternatives would lead to reservoir-wide cumulative effects on TVA mainstream reservoirs.

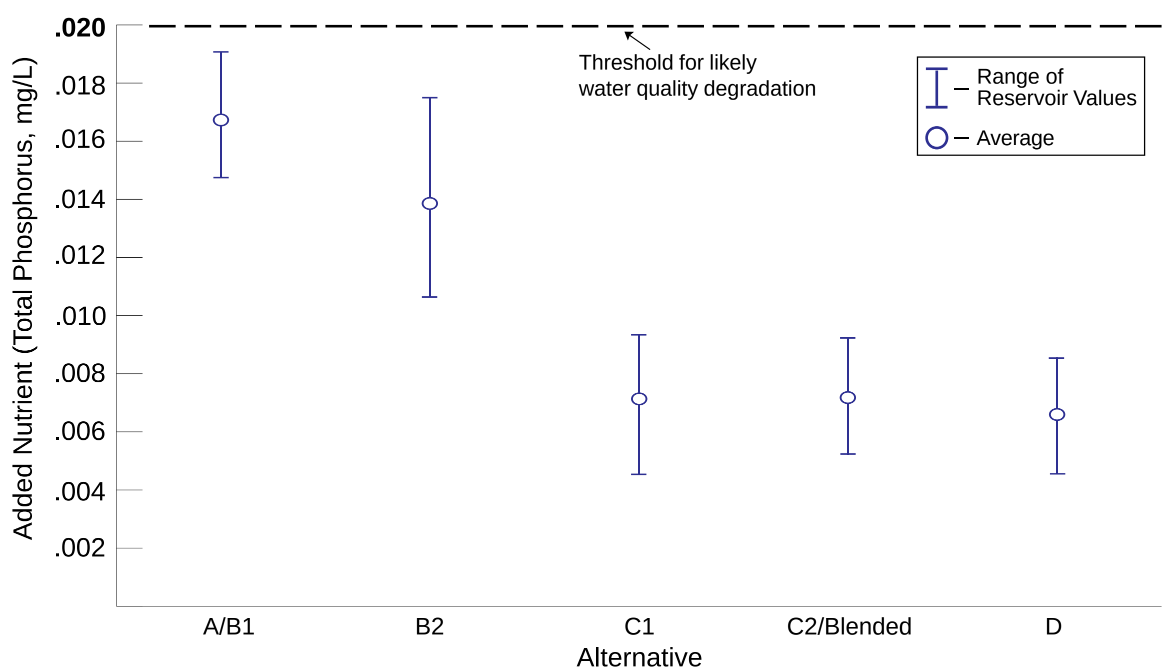
Mainstream Reservoirs. In mainstream reservoirs, nutrient additions from residential development of the shoreline and backlying areas are much too low to produce reservoir-wide changes to aquatic communities or to affect suitability of water for human use *(Figure 4.10-3)*. Residential shoreline development would incrementally add to nutrient loads passing down the Tennessee River system. Elser and Kimmel (1984) demonstrated that greater nutrient availability in one reservoir would pass to the next downstream reservoir in a series. Because of the complexity of in-reservoir phosphorus and nutrient cycling, contributions from residential shoreline development to total nutrient loads passing downstream in the Tennessee River system are unlikely to be discernible from annual variations in total reservoir nutrient additions from all other sources.

Tributary Reservoirs. When considered at the reservoir-wide level, projected nutrient additions to tributary reservoirs from Alternatives A and B1 would result in changes to aquatic communities *(Figure 4.10-4)*. Some reservoirs (e.g., Chatuge) appear sensitive enough that projected nutrient additions from the alternatives could produce increased reservoir-wide eutrophication, resulting in the problems mentioned earlier. Alternatives B2, C1, C2, the Blended Alternative, and Alternative D constrain nutrient additions to levels not likely to produce reservoir-wide impacts to either aquatic ecology or the suitability of waters for human use.

4.10.3 Bacterial Contamination

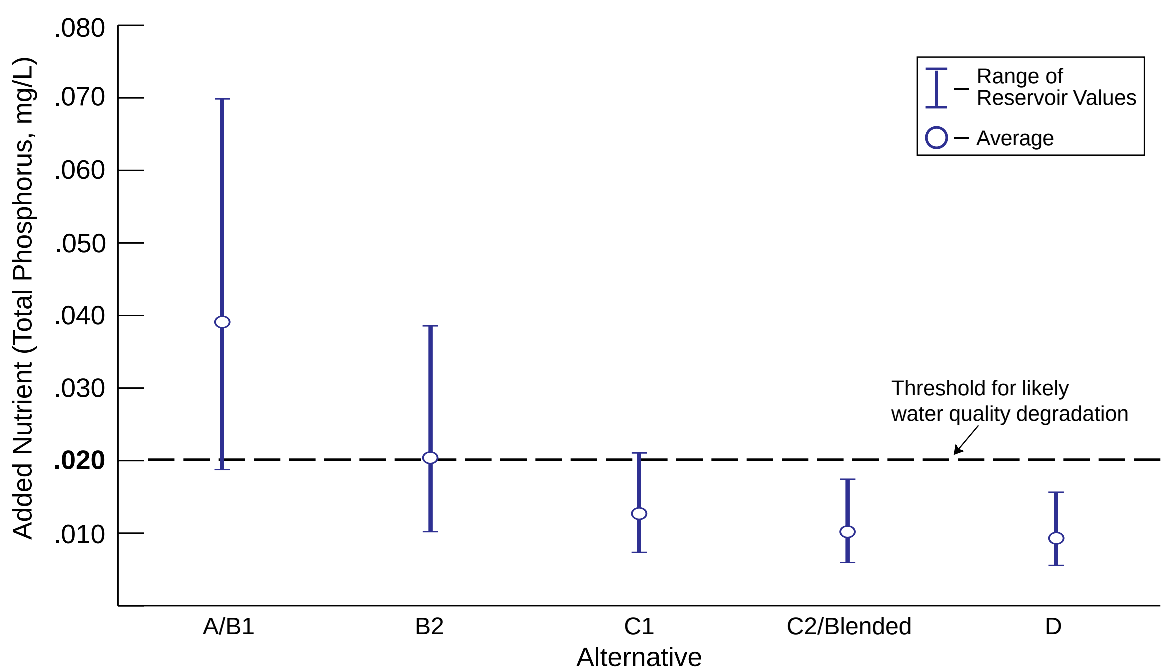
Although general urban development is the primary source of bacterial contamination in reservoirs, residential development of the shoreline and backlying areas along with progressively heavier use of reservoir recreation areas would contribute to the number of sites having bacterial problems in the future. Little expansion of other types of shoreline development (other than residential) is anticipated under any alternative.

Figure 4.10-1. Nutrient (Phosphorus) Additions to Embayments and Local Inflow From SMI Alternatives at Buildout[1] on Representative Mainstream Reservoirs (Chickamauga, Fort Loudoun, Nickajack, and Wilson).



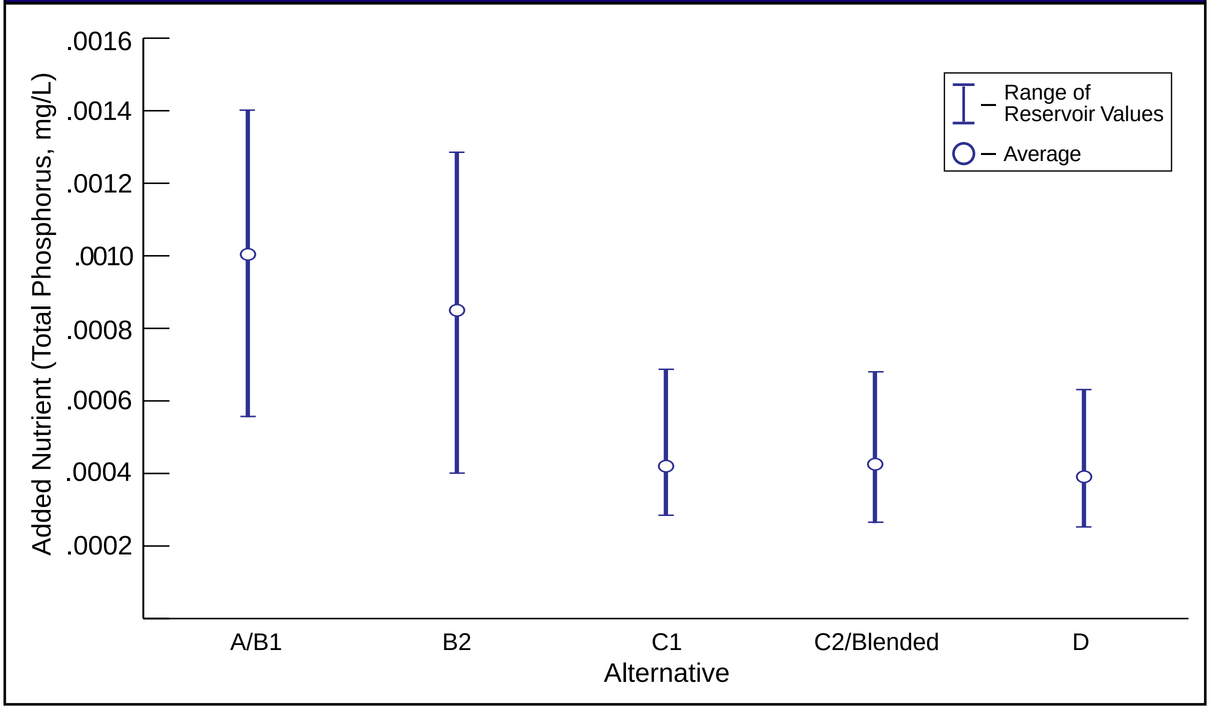
[1]Within the next 25 years.

Figure 4.10-2. Nutrient (Phosphorus) Additions to Embayments and Local Inflow From SMI Alternatives at Buildout[1] on Representative Tributary Reservoirs (Blue Ridge, Chatuge, Cherokee, and Tims Ford).



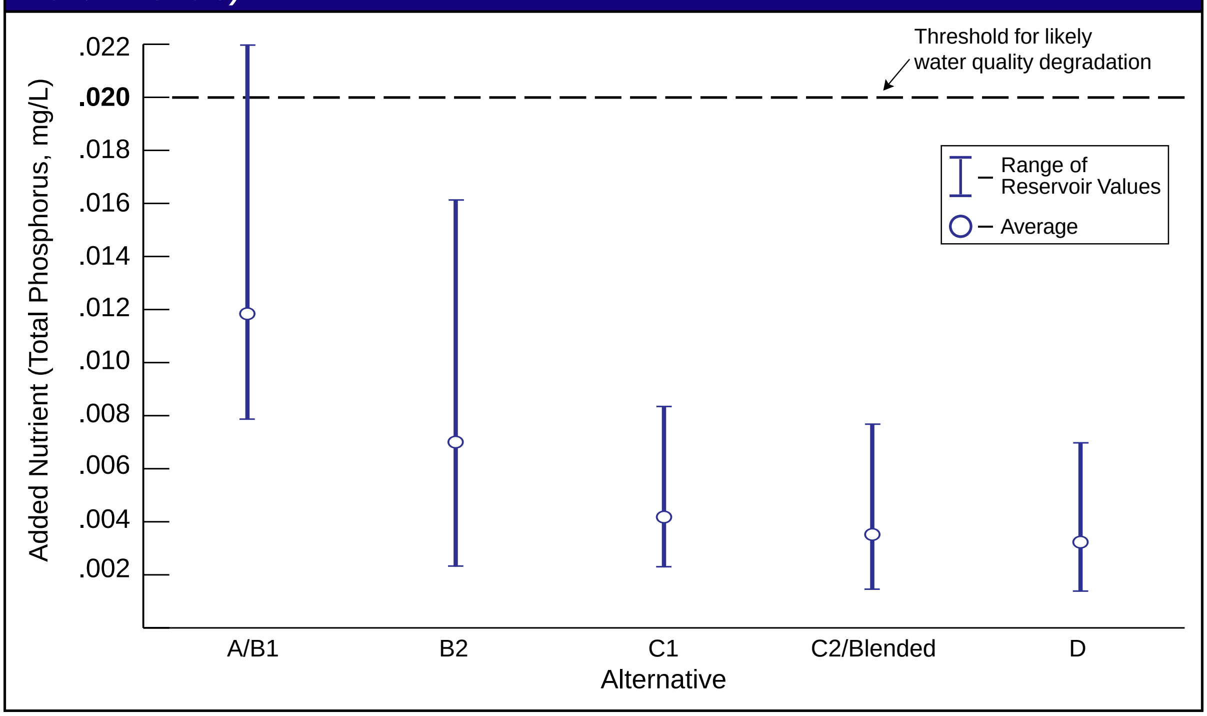
[1]Within the next 25 years.

Figure 4.10-3. Nutrient (Phosphorus) Additions to Total Inflow From SMI Alternatives at Buildout[1] on Representative Mainstream Reservoirs (Chickamauga, Fort Loudoun, Nickajack, and Wilson).



[1]Within the next 25 years.

Figure 4.10-4. Nutrient (Phosphorus) Additions to Total Inflow From SMI Alternatives at Buildout[1] on Representative Tributary Reservoirs (Blue Ridge, Chatuge, Cherokee, and Tims Ford).



[1]Within the next 25 years.

