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## D6b.1 Introduction

The largest cluster of protected species identified during the threatened and endangered species evaluation for the Reservoir Operations Study (ROS) Environmental Impact Statement (EIS) consists of 60 species that typically occur in the main channels of the rivers and streams, including at least some parts of the impounded mainstem Tennessee and Cumberland Rivers. Nearly all of these species are mollusks and fish; however, this cluster also includes two turtles and a large, completely aquatic, salamander (the hellbender). All of these species are typically found in habitats out in the river or stream, where the water is obviously moving.

Holding water in reservoirs can modify habitat conditions important to flowing-water species because temperature and dissolved oxygen (DO) levels stratify in reservoirs during late spring, summer, and early fall; and those changes affect the water released from the dams. During late fall, winter, and early spring, reservoir stratification does not occur and water released from dams is more likely to have temperature and DO characteristics similar to what occurs in unregulated streams. As described in Section 2.3 in the main document, the various types of changes could occur under TVA policy alternatives focus on when reservoir elevations would be raised or lowered, and when and how much water would be released from the dams. TVA aquatic biologists used these basic concepts to help identify 15 specific evaluation measures (metrics) that would indicate differences in direct effects of the policy alternatives. The metrics were designed to focus on specific locations and specific times of the year that are important to the reproduction and survival of federal-protected species living in flowing-water habitats. Times of the year when operations changes would be unlikely to affect flowing-water species were not addressed. Metrics were developed for each of the four types of waterbodies that are involved (warm tributary tailwaters, flowing mainstem reaches, pooled mainstem reaches, and cool-to-warm tributary tailwaters). The following paragraphs describe which metrics were selected for use with regard to each waterbody category, why each metric is pertinent to the evaluation for that waterbody type, and the results of those comparisons. All of this information is summarized and used in the threatened and endangered species evaluation presented in Section 5.13, Threatened and Endangered Species.

Data used to address all but one of these metrics (Metric #3) were derived from the hourly results of the Water Quality modeling work described in Section 4.4, Water Quality. The Water Quality modeling results predict the physical and chemical attributes of the reservoirs and regulated stream reaches, using the weather conditions and rainfall events that would have occurred during each of the 8 consecutive years included in the modeled period (1987 through 1994). In all of these evaluations, a two-tailed, paired mean similarity (t statistic) test was used to compare the results from each policy alternative with the Base Case. Alternatives found to be less than 5 percent likely to have an average value similar to the Base Case average (the 95-percent confidence level) were considered to be substantially different from the Base Case. Alternatives found to be between 5 and 20 percent likely to have an average value similar to the Base Case average (the 80-percent confidence level) were considered to be slightly different from the Base Case. While this latter confidence level is less rigorous than the 95-percent level often used in statistical analyses, it represents a more conservative approach that is appropriate when considering the protection of federal-listed species. Recognizing differences up to the

20-percent similarity level increases the likelihood of identifying changes that could affect habitats and species more often than would occur if only a much lower similarity level (e.g., 5 percent) was used. The biological interpretations of any differences identified during these comparisons were based on whether the change from the Base Case average was toward or away from what would be expected to occur in free-flowing stream habitats supporting populations of the pertinent protected species. The basis for each biological interpretation is included in the paragraph on the specific evaluation metric.

The specific sites where the metrics would be evaluated were selected based primarily on where protected aquatic species have been encountered in each of the affected waterbody types. In each of the four waterbody types, TVA biologists identified three or four specific sites where larger numbers of protected aquatic species were known to occur. For all metrics except Metric #3, results from the water quality model runs were used to generate the requested output data that would occur at or near those sites under the Base Case and each of the action alternatives. On the mainstem Tennessee River, the evaluation focused on sites at the upstream end of Kentucky Reservoir (the Pickwick Landing Dam tailwater), the upstream end of Pickwick Reservoir (the Wilson Dam tailwater), the upstream end of Wheeler Reservoir (the Guntersville Dam tailwater), and the upstream end of Chickamauga Reservoir (the Watts Bar Dam tailwater). On the tributaries, the evaluation focused on sites on the lower Elk River (both warm and cool-to-warm reaches downstream from Tims Ford Dam), the lower Holston River (both warm and cool-to-warm reaches downstream from Cherokee Dam), and the lower French Broad River (the warm reach downstream from Douglas Dam). Because no cool-to-warm reach had been identified on the lower French Broad River, the cool-to-warm reach on the Hiwassee River (downstream from Apalachia Dam) was added to complete the cool-to-warm comparison.

## D6b.2 Pooled Mainstem Reaches

Most of the protected species that occur in the pooled reaches of the mainstem reservoirs are freshwater mussels or fish that live in parts of the impounded river channel where some current still keeps the bottom relatively silt-free. The extent of any changes in water level or water temperature in these impounded areas was not considered likely to affect the resident protected species populations; however, changes in water flow patterns and, especially, any resulting changes in the amount of DO present near the bottom could increase or decrease the amount of suitable habitat for these protected species. The one metric developed for this waterbody category was: **Metric #1. The total volume of water with DO less than 2 mg/L during the year**. Data from the Water Quality modeling work were requested for three mainstem reservoirs (Kentucky, Guntersville, and Chickamauga)—indicating the sum of daily reservoir volumes with DO less than 2 milligrams per liter (mg/L) during each of the 8 modeled years. Alternatives that were represented by average low DO volumes smaller than under the Base Case average (at the 80-percent confidence level or higher) were considered to provide more suitable habitat for protected aquatic species. Alternatives represented by average values larger than under the Base Case average (again, at the 80-percent confidence level or higher) were considered to provide less suitable habitat for these protected species. The results of this comparison (presented in the Metric #1 tables) indicate that all of the policy alternatives except the Tailwater Habitat Alternative would result in low DO volumes comparable to what would occur under the

Base Case. The Tailwater Habitat Alternative would result in larger volumes of low DO water (slightly less suitable habitat conditions for protected aquatic species) in Kentucky and Chickamauga Reservoirs.

## D6b.3 Flowing Mainstem Reaches

As indicated in Table 4.12-03, 44 protected mollusks and fishes occur in flowing reaches of the mainstem Tennessee River downstream from the various dams and in the mainstem Cumberland River downstream from Barkley Dam. These species occur in or over rocky substrates where the current typically maintains at least moderate DO levels and minimizes the amount of sedimentation that stays on the bottom. Changes in the reservoir operations policy under the various alternatives might affect water levels; flow patterns; and, possibly, the duration of low DO concentrations in these waterbodies. Two metrics were developed to evaluate the potential effects of the alternatives in this waterbody category: **Metric #2. The amount of time when the water downstream from a dam held DO less than 2 mg/L during the summer period (July through October)**, and **Metric #3. The minimum water level achieved 90 percent of the time during the year at a given point downstream from a dam.**

Data to address Metric #2 came from the results of the Water Quality modeling work in the form of hours during the summer period in each of the 8 modeled years when the discharge from the upstream dam contained less than 2 mg/L DO. The number of hours calculated for each alternative in the releases from Pickwick, Wilson, Guntersville, and Watts Bar Dams are presented in the Metric #2 tables. Alternatives found to have lower average values in comparison with the Base Case (at the 80-percent confidence level or higher) were considered to provide more DO benefit to resident protected species. The results of this comparison indicate that the Equalized Summer/Winter Flood Risk Alternative, Commercial Navigation Alternative, and Tailwater Recreation Alternative would produce DO conditions in mainstem tailwater releases similar to those under the Base Case at all four of these dams. Reservoir Recreation Alternative A, Reservoir Recreation Alternative B, the Summer Hydropower Alternative, the Tailwater Habitat Alternative, and the Preferred Alternative resulted in modeled DO conditions similar to the Base Case at most of these dams; however, Reservoir Recreation Alternative A yielded higher values in the Guntersville discharge, Reservoir Recreation Alternative B yielded higher values in the Pickwick discharge, the Tailwater Habitat Alternative yielded higher values in the Wilson Dam discharge, and the Preferred Alternative yielded higher values in the Watts Bar discharge. Three of these higher values would result in slightly adverse effects on protected species habitats in those tailwaters; the value for the Preferred Alternative could result in substantially adverse effects over what could occur under the Base Case. Watts Bar, however, is one of two TVA mainstem dams (Fort Loudoun Dam is the other) where TVA committed to providing a minimum of 4 mg/L DO in the discharge as a part of the 1990 Lake Improvement Plan (see Section 4.4.2). While additional effort would be required to meet the minimum DO commitment at Watts Bar Dam if the Preferred Alternative was adopted, TVA would expend the money and effort to make sure that DO concentrations in the discharge would not be adversely affected.

Data to address Metric #3 are calculations made from the results of the Weekly Scheduling Model concerning the water elevations at locations where protected aquatic species occur that would be achieved 90 percent of the time during each of the 8 modeled years. These calculated water elevations for specific sites in the Pickwick, Wilson, Guntersville, and Watts Bar Dam tailwaters are presented in the Metric #3 tables. Alternatives found to have higher minimum water levels than those under the Base Case (at the 80-percent confidence level or higher) were considered to provide more wetted area in which protected aquatic species could occur. As indicated in the Metric #3 tables, two of the policy alternatives (the Equalized Summer/Winter Flood Risk Alternative and the Preferred Alternative) would result in mainstem tailwater elevations similar to what would occur under the Base Case at most or all of the comparison locations. All of the other alternatives would result in minimum tailwater elevations that would be higher (slightly or substantially more habitat for protected species) than would occur under the Base Case. The Equalized Summer/Winter Flood Risk Alternative was the only alternative that would yield lower minimum tailwater elevations (slightly less habitat) at any location; that effect would occur downstream from Watts Bar Dam.

## D6b.4 Mainstem Summary

Most of the policy alternatives would produce substantially higher minimum water elevations (substantially more potential habitat for protected aquatic species) downstream from the mainstem dams (Metric #3). The exceptions to this pattern are the Equalized Summer/Winter Flood Risk Alternative and the Preferred Alternative, both of which would typically produce minimum water elevations similar to those produced under the Base Case. Very few of the policy alternatives would produce any differences in the number of hours with DO less than 2 mg/L released from the mainstem dams (Metric #2). The major exception to this pattern was the expectation of more hours of low DO discharges (substantially adverse habitat conditions) downstream from Watts Bar Dam under the Preferred Alternative; however, TVA has committed to providing a minimum of 4mg/L DO in the discharge from this dam. Other exceptions were more hours of low DO discharges (slightly adverse conditions) from Guntersville Dam under Reservoir Recreation Alternative A, downstream from Pickwick Dam under Reservoir Recreation Alternative B, and downstream from Wilson Dam under the Tailwater Habitat Alternative. Only the Tailwater Habitat Alternative would result in more water volume with DO less than 2 mg/L in at least some of the downstream reservoirs (Metric #1); that alternative yielded indications of more water with low DO (slightly adverse habitat conditions) in Kentucky and Chickamauga Reservoirs. Overall, only the Tailwater Habitat Alternative would result in decreased DO levels in mainstem reservoirs (slightly adverse habitat conditions) in comparison to what would occur under the Base Case, and only the Equalized Summer/Winter Flood Risk Alternative and the Preferred Alternative would result in minimum water levels as low as what would occur under the Base Case. All of the other alternatives would yield higher minimum water levels (providing slightly or substantially more habitat for protected aquatic species). The Preferred Alternative could result in more hours of low DO water downstream from Watts Bar Dam (substantially adverse habitat conditions); however, TVA would ensure that discharge continued to meet its existing 4-mg/l DO target.

## D6b.5 Warm Tributary Tailwaters

Mollusks and fishes make up most of the protected aquatic species that occur in the warmer parts of regulated Tennessee River tributary streams—the warm tributary tailwater waterbodies. These waterbodies include a fairly wide variety of stream sizes and considerable variation in length from their upstream limits to the next downstream reservoir. All of them, however, flow within distinct river beds, have present temperature regimes more or less similar to nearby free-flowing streams, and support relatively diverse and abundant aquatic communities. These waterbodies also often support populations of at least some protected species. Changes in the reservoir operations policy affecting the dams and reservoirs upstream from these waterbodies could result in modifications to both the daily and seasonal averages and ranges of flows, stream elevations, and water temperatures. Six metrics were developed to evaluate the potential effects of the policy alternatives on these warm tailwaters, all of which were modeled at sites on the Elk, Holston, and French Broad Rivers where protected aquatic species are known to occur. These six metrics include one focused on the minimum water level at the site, three focused on flow and water temperature conditions during late spring (when many protected species are reproducing), and two focused on water temperature conditions during late summer (when many native species are accumulating food reserves that would allow them to survive during the colder winter months). These metrics and their evaluations are discussed in the following paragraphs.

