Appendix A – U.S. Fish and Wildlife Service Biological Opinion of October 6, 2006

The following excerpts from the Biological Opinion are relevant to operation of Bear Creek Dam:

- ***Protective Measures to be Implemented***

To help conserve and recover listed species, minimize adverse effects to listed species, and to avoid potential jeopardy to listed species, TVA has committed to implementing the protective measures identified below. These measures are designed to provide permanent improvements that will contribute toward protection and recovery of the species.

1. TVA will develop adaptive management frameworks for implementing the protective measures identified that:

    - Outline the ecological needs of the species in those rivers based on the best available scientific and commercial data
    - Specify biological goals and objectives for listed species in the river reaches included as part of this consultation
    - Identify metrics to monitor progress toward specified goals, the sampling designs for measuring those metrics, and the period over which monitoring will be conducted
    - Describe the management strategies, based on the protective measures described herein, that will be implemented for the purpose of achieving the desired biological goals and objectives

2. TVA will establish a multi-agency working group consisting of TVA technical staff and representatives from the Service, state fish and wildlife agencies from Alabama and Tennessee, and other appropriate agencies (e.g., U.S. Geological Survey) to assess operational changes implemented because of this consultation, and their effects. This working group will meet annually for at least 10 years to review and discuss the effects on biology and habitat requirements of the listed species resulting from operational changes made at Tims Ford Dam, Wilson Dam, and dams in the Bear Creek system, and the need to make operational changes or develop corrective actions. As appropriate and based on the data collected and analyses done following the management/work plans, the working group will identify additions to, elimination of, and revisions to these protective measures. Other technical experts (e.g., mussel biologists, fish biologists) may be invited to the meetings as needed to provide technical expertise or expert opinions. In the event of conflict or disagreement over the implementation of these protective measures and management/work plans that cannot be informally resolved among the working group, the Service and TVA representatives will bring such disagreements to their senior management and resolution will be sought at that level. Also, as appropriate, TVA will seek to enlist the expertise of scientists with comparable ecosystem expertise and who have

been involved in management and monitoring of physical and biological factors for other regulated rivers in the southeastern United States. These experts could assist with efforts for evaluating and implementing measures to improve riverine habitat in the affected areas. TVA personnel will coordinate with the Cookeville Field Office Supervisor and will organize the group and hold the initial meeting by the end of the first half of Fiscal Year 2007 (i.e., March 31, 2007).

8. TVA will provide the instantaneous minimum seasonal flows from dams in the Bear Creek system identified in the table below. TVA will ensure that these flows are maintained except during years of extreme climatic conditions (i.e., flood, drought). These measures will be implemented until final decisions are made about the structure of Bear Creek Dam and its operations after TVA completes its ongoing environmental review, Bear Creek Dam Leakage Resolution. Annual reports will be provided to the Cookeville and Daphne field offices. (**NOTE: The recommended flows contained in this biological opinion are interim measures pending completion of TVA's environmental review. Selection of a preferred alternative will be subject to separate Endangered Species Act section 7 consultation)**

	JAN-APR	MAY-JUNE	JULY-OCT	NOV-DEC
Stream	**Recommended flow (cfs)**	**Recommended flow (cfs)**	**Recommended flow (cfs)**	**Recommended flow (cfs)**
Little Bear Creek	40	38	15	28
Cedar Creek	90	71	20	51
Bear Creek*	347	119	52	83

*If rebuilding and operating the dam is chosen as TVA's preferred alternative for the Bear Creek Dam Leakage Resolution, TVA would plan to incorporate these flows into the operating plan.

EFFECT OF THE TAKE

In the accompanying biological opinion, we determined that these levels of expected take are not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat when the reasonable and prudent measures, with implementing terms and conditions, are carried out for the 18 animal species and the critical habitat addressed in this biological opinion.

Table 4. The incidental take estimated and critical habitat destroyed for the proposed project.