Several investigations have identified elevated bacterial contamination (i.e., fecal coliform) levels associated with residentially developed lakeshores in North America; however, these levels rarely violate federal, provincial, state, or local standards. In an intensive study conducted on TVA's Chickamauga Reservoir, Meinert et al. (1992) found no relationship between the number of lakefront residences or septic systems and levels of fecal coliform. These data did indicate two embayments with a history of severely affected water quality that had been locally impacted from fecal coliform contamination. This was due to large discharges of inadequately treated domestic urban wastewater and nonpoint-source urban runoff. Even though standards may not be violated, elevated levels of fecal coliform have been associated with greater incidences of ear infections for water recreationists along residentially developed shorelines. This implies a low but greater likelihood for the presence of other more serious, disease-causing microorganisms.

Although numerous sources contribute to the problems, the effects of increased residential shoreline development on incidences of fecal coliform contamination would be predominantly local and direct, rather than cumulative in nature. Numerous studies have shown that fecal coliform levels are rapidly diluted with distance from suspected or known sources. The organisms simply do not live long enough to travel far, under normal conditions in the aquatic environment of reservoirs.

Intense development of a particular reservoir could, however, lead to elevated levels of bacterial contamination and result in additional sites not meeting water contact criteria for recreational use. With residential growth occurring along the lakefront, excellent application of wastewater management would have to occur to maintain even the status quo. A larger risk of elevated fecal coliform would occur in proportion to the number of subdivisions developing near the shoreline. This relationship is likely due to general urbanization and conversion of other land uses to residences, rather than direct, cause-and-effect contributions to fecal coliform problems by specific developments.

The two alternatives with the highest percentages of buildout (i.e., **Alternatives A**/**B1**) would result in the greatest potential risk of additional sites not meeting state water quality criteria for recreation due to bacterial contamination. **Alternative C1** would result in proportionally less risk, and **Alternatives B2/C2/D/Blended Alternative** would result in the lowest potential risk.

Affected sites would most likely occur in embayments which are usually more heavily developed than other waterfront areas. Specific occurrences would be related to several factors:

- The density of lot and subdivision development allowed by local authorities in particular embayments.
- The degree to which the integrity of shoreline riparian zones is maintained.
- Whether the subdivision was on individual septic tanks, municipal sewerage, or subdivision-specific “package plant” sewerage.

Subdivision development on municipal or county-operated sewage systems would be less likely to increase bacterial contamination concerns in reservoirs. The greatest potential for direct impacts from individual subdivisions would occur if the subdivision had a “packaged” sewage system or if individual septic systems were used.

4.10.4 Relative Impacts of the Alternatives

The relative impacts to water quality under the seven alternatives are shown in *Figure 4.10-5*.

Figure 4.10-5. Relative Impacts of the Alternatives on Water Quality.[1]

[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.11 Effects on Recreational Use of Shoreline

4.11.1 Introduction

Informal recreation is a term used to describe the recreational activities that occur on undeveloped lands. As public land is converted into private use through residential shoreline alterations and other development, visits to undeveloped shorelines are displaced. People who have been using a particular recreational site for a period of years have usually developed strong attachments to that site (Moore and Graefe, 1994). As of 1994, 17 percent of TVA's reservoir shoreline had been developed for all uses (Section 3.4.1). Under current conditions, many undeveloped areas suitable for camping show typical impacts of camping and other informal use. The number of informal recreational opportunities lost as a result of shoreline development was determined for each alternative and used to measure the potential effects of development on informal recreational activities. Section 3.13 more completely describes the nature of these activities and establishes the baseline of existing informal recreational opportunities.

4.11.2 Determination of Informal Recreational Opportunities Lost

Two assumptions were used in assessing the potential impacts of the alternatives on informal recreation:

- Lands suitable for recreation would be lost at the same rate as all undeveloped land.
- There is a direct relationship between the level of development and the impacts on the three categories of recreational activity.

Using these assumptions as a basis, the number of informal recreational opportunities lost under each alternative was calculated as follows:

- For each alternative, the number of additional shoreline miles that could be developed was calculated for all uses (i.e., residential access, commercial recreation, and industrial). Privately owned flowage easement shorelands were excluded.
- These shoreline mileage estimates were then divided by the total number of undeveloped public shoreland miles. The resulting proportions represent the amount of public shoreland lost under each alternative as a result of shoreline development.
- These proportions were then applied against the base case of existing informal recreational occasions to yield the number of opportunities lost by activity under each alternative *(Table 4.11-1).*

Table 4.11-1. Estimated Informal Recreational Opportunities Lost by Activity Under Each Alternative[1] Compared With Existing Opportunities.

Activity	Existing Opportunities[2]	Opportunities Lost Under Alternative						
		A	B1	B2	C1	C2	D	Blended
Day Use	700,000	378,000	378,000	140,000	231,000	140,000	140,000	140,000
Informal Camping	580,000	313,000	313,000	116,000	191,000	116,000	116,000	116,000
Hunting	64,000	35,000	35,000	13,000	21,000	13,000	13,000	13,000
Total	1,344,000	726,000	726,000	269,000	443,000	269,000	269,000	269,000

[1]Within the next 25 years.

[2]Existing informal recreational opportunities at the current development level.

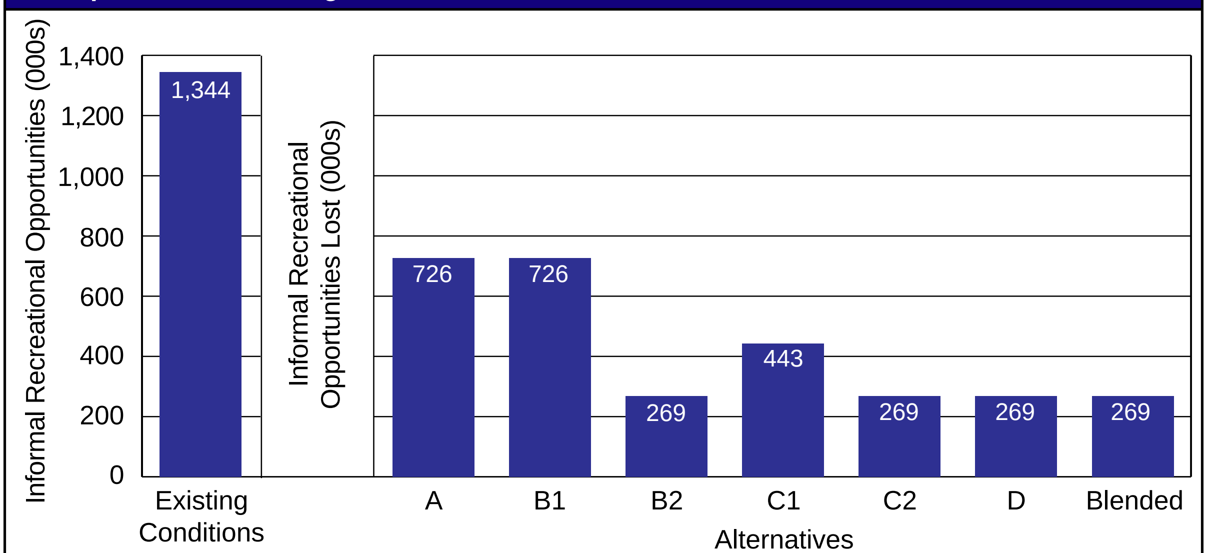
4.11.3 Effects of the Alternatives on Informal Recreational Opportunities

In this analysis, the alternatives are discussed in order of the least amount of change to the most amount of change on informal recreation activities.

Under **Alternatives B2, C2, D**, and the **Blended Alternative**, about 20 percent of existing informal recreational opportunities would be lost within the next 25 years *(Table 4.11-1 and Figure 4.11-1).* During this period, approximately 5,600 day-use, 4,600 informal camping, and 500 hunting opportunities would be lost every year. Losses of this magnitude would not be noticeable for the first several years. However, after 10 or 15 years, recreation users and land managers would begin noticing a difference in available opportunities and public complaints. After 25 years, the effects on informal recreational opportunities would be quite discernible.

Under **Alternative C1**, 33 percent of the informal recreation potential would be lost within the next 25 years. At this level of analysis, it is difficult to determine whether the impacts from this alternative would be appreciably different from those projected under Alternatives B2/C2/D/Blended Alternative.

Figure 4.11-1. Estimated Informal Recreational Opportunities Lost Under Each Alternative[1] Compared With Existing Conditions.



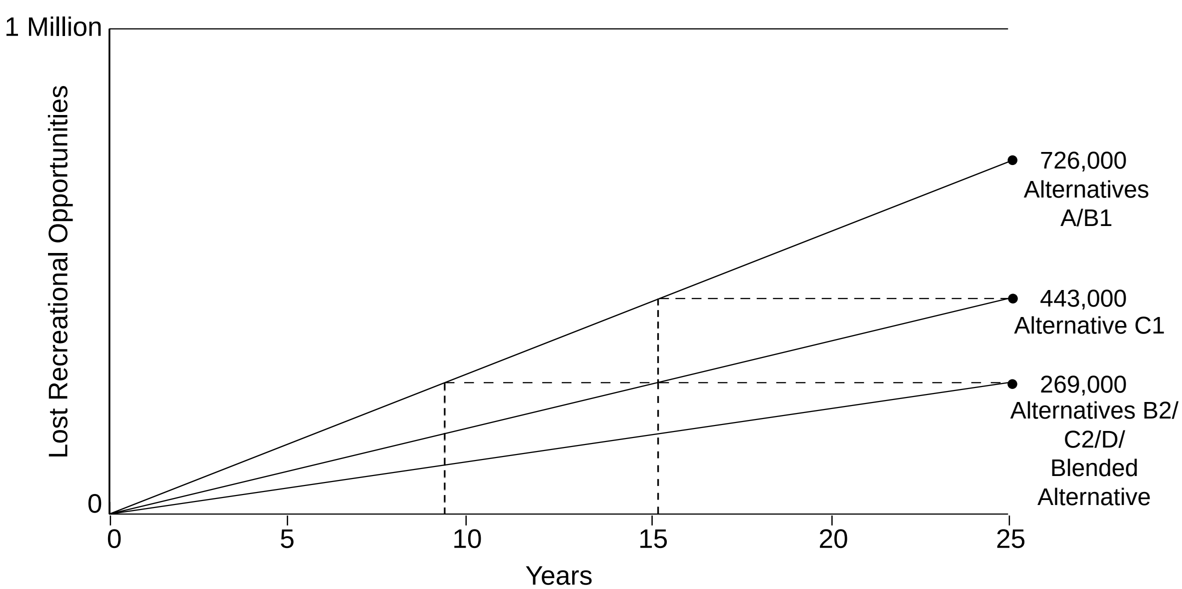
[1]Within the next 25 years.

Under **Alternatives A** and **B1,** over half (54 percent) of the existing informal recreation could be lost within the next 25 years. These alternatives would have the most impact and result in the most observable changes to informal recreational opportunities. Under these alternatives, there would be a much larger number of displaced informal recreation users competing for a significantly reduced land base. Using capacity standards (Section 3.13.4) which define how many recreation users can be accommodated comfortably on a given amount of land, the number of existing informal recreational opportunities was established. Under Alternatives A/B1, these capacities would be greatly exceeded without intense management of informal recreation users.

Recreation area management problems could become noticeable after 10 to 15 years, and these impacts would continue to escalate for 10 more years. Conflicts between informal campers, hunters, and other recreation users; human waste problems; litter; and other problems would show up earlier and continue to grow throughout the next 25 years. Public agencies would have to charge user fees, limit the number of users, and close recreational areas to control the use of the remaining undeveloped shoreland. If these techniques were not effective, informal camping and hunting may not be allowed in the future.

Differences between the alternatives can be illustrated in another way. Assuming that undeveloped land is developed at an equal annual rate under all the alternatives, then Alternative C1 would exceed the total impacts of Alternatives B2/C2/D/Blended Alternative in the 15th year of the 25-year period *(Figure 4.11-2)*. Alternatives A/B1 would surpass the total impacts of Alternatives B2/C2/D/Blended Alternative in the 9th year and exceed the total effects of Alternative C1 in the 15th year.

Figure 4.11-2. Comparison of Recreational Opportunities Lost Over a 25-Year Period by Alternative.



4.11.4 Effects of the Alternatives on Other Recreation

As population increases, demand for informal recreational activities discussed in the previous section is likely to escalate. Between 20 and 30 percent of users who have lost informal opportunities for recreation on TVA reservoir shorelines would look for other informal occasions or seek recreation opportunities in developed recreation areas, such as city, county, and state parks. Both of these factors would pressure public agencies to increase the management of developed recreation areas and undeveloped land and to expand existing developed areas.

Agencies operating recreation areas would spend more time trying to minimize conflicts between hunters and general reservoir users. They would be dealing more often with conflicts between campers looking for undeveloped campsites. It would be necessary to increase management levels on informal lands to minimize litter and human waste problems. Limits may have to be established on some areas, and fees for informal camping may have to be implemented to reduce demand. Some physically impacted areas would have to be closed for several years to allow them to recover from the more intensive impacts.

Under **Alternatives B2, C2, D**, and the **Blended Alternative**, residential shoreline development could potentially occur on up to 38 percent of the reservoir shoreline within the next 25 years. Under **Alternative C1**, up to 48 percent of the shoreline could be used for residential access purposes during this period. Under these alternatives, all lands currently transferred to other agencies for recreation development would remain allocated for public recreation. Approximately 106 miles would be available for additional recreation development, including commercial and public recreation. Based on growth rates observed during the last 10 years, 106 miles should provide a sufficient land base to support demand for additional shoreline facilities within the next 25 years. Increases in visitor use of public parks and existing facilities would be attributable to both increased use of the reservoirs and displaced users of undeveloped shorelands.