**Metric #4. The minimum water level achieved 90 percent of the time during the year at the selected sites.** The data to address this metric were derived from the Water Quality modeling work in the form of the 90-percent occurrence minimum water elevation at each site during each of the 8 modeled years. The calculated elevations for the sites on the Elk, Holston, and French Broad Rivers are presented in the Metric #4 tables. Alternatives found to have higher minimum water levels than under the Base Case (at or above the 80-percent confidence level) were considered to provide more wetted area that could be inhabited by protected aquatic species. The results of these comparisons indicate that most of the alternatives would result in minimum elevations in warm tributary tailwaters that are similar to the elevations produced under the Base Case. The Equalized Summer/Winter Flood Risk Alternative would result in higher minimum tailwater elevations (slightly beneficial habitat conditions for protected aquatic species) at the French Broad River site. The Tailwater Habitat Alternative would result in higher minimum tailwater elevations at the Holston River site (substantially beneficial conditions) and the French Broad River site (slightly beneficial conditions), while the level at the Elk River site would be similar to the elevations produced under the Base Case.

**Metric #5. The difference between the 90- and 10-percent instantaneous flow rates at the selected sites during the second and third weeks in June.** These data points were derived from the Water Quality modeling work as the 90- and 10-percent instantaneous flow levels (in cubic feet per second) estimated to occur at these sites during this 2-week period in each of the 8 modeled years. Subtracting the smaller of these values (the 90-percent flow rate) from the larger describes the range in flows that would have existed at each of these sites during that 2-week period in each modeled year. The calculated range values and paired mean similarity test results are presented in the Metric #5 tables. Alternatives that yielded smaller flow ranges

than under the Base Case (at or above the 80-percent confidence level) were considered to produce more stable flow conditions during this period. The comparisons indicate that all but two of the alternatives would result in flow ranges that would be similar to the Base Case at all three sites. Under the Equalized Summer/Winter Flood Risk Alternative, the flow range would be smaller (substantially beneficial habitat conditions) at the Holston River site and would remain similar to the Base Case at the Elk River and French Broad River sites. The Tailwater Habitat Alternative would result in smaller flow ranges (substantially beneficial habitat conditions) at both the Holston River and French Broad River sites, and would remain similar to the Base Case at the Elk River site.

**Metric #6. The average water temperature at the selected sites during the second and third weeks in June.** These data points were derived from the Water Quality modeling work as the estimated 50-percent occurrence water temperatures at these sites during this 2-week period in each of the 8 modeled years. These values and the associated paired t-test results are presented in the Metric #6 tables. Alternatives that resulted in higher average water temperatures than under the Base Case (at or above the 80-percent confidence level) were considered to be more similar to free-flowing stream reaches where protected aquatic species would be reproducing. As indicated in the tables, all but two of the alternatives would result in average late spring water temperatures at these sites that would be similar to what would occur under the Base Case. The Equalized Summer/Winter Flood Risk Alternative would result in higher average temperatures at all three sites (substantially beneficial habitat conditions at both the Holston River and French Broad River sites, and slightly beneficial conditions at the Elk River site). The Commercial Navigation Alternative would result in higher average temperatures (slightly beneficial habitat conditions) at the Holston River site and average temperatures similar to what would occur under the Base Case at both the French Broad River and Elk River sites.

**Metric #7. The difference between the 90- and 10-percent instantaneous water temperatures at the selected sites during the second and third weeks in June.** These data points were derived from the same Water Quality modeling work used for Metric #6; however for this metric, the extracted information focuses on the difference between the estimated 90- and 10-percent occurrence interval water temperatures at these sites during this 2-week period in each of the modeled years. The resulting temperature ranges and T-test results are presented in the Metric #7 tables. Alternatives that yielded narrower temperature ranges than under the Base Case (at or above the 80-percent confidence level) were considered to produce more stable temperature conditions during this period. These comparisons indicate that the temperature ranges produced under all but two of the modeled alternatives would be similar to the range produced under the Base Case. The Equalized Summer/Winter Flood Risk Alternative would produce temperature ranges at the Elk River and Holston River sites similar to the Base Case but would produce a wider temperature range (substantially adverse habitat conditions) during this period at the French Broad River site. The Tailwater Habitat Alternative would produce temperature ranges similar to the Base Case at the Elk River and French Broad River sites but a more narrow temperature range than under the Base Case (slightly beneficial habitat conditions) at the Holston River site.

**Metric #8. The average water temperature at the selected sites during the third and fourth weeks in August.** These data were derived from the same Water Quality modeling work and considered in the same way as the data extracted for Metric #6; however, this metric focused on a time 2 months later during the year. Alternatives that resulted in higher average temperatures than under the Base Case (at or above the 80-percent confidence level) were considered to enhance the growth and likely survival of protected aquatic species. The results presented in the tables for Metric #8 indicate that the three warm tailwater sites included in this comparison provided different results with regard to this metric. At the Elk River site, all of the policy alternatives yielded average temperatures similar to the Base Case. At the site in the French Broad River, nearly all of the alternatives yielded similar averages to the Base Case, while the Equalized Summer/Winter Flood Risk Alternative yielded a higher average summer water temperature than under the Base Case (substantially beneficial habitat conditions). At the Holston River site, only the Commercial Navigation Alternative yielded average temperatures similar to those under the Base Case; all of the other alternatives yielded lower average summer water temperatures (each indicating substantially adverse habitat conditions than those under the Base Case).

**Metric #9. The difference between the 90- and 10-percent instantaneous water temperatures at the selected sites during the third and fourth weeks in August.** This comparison and data set are comparable to Metric #7; however, the focus here is on a late-summer period instead of mid-June. Alternatives that yielded narrower temperature ranges than under the Base Case average were considered to enhance the growth and likely survival of protected aquatic species. The information presented in the tables for Metric #9 indicates that all but two of the modeled alternatives resulted in temperature ranges that were similar to the range produced under the Base Case. The Equalized Summer/Winter Flood Risk Alternative produced ranges similar to the Base Case at both the Holston River and Elk River sites. At the French Broad River site, however, the temperature range was more narrow (slightly beneficial habitat conditions) than under the Base Case. The Tailwater Habitat Alternative resulted in temperature ranges similar to the Base Case at the sites on the Elk River and French Broad River, but the temperature range at the Holston River site was narrower (substantially beneficial temperature range) than what would occur at that site under the Base Case.

## D6b.6 Cool-to-Warm Tributary Tailwaters

A variety of mollusks and fishes occurs in the parts of regulated Tennessee River tributary streams characterized as cool-to-warm tailwaters. Like the warm tributary tailwaters, these waterbodies include a fairly wide variety of stream sizes and a considerable range of stream lengths from the upstream dams to their downstream limits. All of the flow and temperature regimes in these waterbodies are directly affected by the timing and volume of relatively cold releases from the upstream dams. In addition, these waterbodies support relatively sparse aquatic communities, even though populations of some protected species may be present. Changes in the operations policy affecting the dams and reservoirs upstream from these waterbodies could result in modifications to the daily and seasonal variations in flows, stream elevations, and water temperatures that could be more substantial than would occur in the warm tailwaters.

TVA aquatic biologists decided to use the same six metrics to evaluate the potential effects of the policy alternatives in these cool-to-warm tailwater waterbodies that were used to evaluate the warm tailwater reaches. The only differences in the data sources or use of these metrics were the locations of the sites where they would be applied. For the cool-to-warm tailwaters, the evaluation sites include locations on the Elk River and Holston River upstream from the warm tailwater sites evaluated on those same rivers. The other evaluation site is located on the Hiwassee River, in part because the French Broad River downstream from Douglas Dam does not have a recognized cool-to-warm reach. As before, the six metrics include one focused on the minimum water level at the site (Metric #10), three focused on flow and water temperature conditions during the same 2-week period in late spring (Metrics #11, 12, and 13), and two focused on water temperature conditions during the same 2-week period in late summer (Metrics #14 and 15).

The results and summary statistics associated with **Metric #10. The minimum water level achieved 90 percent of the time during the year at the selected sites**, are presented in the Metric #10 tables. As indicated in the description of companion Metric #4, alternatives found to have higher minimum water levels than under the Base Case (at or above the 80-percent confidence level) were considered to provide more wetted area that could be inhabited by protected aquatic species. The results of these comparisons indicate that nearly all of the alternatives would result in minimum water levels similar to those under the Base Case. The one exception to this uniform relationship occurred under the Tailwater Habitat Alternative, which yielded a higher minimum water level (substantially beneficial) at the Holston River site.

Results and summary statistics associated with **Metric #11. The difference between the 90- and 10-percent instantaneous flow rates at the selected sites during the second and third weeks in June**, are presented in the Metric #11 tables. Like the description for companion Metric #5, alternatives that yielded narrower flow ranges than under the Base Case (at or above the 80-percent confidence level) were considered to provide more stable streamflow conditions during this period. The comparisons indicate that all but two of the alternatives would result in mid-June flow ranges in cool-to-warm tributary tailwaters that are similar to ranges under the Base Case. The Equalized Summer/Winter Flood Risk Alternative would result in flow ranges similar to the Base Case at the Hiwassee River site but would produce a narrower flow range (slightly beneficial habitat conditions) at the Elk River site and a more narrow flow range (substantially beneficial) at the Holston River site. The Tailwater Habitat Alternative would result in flow ranges similar to the Base Case at the Elk River site but narrower (substantially beneficial) flow ranges at both the Holston River and Hiwassee River sites.

Results and statistics associated with **Metric #12. The average water temperature at the selected sites during the second and third weeks in June**, are presented in the Metric #12 tables. Alternatives that resulted in higher average water temperatures than under the Base Case (at or above the 80-percent confidence level) were considered to be more similar to free-flowing stream reaches where protected aquatic species would be spawning. As indicated in the tables for Metric #12, the Hiwassee River site reacted differently to this metric than the sites on both the Elk and Holston Rivers. The Hiwassee River site yielded higher (substantially

beneficial) average water temperatures during this period for all of the policy alternatives compared with the Base Case. At the sites on the Elk and Holston Rivers, only the Equalized Summer/Winter Flood Risk Alternative yielded higher (substantially beneficial) average temperatures; all of the other alternatives yielded average temperatures similar to what would occur under the Base Case.

Data and statistics related to **Metric #13. The difference between the 90- and 10-percent instantaneous water temperatures at the selected sites during the second and third weeks in June**, are presented in the Metric #13 tables. As described for Metric #7, alternatives that yielded more narrow temperature ranges than under the Base Case (at or above the 80-percent confidence level) were considered to produce more stable temperature conditions during this period. These comparisons indicate that most of the policy alternatives would produce temperature ranges similar to those under the Base Case. The Tailwater Habitat Alternative would result in temperature ranges similar to the Base Case at the Holston River and Elk River sites but a more narrow (slightly beneficial) range at the Hiwassee River site. The Equalized Summer/Winter Flood Risk Alternative would produce temperature ranges similar to the Base Case at the Hiwassee River site, narrower (substantially beneficial) temperature ranges at the Elk River site, and wider (substantially adverse) temperature ranges at the Holston River site.

Results and statistics associated with **Metric #14. The average water temperature at the selected sites during the third and fourth weeks in August**, are presented in the Metric #14 tables. Alternatives that resulted in higher average temperatures than under the Base Case (at or above the 80-percent confidence level) were considered to enhance the growth and likely survival of protected aquatic species (same as for Metric #8). The results indicate that each cool-to-warm tributary tailwater reacted differently to this metric. At the Hiwassee River site, all of the policy alternatives would produce higher (substantially beneficial) average temperatures than would occur under the Base Case. At the Elk River site, Reservoir Recreation Alternative A, the Commercial Navigation Alternative, the Tailwater Habitat Alternative, and the Preferred Alternative would produce average temperatures similar to what would occur under the Base Case; while Reservoir Recreation Alternative B, the Equalized Summer/Winter Flood Risk Alternative, and the Tailwater Recreation Alternative would produce averages higher (slightly more beneficial) than would occur under the Base Case. At the Holston River site, all of the policy alternatives except the Commercial Navigation Alternative would produce lower (substantially adverse) average temperatures than would occur under the Base Case. The Commercial Navigation Alternative yielded average temperatures similar to what would be produced under the Base Case at the Holston River site.