Under **Alternatives A** and **B1,** residential shoreline development could occur on up to 63 percent of the shoreline within the next 25 years. Few, if any, shoreline areas would be available for additional recreation developments, and conservatively, as much as 37 shoreline miles could be withdrawn from existing parks and allocated for residential access. These lands are currently managed by state or local agencies for public recreation development under leases of varying terms.

Under current conditions, there is little excess capacity at developed recreation areas on summer and holiday weekends. Additional use of a facility by displaced users of undeveloped lands could be accommodated if it occurred Monday through Thursday when most of the developed facility capacity is idle. However, problems would occur in these areas if increased use levels occurred when the facility was at or near peak capacity. Overcrowding would result and cause further displacement of users, facility abuse, and conflicts between users. Most campgrounds and boat ramp facilities are full during summer weekends and are using overflow capacity on holiday weekends during the summer. The long-term results could be that:

- Boaters would have to wait a little longer to launch their boats at the ramps.
- Picnickers would have a difficult time finding a table.
- Campers would have to accept less desirable campsites or schedule their visits between Monday and Thursday.

As a result of this increased visitation, public parks and commercial recreation areas would need a higher level of maintenance and more security patrols. Additional boat-launching ramps, parking areas, picnic facilities, and campsites may be needed to handle more visitors at one time.

Under all alternatives, it is estimated that a maximum of 247 miles (2.2 percent) of additional shoreline could be developed for industrial use over the next 25 years. Direct impacts from specific industrial development projects could be locally important. However, cumulative impacts on recreation from industrial development are expected to be regionally insignificant.

4.11.5 Relative Impacts of the Alternatives

The relative impacts to recreation under the seven alternatives are shown in *Figure 4.11-2*.

***Figure 4.11-3. Relative Impacts of the Alternatives on Recreational Use of the Shoreline.*[1]**

Indicator

Number of Day-Use, Informal Camping, and Hunting Opportunities Lost

Greatest Loss — **Smallest Loss**

A/B1 — **C1** — **B2/C2/D/Blended**

[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.12 Effects on Aesthetic Resources

4.12.1 Introduction

Both the SMI public involvement process and research conducted for TVA by the Gallup Organization (Larsen, 1993a) reinforce how important aesthetic qualities are to Tennessee Valley residents and visitors. During SMI public involvement, the public expressed the desire to preserve and/or enhance the shoreline's natural beauty (aesthetics). Aesthetics is an important consideration, because under each of the seven alternatives the shoreline would look considerably different. To supplement the Gallup poll and SMI scoping results, TVA investigated the relationship between residential shoreline alterations and public perceptions of shoreline aesthetics. The survey instrument and a detailed description of the survey methodology are presented in Appendix H. This visual survey was conducted before the Blended Alternative was crafted. However, since the Blended Alternative was developed by merging and modifying features of the six original proposed alternatives, the visual survey results can be used to make inferences about the Blended Alternative's impacts to aesthetic resources.

4.12.2 Effects of the Alternatives

Results of the Survey, *Viewing Tennessee Valley Shoreline*

Approximately 70 percent (663) of those sampled (950) returned completed forms to TVA for analysis. Respondents were composed of previous SMI participants (561), former Gallup participants (47), and TVA public land visitors who completed a visitor comment card during 1994 and 1995 (55). Most respondents (95 percent) were residents of Tennessee Valley states. The other 5 percent (33 respondents) came from other eastern states (i.e., Ohio, Michigan, Florida, etc.). All respondents indicated that they engaged in one or more recreational activities on TVA lakes and adjoining properties. The majority (476 or 72 percent) owned residential property along TVA-managed reservoirs. The remaining 28 percent (187) identified themselves as recreational visitors to TVA-managed reservoirs and lakeshores. All 30 TVA-managed reservoirs addressed in this FEIS were represented.

Preference scores of the following four indicators were used to measure the effects of the seven alternatives on aesthetic resources (Sections 1.8.10 and 3.14.5).

• Water-use facility design	Variations in the type, size, color, and building materials of docks and other water-use facilities.
• Density	Distance between private docks
• Amount of residential shoreline development	Percentage of the shoreline used for residential shoreline development.
• Shoreline vegetation alterations	Amount of vegetative clearing; presence and depth of a shoreline management zone.

Water-Use Facility Design

Respondents were shown five photos depicting the range of water-use facilities that represented the original proposed six alternatives *(Figure 4.12-1)*. Alternatives B1 and B2 were not differentiated because they follow the same standards and differ only in the amount of shoreline open to residential shoreline development. The same applies to Alternatives C1 and C2. Because existing conditions (i.e., Alternatives B1 and B2) vary so widely, two pictures were used to illustrate this diversity. Descriptions of the five pictures as they relate to the alternatives are as follows:

- **Alternative A**: This picture (F2) shows a facility that includes two uncovered boatslips, one large enclosed boatslip, and a large, covered dock.
- **Alternatives B1** and **B2**: These pictures depict an enclosed boathouse both with (F3) and without (F1) a small, uncovered dock area.
- **Alternatives C1** and **C2**: This picture (F4) depicts a boatslip with a roof but no sides.
- **Alternative D**: This picture (F5) shows a boatslip with no roof or sides.
- **Blended Alternative**: Under this alternative, a 1,000-square-foot maximum footprint would be allowed, not including the access walkway. Boat slips could have a covered roof and exterior siding, or be uncovered. Dock standards under the Blended Alternative are designed in a way that numerous different shapes, sizes, and configurations of facilities could be built. As such, one photo does not adequately represent the number of choices that would be available. The photo that is most characteristic of the Blended Alternative is F3.

The majority (73 percent) preferred the photograph of the facility that represented Alternatives C1 and C2. ("Preferred" is the sum of "highly preferred" and "somewhat preferred.") The picture representing Alternative D rated a preference score of 65 percent. The two photos representing Alternatives B1 and B2 were favored by 60 percent (F3) and 44 percent (F1). Overall, an average of 52 percent of the respondents preferred facility designs representing existing conditions. The picture representing Alternative A received a preference rating of 50 percent.

Based on preference scores of water-use facility design photos, single-covered boatslips with no sides (i.e., Alternatives C1/C2) would have the most beneficial impact on aesthetic resources. Facilities representing Alternative D would have somewhat less beneficial effects than those characterizing Alternatives C1/C2. Water-use facilities which have sides, patio areas, and larger enclosed multislips (i.e., Alternatives A, B1, B2, and the Blended Alternative) would have somewhat less beneficial effects than those characterizing Alternative D. Facilities which are enclosed but have no associated patio areas (a possibility under Alternatives B1, B2, and the Blended Alternative) would result in the least beneficial impact.

Respondents were also asked to rate the importance of seven attributes associated with the scenic quality of water-use facilities *(Figure 4.12-2).* All seven facility characteristics were considered important by the majority (65 percent or more) of respondents. Three out of four respondents (75 percent) indicated that maintenance/upkeep was "very important." The majority indicated that intrusiveness[1] (64 percent) and density[2] (54 percent) were also "very important." Color ranked as least important, even though one out of four respondents (28 percent) considered this characteristic "very important."

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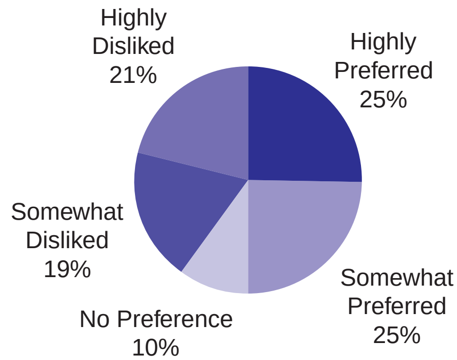
[1]The degree to which a facility blocks, interferes with, or fails to blend with its surroundings.

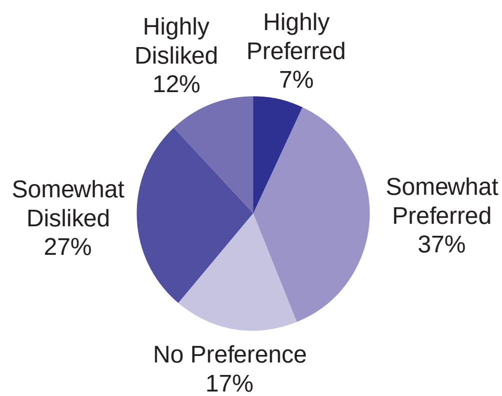
[2]The distance between private docks fronting lakeshore homes.

Figure 4.12-1. Preferences for Water-Use Facility Designs by Alternative.

Alternative A
(Photo F2)



Alternatives B1 & B2
(Photo F1)



Alternatives B1 & B2
(Photo F3)

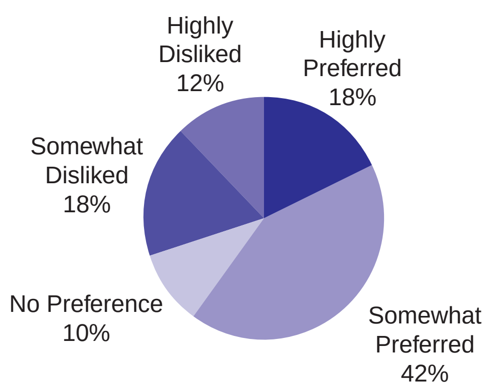
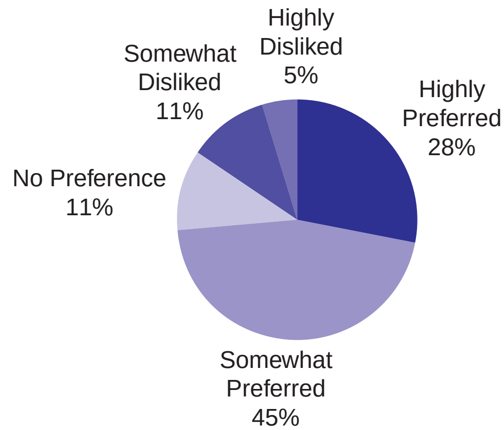


Figure 4.12-1 (Cont.). Preferences for Water-Use Facility Designs by Alternative.

Alternatives C1 & C2
(Photo F4)



Alternative D
(Photo F5)

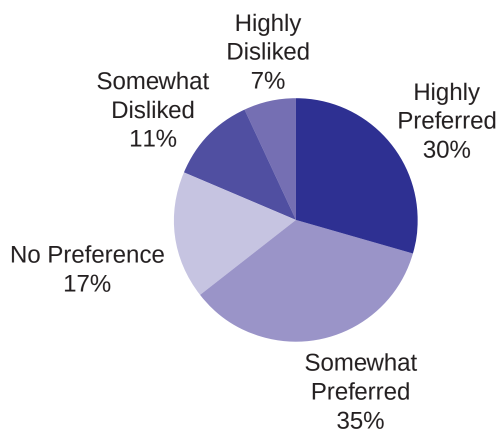
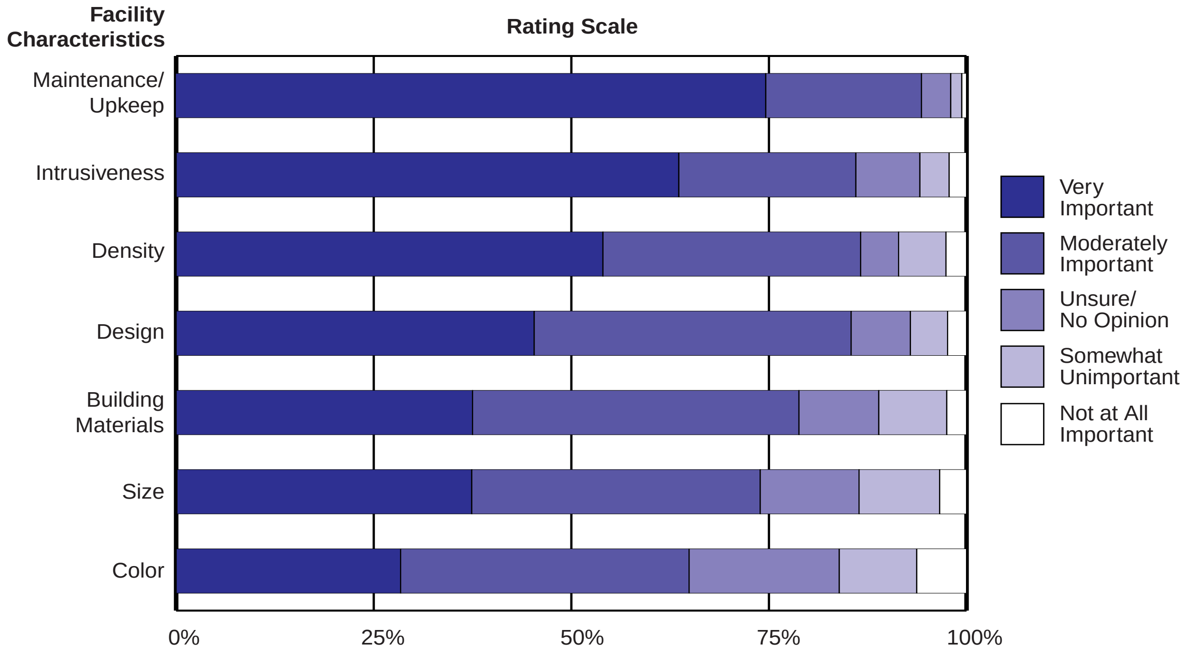


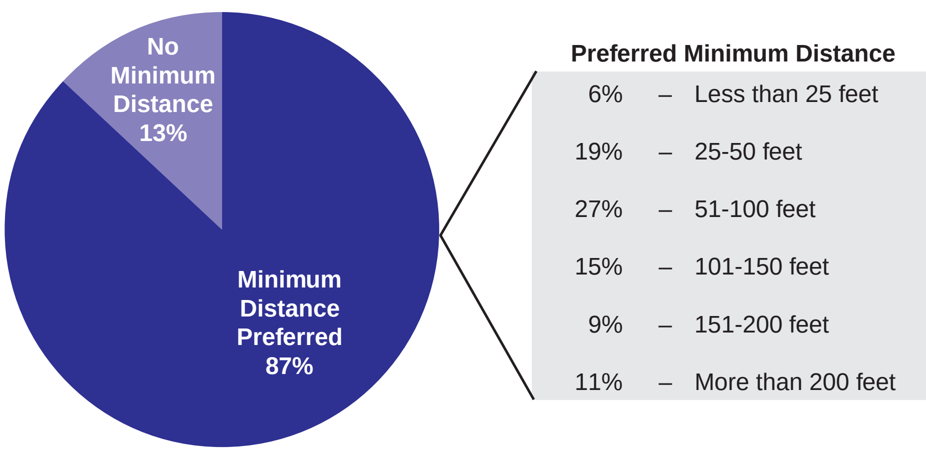
Figure 4.12-2. Importance of Seven Characteristics Related to Scenic Quality of Water-Use Facilities.