Data and statistics related to **Metric #15. The difference between the 90- and 10-percent instantaneous water temperatures at the selected sites during the third and fourth weeks in August**, are presented in the tables for Metric #15. As described for Metric #9, alternatives that yielded more narrow temperature ranges than under the Base Case (at or above the 80-percent confidence level) were considered to produce more stable temperature conditions when protected aquatic species were growing and accumulating fat that might help them better survive the winter. These results also indicate that each of the three cool-to-warm tributary

tailwaters reacted somewhat differently to this metric. At the Hiwassee River site, all of the policy alternatives yielded temperature ranges similar to what would occur under the Base Case. At the Elk River site, Reservoir Recreation Alternative A, the Commercial Navigation Alternative, the Tailwater Habitat Alternative, and the Preferred Alternative yielded ranges similar to the Base Case; while Reservoir Recreation Alternative B, the Equalized Summer/Winter Flood Risk Alternative, and the Tailwater Recreation Alternative yielded more narrow ranges (substantially beneficial) than would occur under the Base Case. At the Holston River site, the Commercial Navigation Alternative and the Preferred Alternative yielded ranges similar to the Base Case; while all of the other alternatives yielded ranges more narrow than would occur under the Base Case (slightly beneficial under Reservoir Recreation Alternative A and the Equalized Summer/Winter Flood Risk Alternative and substantially beneficial under Reservoir Recreation Alternative B, Tailwater Recreation Alternative, and the Tailwater Habitat Alternative).

## D6b.7 Tributary Summary

With regard to the minimum water level metrics (Metrics #4 and #10), only the Equalized Summer/Winter Flood Risk Alternative and the Tailwater Habitat Alternative would produce effects different from what would occur under the Base Case. The Equalized Summer/Winter Flood Risk Alternative would result in higher minimum water levels (slightly more minimum wetted area) at the (warm) French Broad River site, while the Tailwater Habitat Alternative would result in higher minimum water levels at the site on the French Broad River (slightly beneficial habitat conditions) and at both sites on the Holston River (substantially beneficial conditions).

With regard to the mid-June flow range metrics (Metrics #5 and #11), only the Equalized Summer/Winter Flood Risk Alternative and the Tailwater Habitat Alternative would produce effects different from what would occur under the Base Case. The Equalized Summer/Winter Flood Risk Alternative would produce less variation in mid-June flow ranges at both sites on the Holston River (substantially beneficial habitat conditions for protected species) and at the cool-to-warm site on the Elk River (slightly beneficial conditions). The Tailwater Habitat Alternative would produce less variation in flow ranges (substantially beneficial conditions) at the sites on the Holston, French Broad, and Hiwassee Rivers but did not result in flow ranges any different from the Base Case at either site on the Elk River.

The four average temperature metrics (Metrics #6 and #12 concerning mid-June, and Metrics #8 and #14 concerning late August) tend to follow consistent patterns, at least on the individual rivers. All of the policy alternatives would produce higher (substantially beneficial) average temperatures than under the Base Case at the Hiwassee River site during both periods. All of the policy alternatives except the Commercial Navigation Alternative would produce lower (substantially adverse) average temperatures than under the Base Case at both Holston River sites in late August (Metric #14). The Equalized Summer/Winter Flood Risk Alternative would produce higher (substantially beneficial conditions) average temperatures at the cool-to-warm site on the Elk River during both periods, higher (slightly beneficial) average

temperatures at the warm site on the Elk River in mid-June, and higher (substantially beneficial) average temperatures at both Holston River sites in mid-June.

Concerning the four temperature range metrics, the policy alternatives would produce very few differences from the ranges under the Base Case at the warm tailwater sites during either mid-June (Metric #7) or late August (Metric #9). Two of the exceptions to this pattern would occur under the Tailwater Habitat Alternative, which would produce less temperature variation at the warm reach site on the Holston River during both mid-June (slightly beneficial habitat conditions) and in late August (substantially beneficial conditions). The other exceptions would occur at the French Broad River site under the Equalized Summer/Winter Flood Risk Alternative, which would produce more temperature variation (substantially adverse conditions) in mid-June and less variation (slightly beneficial conditions) in late August than would occur under the Base Case.

In the cool-to-warm tailwater reaches, the effects of the alternatives on the temperature range metrics would differ, depending on which month was being examined. During mid-June (Metric #13), the Tailwater Habitat Alternative would produce less variation (slightly beneficial conditions) at the Hiwassee River site. Also during mid-June, the Equalized Summer/Winter Flood Risk Alternative would produce more temperature variation (substantially adverse habitat conditions) at the Holston River site and less temperature variation (substantially beneficial conditions) at the Elk River site. During late August (Metric #15), none of the alternatives would produce temperature variations different from the Base Case at the Hiwassee River site. At the Elk River site, Reservoir Recreation Alternative B, the Equalized Summer/Winter Flood Risk Alternative, and the Tailwater Recreation Alternative would produce less temperature variation (substantially beneficial conditions) during this period. At the Holston River site, five of the alternatives would produce less temperature variation during late August (slightly beneficial habitat conditions under Reservoir Recreation Alternative A and the Equalized Summer/Winter Flood Risk Alternative; substantially beneficial conditions under Reservoir Recreation B, the Tailwater Recreation Alternative, and the Preferred Alternative).

| EVALUATION ABBREVIATIONS USED IN THE METRIC TABLES | |
|---|---|
| **Abbreviation** | **Definition** |
| A | Adverse effects on protected aquatic species |
| B | Beneficial effects on protected aquatic species |
| N | Not statistically different from the Base Case |
| S | Slightly (80- to 95-percent confidence level) |
| SS | Substantially (95-percent confidence level or higher) |

## Mainstem Reservoirs

**Metric #1:** Sum of daily volumes in mainstem reservoirs with DO less than 2 mg/L during January through December.

**Data Units:** Million cubic meters.

**Evaluation Perspective:** Smaller volumes of low DO water would indicate better habitat conditions for protected benthic species.

**Kentucky Reservoir**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 3,285 | 4,582 | 5,518 | 4,430 | 1,777 | 5,346 | 11,547 | 4,863 |
| 1988 | 14,155 | 11,147 | 19,377 | 18,844 | 6,584 | 19,973 | 34,943 | 13,909 |
| 1989 | 174 | 351 | 1,143 | 906 | 180 | 1,233 | 1,371 | 253 |
| 1990 | 2,502 | 4,296 | 6,680 | 5,451 | 1,434 | 6,612 | 10,813 | 4,070 |
| 1991 | 1,535 | 2,356 | 2,448 | 2,012 | 1,232 | 2,496 | 2,561 | 2,087 |
| 1992 | 210 | 637 | 626 | 515 | 185 | 526 | 673 | 323 |
| 1993 | 6,033 | 9,757 | 11,078 | 10,403 | 3,741 | 11,048 | 20,392 | 7,955 |
| 1994 | 473 | 936 | 1,245 | 1,015 | 463 | 1,307 | 1,369 | 725 |
| **Average** | **3,545.9** | **4,257.8** | **6,014.4** | **5,447.0** | **1,949.5** | **6,067.6** | **10,458.6** | **4,273.1** |
| **Similarity** | | 75.35% | 39.80% | 50.74% | 40.05% | 39.60% | 15.41% | 76.25% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SA** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Guntersville Reservoir

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 4,407 | 7,757 | 7,667 | 6,044 | 4,836 | 6,876 | 8,140 | 4,395 |
| 1988 | 10,739 | 9,688 | 11,676 | 8,566 | 7,895 | 11,432 | 12,522 | 6,922 |
| 1989 | 27 | 40 | 114 | 70 | 36 | 120 | 95 | 60 |
| 1990 | 608 | 2,036 | 2,623 | 2,036 | 666 | 2,374 | 2,112 | 1,073 |
| 1991 | 270 | 636 | 655 | 599 | 270 | 665 | 734 | 475 |
| 1992 | 846 | 1,236 | 1,018 | 6,55 | 655 | 1,068 | 1,291 | 1,542 |
| 1993 | 5,238 | 7,022 | 8,866 | 6,621 | 5,237 | 8,770 | 8,450 | 5,734 |
| 1994 | 275 | 417 | 387 | 2,360 | 275 | 345 | 166 | 386 |
| **Average** | **2,801.2** | **3,604.0** | **4,125.8** | **3,368.9** | **2,483.8** | **3,956.2** | **4,188.8** | **2573.4** |
| **Similarity** | | 68.21% | 53.82% | 75.23% | 85.61% | 58.39% | 53.11% | 89.18% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Chickamauga Reservoir

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 2,019 | 1,824 | 1,742 | 1,491 | 2,304 | 1,811 | 3,522 | 1,753 |
| 1988 | 1,919 | 2,278 | 2,411 | 1,586 | 1,963 | 2,389 | 3,444 | 2,143 |
| 1989 | 335 | 363 | 366 | 368 | 323 | 358 | 392 | 429 |
| 1990 | 1,626 | 1,329 | 1,226 | 1,124 | 1,644 | 1,254 | 1,968 | 1,403 |
| 1991 | 1,451 | 1,546 | 1,505 | 1,147 | 1,479 | 1,490 | 2,303 | 1,610 |
| 1992 | 1,173 | 1,321 | 1,294 | 1,170 | 1,214 | 1,314 | 1,683 | 1,267 |
| 1993 | 3,069 | 3,216 | 3,133 | 2,801 | 3,119 | 3,123 | 6,183 | 2,983 |
| 1994 | 870 | 1,018 | 1,050 | 899 | 866 | 1,041 | 1,491 | 1,054 |
| **Average** | **1,557.8** | **1,611.9** | **1,590.9** | **1,323.2** | **1,614.0** | **1,597.5** | **2,623.2** | 1,580.2 |
| **Similarity** | | 89.94% | 93.82% | 55.05% | 89.61% | 92.57% | 14.43% | 95.56% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SA** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Mainstem Tailwaters

**Metric #2:** Number of hours of dam release with DO less than 2 mg/L during July through October.

**Data Units:** Hours.

**Evaluation Perspective:** Shorter amounts of time when the DO was low would indicate better conditions for protected benthic species.

**Pickwick Dam Releases**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 |
| 1988 | 1 | 0 | 0 | 0 | 5 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 2 | 2 | 2 | 0 | 2 | 0 | 0 |
| 1991 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Average** | **0.1** | **0.5** | **1.1** | **0.3** | **0.6** | **0.3** | **0.0** | 0.3 |
| **Similarity** | | 30.26% | 14.69% | 66.16% | 44.58% | 66.16% | 33.43% | 66.16% |
| **Evaluation** | | **N** | **SA** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**Wilson Dam Releases**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 76 | 80 | 183 | 45 | 72 | 152 | 481 | 69 |
| 1988 | 228 | 235 | 236 | 196 | 323 | 243 | 495 | 41 |
| 1989 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 1990 | 32 | 47 | 66 | 96 | 30 | 60 | 277 | 34 |
| 1991 | 1 | 3 | 4 | 1 | 0 | 6 | 22 | 3 |
| 1992 | 0 | 11 | 13 | 8 | 2 | 18 | 69 | 6 |
| 1993 | 18 | 24 | 21 | 19 | 15 | 24 | 74 | 19 |
| 1994 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| **Average** | **44.4** | **50.1** | **65.6** | **45.8** | **55.3** | **63.0** | **177.4** | **21.6** |
| **Similarity** | | 88.66% | 62.81% | 97.09% | 82.44% | 66.34% | 11.73% | 44.83% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SA** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

*See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.*

### Guntersville Dam Releases

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1988 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1990 | 0 | 4 | 5 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Average** | **0.0** | **0.8** | **0.6** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** |
| **Similarity** | | 17.59% | 33.43% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |
| **Evaluation** | | **SA** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Watts Bar Dam Releases

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 67 | 150 | 32 | 153 | 74 | 28 | 0 | 147 |
| 1988 | 73 | 77 | 59 | 0 | 10 | 21 | 741 | 130 |
| 1989 | 2 | 6 | 27 | 11 | 2 | 35 | 0 | 113 |
| 1990 | 41 | 87 | 57 | 103 | 43 | 72 | 0 | 332 |
| 1991 | 17 | 52 | 95 | 83 | 21 | 109 | 0 | 443 |
| 1992 | 109 | 85 | 144 | 70 | 130 | 156 | 645 | 370 |
| 1993 | 144 | 131 | 37 | 151 | 139 | 32 | 24 | 173 |
| 1994 | 3 | 34 | 40 | 65 | 3 | 54 | 0 | 230 |
| **Average** | **57.0** | **77.8** | **61.4** | **79.5** | **52.8** | **63.4** | **176.3** | **242.3** |
| **Similarity** | | 41.62% | 85.16% | 41.86% | 87.63% | 79.99% | 31.58% | 0.16% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **SSA** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Mainstem Tailwaters

**Metric #3 -** Minimum water level achieved 90 percent of the time during the year at a given location.

**Data Units:** Elevation in feet above mean sea level.

**Evaluation Perspective:** Higher minimum water levels would indicate more available habitat for protected species.

**Pickwick Dam Tailwater (TRM 190)**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 354.6 | 354.6 | 356.3 | 354.6 | 356.8 | 356.3 | 355.8 | 354.6 |
| 1988 | 354.6 | 354.6 | 356.0 | 354.6 | 356.4 | 356.0 | 355.3 | 354.6 |
| 1989 | 357.3 | 357.4 | 358.6 | 357.3 | 358.6 | 358.6 | 358.1 | 357.2 |
| 1990 | 355.7 | 356.7 | 357.8 | 355.7 | 358.4 | 357.8 | 357.4 | 355.8 |
| 1991 | 355.7 | 357.3 | 358.1 | 355.9 | 358.6 | 358.1 | 357.4 | 355.8 |
| 1992 | 355.7 | 356.7 | 357.5 | 355.7 | 357.4 | 357.7 | 357.3 | 355.7 |
| 1993 | 355.0 | 356.3 | 357.5 | 354.8 | 358.6 | 357.5 | 357.0 | 355.2 |
| 1994 | 356.3 | 357.3 | 358.6 | 355.9 | 358.6 | 358.6 | 357.7 | 356.26 |
| **Average** | **355.6** | **356.4** | **357.6** | **355.6** | **357.9** | **357.6** | **357.0** | **355.6** |
| **Similarity** | | 17.00% | 0.10% | 91.37% | 0.02% | 0.09% | 1.01% | 95.57% |
| **Evaluation** | | **SB** | **SSB** | **N** | **SSB** | **SSB** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**Wilson Dam Tailwater (TRM 256)**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 409.5 | 411.1 | 411.0 | 409.2 | 410.7 | 411.0 | 411.0 | 409.7 |
| 1988 | 409.4 | 410.8 | 410.8 | 409.3 | 410.7 | 410.8 | 410.8 | 409.4 |
| 1989 | 411.1 | 411.9 | 412.2 | 410.7 | 411.7 | 412.1 | 411.8 | 411.1 |
| 1990 | 410.7 | 412.1 | 412.1 | 410.0 | 411.1 | 412.1 | 412.3 | 411.3 |
| 1991 | 410.5 | 412.1 | 412.1 | 410.8 | 411.1 | 412.1 | 412.0 | 411.1 |
| 1992 | 410.6 | 411.9 | 411.9 | 410.4 | 411.4 | 411.9 | 411.7 | 410.8 |
| 1993 | 410.3 | 411.7 | 411.9 | 410.2 | 411.0 | 411.9 | 411.9 | 410.8 |
| 1994 | 410.9 | 412.1 | 412.1 | 410.5 | 411.5 | 412.1 | 412.2 | 411.2 |
| **Average** | **410.4** | **411.7** | **411.8** | **410.1** | **411.2** | **411.8** | **411.7** | **410.7** |
| **Similarity** | | 0.03% | 0.03% | 45.10% | 0.86% | 0.03% | 0.04% | 40.65% |
| **Evaluation** | | **SSB** | **SSB** | **N** | **SSB** | **SSB** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Guntersville Dam Tailwater (TRM 349)

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 552.1 | 553.4 | 553.7 | 551.6 | 553.1 | 553.7 | 553.8 | 552.1 |
| 1988 | 551.8 | 553.2 | 553.2 | 551.4 | 552.7 | 553.2 | 553.3 | 551.9 |
| 1989 | 555.7 | 555.9 | 556.0 | 555.4 | 555.7 | 556.0 | 556.0 | 556.1 |
| 1990 | 554.3 | 555.3 | 555.5 | 553.8 | 554.6 | 555.5 | 555.3 | 555.1 |
| 1991 | 554.3 | 555.7 | 555.6 | 555.0 | 554.4 | 555.6 | 555.3 | 555.4 |
| 1992 | 554.8 | 555.7 | 555.7 | 554.1 | 555.1 | 555.7 | 555.4 | 555.7 |
| 1993 | 553.7 | 554.6 | 555.1 | 553.4 | 553.9 | 555.0 | 554.9 | 554.6 |
| 1994 | 555.7 | 555.8 | 555.7 | 554.8 | 555.8 | 555.7 | 555.3 | 555.8 |
| **Average** | **554.1** | **555.0** | **555.1** | **553.7** | **554.4** | **555.1** | **554.9** | **554.6** |
| **Similarity** | | 18.71% | 13.34% | 63.29% | 58.95% | 13.79% | 17.91% | 50.43% |
| **Evaluation** | | **SB** | **SB** | **N** | **N** | **SB** | **SB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Watts Bar Dam Tailwater (RM 530)

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 676.0 | 677.6 | 677.9 | 675.0 | 677.5 | 677.9 | 678.0 | 676.4 |
| 1988 | 676.0 | 677.5 | 677.5 | 675.0 | 677.5 | 677.5 | 677.8 | 676.0 |
| 1989 | 678.2 | 678.6 | 679.3 | 677.6 | 678.6 | 679.3 | 678.9 | 677.4 |
| 1990 | 678.2 | 679.6 | 679.4 | 676.8 | 678.7 | 679.4 | 679.7 | 679.0 |
| 1991 | 679.1 | 680.0 | 680.0 | 678.2 | 679.3 | 680.0 | 680.0 | 679.1 |
| 1992 | 677.0 | 679.1 | 679.1 | 676.8 | 678.0 | 679.1 | 678.8 | 678.2 |
| 1993 | 677.7 | 679.1 | 679.6 | 677.4 | 678.5 | 679.4 | 679.9 | 678.2 |
| 1994 | 679.1 | 679.9 | 679.4 | 676.7 | 679.3 | 679.3 | 680.4 | 678.7 |
| **Average** | **677.7** | **678.9** | **679.0** | **676.7** | **678.4** | **679.0** | **679.2** | **677.9** |
| **Similarity** | | 3.89% | 2.29% | 12.53% | 15.24% | 2.51% | 1.55% | 72.91% |
| **Evaluation** | | **SSB** | **SSB** | **SA** | **SB** | **SSB** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Warm Tributary Tailwaters

**Metric #4 -** Minimum water level achieved 90 percent of the time during the year at a given location.

**Data Units:** Elevation in feet above mean sea level.

**Evaluation Perspective:** Higher minimum water levels would indicate more available habitat for protected aquatic species.

**Holston River Mile 30**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 865.0 | 864.8 | 864.9 | 864.8 | 864.6 | 864.9 | 865.6 | 864.8 |
| 1988 | 863.9 | 863.9 | 864.0 | 863.8 | 863.8 | 863.9 | 864.2 | 863.8 |
| 1989 | 863.8 | 863.9 | 863.9 | 864.4 | 863.8 | 863.9 | 864.8 | 863.8 |
| 1990 | 863.9 | 863.9 | 863.9 | 863.9 | 863.9 | 863.9 | 865.1 | 863.9 |
| 1991 | 863.9 | 863.9 | 863.9 | 864.0 | 863.9 | 863.9 | 864.8 | 863.9 |
| 1992 | 863.8 | 863.8 | 863.9 | 864.4 | 863.9 | 863.9 | 864.9 | 863.9 |
| 1993 | 864.0 | 864.4 | 864.4 | 864.6 | 864.0 | 864.4 | 865.0 | 863.9 |
| 1994 | 864.9 | 864.9 | 865.0 | 864.7 | 864.9 | 865.0 | 865.5 | 864.8 |
| **Average** | **864.16** | **864.19** | **864.24** | **864.32** | **864.11** | **864.25** | **864.99** | **864.10** |
| **Similarity** | | 88.24% | 73.71% | 45.86% | 84.72% | 71.12% | 0.23% | 81.27% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**French Broad River Mile 18**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 843.76 | 843.5 | 843.6 | 843.4 | 843.6 | 843.6 | 843.6 | 843.5 |
| 1988 | 843.4 | 843.4 | 843.4 | 843.4 | 843.4 | 843.4 | 843.4 | 843.4 |
| 1989 | 843.6 | 843.6 | 843.6 | 843.7 | 843.6 | 843.7 | 844.5 | 843.6 |
| 1990 | 843.6 | 843.4 | 843.4 | 843.5 | 843.6 | 843.5 | 843.7 | 843.5 |
| 1991 | 843.7 | 843.7 | 843.6 | 843.6 | 843.7 | 843.6 | 844.2 | 843.6 |
| 1992 | 843.7 | 843.6 | 843.6 | 843.6 | 843.7 | 843.6 | 844.3 | 843.6 |
| 1993 | 843.6 | 843.7 | 843.6 | 843.4 | 843.6 | 843.6 | 843.4 | 843.7 |
| 1994 | 843.8 | 843.7 | 843.7 | 843.6 | 843.8 | 843.7 | 844.7 | 843.8 |
| **Average** | **843.62** | **843.57** | **843.57** | **843.52** | **843.62** | **843.59** | **843.97** | **843.59** |
| **Similarity** | | 37.04% | 31.93% | 10.75% | 92.80% | 54.55% | 7.96% | 58.44% |
| **Evaluation** | | **N** | **N** | **SB** | **N** | **N** | **SB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

**Elk River Mile 73**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 611.2 | 611.2 | 611.2 | 611.2 | 611.2 | 611.2 | 611.2 | 611.2 |
| 1988 | 611.0 | 611.0 | 611.0 | 611.0 | 611.0 | 611.0 | 611.0 | 611.0 |
| 1989 | 612.6 | 612.6 | 612.6 | 612.5 | 612.6 | 612.6 | 612.6 | 612.6 |
| 1990 | 611.9 | 611.9 | 611.3 | 611.2 | 611.9 | 611.3 | 611.9 | 611.9 |
| 1991 | 611.9 | 611.8 | 611.5 | 611.4 | 611.9 | 611.5 | 611.8 | 611.8 |
| 1992 | 611.9 | 611.9 | 611.7 | 611.6 | 611.9 | 611.7 | 611.9 | 611.9 |
| 1993 | 611.8 | 611.8 | 611.4 | 611.3 | 611.8 | 611.4 | 611.8 | 611.8 |
| 1994 | 612.3 | 612.3 | 612.3 | 611.8 | 612.3 | 612.3 | 612.3 | 612.3 |
| **Average** | **611.81** | **611.81** | **611.62** | **611.48** | **611.82** | **611.62** | **611.81** | **611.81** |
| **Similarity** | | 98.74% | 49.06% | 22.17% | 97.43% | 49.06% | 98.80% | 98.50% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

## Warm Tributary Tailwaters

**Metric #5:** Difference between 90 and 10 percentile instantaneous flows at a given location during second through third weeks of June.

**Data Units:** Flow range in cubic feet per second.

**Evaluation Perspective:** Less variation in flow rates during this period would indicate better spring conditions for protected species reproduction and growth.