Density

The distance between private docks, or density, was identified as being very important. The majority of respondents (87 percent) preferred some minimum distance between private docks *(Figure 4.12-3)*. Although a few proponents preferred a minimum of less than 25 feet, most favored greater distances. The most preferred interval was from 51 to 100 feet (27 percent). Collectively, about 35 percent of all respondents preferred more than 100 feet between docks.

Figure 4.12-3. Preferred Minimum Distance Between Private Docks (Density).



Based on survey results, a minimum distance somewhere between 25 and 100 feet would have the most positive impact to aesthetic resources. Approximately 46 percent of those surveyed preferred a minimum distance between docks in this range. Alternatives C1/C2/Blended Alternative propose a standard minimum distance of 50 feet and Alternative D would require a minimum distance of 100 feet between docks. These alternatives would therefore have the most impact on aesthetic resources with respect to density.

Alternatives A/B1/B2 do not propose a minimum distance between facilities, and therefore would not protect aesthetic resources from excessive density.

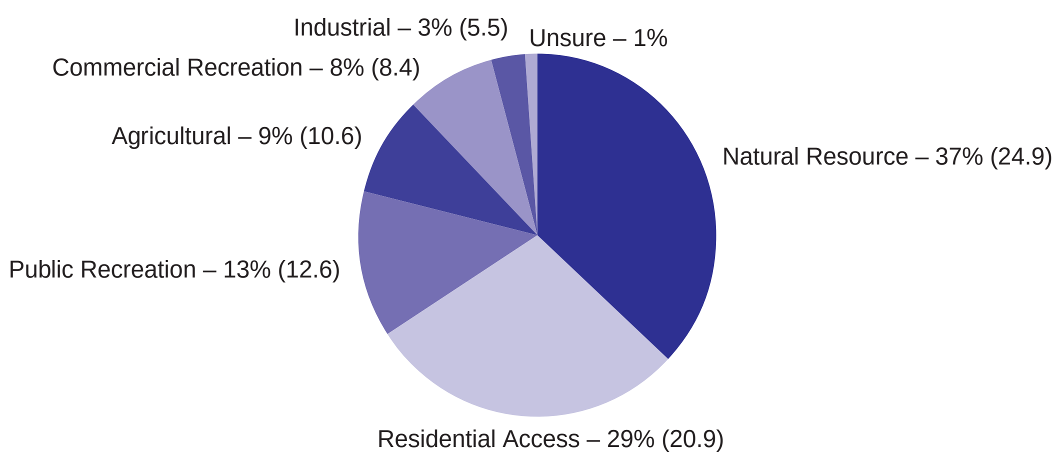
Amount of Residential Shoreline Development

Respondents were asked to indicate what percentage of the shoreline should be committed to the following uses:

- Residential access (docks and other shoreline uses associated with lakeside homes),
- Commercial recreation (commercially operated marinas, resorts, etc.),
- Public recreation (local/state/federally operated campgrounds, parks, etc.),
- Industrial (barge terminals, ports, etc.),
- Agricultural (crop production, livestock grazing, etc.), and
- Natural resource (forests, wildlife areas, etc.).

Respondents favored natural resource areas and residential access as the primary shoreline uses (37 percent and 29 percent, respectively) *(Figure 4.12-4)*. Recreational visitors preferred that residential shoreline development not exceed an average of 18 percent, and property owners preferred 33 percent. Using this indicator, Alternatives B2/C2/D/Blended Alternative (at a 38 percent potential buildout) would, therefore, result in the lowest adverse impacts to aesthetic resources. Impacts from Alternative C1 would be higher at 48 percent potential buildout. Alternatives A/B1 would result in the greatest visual impacts, since up to 63 percent could potentially be developed with residential shoreline alterations.

Figure 4.12-4. Preferences for Amount of Residential Shoreline Development Compared With Other Land Uses.

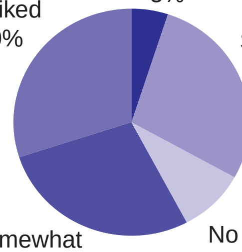


Note: The percentage refers to the average amount of shoreline that should be committed to that particular use. The number in parentheses is the standard deviation. The minimum amount given for each of these six categories was 0 and the maximum number was 100.

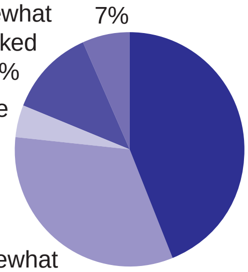
Shoreline Vegetation Alterations

Respondents were shown five pictures representing the alternatives *(Figure 4.12-5)* and asked questions related to their visual preferences of shoreline vegetation. Each picture portrays a different level of shoreline vegetation alteration, ranging from heavy to slight. Alternatives B1 and B2 were not differentiated because they follow the same standards and differ only in the amount of shoreline open for potential residential shoreline development. The same applies to Alternatives C1 and C2. Because existing conditions (i.e., Alternatives B1 and B2) vary so widely, two pictures were used to illustrate this diversity.

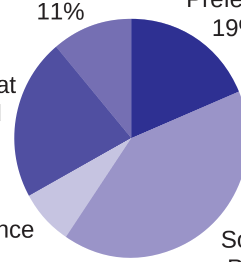
Figure 4.12-5. Preferences for Scenes of Shoreline Vegetation Alterations by Alternative.



Alternative A
(Photo R1)



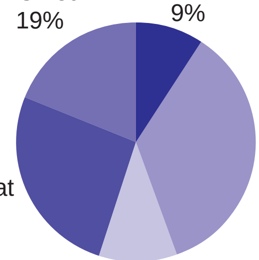
Alternatives B1 & B2
(Photo R2)



Alternatives B1 & B2
(Photo R4)

Figure 4.12-5 (Cont.). Preferences for Scenes of Shoreline Vegetation Alterations by Alternative.

Alternatives C1 & C2
(Photo R5)



Alternative D
(Photo R3)

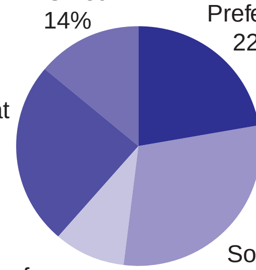
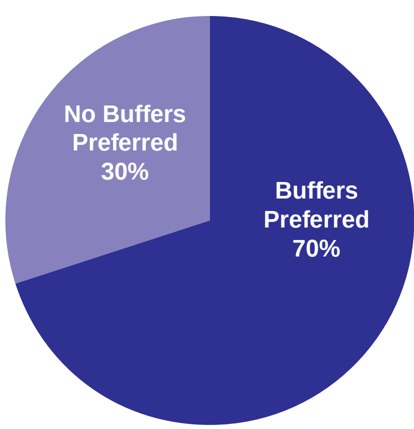


Figure 4.12-6. Preferred Depth of Shoreline Buffers.



Preferred depth of buffers

14%	–	Less than 25 feet
20%	–	25-50 feet
15%	–	51-100 feet
6%	–	101-150 feet
5%	–	151-200 feet
10%	–	More than 200 feet

Descriptions of the five pictures as they relate to the alternatives are as follows:

- Alternative A: This picture (R1) shows mowed grass to the water's edge and no trees.
- Alternatives B1 and B2: Photo R2 shows mowed grass to the water's edge and mature trees with no understory. Photo R4 shows mature trees with no understory and natural ground cover (i.e., leaf litter and vines).
- Alternatives C1 and C2: This picture (R5) shows reverting vegetation along the shoreline and a mowed lawn closer to the house.
- Alternative D: This picture (R3) shows forested cover along the shoreline. Both mature trees and understory vegetation extend back toward the house.
- Blended Alternative: The vegetation scenario depicted in photo R4 (Alternatives B1 and B2) most closely resembles how vegetation further than 25 feet from shore would be managed under the Blended Alternative. The Blended Alternative combines tree-cutting practices from TVA's existing guidelines (Alternatives B1 and B2) with a more flexible SMZ that would be much narrower (25 feet deep) than that proposed under Alternatives C1 and C2 (100 feet deep). The Blended Alternative also provides for clearing of plants, such as poison ivy, within the 25-foot-deep SMZ and elsewhere on TVA land. This is in contrast to Alternatives C1, C2, and D, which would not allow vegetation disturbance in the SMZ (except for clearing the access corridor).
- The near-shore vegetation (within 25 feet of the shoreline) would be managed under the Blended Alternative to resemble a modified version of photo R3. The near-shore vegetation would differ from the R3 scene because a wider access/view corridor (up to 20 feet wide) would be allowed along with removal of certain understory plants.

The two pictures depicting allowable shoreline vegetation alterations under Alternatives B1 and B2 were preferred by a majority. ("Preferred" is the sum of "highly preferred" and "somewhat preferred.") About 77 percent preferred photo R2, and 60 percent favored photo R4. Overall, an average of about 69 percent preferred shoreline vegetation alterations representing existing conditions. The picture representing Alternative D was preferred by 52 percent, followed by the scene characterizing Alternatives C1 and C2 (45 percent). The photo representing Alternative A was rated last (33 percent).

Respondents were also asked if they would prefer to see a buffer strip along the shoreline, and if so, they were instructed to specify how deep (i.e., wide) it should be *(Figure 4.12-6).* Seven out of 10 respondents (70 percent) preferred a buffer strip along the shoreline. A depth between 25 and 50 feet was preferred by 20 percent, and a depth between 51 and 100 feet wide was preferred by 15 percent. About one out of five (21 percent) respondents favored a depth of more than 100 feet. The Blended Alternative would conserve a 25-foot strip (see Section 2.8.3) of forested TVA land. Alternatives C1 and C2 would require a 100-foot SMZ, if possible (Sections 2.5.2 and 2.6). Under Alternative D, all TVA land would be used as a vegetative SMZ (Section 2.7.2). Alternatives A, B1, and B2 do not promote the use of SMZs.

Relating vegetation preferences to the alternatives was more difficult, because responses to the questions were extremely varied. A beneficial aesthetic impact would result from the presence of mature trees. The type of ground cover (i.e., grass, leaves, and leaf litter, or vegetation understory) would not be as important if mature trees were present. A landscape with no trees and mowed grass to the water's edge could result in adverse aesthetic impacts. From a vegetation alteration perspective, survey respondents indicated that Alternative A could create adverse aesthetic impacts. Respondents also indicated shoreline vegetation alterations under Alternatives B1/B2 would result in beneficial aesthetic impacts. The Blended Alternative would provide less aesthetic benefits than Alternatives B1/B2, but greater benefits than Alternatives D, C1/C2, and A. SMZs (promoted in Alternatives C1, C2, D, and the Blended Alternative) would also have positive aesthetic effects.

Summary of Effects of the Alternatives

Water-use facility designs characteristic of Alternatives C1/C2 were most preferred, followed by those representative of Alternative D. Approximately 87 percent of respondents supported a minimum distance between docks (i.e., density standard). Alternatives A/B1/B2 do not propose a density standard. Alterna tives C1/C2/Blended Alternative propose a 50-foot minimum distance between docks, and Alternative D would require 100 feet. Therefore, these alternatives would have a positive effect on aesthetic resources.

Overall, respondents stated that the amount of residential shoreline development should not exceed 29 percent of the total shoreline. Recreational visitors preferred that residential shoreline development not exceed an average of 18 percent, while property owners preferred 33 percent. Using this indicator, Alternatives B2/C2/D/Blended Alternative (at a maximum 38 percent buildout) would result in the lowest adverse impacts to aesthetic resources. Impacts from Alternative C1 would be higher at 48 percent potential buildout. Alternatives A/B1 would result in the greatest visual impacts, since up to 63 percent could potentially be developed for residential purposes.