**Holston River Mile 30**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 8,212 | 4,682 | 4,682 | 1,920 | 5,427 | 5,383 | 2,529 | 6,227 |
| 1988 | 10,679 | 11,258 | 12,332 | 6,815 | 14,869 | 12,219 | 469 | 9,667 |
| 1989 | 13,407 | 13,155 | 13,155 | 13,255 | 13,131 | 13,156 | 4,380 | 13,096 |
| 1990 | 9,250 | 5,871 | 5,871 | 327 | 9,250 | 5,869 | 2,209 | 8,653 |
| 1991 | 10,942 | 8,268 | 8,268 | 1,986 | 10,942 | 8,222 | 1,681 | 9,025 |
| 1992 | 9,448 | 12,662 | 13,073 | 8,480 | 5,537 | 12,411 | 2,588 | 7,406 |
| 1993 | 6,254 | 4,065 | 4,087 | 725 | 6,254 | 4,065 | 2,578 | 2,943 |
| 1994 | 9,442 | 6,316 | 6,316 | 70 | 9,442 | 6,370 | 1,249 | 8,933 |
| **Average** | **9,704.4** | **8,284.6** | **8,473.1** | **4,197.1** | **9,356.6** | **8,461.8** | **2,210.2** | **8,243.8** |
| **Similarity** | | 35.41% | 43.88% | 1.01% | 81.38% | 41.47% | 0.00% | 26.95% |
| **Evaluation** | | **N** | **N** | **SSB** | **N** | **N** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### French Broad River Mile 18

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 10,199 | 8,764 | 8,764 | 9,436 | 8,380 | 8,764 | 4,376 | 10,517 |
| 1988 | 9,396 | 9,996 | 10,629 | 9,352 | 10,720 | 11,787 | 1,157 | 9,438 |
| 1989 | 18,119 | 18,119 | 18,119 | 19,384 | 18,119 | 18,119 | 8,640 | 18,012 |
| 1990 | 8,614 | 7,832 | 7,832 | 8,844 | 8,614 | 7,832 | 3,390 | 8,547 |
| 1991 | 14,620 | 13,095 | 13,095 | 17,196 | 14,620 | 13,095 | 2,900 | 14,522 |
| 1992 | 16,843 | 17,227 | 17,227 | 18,794 | 18,464 | 17,227 | 8,169 | 17,103 |
| 1993 | 8,594 | 8,210 | 8,210 | 9,335 | 8,594 | 8,037 | 3,138 | 8,577 |
| 1994 | 14,791 | 13,322 | 13,322 | 14,297 | 14,791 | 13,322 | 2,175 | 14,804 |
| **Average** | **12,646.9** | **12,070.6** | **12,149.8** | **13,329.8** | **12,787.8** | **12,272.8** | **4,243.2** | **12,690.0** |
| **Similarity** | | 77.51% | 80.42% | 75.35% | 94.58% | 85.17% | 0.02% | 98.26% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Elk River Mile 73

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 104 | 104 | 104 | 104 | 104 | 104 | 104 | 104 |
| 1988 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 |
| 1989 | 5,539 | 5,539 | 5,458 | 7,119 | 5,539 | 5,458 | 5,359 | 5,539 |
| 1990 | 1,258 | 1,258 | 1,204 | 716 | 1,258 | 1,204 | 1,258 | 1,258 |
| 1991 | 3,217 | 3,217 | 3,072 | 899 | 3,217 | 3,072 | 3,118 | 3,217 |
| 1992 | 1,144 | 1,144 | 1,051 | 1,051 | 1,144 | 1,051 | 1,144 | 1,144 |
| 1993 | 1,169 | 1,169 | 996 | 520 | 1,169 | 996 | 1,169 | 1,169 |
| 1994 | 1,084 | 1,084 | 941 | 141 | 1,084 | 941 | 1,084 | 1,084 |
| **Average** | **1,692.1** | **1,692.1** | **1,606.0** | **1,321.6** | **1,692.1** | **1,606.0** | **1,657.2** | **1,692.1** |
| **Similarity** | | 100.00% | 92.61% | 73.21% | 100.00% | 92.61% | 96.97% | 100.00% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Warm Tributary Tailwaters

**Metric #6:** The average instantaneous water temperatures at a given location during the second through third weeks in June.

**Data Units:** Water termpaturature range in degrees Celsius.

**Evaluation Perspective:** Higher mean water temperatures during this period would indicate better spring conditions for protected species reproduction and growth.

**Holston River Mile 30**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 13.4 | 14.0 | 14.0 | 18.9 | 14.3 | 13.9 | 14.0 | 13.4 |
| 1988 | 12.0 | 10.9 | 11.6 | 11.0 | 16.2 | 11.8 | 9.9 | 10.1 |
| 1989 | 8.9 | 9.6 | 10.5 | 13.5 | 10.9 | 10.2 | 9.5 | 9.2 |
| 1990 | 13.3 | 13.8 | 14.2 | 24.5 | 13.3 | 14.1 | 13.6 | 13.4 |
| 1991 | 12.6 | 12.8 | 13.3 | 21.6 | 12.6 | 13.4 | 12.6 | 12.9 |
| 1992 | 12.9 | 13.4 | 11.5 | 13.0 | 17.9 | 11.9 | 12.7 | 14.0 |
| 1993 | 11.1 | 12.3 | 12.7 | 21.6 | 11.1 | 12.8 | 12.2 | 15.9 |
| 1994 | 14.0 | 14.6 | 14.6 | 25.4 | 14.0 | 14.7 | 14.3 | 14.1 |
| **Average** | **12.28** | **12.67** | **12.80** | **18.69** | **13.79** | **12.84** | **12.35** | **12.90** |
| **Similarity** | | 64.77% | 51.55% | 0.74% | 16.32% | 48.32% | 93.58% | 53.07% |
| **Evaluation** | | **N** | **N** | **SSB** | **SB** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**French Broad River Mile 18**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 14.8 | 14.9 | 14.9 | 18.7 | 15.5 | 14.9 | 15.1 | 14.8 |
| 1988 | 19.2 | 18.1 | 17.8 | 20.3 | 20.5 | 17.9 | 18.6 | 18.5 |
| 1989 | 16.9 | 16.9 | 16.9 | 18.5 | 16.9 | 16.9 | 17.0 | 17.0 |
| 1990 | 17.4 | 17.5 | 17.6 | 19.8 | 17.4 | 17.4 | 17.6 | 17.2 |
| 1991 | 16.6 | 16.6 | 16.6 | 18.6 | 16.6 | 16.6 | 16.8 | 16.6 |
| 1992 | 16.6 | 16.5 | 16.5 | 17.8 | 16.6 | 16.6 | 16.6 | 16.6 |
| 1993 | 17.0 | 17.1 | 17.1 | 18.6 | 17.0 | 17.1 | 17.2 | 16.8 |
| 1994 | 17.39 | 17.3 | 17.4 | 19.2 | 17.2 | 17.4 | 17.4 | 17.4 |
| **Average** | **16.96** | **16.86** | **16.84** | **18.94** | **17.21** | **16.85** | **17.05** | **16.85** |
| **Similarity** | | 85.08% | 82.32% | 0.17% | 71.94% | 83.20% | 87.40% | 83.73% |
| **Evaluation** | | **N** | **N** | **SSB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

**Elk River Mile 73**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 26.7 | 26.7 | 26.7 | 26.6 | 26.7 | 26.7 | 26.7 | 26.7 |
| 1988 | 24.7 | 24.7 | 24.7 | 24.6 | 24.8 | 24.6 | 24.6 | 24.7 |
| 1989 | 18.8 | 18.8 | 18.9 | 20.2 | 18.8 | 18.8 | 18.8 | 18.8 |
| 1990 | 24.1 | 24.3 | 24.8 | 26.9 | 24.1 | 24.8 | 24.0 | 24.1 |
| 1991 | 21.5 | 21.4 | 21.6 | 25.6 | 21.5 | 21.7 | 21.4 | 21.5 |
| 1992 | 24.4 | 24.4 | 24.6 | 24.6 | 24.4 | 24.6 | 24.4 | 24.3 |
| 1993 | 22.7 | 22.9 | 23.7 | 26.9 | 23.0 | 23.6 | 22.8 | 22.8 |
| 1994 | 23.6 | 23.8 | 24.2 | 27.1 | 23.7 | 24.1 | 23.5 | 23.5 |
| **Average** | **23.31** | **23.38** | **23.64** | **25.32** | **23.38** | **23.61** | **23.29** | **23.31** |
| **Similarity** | | 95.31% | 78.34% | 10.83% | 95.07% | 80.37% | 98.94% | 99.65% |
| **Evaluation** | | **N** | **N** | **SB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

## Warm Tributary Tailwaters

**Metric #7:** Difference between 90 and 10 percentile instantaneous water temperatures at a given location during the second through third weeks in June.

**Data Units:** Water Temperature range in degrees Celsius.

**Evaluation Perspective:** Less variation in water temperatures during this period would indicate better spring conditions for protected species reproduction and growth.

**Holston River Mile 30**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 3.1 | 3.5 | 3.5 | 4.8 | 3.2 | 3.3 | 1.8 | 3.2 |
| 1988 | 4.3 | 4.3 | 4.7 | 4.5 | 5.7 | 4.4 | 3.4 | 4.6 |
| 1989 | 2.6 | 2.6 | 2.7 | 8.1 | 10.0 | 2.6 | 2.3 | 2.7 |
| 1990 | 3.4 | 3.7 | 3.8 | 5.6 | 3.4 | 3.7 | 2.2 | 3.5 |
| 1991 | 2.9 | 3.3 | 3.3 | 9.3 | 2.9 | 3.2 | 1.7 | 3.4 |
| 1992 | 11.4 | 11.2 | 3.6 | 3.8 | 11.9 | 3.6 | 3.2 | 11.0 |
| 1993 | 4.2 | 4.4 | 4.4 | 7.0 | 4.2 | 4.5 | 3.1 | 13.6 |
| 1994 | 3.7 | 4.6 | 4.6 | 4.3 | 3.7 | 4.5 | 2.5 | 4.2 |
| **Average** | **4.44** | **4.70** | **3.81** | **5.92** | **5.62** | **3.72** | **2.53** | **5.77** |
| **Similarity** | | 85.16% | 55.40% | 24.72% | 46.59% | 50.03% | 8.76% | 46.47% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### French Broad River Mile 18

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 2.4 | 2.5 | 2.5 | 2.3 | 2.3 | 2.5 | 1.7 | 2.4 |
| 1988 | 3.2 | 3.2 | 2.6 | 3.6 | 3.6 | 2.8 | 3.3 | 3.4 |
| 1989 | 2.6 | 2.6 | 2.6 | 3.7 | 2.6 | 2.6 | 2.6 | 2.8 |
| 1990 | 2.8 | 2.9 | 2.9 | 6.1 | 2.8 | 2.9 | 2.3 | 2.9 |
| 1991 | 2.1 | 2.3 | 2.3 | 5.3 | 2.1 | 2.3 | 2.1 | 2.2 |
| 1992 | 2.0 | 1.9 | 1.9 | 2.1 | 2.1 | 2.0 | 2.2 | 2.2 |
| 1993 | 3.2 | 3.1 | 3.1 | 5.5 | 3.2 | 3.1 | 2.2 | 3.1 |
| 1994 | 2.9 | 3.2 | 3.2 | 6.0 | 3.0 | 3.2 | 2.8 | 3.0 |
| **Average** | **2.64** | **2.72** | **2.64** | **4.32** | **2.71** | **2.68** | **2.40** | **2.74** |
| **Similarity** | | 74.08% | 99.34% | 1.40% | 79.71% | 86.99% | 31.44% | 68.00% |
| **Evaluation** | | **N** | **N** | **SSA** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Elk River Mile 73

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 2.3 | 2.3 | 2.2 | 2.2 | 2.3 | 2.2 | 2.2 | 2.4 |
| 1988 | 5.5 | 5.5 | 5.8 | 5.4 | 5.1 | 5.7 | 5.6 | 5.6 |
| 1989 | 4.0 | 4.1 | 4.1 | 6.0 | 3.8 | 4.1 | 4.0 | 4.1 |
| 1990 | 3.7 | 3.2 | 3.6 | 2.5 | 3.8 | 3.5 | 3.6 | 3.6 |
| 1991 | 4.6 | 4.7 | 4.5 | 3.0 | 4.8 | 4.5 | 4.7 | 4.8 |
| 1992 | 5.1 | 5.1 | 5.0 | 5.0 | 5.0 | 4.9 | 4.8 | 5.0 |
| 1993 | 3.5 | 3.2 | 2.5 | 1.9 | 3.2 | 2.6 | 3.4 | 3.5 |
| 1994 | 6.1 | 5.2 | 5.8 | 3.7 | 5.8 | 5.9 | 5.3 | 5.6 |
| **Average** | **4.34** | **4.15** | **4.17** | **3.72** | **4.22** | **4.18** | **4.19** | **4.32** |
| **Similarity** | | 75.35% | 79.32% | 38.70% | 84.19% | 80.64% | 79.92% | 96.18% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Warm Tributary Tailwaters

**Metric #8:** The average instantaneous water temperatures at a given location during the third through fourth weeks in August.

**Data Units:** Water temperature range in degrees Celsius.

**Evaluation Perspective:** Higher mean water temperatures during this period would indicate better summer conditions for protected species survival and growth.

**Holston River Mile 30**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 24.7 | 19.2 | 18.1 | 20.5 | 24.5 | 18.7 | 16.9 | 21.6 |
| 1988 | 29.2 | 29.0 | 26.5 | 29.8 | 28.6 | 27.6 | 26.8 | 29.0 |
| 1989 | 23.0 | 19.6 | 19.5 | 19.3 | 22.3 | 19.4 | 18.8 | 20.5 |
| 1990 | 24.6 | 17.7 | 17.7 | 18.9 | 24.6 | 18.0 | 17.4 | 18.8 |
| 1991 | 25.6 | 17.1 | 17.3 | 20.5 | 25.6 | 17.7 | 16.8 | 19.1 |
| 1992 | 23.4 | 16.7 | 15.8 | 18.0 | 23.3 | 15.7 | 15.0 | 18.1 |
| 1993 | 23.5 | 16.6 | 15.4 | 17.8 | 23.5 | 15.4 | 14.7 | 18.0 |
| 1994 | 23.3 | 18.0 | 17.9 | 18.3 | 23.3 | 18.0 | 17.4 | 18.6 |
| **Average** | **24.66** | **19.23** | **18.53** | **20.39** | **24.46** | **18.83** | **17.98** | **20.45** |
| **Similarity** | | 0.46% | 0.07% | 1.65% | 84.45% | 0.19% | 0.06% | 1.35% |
| **Evaluation** | | **SSA** | **SSA** | **SSA** | **N** | **SSA** | **SSA** | **SSA** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**French Broad River Mile 18**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 22.7 | 23.1 | 22.3 | 26.1 | 22.6 | 22.5 | 21.8 | 23.2 |
| 1988 | 26.8 | 26.8 | 26.0 | 26.8 | 27.3 | 26.3 | 26.2 | 26.5 |
| 1989 | 24.3 | 24.2 | 24.2 | 24.2 | 24.3 | 24.2 | 24.4 | 24.0 |
| 1990 | 22.4 | 21.2 | 21.2 | 24.6 | 22.4 | 21.2 | 21.4 | 21.8 |
| 1991 | 23.9 | 22.8 | 22.8 | 24.8 | 23.9 | 22.8 | 22.9 | 23.6 |
| 1992 | 23.2 | 22.3 | 21.3 | 24.4 | 23.2 | 21.3 | 21.5 | 22.7 |
| 1993 | 21.1 | 21.6 | 20.7 | 25.8 | 21.1 | 20.7 | 20.7 | 21.5 |
| 1994 | 23.8 | 23.8 | 23.8 | 24.7 | 23.8 | 23.8 | 23.8 | 24.0 |
| **Average** | **23.52** | **23.23** | **22.79** | **25.19** | **23.57** | **22.86** | **22.84** | **23.41** |
| **Similarity** | | 74.03% | 41.27% | 2.66% | 95.89% | 46.49% | 44.95% | 88.75% |
| **Evaluation** | | **N** | **N** | **SSB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

*See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.*

**Elk River Mile 73**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 27.3 | 27.3 | 27.3 | 27.2 | 27.3 | 27.3 | 27.3 | 27.4 |
| 1988 | 28.6 | 28.6 | 28.7 | 28.7 | 28.0 | 28.7 | 28.6 | 28.7 |
| 1989 | 24.2 | 23.5 | 25.8 | 24.1 | 23.7 | 25.7 | 23.5 | 24.0 |
| 1990 | 27.0 | 26.2 | 28.5 | 28.6 | 26.8 | 28.4 | 26.4 | 26.7 |
| 1991 | 24.4 | 24.0 | 26.4 | 26.4 | 24.5 | 26.4 | 24.0 | 24.1 |
| 1992 | 21.2 | 21.0 | 23.6 | 24.6 | 21.4 | 23.7 | 21.0 | 21.1 |
| 1993 | 26.8 | 26.1 | 29.4 | 29.3 | 26.8 | 29.3 | 26.1 | 26.8 |
| 1994 | 21.9 | 21.6 | 23.7 | 23.9 | 22.0 | 23.6 | 21.8 | 21.6 |
| **Average** | **25.19** | **24.79** | **26.66** | **26.60** | **25.04** | **26.64** | **24.84** | **25.04** |
| **Similarity** | | 77.47% | 24.90% | 26.74% | 91.39% | 25.59% | 79.87% | 91.56% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

## Warm Tributary Tailwaters

**Metric #9:** Difference between 90 and 10 percentile instantaneous water temperatures during third through fourth weeks of August at a given location.

**Data Units:** Temperature range in degrees Celsius.

**Evaluation Perspective:** Less variation in water temperature during this period would indicate better spring conditions for protected species survival and growth.

**Holston River Mile 30**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 3.8 | 3.6 | 3.0 | 3.4 | 3.8 | 3.1 | 2.3 | 3.9 |
| 1988 | 3.0 | 3.0 | 2.9 | 2.2 | 2.4 | 2.7 | 3.2 | 3.4 |
| 1989 | 2.9 | 3.1 | 3.3 | 3.2 | 3.3 | 3.2 | 1.9 | 2.7 |
| 1990 | 3.2 | 3.6 | 4.2 | 3.6 | 3.2 | 4.1 | 2.6 | 3.2 |
| 1991 | 3.2 | 3.3 | 3.3 | 9.3 | 3.2 | 3.2 | 2.5 | 3.2 |
| 1992 | 2.6 | 3.1 | 2.8 | 3.1 | 2.7 | 2.9 | 2.3 | 3.3 |
| 1993 | 5.8 | 3.9 | 3.6 | 3.6 | 5.8 | 3.5 | 1.9 | 3.7 |
| 1994 | 6.7 | 3.1 | 3.1 | 2.9 | 6.7 | 3.4 | 3.0 | 3.3 |
| **Average** | **3.89** | **3.33** | **3.27** | **3.91** | **3.89** | **3.26** | **2.46** | **3.34** |
| **Similarity** | | 32.10% | 28.62% | 98.92% | 99.29% | 27.47% | 2.20% | 33.33% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### French Broad River Mile 18

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 2.6 | 2.5 | 2.5 | 1.7 | 2.6 | 2.5 | 2.2 | 2.4 |
| 1988 | 1.7 | 1.9 | 1.7 | 1.9 | 2.0 | 1.7 | 1.5 | 1.8 |
| 1989 | 1.1 | 1.5 | 1.5 | 1.3 | 1.1 | 1.5 | 1.7 | 1.4 |
| 1990 | 2.4 | 2.6 | 2.9 | 1.7 | 2.4 | 2.9 | 1.8 | 2.7 |
| 1991 | 1.3 | 1.8 | 1.9 | 1.4 | 1.3 | 1.9 | 2.0 | 1.4 |
| 1992 | 1.8 | 1.9 | 1.7 | 1.1 | 1.8 | 1.7 | 2.0 | 1.8 |
| 1993 | 2.5 | 2.5 | 2.4 | 1.7 | 2.5 | 2.3 | 1.8 | 2.3 |
| 1994 | 1.5 | 1.6 | 1.6 | 1.5 | 1.5 | 1.6 | 1.9 | 1.4 |
| **Average** | **1.87** | **2.02** | **2.03** | **1.54** | **1.91** | **2.02** | **1.86** | **1.90** |
| **Similarity** | | 56.82% | 56.78% | 15.43% | 89.55% | 58.58% | 94.94% | 91.78% |
| **Evaluation** | | **N** | **N** | **SB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Elk River Mile 73

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 2.6 | 2.7 | 2.6 | 2.7 | 2.6 | 2.6 | 2.6 | 2.7 |
| 1988 | 2.6 | 3.0 | 2.8 | 2.6 | 3.2 | 2.6 | 2.8 | 2.6 |
| 1989 | 4.0 | 4.1 | 2.7 | 3.9 | 3.7 | 2.8 | 3.9 | 4.0 |
| 1990 | 3.4 | 3.5 | 3.4 | 3.6 | 3.4 | 3.3 | 3.6 | 3.3 |
| 1991 | 2.6 | 2.7 | 2.8 | 2.8 | 2.4 | 2.9 | 2.8 | 3.4 |
| 1992 | 4.4 | 4.5 | 4.2 | 2.8 | 4.6 | 4.0 | 4.7 | 4.4 |
| 1993 | 3.4 | 3.4 | 3.0 | 3.1 | 3.2 | 3.1 | 3.4 | 3.4 |
| 1994 | 3.2 | 3.6 | 2.5 | 5.7 | 3.5 | 2.5 | 2.7 | 3.0 |
| **Average** | **3.27** | **3.43** | **2.99** | **3.40** | **3.32** | **2.98** | **3.32** | **3.34** |
| **Similarity** | | 62.93% | 39.79% | 76.57% | 87.15% | 35.10% | 89.20% | 82.85% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Cool-to-Warm Tributary Tailwaters

**Metric #10:** Minimum water level achieved 90 percent of the time during the year at a given location.

**Data Units:** Elevation in feet above mean sea level.

**Evaluation Perspective:** Higher minimum water levels would indicate more available habitat for protected aquatic species.

**Holston River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 911.47 | 911.35 | 911.47 | 911.38 | 911.39 | 911.48 | 912.15 | 911.44 |
| 1988 | 911.13 | 911.13 | 911.16 | 911.11 | 911.10 | 911.14 | 911.21 | 911.10 |
| 1989 | 911.11 | 911.13 | 911.14 | 911.27 | 911.11 | 911.14 | 911.49 | 911.12 |
| 1990 | 911.15 | 911.15 | 911.15 | 911.14 | 911.16 | 911.15 | 911.79 | 911.14 |
| 1991 | 911.14 | 911.14 | 911.15 | 911.16 | 911.14 | 911.15 | 911.42 | 911.13 |
| 1992 | 911.11 | 911.12 | 911.16 | 911.20 | 911.12 | 911.17 | 911.57 | 911.13 |
| 1993 | 911.17 | 911.19 | 911.19 | 911.29 | 911.17 | 911.20 | 911.59 | 911.14 |
| 1994 | 911.46 | 911.50 | 911.58 | 911.28 | 911.47 | 911.54 | 912.24 | 911.37 |
| **Average** | **911.22** | **911.21** | **911.25** | **911.23** | **911.21** | **911.25** | **911.68** | **911.20** |
| **Similarity** | | 95.96% | 69.86% | 86.89% | 87.55% | 73.20% | 0.44% | 76.50% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**Hiwassee River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 743.81 | 743.81 | 743.81 | 743.81 | 743.81 | 743.81 | 743.88 | 743.80 |
| 1988 | 743.81 | 743.81 | 743.81 | 743.81 | 743.81 | 743.81 | 743.86 | 743.80 |
| 1989 | 744.15 | 744.70 | 744.42 | 744.52 | 743.94 | 744.15 | 745.40 | 744.52 |
| 1990 | 743.93 | 743.93 | 743.88 | 743.93 | 743.93 | 743.88 | 744.10 | 743.88 |
| 1991 | 745.09 | 744.88 | 744.43 | 744.10 | 745.03 | 744.45 | 745.33 | 744.54 |
| 1992 | 743.88 | 743.86 | 743.86 | 743.87 | 743.89 | 743.87 | 744.13 | 743.84 |
| 1993 | 743.91 | 743.93 | 743.88 | 743.86 | 743.91 | 743.87 | 744.01 | 743.86 |
| 1994 | 745.33 | 745.36 | 745.82 | 745.33 | 745.33 | 746.17 | 745.51 | 745.13 |
| **Average** | **744.24** | **744.29** | **744.24** | **744.15** | **744.21** | **744.25** | **744.53** | **744.17** |
| **Similarity** | | 88.27% | 99.58% | 76.94% | 91.62% | 97.68% | 41.25% | 80.95% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

**Elk River Mile 125**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 720.25 | 720.25 | 720.25 | 720.25 | 720.25 | 720.25 | 720.26 | 720.25 |
| 1988 | 720.22 | 720.22 | 720.22 | 720.22 | 720.22 | 720.22 | 720.22 | 720.22 |
| 1989 | 720.37 | 720.37 | 720.36 | 720.36 | 720.37 | 720.36 | 720.37 | 720.37 |
| 1990 | 720.26 | 720.26 | 720.24 | 720.24 | 720.26 | 720.24 | 720.26 | 720.26 |
| 1991 | 720.29 | 720.29 | 720.28 | 720.27 | 720.29 | 720.28 | 720.29 | 720.29 |
| 1992 | 720.25 | 720.25 | 720.24 | 720.23 | 720.25 | 720.24 | 720.27 | 720.25 |
| 1993 | 720.26 | 720.26 | 720.25 | 720.24 | 720.26 | 720.25 | 720.26 | 720.26 |
| 1994 | 720.31 | 720.31 | 720.32 | 720.27 | 720.31 | 720.32 | 720.31 | 720.31 |
| **Average** | **720.28** | **720.28** | **720.27** | **720.26** | **720.28** | **720.27** | **720.28** | **720.28** |
| **Similarity** | | 98.19% | 86.00% | 47.94% | 99.70% | 86.00% | 82.01% | 97.89% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

## Cool-to-Warm Tributary Tailwaters

**Metric #11:** Difference between 90- and 10-percent instantaneous flows during second through third weeks of June at a given location.