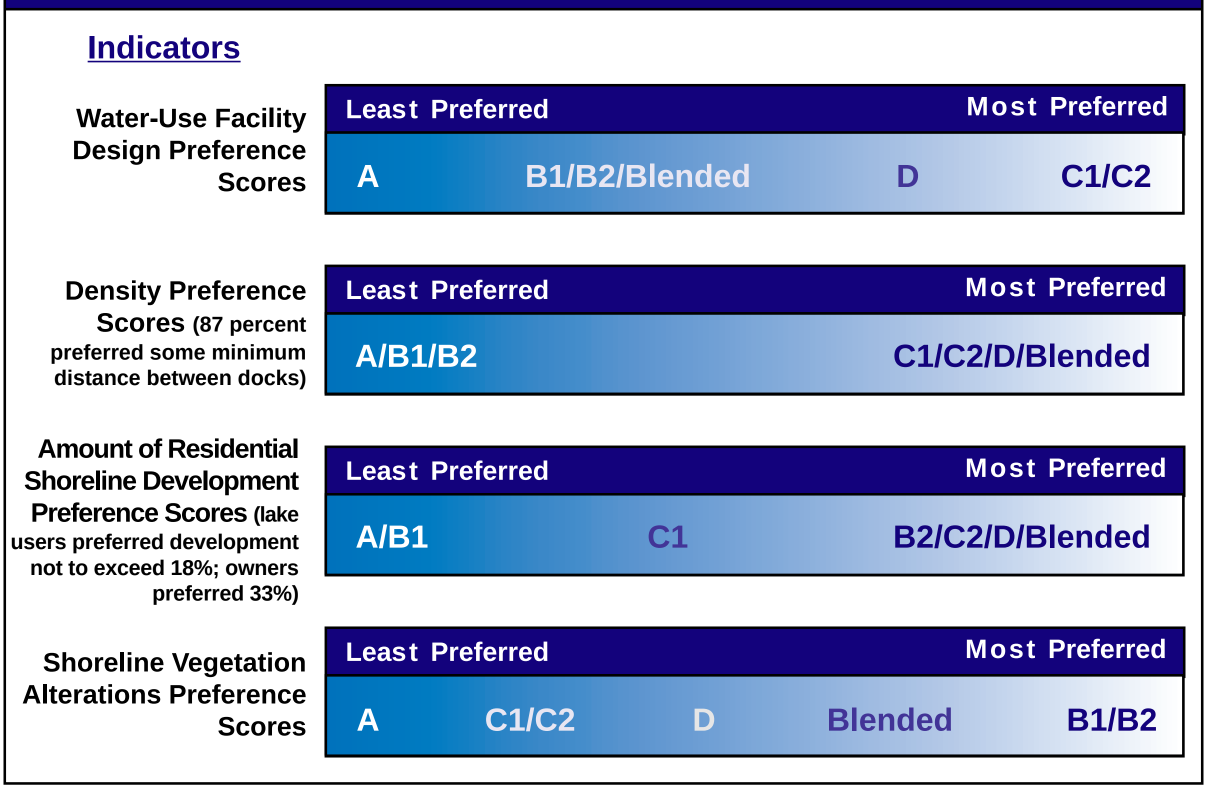
Based on survey preferences, shoreline vegetation alterations under Alternatives B1/B2 would have the most beneficial aesthetic impact. This is followed by the Blended Alternative, Alternative D, and Alternatives C1/C2. Vegetation alterations characterized by Alternative A would have the least beneficial impact. Alternatives C1/C2/D/Blended Alternative provide for a vegetative buffer strip, which was preferred by a majority of those surveyed. As shown in *Figure 4.12-6*, more people preferred the buffer strip depth proposed under the Blended Alternative (i.e., 25 feet) over that proposed under Alternatives C1, C2 (i.e., 100 feet), and D (i.e., all TVA-managed land). During public review of the DEIS, many comments were received both in support of and in opposition to SMZs. Vegetation standards in the Blended Alternative address these issues.

When analyzed collectively, respondent preference results derived from the survey questions point to Alternative C2 as the option with the most acceptable aesthetic impacts, followed by the Blended Alternative and Alternative D. Alternative B2 would be next, followed by Alternative C1 and Alternative B1. Alternative A would result in the greatest adverse impacts to aesthetic resources.

4.12.3 Relative Impacts of the Alternatives

The relative impacts to aesthetic resources under the seven alternatives are shown in *Figure 4.12-7*.

Figure 4.12-7. Relative Impacts of the Alternatives on Aesthetic Resources.[1]



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.13 Effects on Cultural Resources

4.13.1 Introduction

TVA conservatively estimates that there are approximately 5,500 archaeological sites located along the shoreline, primarily on undeveloped land (Section 3.15). Archaeological sites are not distributed equally along the shoreline (Solis and Futato, 1987). However, areas where people live today are often the same places inhabited in earlier times. Therefore, as residential shoreline development increases, the potential for impacts to cultural resources would also increase.

If cultural resources are located on federally owned land, they are protected by the National Historic Preservation Act of 1966 and the Archaeological Resources Protection Act of 1979. Archaeological surveys are conducted on a case-by-case basis in all TVA-controlled areas potentially subject to ground-disturbing actions such as channel excavation, shoreline development, or timber harvesting. All archaeological resources or historic structures within these areas are avoided whenever possible. If avoidance is not possible, then any adverse effects to these resources are mitigated.

In analyzing the effects of the alternatives on cultural resources, TVA considered the following:

- Direct impacts from actions that would cause the most soil disturbance along the shoreline, such as channel excavation, vegetation clearing, and construction.
- Indirect impacts from development of backlying properties (i.e., subdivisions).

In addition, the number of cultural sites potentially disturbed or mitigated was estimated for each alternative, assuming that number of miles of shoreline developed is directly proportional to the number of archaeological sites affected.

Under any alternative, soil-disturbing activities will be reviewed by TVA to determine potential effects to cultural resources. Activities would be approved, mitigated, or denied according to the historical importance of the resource. If mitigation were required, an appropriate archaeological survey would be completed, and potentially impacted resources on TVA property would be properly recorded and removed. Furthermore, a shoreline inventory is expected to be completed within one year of the publication of the SMI Record of Decision to identify cultural sites needing protection.

4.13.2 Effects of the Alternatives

Alternative A would allow the most extensive channel excavation, which could disturb archaeological sites along the shoreline, as well as inundated archeological resources. However, TVA would work to prevent destruction of any significant archaeological sites and mitigate any potential disturbances.

This alternative would also allow the most extensive vegetation clearing, which also has the potential to disturb archaeological sites. Obviously, less soil would be disturbed if hand tools were used in clearing instead of mechanical equipment (i.e., bulldozers). The less soil disturbed, the less likely impacts to archaeological resources would have to be mitigated. Also, clearing shoreline vegetation could contribute to erosion of the shoreline (Section 4.6), which could, in turn, wear down archaeological sites located there.

Alternative A would allow bank stabilization with methods determined by the applicant. However, the least expensive methods for bank stabilization may not necessarily be the best for protecting archaeological sites. Filter fabric used with certain flora plantings may still result in some erosion of a site, whereas filter fabric used with riprap eliminates erosion and protects the site from looters. Riprap is more expensive but protects archaeological sites much better than other methods. Thus, allowing the applicant to determine the stabilization method could result in direct negative effects to cultural resources. To mitigate any effects to cultural and other resources, the applicant would need to work with TVA to choose the most appropriate method.

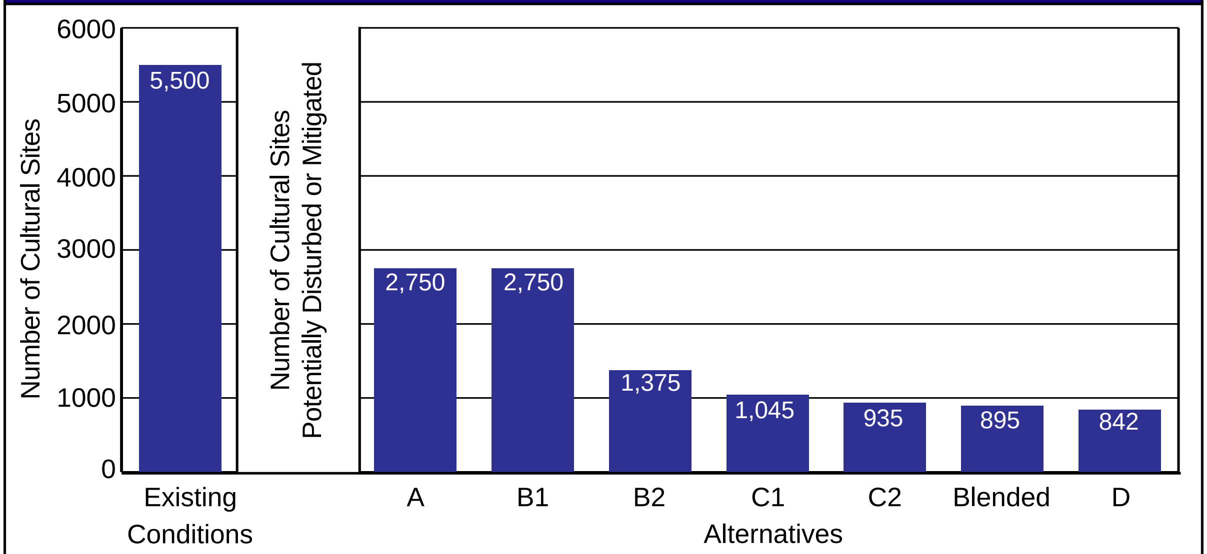
Construction would not be limited under this alternative, and there would generally be no limits on size, number, or types of structures. This kind of unlimited construction could have adverse effects on archaeological sites. For example, improper construction could contribute to shoreline erosion, which could impact cultural resources.

Historic structures are generally not located in the shoreline area, but may exist on privately owned backlying property. The types of alterations allowed along the shoreline or in the shoreline area could indirectly impact the landscape as it relates to a historic structure. For example, a large, modern, brightly painted, metal boathouse could adversely impact the scenic quality of a historic farm complex. Furthermore, residential shoreline development could have indirect adverse effects on backlying archaeological sites and historic structures. Development of the shoreline would likely advance the growth of subdivisions or other developments on backlying properties. Consequently, the ensuing soil-disturbing activities could impact the cultural resources located there.

Under Alternative A, another 50 percent of the shoreline could potentially be developed with residential shoreline alterations over the next 25 years *(Table 4.2-1)*. Of this 50 percent, 35 percent would be TVA-owned and 15 percent would be flowage easement shoreland.

- Along the TVA-owned shoreline, 1,925 cultural sites potentially could be disturbed or mitigated (35 percent of 5,500 total sites).
- On privately owned flowage easement shoreland, 825 sites could be affected (15 percent of 5,500 total sites).
- Therefore, under Alternative A, about 2,750 sites potentially could be disturbed or mitigated *(Figure 4.13-1)*.

Figure 4.13-1. Number of Cultural Sites Potentially Disturbed or Mitigated Under Each Alternative[1] Compared With Existing Conditions.



[1]Within the next 25 years.

Under **Alternative B1**, TVA would continue its current guidelines. Channel excavation would be minimized whenever possible, and vegetation clearing would be more limited than under Alternative A. Therefore, less soil would be disturbed, and there would be fewer direct effects on cultural resources. Any new construction along the shoreline would require a permit from TVA. There would be some general guidelines regarding size and number of structures per lot.

The amount of additional residential shoreline development that could occur would be the same as Alternative A (50 percent).

- Therefore, under Alternative B1, about 2,750 archaeological sites potentially could be disturbed or mitigated.

Under **Alternative B2,** effects to cultural resources would be similar to those projected for Alternative B1. However, only 25 percent additional shoreline would potentially be developed with residential shoreline alterations. Of this 25 percent, 10 percent would be TVA-owned and 15 percent would be flowage easement shoreland.

- Along the TVA-owned shoreline, 550 sites potentially could be disturbed or mitigated (10 percent of 5,500 total sites).
- On privately owned flowage easement shoreland, 825 sites could be affected (15 percent of 5,500 total sites).
- Therefore, under Alternative B2, about 1,375 sites potentially could be disturbed or mitigated.

Alternative C1 differs from the first three alternatives in that it calls for a shoreline inventory and categorization system (Section 2.5.1 and Appendix C). Using this system, significant cultural resources would fall under the shoreline protection designation. Alternative C1 would also adopt specific development standards. For example, channel excavation would be limited. Treatment plans for eroding shorelines would consider potential impacts to cultural resources and would incorporate protection measures. SMZs would be maintained and, thus, less shoreland would be disturbed. Community docks and water-use facilities would be encouraged to decrease the amount of construction along the shoreline. Since less soil would be disturbed, fewer cultural resources would be impacted.

Under Alternative C1, another 35 percent of the shoreline could potentially be developed with residential shoreline alterations over the next 25 years. Of this 35 percent, 20 percent would be TVA-owned and 15 percent would be flowage easement shoreland.

- Under this alternative, TVA would establish SMZs on its property but allow an adjacent private landowner to apply for a vegetation management corridor across TVA shoreland equal to 20 percent (up to a maximum width of 50 feet) of the property owner’s lot frontage (Section 2.5.2). Therefore, the number of cultural sites affected would be significantly less than under Alternatives A/B1 and somewhat less than Alternative B2. Along the TVA-owned shoreline, about 220 sites potentially could be disturbed or mitigated (20 percent x 5,500 total sites x 20 percent for a vegetation management corridor).
- However, on flowage easement property, vegetation management standards would not be mandatory, and approximately 825 sites could be disturbed or mitigated (15 percent of 5,500 total sites).
- Therefore, under Alternative C1, about 1,045 sites potentially could be disturbed or mitigated.

Under **Alternative C2**, effects to cultural resources would be similar to those projected for Alternative C1. However, only 25 percent additional shoreline would potentially be developed with residential shoreline alterations. Of this 25 percent, 10 percent would be TVA-owned and 15 percent would be flowage easement shoreland.

- Along TVA-owned shoreline, approximately 110 cultural sites potentially could be disturbed or mitigated (10 percent x 5,500 total sites x 20 percent for a vegetation management corridor).
- However, on flowage easement property, vegetation management standards would not be mandatory, and approximately 825 sites could be disturbed or mitigated.
- Therefore, under Alternative C2, about 935 sites potentially could be disturbed or mitigated.