**Data Units:** Flow range in cubic feet per second.

**Evaluation Perspective:** Less variation in flow rates during this period would indicate better spring conditions for protected species reproduction and growth.

**Holston River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 9,431 | 5,746 | 5,746 | 2,791 | 6,375 | 6,302 | 2,938 | 6,701 |
| 1988 | 11,242 | 11,191 | 12,142 | 7,245 | 15,858 | 11,733 | 469 | 10,935 |
| 1989 | 14,256 | 14,222 | 14,225 | 13,766 | 13,224 | 14,221 | 4,380 | 14,093 |
| 1990 | 9,775 | 6,327 | 6,327 | 148 | 9,775 | 6,330 | 2,737 | 9,714 |
| 1991 | 13,158 | 9,500 | 9,500 | 2,991 | 13,158 | 9,602 | 1,358 | 9,737 |
| 1992 | 9,820 | 13,493 | 13,736 | 10,152 | 6,413 | 13,737 | 3,030 | 7,604 |
| 1993 | 6,562 | 4,676 | 4,737 | 611 | 6,562 | 4,660 | 2,945 | 3,042 |
| 1994 | 9,765 | 6,619 | 6,619 | 95 | 9,765 | 6,818 | 966 | 9,707 |
| **Average** | **10,501.0** | **8,972.1** | **9,129.0** | **4,724.9** | **10,141.2** | **9,175.4** | **2,353.0** | **8,914.6** |
| **Similarity** | | 34.07% | 40.21% | 1.18% | 81.84% | 40.79% | 0.00% | 29.26% |
| **Evaluation** | | **N** | **N** | **SSB** | **N** | **N** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Hiwassee River Mile 48

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 2,465 | 2,465 | 2,465 | 2,616 | 2,465 | 2,400 | 992 | 2,398 |
| 1988 | 2,660 | 2,645 | 2,610 | 2,636 | 2,573 | 2,400 | 340 | 2,668 |
| 1989 | 4,260 | 4,260 | 4,260 | 2,072 | 4,259 | 4,361 | 4,406 | 3,380 |
| 1990 | 2,657 | 2,495 | 2,495 | 2,490 | 2,657 | 2,391 | 1,058 | 2,652 |
| 1991 | 2,402 | 2,550 | 2,551 | 2,635 | 2,402 | 2,456 | 397 | 2,061 |
| 1992 | 2,465 | 2,570 | 2,640 | 2,495 | 2,451 | 2,400 | 992 | 2,345 |
| 1993 | 2,661 | 2,489 | 2,489 | 2,480 | 2,661 | 2,391 | 770 | 2,684 |
| 1994 | 1,028 | 1,532 | 1,532 | 1,730 | 1,028 | 2,158 | 618 | 1,039 |
| **Average** | **2,574.8** | **2,625.7** | **2,630.2** | **2,394.1** | **2,562.2** | **2,619.8** | **1,196.6** | **2,399.0** |
| **Similarity** | | 90.21% | 89.33% | 59.10% | 97.74% | 91.13% | 2.76% | 65.76% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Elk River Mile 125

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| 1988 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1989 | 3,844 | 3,844 | 3,842 | 3,905 | 3,844 | 3,842 | 3,628 | 3,844 |
| 1990 | 1,542 | 1,542 | 934 | 50 | 1,542 | 934 | 1,542 | 1,542 |
| 1991 | 3,694 | 3,694 | 3,496 | 65 | 3,694 | 3,496 | 3,455 | 3,694 |
| 1992 | 82 | 82 | 63 | 63 | 82 | 63 | 82 | 82 |
| 1993 | 2,216 | 2,216 | 1,843 | 28 | 2,216 | 1,843 | 2,216 | 2,216 |
| 1994 | 1,434 | 1,434 | 1,227 | 9 | 1,434 | 1,227 | 1,434 | 1,434 |
| **Average** | **1,602.3** | **1,602.3** | **1,426.4** | **515.78** | **1,602.3** | **1,426.4** | **1,545.5** | **1,602.3** |
| **Similarity** | | 100.00% | 82.39% | 16.22% | 100.00% | 82.39% | 94.17% | 100.00% |
| **Evaluation** | | **N** | **N** | **SB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Cool-to-Warm Tributary Tailwaters

**Metric #12:** The average instantaneous water temperatures at a given location during the second through third weeks in June at a given location.

**Data Units:** Water temperature in degrees Celsius.

**Evaluation Perspective:** Higher mean water temperatures during this period would indicate better spring conditions for protected species reproduction and growth.

**Holston River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 11.9 | 11.8 | 11.8 | 14.7 | 12.0 | 11.9 | 11.8 | 11.8 |
| 1988 | 10.0 | 8.8 | 9.7 | 9.0 | 14.6 | 9.8 | 8.4 | 8.1 |
| 1989 | 8.0 | 8.8 | 9.8 | 10.6 | 8.0 | 9.5 | 9.0 | 8.6 |
| 1990 | 11.6 | 11.6 | 12.0 | 15.4 | 11.6 | 12.0 | 11.7 | 11.7 |
| 1991 | 11.2 | 11.1 | 11.6 | 14.5 | 11.2 | 11.7 | 11.1 | 11.2 |
| 1992 | 9.1 | 9.9 | 10.4 | 11.3 | 10.9 | 10.5 | 10.3 | 10.3 |
| 1993 | 8.8 | 8.9 | 9.4 | 12.9 | 8.8 | 9.4 | 8.8 | 9.7 |
| 1994 | 12.4 | 12.4 | 12.4 | 16.1 | 12.4 | 12.4 | 12.3 | 12.2 |
| **Average** | **10.39** | **10.42** | **10.88** | **13.06** | **11.19** | **10.91** | **10.42** | **10.44** |
| **Similarity** | | 97.07% | 50.06% | 2.51% | 40.24% | 48.21% | 96.47% | 94.56% |
| **Evaluation** | | **N** | **N** | **SSB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**Hiwassee River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 12.0 | 14.3 | 14.4 | 15.5 | 14.8 | 15.6 | 14.9 | 14.8 |
| 1988 | 13.0 | 14.4 | 14.4 | 15.4 | 15.2 | 15.4 | 14.4 | 14.6 |
| 1989 | 12.8 | 14.5 | 14.5 | 15.1 | 14.4 | 14.4 | 14.4 | 14.9 |
| 1990 | 14.2 | 16.0 | 16.0 | 16.4 | 15.8 | 16.5 | 16.2 | 16.0 |
| 1991 | 14.2 | 15.9 | 15.9 | 16.6 | 15.7 | 15.9 | 15.8 | 15.9 |
| 1992 | 13.4 | 13.9 | 13.5 | 14.4 | 14.6 | 14.8 | 14.2 | 14.5 |
| 1993 | 12.4 | 15.1 | 15.1 | 15.4 | 14.5 | 15.6 | 14.9 | 14.8 |
| 1994 | 13.8 | 15.5 | 15.5 | 16.5 | 15.4 | 15.7 | 15.4 | 15.6 |
| **Average** | **13.21** | **14.95** | **14.90** | **15.64** | **15.05** | **15.48** | **15.00** | **15.12** |
| **Similarity** | | 0.07% | 0.12% | 0.00% | 0.01% | 0.00% | 0.03% | 0.01% |
| **Evaluation** | | **SSB** | **SSB** | **SSB** | **SSB** | **SSB** | **SSB** | **SSB** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

**Elk River Mile 125**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 18.9 | 18.9 | 18.9 | 19.1 | 19.0 | 18.9 | 18.9 | 18.9 |
| 1988 | 18.6 | 18.6 | 18.7 | 18.8 | 18.6 | 18.7 | 18.6 | 18.6 |
| 1989 | 13.0 | 13.0 | 13.1 | 15.4 | 13.1 | 13.1 | 12.9 | 13.1 |
| 1990 | 17.2 | 17.1 | 17.6 | 21.6 | 17.2 | 17.6 | 17.1 | 17.3 |
| 1991 | 16.2 | 16.2 | 16.4 | 21.4 | 16.2 | 16.4 | 16.2 | 16.3 |
| 1992 | 18.4 | 18.4 | 19.1 | 19.3 | 18.4 | 19.1 | 18.4 | 18.4 |
| 1993 | 14.9 | 14.9 | 15.1 | 20.2 | 15.0 | 15.1 | 14.9 | 14.9 |
| 1994 | 17.1 | 17.2 | 17.5 | 21.3 | 17.2 | 17.5 | 17.2 | 17.2 |
| **Average** | **16.79** | **16.80** | **17.05** | **19.65** | **16.84** | **17.05** | **16.78** | **16.83** |
| **Similarity** | | 99.56% | 80.25% | 1.35% | 96.22% | 80.43% | 98.97% | 97.01% |
| **Evaluation** | | **N** | **N** | **SSB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

## Cool-to-Warm Tributary Tailwaters

**Metric #13:** Difference between 90 and 10 percentile instantaneous water temperatures at a given location during the second through third weeks in June at a given location.

**Data Units:** Water temperature range in degrees Celsius.

**Evaluation Perspective:** Less variation in water temperatures during this period would indicate better spring conditions for protected species reproduction and growth.

**Holston River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 1.0 | 1.4 | 1.4 | 3.3 | 1.3 | 1.3 | 1.2 | 1.2 |
| 1988 | 3.5 | 2.6 | 2.9 | 2.4 | 7.0 | 3.0 | 2.2 | 2.2 |
| 1989 | 2.1 | 2.6 | 2.8 | 2.4 | 2.4 | 2.6 | 2.2 | 2.2 |
| 1990 | 2.0 | 1.5 | 1.4 | 5.0 | 1.9 | 1.4 | 1.5 | 1.5 |
| 1991 | 1.8 | 1.4 | 1.3 | 4.2 | 1.8 | 1.4 | 1.3 | 1.3 |
| 1992 | 2.3 | 2.2 | 0.9 | 1.1 | 4.1 | 1.0 | 1.2 | 1.2 |
| 1993 | 1.4 | 1.9 | 1.9 | 5.1 | 1.4 | 1.9 | 1.5 | 1.5 |
| 1994 | 1.4 | 1.2 | 1.2 | 5.3 | 1.4 | 1.2 | 1.4 | 1.4 |
| **Average** | **1.95** | **1.85** | **1.72** | **3.59** | **2.66** | **1.73** | **1.57** | **1.57** |
| **Similarity** | | 77.49% | 55.90% | 1.70% | 35.06% | 56.69% | 23.47% | 23.47% |
| **Evaluation** | | **N** | **N** | **SSA** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Hiwassee River Mile 48

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 12.1 | 10.1 | 10.1 | 7.6 | 9.7 | 7.6 | 5.5 | 9.4 |
| 1988 | 7.0 | 6.3 | 6.8 | 5.8 | 4.9 | 6.8 | 5.7 | 6.5 |
| 1989 | 2.9 | 3.3 | 3.3 | 3.2 | 3.3 | 3.2 | 3.2 | 3.1 |
| 1990 | 6.2 | 7.0 | 7.0 | 7.6 | 5.8 | 5.5 | 5.2 | 5.5 |
| 1991 | 3.6 | 3.8 | 3.8 | 4.4 | 3.6 | 3.6 | 3.8 | 3.3 |
| 1992 | 8.8 | 7.7 | 5.1 | 6.3 | 7.4 | 5.9 | 4.8 | 7.5 |
| 1993 | 10.1 | 10.1 | 10.1 | 8.3 | 8.5 | 6.5 | 5.6 | 6.9 |
| 1994 | 3.7 | 3.6 | 3.6 | 3.8 | 3.5 | 3.5 | 4.0 | 3.4 |
| **Average** | **6.80** | **6.48** | **6.24** | **5.89** | **5.83** | **5.33** | **4.73** | **5.71** |
| **Similarity** | | 83.98% | 72.19% | 51.58% | 52.11% | 28.75% | 11.76% | 46.20% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **SB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Elk River Mile 125

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 3.8 | 3.8 | 3.8 | 3.8 | 3.9 | 3.9 | 3.8 | 3.8 |
| 1988 | 6.8 | 6.4 | 6.6 | 6.7 | 6.7 | 6.7 | 6.5 | 6.1 |
| 1989 | 7.3 | 7.4 | 7.4 | 9.3 | 7.4 | 7.4 | 7.0 | 10.2 |
| 1990 | 9.3 | 9.4 | 9.2 | 4.2 | 9.3 | 9.2 | 9.4 | 9.3 |
| 1991 | 9.4 | 9.5 | 9.6 | 5.2 | 9.4 | 9.6 | 9.4 | 9.6 |
| 1992 | 6.2 | 6.1 | 5.9 | 5.8 | 6.2 | 5.9 | 6.2 | 5.4 |
| 1993 | 10.6 | 10.8 | 10.7 | 4.7 | 10.8 | 10.7 | 10.8 | 11.7 |
| 1994 | 9.8 | 10.0 | 9.9 | 5.1 | 9.9 | 9.8 | 10.0 | 8.5 |
| **Average** | **7.89** | **7.92** | **7.88** | **5.59** | **7.96** | **7.90** | **7.88** | **8.08** |
| **Similarity** | | 98.20% | 98.82% | 4.00% | 95.75% | 99.66% | 99.25% | 88.29% |
| **Evaluation** | | **N** | **N** | **SSB** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Cool-to-Warm Tributary Tailwaters

**Metric #14:** The average instantaneous water temperatures at a given location during the third through fourth weeks in August at a given location.

**Data Units:** Water temperatures in degrees Celsius.

**Evaluation Perspective:** Higher mean water temperatures during this period would indicate better summer conditions for protected species survival and growth.

**Holston River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 23.6 | 17.9 | 16.5 | 19.0 | 23.4 | 17.1 | 15.6 | 20.4 |
| 1988 | 27.8 | 27.5 | 25.1 | 28.6 | 26.8 | 26.2 | 25.5 | 27.9 |
| 1989 | 22.2 | 18.3 | 17.7 | 17.9 | 21.5 | 17.8 | 17.2 | 19.4 |
| 1990 | 23.6 | 16.2 | 15.5 | 17.3 | 23.6 | 15.8 | 14.9 | 17.2 |
| 1991 | 24.6 | 15.2 | 15.0 | 16.6 | 24.6 | 15.5 | 14.7 | 17.7 |
| 1992 | 22.6 | 15.4 | 13.8 | 16.5 | 22.4 | 13.8 | 13.0 | 16.8 |
| 1993 | 22.3 | 14.9 | 13.3 | 16.0 | 22.3 | 13.4 | 12.6 | 16.2 |
| 1994 | 19.8 | 16.8 | 16.6 | 17.1 | 19.8 | 16.7 | 16.5 | 17.2 |
| **Average** | **23.31** | **17.77** | **16.71** | **18.64** | **23.07** | **17.04** | **16.24** | **19.11** |
| **Similarity** | | 0.51% | 0.07% | 1.44% | 82.60% | 0.18% | 0.07% | 1.83% |
| **Evaluation** | | **SSA** | **SSA** | **SSA** | **N** | **SSA** | **SSA** | **SSA** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

**Hiwassee River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 15.6 | 18.1 | 18.2 | 20.7 | 18.3 | 19.2 | 18.8 | 18.7 |
| 1988 | 18.4 | 20.3 | 19.5 | 21.1 | 21.4 | 19.7 | 20.0 | 20.3 |
| 1989 | 17.4 | 20.6 | 20.6 | 21.2 | 20.5 | 20.6 | 20.8 | 20.9 |
| 1990 | 18.3 | 19.7 | 19.7 | 20.8 | 20.1 | 20.0 | 20.0 | 20.1 |
| 1991 | 18.2 | 19.7 | 19.7 | 20.8 | 20.3 | 19.7 | 19.6 | 20.2 |
| 1992 | 16.6 | 17.8 | 17.8 | 19.0 | 18.4 | 17.9 | 17.3 | 18.1 |
| 1993 | 16.9 | 18.8 | 19.1 | 20.4 | 18.9 | 19.4 | 19.0 | 19.2 |
| 1994 | 18.0 | 20.6 | 20.6 | 21.4 | 20.6 | 20.6 | 20.6 | 21.1 |
| **Average** | **17.42** | **19.46** | **19.41** | **20.66** | **19.81** | **19.64** | **19.51** | **19.83** |
| **Similarity** | | 0.04% | 0.04% | 0.00% | 0.01% | 0.01% | 0.04% | 0.03% |
| **Evaluation** | | **SSB** | **SSB** | **SSB** | **SSB** | **SSB** | **SSB** | **SSB** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

**Elk River Mile 125**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 20.1 | 20.1 | 20.2 | 20.3 | 20.1 | 20.1 | 20.0 | 20.1 |
| 1988 | 20.2 | 20.2 | 20.4 | 20.6 | 19.0 | 20.4 | 20.2 | 20.2 |
| 1989 | 18.3 | 18.1 | 18.7 | 17.9 | 18.3 | 18.7 | 18.2 | 18.3 |
| 1990 | 18.4 | 18.0 | 21.6 | 21.7 | 18.3 | 21.6 | 18.1 | 18.2 |
| 1991 | 17.5 | 17.4 | 20.3 | 20.3 | 17.6 | 20.3 | 17.4 | 17.5 |
| 1992 | 14.4 | 14.2 | 15.7 | 18.0 | 14.4 | 15.7 | 14.3 | 14.4 |
| 1993 | 16.8 | 16.6 | 20.5 | 20.7 | 16.8 | 20.5 | 16.6 | 16.7 |
| 1994 | 16.7 | 16.6 | 17.0 | 17.1 | 16.7 | 17.0 | 16.6 | 16.6 |
| **Average** | **17.81** | **17.66** | **19.30** | **19.58** | **17.64** | **19.28** | **17.68** | **17.76** |
| **Similarity** | | 87.78% | 15.46% | 6.94% | 85.15% | 15.81% | 89.27% | 95.65% |
| **Evaluation** | | **N** | **SB** | **SB** | **N** | **SB** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

## Cool-to-Warm Tributary Tailwaters

**Metric #15:** Difference between 90- and 10-percent instantaneous water temperatures during third through fourth weeks of August at a given location.

**Data Units:** Temperature range in degrees Celsius.

**Evaluation Perspective:** Less variation in water temperature during this period would indicate better spring conditions for protected species survival and growth.

**Holston River Mile 48**

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 4.0 | 4.1 | 2.6 | 3.9 | 4.1 | 2.8 | 1.7 | 4.2 |
| 1988 | 2.0 | 3.2 | 2.4 | 2.7 | 2.5 | 2.4 | 2.4 | 4.7 |
| 1989 | 2.7 | 1.7 | 1.6 | 1.6 | 3.4 | 1.6 | 1.4 | 2.4 |
| 1990 | 3.7 | 1.7 | 1.7 | 1.8 | 3.7 | 1.7 | 1.5 | 2.5 |
| 1991 | 3.8 | 1.9 | 1.8 | 3.6 | 3.8 | 1.9 | 1.6 | 2.7 |
| 1992 | 2.8 | 2.4 | 1.7 | 2.4 | 2.9 | 1.6 | 1.3 | 3.3 |
| 1993 | 6.3 | 4.2 | 2.2 | 3.8 | 6.3 | 2.3 | 1.7 | 4.4 |
| 1994 | 2.8 | 1.7 | 1.7 | 1.8 | 2.9 | 2.0 | 1.7 | 2.3 |
| **Average** | **3.52** | **2.60** | **1.96** | **2.67** | **3.70** | **2.04** | **1.65** | **3.30** |
| **Similarity** | | 15.04% | 0.66% | 16.64% | 78.16% | 0.98% | 0.17% | 70.50% |
| **Evaluation** | | **SB** | **SSB** | **SB** | **N** | **SSB** | **SSB** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

### Hiwassee River Mile 48

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 4.5 | 3.6 | 5.2 | 3.2 | 3.8 | 4.2 | 4.9 | 3.6 |
| 1988 | 7.0 | 3.9 | 4.7 | 4.6 | 5.7 | 4.1 | 4.8 | 3.2 |
| 1989 | 2.5 | 2.5 | 3.0 | 2.4 | 2.5 | 3.0 | 3.2 | 2.4 |
| 1990 | 3.2 | 4.1 | 6.2 | 3.0 | 3.1 | 4.7 | 4.7 | 3.6 |
| 1991 | 2.5 | 2.7 | 2.6 | 2.4 | 2.4 | 2.6 | 2.6 | 2.5 |
| 1992 | 2.3 | 2.4 | 3.0 | 2.3 | 2.2 | 2.8 | 2.6 | 2.2 |
| 1993 | 3.3 | 3.4 | 6.6 | 3.0 | 3.1 | 4.7 | 4.7 | 3.6 |
| 1994 | 2.4 | 2.2 | 2.2 | 1.6 | 2.2 | 2.2 | 2.2 | 1.6 |
| **Average** | **3.48** | **3.09** | **4.18** | **2.82** | **3.13** | **3.52** | **3.71** | **2.85** |
| **Similarity** | | 55.16% | 40.68% | 33.02% | 63.16% | 94.61% | 74.54% | 34.08% |
| **Evaluation** | | **N** | **N** | **N** | **N** | **N** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

### Elk River Mile 125

| Year | Base Case | Reservoir Recreation A | Reservoir Recreation B | Equalized Summer/ Winter Flood Risk | Commercial Navigation | Tailwater Recreation | Tailwater Habitat | Preferred |
|---|---|---|---|---|---|---|---|---|
| 1987 | 4.6 | 4.6 | 4.5 | 4.5 | 4.6 | 4.6 | 4.7 | 4.6 |
| 1988 | 4.3 | 4.3 | 4.3 | 4.2 | 11.3 | 4.2 | 4.2 | 4.3 |
| 1989 | 7.8 | 7.8 | 7.4 | 8.1 | 7.8 | 7.4 | 7.8 | 7.9 |
| 1990 | 10.1 | 10.0 | 5.1 | 5.0 | 9.9 | 5.3 | 10.0 | 10.1 |
| 1991 | 7.9 | 7.9 | 4.5 | 4.6 | 7.8 | 4.6 | 7.8 | 7.8 |
| 1992 | 7.8 | 7.9 | 6.1 | 4.2 | 7.8 | 6.1 | 7.8 | 7.8 |
| 1993 | 9.8 | 10.0 | 4.3 | 4.3 | 9.7 | 4.3 | 9.9 | 9.8 |
| 1994 | 7.0 | 7.1 | 6.8 | 7.4 | 7.0 | 6.7 | 7.0 | 7.0 |
| **Average** | **7.41** | **7.45** | **5.37** | **5.28** | **8.23** | **5.40** | **7.41** | **7.41** |
| **Similarity** | | 97.30% | 3.15% | 3.59% | 44.20% | 3.32% | 99.63% | 99.63% |
| **Evaluation** | | **N** | **SSB** | **SSB** | **N** | **SSB** | **N** | **N** |

Note: Data for the Summer Hydropower Alternative could not be generated for all modeled years.

***See Evaluation Abbreviations Used in the Metric Tables on page D6b-12.***

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