Under Alternatives C1, C2, D, and the **Blended Alternative**, a shoreline inventory and categorization system would also be used to identify and protect the significant cultural resources along the shoreline. Because of this shoreline protection system, it is likely that most cultural resources would be avoided.

Standards proposed under the Blended Alternative would also help to minimize impacts to cultural resources. Channel excavation on TVA-owned residential access shoreland would be limited to 150 cubic yards or less. Again, with the shoreline protection system in place, it is unlikely cultural resources would be disturbed.

Under this alternative, TVA would recommend appropriate shoreline stabilization solutions, as requested, and the homeowner could choose between riprap, gabions, biostabilization, or a combination of these methods. The cultural resources/SMI inventory would be utilized to make recommendations that would have the least impact to any cultural resources present.

Before siting access corridors or allowing other vegetation disturbance, TVA would check the cultural resources/SMI inventory to determine if cultural resources were present, and if so, the access corridor would be relocated and other necessary modifications to plans would be made.

The Blended Alternative would allow dock and boat ramp construction. Again, TVA would use the shoreline categorization system to identify cultural resources and adjust the placement of these shoreline structures if necessary.

The number of sites potentially disturbed or mitigated under the Blended Alternative would be fewer than the number projected for Alternative C2 and more than that anticipated under Alternative D. Under the Blended Alternative, an additional 25 percent of the shoreline could potentially be developed with residential shoreline alterations over the next 25 years. Of this 25 percent, 10 percent would be TVA-owned and 15 percent would be flowage easement shoreland.

- Under this alternative, TVA would establish a 25-foot-deep SMZ on its property but allow an adjacent property owner to establish an access pathway up to 20 feet wide and to remove select trees elsewhere on TVA land. Using 157 feet as the average width of a lakefront lot (see *Table 3.4-4)*, about 13 percent of a landowner's property could be affected by this access path (20 feet/ 157 feet). Therefore, along TVA-owned shoreline, about 70 sites could be disturbed or mitigated (10 percent x 5,500 total sites x .127).
- However, on flowage easement property, vegetation management standards would not be mandatory, and approximately 825 sites potentially could be disturbed or mitigated.
- Therefore, under the Blended Alternative, approximately 895 sites could be disturbed or mitigated.

Alternative D would result in the least amount of soil disturbance of any alternative because more protective shoreline development standards would be applied (Section 2.7.2). TVA would limit reservoir access to a 6-foot-wide path at a location specified by TVA. The path would be sited to avoid archaeological sites. Also, TVA would determine the type of erosion control most appropriate for a particular area.

To be eligible for a dock or a boatslip, an applicant would have to meet a 200-foot minimum lot width requirement. Boat-launching ramps would be considered only at community lots where there were no public ramps within a 20-mile radius of the residential development. Channel excavation would be restricted. Furthermore, by limiting construction along the shoreline, some backlying development may be discouraged.

Under Alternative D, another 25 percent of the shoreline could potentially be developed with residential shoreline alterations over the next 25 years. Of this 25 percent, 10 percent would be TVA-owned and 15 percent would be flowage easement shoreland.

- Under this alternative, TVA would limit reservoir access to a 6-foot-wide pathway across TVA property. This would be equal to a maximum of 3 percent of the property owner's lot frontage (6 feet ÷ 200 feet minimum lot width). Therefore, about 17 cultural sites along TVA-owned shoreline potentially could be disturbed or mitigated (10 percent x 5,500 total sites x 3 percent).
- However, on flowage easement property, vegetation management standards would not be mandatory, and approximately 825 sites could be disturbed or mitigated.
- Therefore, under Alternative D, about 842 sites potentially could be disturbed or mitigated.

Under each alternative, potential disturbance of archaeological sites on flowage easement shoreland would remain constant, while disturbance of cultural sites on TVA fee-owned land would fluctuate, depending on the amount of additional land that could be developed.

Again, all cultural resources on TVA-owned property are protected under federal legislation. Any direct, indirect, or cumulative effects will be mitigated or avoided. However, mitigation is not the same as preservation. The less soil disturbance that takes place, the better for the preservation of cultural resources.

Regardless of the alternative, impacts to cultural resources can occur from other land uses besides residential shoreline development (i.e., industrial development and commercial recreational facilities). Cumulative impacts occur when, over time, the impacts from individual developments combine with those from all other developments. Even a well-mitigated small development project may have a minor impact on cultural resources. When these impacts are combined with those from other projects, cumulative impacts can occur.

For example, industrial development usually requires large parcels of land. Unlike residential shoreline developers, industry tends to develop the entire parcel. Therefore, one facility disturbs many acres of land. Any effects to archaeological resources will be mitigated. However, one industrial development often encourages other developments to locate nearby, which disturbs more land. As this trend continues, the minor, mitigated impacts can result in cumulative impacts. However, the potential for cumulative and other impacts along with appropriate mitigation measures would be further considered in the environmental review of any new proposal.

Commercial recreation facilities can also contribute to cumulative impacts. However, there would not typically be the same level of soil disturbance for a marina as there would be for an industrial complex. Natural resource management along the shoreline contributes the least to cumulative impacts on archaeological sites because very little soil is disturbed.

Most cumulative impacts are expected to occur as a result of increased residential shoreline development. Over the next 25 years, it is estimated that a maximum of 1 percent of additional shoreline could be developed for recreation and 2.2 percent for industrial use. Cumulative impacts on cultural resources from these and other land uses (i.e., forest management and agricultural practices) are not expected to be regionally significant. However, at a reservoir level, they could be locally important.

4.13.3 Relative Impacts of the Alternatives

The relative impacts to cultural resources under the seven alternatives are shown in *Figure 4.13-2*.

Figure 4.13-2. Relative Impacts of the Alternatives on Cultural Resources.[1]

Indicator	Greatest Potential					Lowest Potential
Number of Cultural Sites Potentially Disturbed or Mitigated	A/B1	B2	C1	C2	Blended	D

[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.14 Effects on Socioeconomics

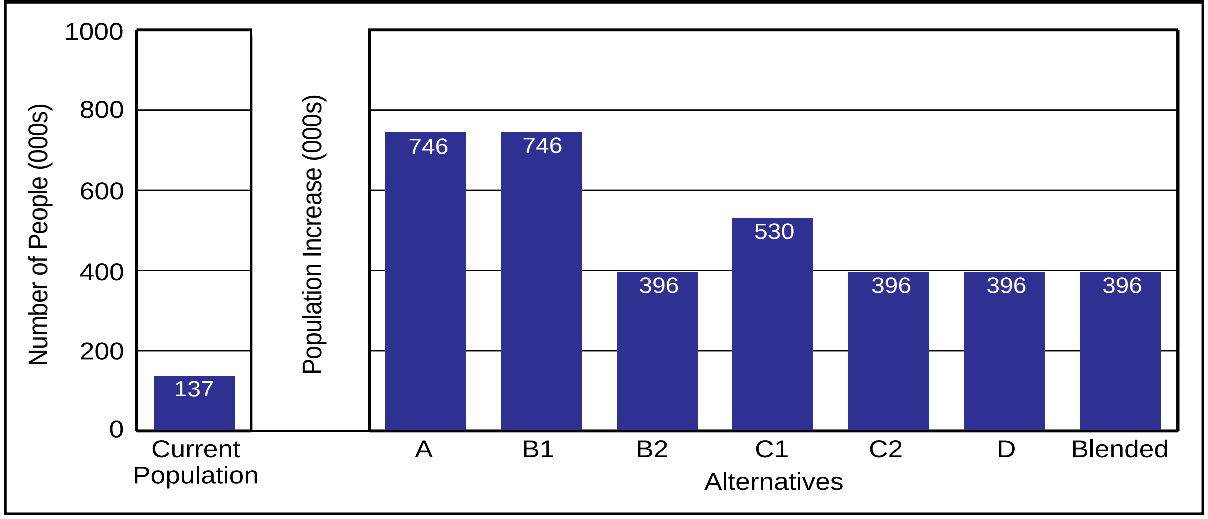
4.14.1 Introduction

The major socioeconomic impacts from residential shoreline development are expected to be on population, income and employment, and property values and taxes. There could also be potentially major, direct, local, positive effects to population, income, employment, and perhaps property values and taxes from industrial development of shoreland and, to a lesser extent, from recreation development. Industrial expansion could be locally significant because the development may have to be intensive at one location along the shoreline to be cost-effective. An analysis of expected development for the next 25 years shows that a maximum of 1 percent of additional shoreline could be developed for recreation and 2.2 percent for industrial use. At this level of development, cumulative impacts on socioeconomic resources are expected to be regionally insignificant; however, at the individual reservoir level, these impacts could be locally important.

4.14.2 <u>Population</u>

As discussed in Section 3.16.2, approximately 137,000 people are currently living on the lakefront or on backlots associated with lakefront developments. This is about 1.6 percent of the 1994 population of the Tennessee Valley 201-county region (8.7 million). Under any of the alternatives, the number of residents adjacent to the shoreline would increase greatly *(Figure 4.14-1)*. Variations among the alternatives would result largely from differences in the amount of shoreline available for residential access and development.

Figure 4.14-1. Impacts on Lakefront Development Population[1] by Alternative[2] Compared with Current Conditions.



[1]People living on the lakefront or on backlots associated with lakefront development.

[2]Within the next 25 years.

Based on the current high demand for waterfront lots and on the expected continuation of regional population growth, it is assumed that all of the available land would eventually be developed for either full-time or part-time residential access. After 25 years, 5 to 8 percent of the region's population (projected to be 10.8 million) would be living on lakefront lots. While other factors, such as average lot size, may vary somewhat among the alternatives, these factors were not considered in this analysis.

There are three buildout scenarios that project varying amounts of additional shoreline that could be developed for residential access (Section 4.2). A range of population levels has been estimated for each of these three scenarios (Appendix P). The medium-level projection was used to estimate population, income, and employment impacts.

Under **Alternatives A/B1**, 5,510 additional miles of shoreline could be affected by residential shoreline development *(Table 4.2-1)*. Based on current average lot sizes and densities, there would be about 156,000 new lakefront lots (Appendix P). Assuming that 80 percent of these are occupied on a full-time basis and that there are 2.67 persons per household (U.S. Department of Commerce, 1995), population along lakefront lots would increase by about 333,000. In addition, there would be about 172,000 backlots developed in conjunction with these new developments. Assuming that 90 percent of these are occupied on a full-time basis, this would result in another 413,000 residents. Additional population as a result of residential shoreline development would be approximately 746,000 persons under these alternatives. When added to the current population, total population on lakefront lots and in lakefront subdivisions would increase to around 883,000 persons, equivalent to about 8 percent of the Tennessee Valley region population in 25 years. In addition to this permanent population increase, as many as 30,000 additional lakefront units and 17,000 backlot units could be developed for part-time use by the owners and their families and friends.

Under **Alternative C1**, fewer additional miles of shoreline (3,864) would potentially be developed. This would result in about 111,000 additional lakefront lots, plus about 122,000 additional residential backlots. Using the same household size and occupancy assumptions, there would be about 237,000 additional lakefront and 293,000 additional backlot residents. Additional population as a result of residential shoreline development would be about 530,000 persons. Total population on lakefront lots and in lakefront subdivisions would be about 667,000, equivalent to about 6 percent of the Tennessee Valley region population in 25 years. About 22,000 additional lakefront lots and 13,000 backlots would be developed for part-time use.

Under **Alternatives B2/C2/D/Blended Alternative**, an additional 2,809 miles of shoreline would potentially be developed. This would likely result in about 83,000 additional lakefront lots, resulting in a population increase of about 177,000 persons. In addition, there would be about 91,000 additional backlots, resulting in a population increase of about 219,000 persons. Additional population as a result of residential shoreline development would be about 396,000 persons. Total population on lakefront lots and in lakefront subdivisions would be about 533,000, equivalent to about 5 percent of the population of the Tennessee Valley region in 25 years. Another 16,000 lakefront units and 9,000 backlot units would likely be developed for use on a part-time basis.

Under any of the alternatives, some of the additional lakefront residents would be persons attracted to the Tennessee Valley because of the lakes and who otherwise would not move to the area. Based on current trends, most of the working-age people and a large share of retirees would be persons who would be living elsewhere in the Valley, generally in the same or a nearby county. Therefore, there would be no regionally important population effects, even though these impacts could be locally important.

4.14.3 Income and Employment

Since the net regional population impact would be relatively small under any of the alternatives, there would be no important regional income and employment impacts directly attributable to shoreline development. However, while places of employment would shift very little, the location of some homesites would change among counties. This would increase total residential income and employment in some counties and lower it in others. These shifts would be very difficult to assess and would require site-specific studies. Similarly, additional residential construction would be largely a shift within the general area and would not result in important regionwide impacts. However, there could be important local impacts, and a specific development, such as Cooper Communities on Tellico Reservoir, might attract a large share of its residents from outside the region. If TVA approval of a specific development were needed, the site-specific impacts would be assessed in a separate environmental review.

Local impacts to income and employment would result from part-time residential units, construction of water-based facilities, and informal recreation losses. These impacts are summarized in *Tables 4.14-1* and *4.14-2* and discussed in the following sections.

Part-Time Residential Units

Additional income would be generated by use of part-time residential units, some of which would have a residential structure, while others may have only a boat dock or other facility. Many of these expenditures, however, would occur elsewhere in the Valley if they did not occur on the TVA shoreline. Possible expenditures would include such things as:

- Locating on a private or non-TVA public lake.
- Purchasing a houseboat maintained at a commercial facility.
- Constructing a vacation home in the mountains.

The magnitude of these impacts would vary among the alternatives, since different numbers of part-time units would be available.

Income and employment increases from use of part-time residential units would be greatest under **Alternatives A** and **B1**, followed by **Alternative C1**, and lowest under **Alternatives B2/Blended Alternative, C2,** and **D**.

Table 4.14-1. Total Annual Income Impacts (Direct and Indirect) by Alternative[1] Resulting From Use of Part-Time Residential Units, Construction of Water-Based Facilities, and Loss of Informal Recreation.				
Alternatives	**Increase From Use of Part-Time Residential Units (Million $)**	**Increase From Construction of Water-Based Facilities (Million $)**	**Decrease From Informal Recreational Losses (Million $)**	**Total Increase in Annual Income (Million $)**
A	94	127	(8)	213
B1	94	78	(8)	164
B2	50	40	(3)	87
C1	67	46	(5)	108
C2	50	33	(3)	80
D	50	23	(3)	70
Blended	50	40	(3)	87

[1]Within the next 25 years.

Table 4.14-2. Total Annual Employment Impacts (Direct and Indirect) by Alternative[1] Resulting From Use of Part-Time Residential Units, Construction of Water-Based Facilities, and Loss of Informal Recreation.				
Alternatives	**Increase From Use of Part-Time Residential Units (Number of Jobs)**	**Increase From Construction of Water-Based Facilities (Number of Jobs)**	**Decrease From Informal Recreational Losses (Number of Jobs)**	**Total Increase in Annual Employment (Number of Jobs)**
A	5,500	3,300	(300)	8,500
B1	5,500	2,000	(300)	7,200
B2	2,900	1,100	(100)	3,900
C1	3,900	1,200	(200)	4,900
C2	2,900	900	(100)	3,700
D	2,900	600	(100)	3,400
Blended	2,900	1,100	(100)	3,900

[1]Within the next 25 years.

Construction

Construction of new houses, boat docks, and other facilities would generate additional local income. Housing construction for full-time use would not produce important regionwide impacts, since most of this construction would be for persons who would otherwise live in the same or a nearby county. Some portion of this housing would be for retirees who would otherwise live outside the region. While the size of this market is unknown, it is not expected to be a major share of the total. However, some of the full-time housing unit construction may produce locally important impacts. Also, much of the housing construction for part-time use would occur elsewhere in the Valley if reservoir locations were not available. While this construction could have important local impacts, it is not expected to result in important regionwide effects.

On the other hand, construction of boat docks and other water-use facilities would result in some regionwide impacts that might not otherwise occur. These could be important to the local economy in counties along the reservoirs where additional development would occur. *Table 2.7-1* summarizes the construction standards by alternative and lists the footprint requirements for boat docks and covered boatslips. These standards vary from having no restrictions under Alternative A to allowing only an uncovered slip for one boat with 300 square feet of dock under Alternative D.

Construction costs for boat docks and covered boatslips would also vary among the alternatives *(Table 4.14-3)*. It is estimated that approximately 45 percent of the construction cost of a boat dock can be attributed to materials and equipment and 55 percent to labor and profit. When other amenities, such as a boathouse and deck, are added, materials and equipment account for about 70 percent of the construction cost, and 30 percent is labor and profit.

Table 4.14-3. Construction Costs for Boat Docks and Covered Boatslips by Alternative.[1]

Alternatives	Range of Construction Costs	Average Construction Cost
A	$15,000 – $20,000	$18,000
B1	$7,500 – $15,000	$11,000
B2	$7,500 – $15,000	$11,000
C1	$6,500 – $10,000	$9,000
C2	$6,500 – $10,000	$9,000
D	$3,000 – $5,000	$4,000
Blended	$7,500 – $15,000	$11,000

[1]Within the next 25 years.

The number of new boat docks and covered boatslips would vary with each alternative, depending on the number of new waterfront residential units constructed. Income and employment increases from construction of water-based facilities would be greatest under Alternative A — followed by Alternatives B1, C1, B2/Blended Alternative, and C2 — and lowest under Alternative D.

Informal Recreational Losses

There would also be effects on income and employment generated by loss of informal recreational use of the shoreline by nonproperty owners. A large number of the existing informal recreational opportunities would be lost under any of the alternatives (Section 4.11). After 25 years, the number of lost occasions ranges from 726,000 per year under Alternatives A/B1 to 269,000 per year under Alternatives B2/C2/D/Blended Alternative. Income and employment decreases from lost recreational opportunities would be greatest under Alternatives A/B1, followed by Alternative C1, and least under Alternatives B2/C2/D/Blended Alternative.

Tourism

The tourism industry is important to the Valley's economy, creating many jobs and an important share of Valley income. Under Alternative A, major negative impacts to tourism could occur on a local scale. They would be less likely under Alternative B1 and considerably less likely under the other alternatives. However, TVA does not anticipate significant tourism impacts on a Valleywide scale under any of the alternatives. Local impacts will be assessed, as appropriate, in the individual reservoir land management plans.

Summary of Effects to Total Annual Income and Employment

In 1993, total personal income of the Tennessee Valley region was about $150 billion, and employment was approximately 3.6 million. Therefore, the maximum effects (i.e., those resulting from Alternative A) would represent a negligible share of current regional income (0.14 percent) and employment (0.24 percent). However, effects on the local economy could be important. Total income and employment increases would be greatest under Alternative A — followed by Alternatives B1, C1, B2/Blended Alternative, and Alternative C2 — and lowest under Alternative D.

Development in Backlying Areas

Increases in residential shoreline development along the reservoirs would also lead to more business and infrastructure development in backlying areas. Since most of this development would be populationinduced, it would generally take place elsewhere in the general area if the reservoir-related development did not occur. However, development along the reservoirs would induce some related development to locate closer to the reservoirs than it would have otherwise. This development would include such things as strip shopping centers, various stand-alone businesses, and supporting infrastructure such as roads, water, and sewer. These developments could further contribute to local environmental impacts to resources such as water quality, wetlands, etc. While these impacts would probably not be important systemwide under any of the alternatives, some could be important locally. These impacts would be addressed when individual reservoir land management plans are prepared.

4.14.4 Property Values

Property Values

Based on historical trends, property values along and near the shoreline would continue to increase under all alternatives. The desirability of such property and the scarcity of both lake property and land in general would continue to push prices upward. Limitations on development resulting from resource protection laws would likely contribute to the scarcity of developable property. Also, local regulations may affect how property can be developed. These effects would occur under all alternatives.

However, there would be important differences among the alternatives. A recent study in the state of Maine found that water quality has an important impact on lakefront property values (Michael et al., 1996). Various studies have shown positive impacts on residential developments from quality design, landscaping, and other amenities. An important factor is quality site planning for the entire development, not just for individual sites (Bookout et al., 1994). For example, around Chesapeake Bay, land use controls that limited densities, development-related runoff, erosion, and habitat disturbance increased property values (Beaton and Pollock, 1992).

Proximity to open space, greenways, parks, and recreational trails tends to add value. However, this is not necessarily true if property is adjacent to heavily used, active areas or places where residents or property owners feel vulnerable to disturbance or damage from users (Brabec, 1992; Correll et al., 1978; Hammer et al., 1974). Property values are also affected by the quality of views. It is not just the looks of a specific tract of land that determines its value, but also the larger view from that property — next door, up the ridge, or across the lake (Brabec and Kirby, 1992). Three factors would determine future property values: development standards; view (both nearby and panoramic); and scarcity.

Under **Alternative A,** quality of water-use facility design, landscaping, and other amenities would be up to the property owner, and shoreline property would receive little protection. In addition, the lack of standards would eventually diminish the quality of the view of many (if not most) residents, especially those not fortunate enough to be in view of parks or other preserved areas. As a result, property values would generally be lower than they would be if current guidelines were continued. However, values would still increase over time.

Under **Alternative B1**, TVA's existing guidelines would continue, and property values would continue to increase as shoreline and nearby lots became more scarce. In general, this effect would be greater near larger population centers and in the more desirable locations. However, over time it would likely impact most of the available shoreline as regional and national population increased. Under **Alternative B2**, there would be fewer water access sites available than under Alternative B1, which allows for additional areas to be opened. As a result of this scarcity, land prices would ultimately be higher than under Alternative B1.

Under **Alternative C1**, development standards would result in better quality design and better views. Property values would be about equal to those projected under Alternative B2. Under **Alternative C2**, there would be fewer water access sites available than under Alternative C1, which allows for additional areas to be opened. Therefore, property values probably would be higher than under Alternative C1.

Under **Alternative D**, views across the lake would be better than under the other alternatives. However, standards limiting shoreline clearing would diminish ability to see this view from residences on most shoreline and nearby lots. The net result would probably be lower property values than under Alternatives C1 and C2, although it is not clear whether the effect would be enough to make property values lower than under existing guidelines. This conclusion is supported by a TVA study of property values on Tellico and Fort Loudoun Reservoirs (TVA, 1995d). This study found that lots in residential developments characteristic of the managed shoreline development approach (i.e., Alternatives C1 and C2) sold for about 25 percent more than those representative of Alternative D.

Under the **Blended Alternative**, high development standards would be maintained, while allowing property owners more flexibility than under Alternatives C1, C2, and D. The availability of water-access sites would be about the same as under Alternatives C2 and D. Therefore, property values could be slightly higher than under Alternative C2 or any of the other alternatives.

In general, property values would increase across the alternatives starting with Alternative A and followed by Alternatives B1, B2/C1, and C2. Property values under the Blended Alternative would be highest of all. In comparing Alternative B2 to Alternative C1, the competing effects of scarcity and quality of development leave it unclear as to which would result in higher values. Therefore, the impacts under these alternatives are assumed to be equal. Under Alternative D, property values would be about 25 percent less than under Alternative C2. Although Alternative D would result in lower property values than Alternative C2, there was not enough sales price data to quantify a relationship between Alternative D and the other alternatives.

Property Taxes and Local Tax Base

Property taxes are directly tied to property values. Since, as noted above, property values are expected to continue to increase under any of the alternatives, property taxes would also continue to increase on properties now developed. Also, under any of the alternatives an additional 25 percent of the shoreline could potentially be developed. Not only would this property continue to increase in value in its undeveloped state, but as development occurs, the value, and therefore the local tax base would increase due to construction of houses. Most of this development, however, would occur somewhere in the area if it did not occur along the reservoirs. Therefore, the net effect on the tax base would be considerably less than the increased tax base associated with existing reservoir development.

In certain cases, allowing shoreline development would result in some shift of tax base among jurisdictions. This would occur when the shoreline being developed is in a different county or city from that in which much of the residential development would otherwise have occurred.

As discussed above, under Alternatives A and B1, the lack of development standards and a decrease in the quality of view would tend to have a dampening effect on the increase in property values. This would in turn similarly affect property taxes and the local tax base. In general, then, property taxes and the local tax base would progressively increase from Alternative A to B1, followed by Alternatives B2/C1. Alternative C2 would be next, followed by the Blended Alternative, which would likely result in the greatest increase in taxes and the tax base. Alternative D would be lower than Alternative C2 but cannot be directly compared with other alternatives (see discussion under Property Values). Also, with respect to Alternatives B2 and C1, it is not clear as to which alternative would result in higher taxes.

4.14.5   Environmental Justice

Environmental justice involves the potential for agency actions to disproportionately impact minority or low-income populations. This concern arises primarily in the siting of new industrial or commercial facilities, although it can be important in the development of policies that produce or result in nonuniform effects.

SMI participants did not identify environmental justice as an important issue during the public involvement process. Available population data do not identify shoreline populations by income or race. However, all types of populations and incomes appear to be located along the TVA reservoir system, based on the general observations of TVA personnel over the years.

Today the price of most property on the reservoirs is generally out of the range of low-income populations. On the other hand, there should be no barriers to the purchase of such land by minorities if they are able and willing to pay the necessary price. There might be some potential for disproportionate loss of recreation opportunities for low-income populations should development occur on or near prime informal recreation areas. While there are no available data on the socioeconomic status of users of informal recreation areas, TVA experience is that these users are of all levels. On the other hand, lower-income persons may be more likely to engage in informal recreational activities due to the high cost of boating and other formal activities. If there is any such difference, however, TVA expects it to be slight, especially at the regional level.

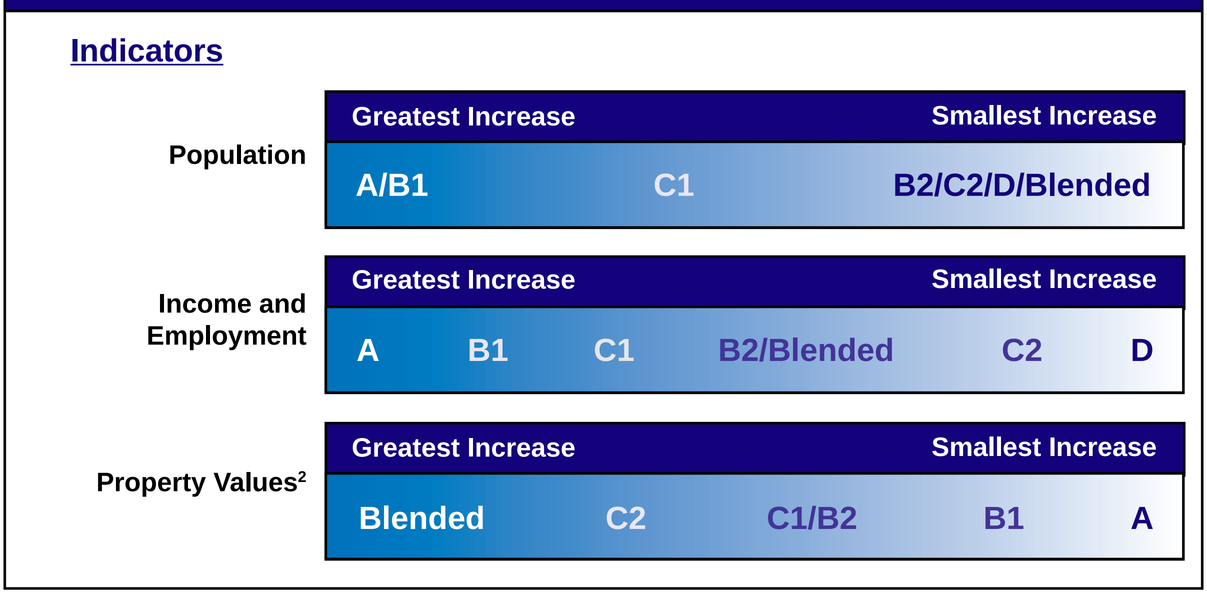
The purpose of SMI is to review existing permitting guidelines and establish a shoreline management policy that will better protect shoreline resources, while allowing adjacent residents reasonable access to the water. TVA will apply the SMI policy uniformly along all TVA-controlled shorelines, and as such, SMI is not expected to have disproportionate impacts on minority or low-income populations. In fact, under most of the alternatives evaluated for SMI, including TVA's preferred **Blended Alternative**, potential environmental impacts should be lessened, compared to TVA's existing shoreline management practices. Therefore, the risk of adverse health and welfare impacts on all users of the TVA reservoir system should be reduced.

TVA will continue to consider environmental justice concerns when preparing individual reservoir land use plans and in the review of specific reservoir-level projects. At the local level, it is more feasible to segment population data, and it is possible that discrete projects could have disproportionate impacts on minority or low-income populations.

4.14.6 Relative Impacts of the Alternatives

The relative impacts to socioeconomics under the seven alternatives are shown in *Figure 4.14-2*.

Figure 4.14-2. Relative Impacts of the Alternatives on Socioeconomics.[1]



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

[2]Alternative D is not shown because its impact with respect to the other alternatives is not clear.

4.15 Effects on Navigation

4.15.1 Introduction

Protection of the waterway is provided for under Section 26a of the TVA Act (1933, as amended). Section 26a review ensures that construction of private water-use facilities does not encroach upon the commercial navigation channel or marked recreational channels. Consequently, there will be no direct impact on commercial navigation from the construction of water-use facilities under any of the alternatives.

4.15.2 Commercial Navigation and Recreational Boating

Increasing the number of shoreline miles available for docks and other shoreline alterations would increase the number of residences with direct access to the reservoirs. Increased recreational boating (if any) associated with increased shoreline development is not expected to have a significant impact on commercial navigation under any of the alternatives.

Preliminary data from the U.S. Coast Guard indicate that collisions between commercial tows and recreational boaters occur on reservoirs where barge traffic is the heaviest. On the Tennessee River, Kentucky Reservoir has the largest volume of barge traffic. Barge traffic declines steadily as it moves upstream. In 1996, 3,401 commercial tows passed through Kentucky Lock, compared to 1,882 tows through Wilson and 247 through Fort Loudoun. Although Kentucky Reservoir has little residential shoreline development (6 percent as of 1994), the two reported collisions involving tows and recreational boaters during the past four years occurred on this reservoir. On the other hand, there were no collisions on Wilson Reservoir, where residential shoreline development is already around 52 percent of the total shoreline *(Table 3.4-3)*. Approximately 55 percent of barge traffic on the Tennessee River goes through Wilson Lock.

Any increase in collisions involving commercial tows and recreational boaters is expected to be more directly related to the volume of barge traffic on the reservoir, boating operation, and alcohol misuse. Red Cross records indicate that misuse of alcohol is involved in two-thirds of all recreational boating accidents nationwide (American Red Cross, 1991).

TVA estimates that commercial barge traffic on the Tennessee River would increase from 45.7 million tons in 1996 to 78 million tons over the next 25 years; however, growth is not projected to occur systemwide. Most of the growth is projected to occur on the lower end of the system below Chickamauga Lock. The small navigation locks at Chickamauga, Watts Bar, and Fort Loudoun have hindered development of barge terminals on the upper reach of the Tennessee River system. Chickamauga Lock at Chattanooga has structural problems that require the lock to be closed permanently in the next five years. Closing the lock would mean that all barge traffic above Chattanooga would stop. If a new lock is constructed as planned, barge traffic would be expected to increase on Chickamauga Reservoir, primarily from coal and scrap steel moving out of East Tennessee and Kentucky. Melton Hill and Tellico Reservoirs, both accessible to barges, currently have limited barge traffic. TVA does not expect that either of these reservoirs would experience significant barge terminal development in the foreseeable future. On tributary reservoirs that cannot be accessed by lock or canal, there would be no impact on commercial navigation.

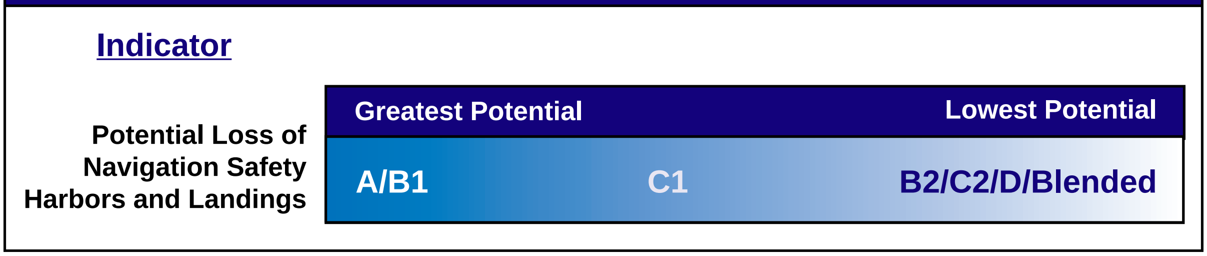
4.15.3 Safety Harbors and Landings

TVA prohibits the construction of docks and other residential shoreline alterations within the marked limits of safety harbors and landings. Few of these harbors and landings have been made available in the past for residential shoreline development. As lakefront development increases, TVA expects requests from backlying property owners for the use of safety harbors and landings to increase. Data are not available to estimate how many safety harbors would be released for development of docks under the SMI alternatives. However, it is assumed that the loss of essential safety harbors and landings would decrease navigation safety on the Tennessee River and that the loss of these harbors would correlate with the number of shoreline miles potentially developed. Therefore, the potential loss of safety harbors and landings would be greatest under **Alternatives A/B1,** followed by **Alternative C1,** and least under **Alternatives B2/C2/D/Blended Alternative**.

4.15.4 Relative Impacts of the Alternatives

The relative impacts to navigation under the seven alternatives are shown in *Figure 4.15-1*.

Figure 4.15-1. Relative Impacts of the Alternatives on Navigation.[1]



[1]Impact bars are provided to qualitatively rank the alternatives and are not intended to show the magnitude of difference between alternatives.

4.16 Adverse Environmental Impacts Which Cannot Be Avoided Should the Proposal Be Implemented

The SMI proposal addresses the amount and type of residential shoreline development that would be allowed on TVA-managed reservoirs. Some increase in developed shoreline would occur regardless of the action TVA takes, because a portion of the shoreline is privately owned. Landowners adjacent to TVA reservoirs have deeded or implied rights to water access on 38 percent of the shoreline.

Shoreline development would result in losses in forest area, local impacts to forest wildlife habitat, and a decrease in the quality of wintering waterfowl habitat. Reduction in forest area would in turn reduce habitat required by forest species and increase suitable habitat for cowbirds, which would, in turn, impact the nesting success of birds. Shoreline development also could result in a loss of potentially suitable, but presently unoccupied habitat for shoreline-using endangered and threatened species. Wetlands functions and values could also be impacted by some shoreline development. Aquatic habitat suitability would decrease under most shoreline management options as more shoreline is opened for residential development. Residential development could also lead to nutrient enrichment of some reservoirs and fecal coliform contamination in some embayments.

From a recreation standpoint, residential shoreline development would essentially privatize public lands in front of lakefront houses, even though a strip of land adjacent to the shoreline may be public. This would unavoidably displace informal recreational users.

The magnitude of the above adverse environmental impacts would vary among alternatives and is discussed in detail in previous sections of Chapter 4. Through existing and proposed environmental protection measures incorporated into the **Blended Alternative**, many of the potential adverse impacts from developing shoreline at the 38 percent level could be avoided.

4.17 Relationship Between Short-Term Uses and Maintenance and Enhancement of Long-Term Productivity

Commitment of the shorelands to residential access and development is essentially a long-term decision that would decrease the productivity of land for forest, wildlife, recreation, and natural area management. Long-term productivity decreases would be greatest under **Alternatives A, B1,** and **C1**. As described in earlier sections, the types of changes that occur with residential development would result in a decline in the habitat quality for some terrestrial species and an increase in habitat for others. Many of the water-related impacts of shoreline development could be minimized by the use of appropriate controls on erosion, added nutrients, and pesticide input.

Increased development would occur under any of the alternatives and result in population increases along the shoreline. New jobs and income would be generated by the spending activities of these new residents, leading to enhanced long-term socioeconomic productivity. This would be the case as long as the desirable features that prompted their move to the shoreline were maintained or enhanced. The managed development approaches of Alternatives C1, **C2,** and the **Blended Alternative** would likely increase the desirability of specific developments. The likelihood of maintaining these desirable features would decrease as fewer controls were placed on development and as more shoreline was opened to residential access (i.e., under Alternatives A and B1).

4.18 Energy Requirements and Conservation Potential

Energy is used to build and maintain backlying residential areas, as well as to manage vegetation around residences and the shoreline. Although shoreline development is not likely to have much influence on regional energy use trends, those alternatives that allow mechanized clearing of TVA land (**Alternatives A, B1,** and **B2**) would result in relatively greater short- and long-term energy usage. Short-term energy would be from machines used to clear the land, and long-term energy usage would be from fuel used by mowers to maintain grassy areas. **Alternatives C1, C2, D,** and the **Blended Alternative** would tend to conserve energy, because they encourage tree canopies which shade houses and thereby reduce cooling loads.

Based on the *Integrated Resource Plan EIS* (TVA, 1995c), there were 3,068,076 TVA residential customers in 1994, using 46,330 million kWh (kilowatt-hours). With 137,000 people living along the lakefront and 2.67 persons per household (Section 3.16.2), there are 51,300 homes along the lakefront. At 15,100 kWh per home, total residential electricity sales for lakefront residents are estimated to be 775 million kWh.

The *Integrated Resource Plan EIS* (TVA, 1995c) assumes that residential energy efficiency would improve 7.2 percent by 2020, suggesting that residential energy consumption per household could decrease to 14,000 kWh. However, other factors, including additional end uses, more affluent lifestyles, and the trend toward larger homes could increase annual energy usage per home to as much as 24,000 kWh. Under Alternatives A/B1, population could increase by 746,000 residents in 25 years. Therefore, additional total electricity sales to support these residents could range from 3,912 to 6,706 million kWh. Similarly, under Alternatives B2/C2/D/Blended Alternative, additional electricity sales would be from 2,071 to 3,551 million kWh, and sales for Alternative C1 would be from 2,779 to 4,764 million kWh. Because most of the new residential development would not result from a regionwide population increase, these energy resources would probably be used elsewhere in the region if they were not used along the shoreline.

Compared to Tennessee Valley residents in general, certain energy end-uses would be more likely to be found in shoreline homes. These include water pumps, additional decorative and security lighting, boat lifts, and boat heaters. Estimated annual incremental electricity usage would range from 300 kWh to 700 kWh per home. Average incremental energy usage would probably be towards the lower end of the range. Under Alternatives A/B1, incremental electricity sales to support these residents could approach 83 to 193 million kWh in 25 years. Similarly, under Alternatives B2/C2/D/Blended Alternative, electricity sales would be from 44 to 102 million kWh, and sales for Alternative C1 would be from 59 to 138 million kWh. In addition to electricity usage, gasoline consumption could be higher for shoreline residents. Those who commute to work would have to travel longer distances. Also, shoreline residents are likely to use more boat gasoline when compared to the average Tennessee Valley resident.

4.19 Irreversible and Irretrievable Commitments of Resources Involved in Proposed Action

The irretrievable use of nonrenewable resources (i.e., fuel, energy, and some construction materials) would occur under all of the alternatives due to residential shoreline development. However, most of the new development would not result from a regionwide population increase. This means that the same development would occur somewhere else in the region. Therefore, most (if not all) of these resources would be used somewhere in the region to provide the same residential development services, regardless of the alternative chosen.

As shoreline is converted to residential use, the land is essentially permanently changed and not available for agricultural, forestry, wildlife habitat, natural area, and recreational uses in the foreseeable future. This is an irreversible commitment of land which would be greater in magnitude under those alternatives that open larger amounts of shoreline to residential access and development, such as **Alternatives A** and **B1**. **Alternative C1** would open additional land for access and development but also establish development standards and SMZs, which would protect renewable resources more than **Alternative B2**. **Alternatives C2, D**, and the **Blended Alternative** minimize vegetation clearing, provide SMZs, and could result in potential buildout of 38 percent of the shoreline; therefore, these alternatives would tend to better protect renewable resources found along the shoreline.