SPECIES	INDIVIDUALS	TAKE TYPE	CH DESTROYED
Cumberlandian combshell	**All below Bear Creek Dam**	**Harm, Harass**	25 miles from BCM 23 to the MS/AL state line

Table 5. How incidental take will be monitored if the specific number of individuals cannot be determined.

SPECIES	CRITICAL HABITAT	HABITAT	OTHER
Cumberlandian combshell	Changes in DO, turbidity, temperature, copper, zinc, manganese, aluminum, ammonia, chlorine, or arsenic in Bear Creek exceeding or failing to meet established State standards		

REASONABLE AND PRUDENT MEASURES

We believe the following reasonable and prudent measures are necessary to minimize impacts of incidental take of the 18 animal species addressed in this biological opinion:

1. TVA will implement measures at additional dams as part of its Reservoir Release Improvement Program to enhance, restore, and maintain suitable habitat conditions in tailwater reaches below those dams.

2. TVA will continue its ongoing research on migratory shorebirds in the Tennessee River Basin.

3. TVA will work with the Fish and Wildlife Service, state fish and wildlife agencies, and non-governmental groups to promote and enhance recovery of federally listed species.

4. TVA will utilize its resource stewardship programs, to the extent resources are available, to assist landowners along river reaches below its dams to improve aquatic habitat conditions.

5. TVA will continue its efforts to monitor and maintain data for federally listed, proposed, and candidate species in the Tennessee River Basin.

6. For at least 10 years, TVA will maintain bio-monitoring stations within the Bear Creek watershed and will, in coordination with appropriate Service biologists and State resource biologists, develop a monitoring plan which sets timeframes for monitoring and reporting. TVA will conduct an evaluation of current land use practices in the Bear Creek watershed and will identify

areas of greatest potential for sediment contribution. TVA will determine and evaluate bedload sedimentation rates in Cedar Creek and Little Bear Creek.

7. TVA will institute monitoring in the Elk River to track the status of listed species in the Elk River.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, TVA must comply with the following terms and conditions which carry out the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Dissolved oxygen levels will be monitored at all dams that do not currently have aeration capability. If dissolved oxygen levels lower than 5 parts per million are consistently observed below any dam, measures will be implemented to modify discharge rates from those dams to improve dissolved oxygen concentration in the releases when feasible. Established minimum flows will also be monitored and modified if needed to ensure that there is adequate minimum flow in the tailwater reaches to maintain fish and mussel populations.

2. As per the commitment identified in the Reservoir Operations Study Final Environmental Impact Statement, TVA will continue to work with Service refuge biologists to monitor and evaluate the status of migratory shorebirds in the Tennessee River Basin through Fiscal Year 2009. An evaluation of use of TVA and National Wildlife Refuge lands by piping plovers will be conducted to determine types and amount of habitat used by the birds during migration, and the availability of such habitat to the birds.

…

4. TVA will utilize its existing stewardship programs to assist landowners in the Tennessee River Basin to protect and improve aquatic habitats. TVA stewardship personnel will explore opportunities to work with landowners along rivers within its jurisdiction to improve water quality by such actions as reducing sedimentation, stabilizing riverbanks, and restoring vegetated riparian zones.

5. Monitoring will continue throughout the Tennessee River Basin to maintain up-to-date data on federally listed, proposed, and candidate species on lands and in waters within TVA's jurisdiction. Data will be shared with appropriate Service field offices.

6. TVA will coordinate with biologists from the Service's Daphne Field Office to select and establish permanent water quality monitoring stations in the Bear Creek drainage and assist in inter-agency cooperative efforts to document threats to the water quality and habitat appropriate for the mussel community in the Bear Creek tailwater. Water quality parameters to be monitored will include, but not be limited to: flow, dissolved oxygen, water temperature,

sediment movement, benthic drift, copper, zinc, manganese, aluminum, ammonia, and arsenic. TVA will provide Daphne Field Office biologists with the results of monitoring and will coordinate with those biologists to correct problems.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from current operation and maintenance activities at TVA dams. We believe that no more than the following levels of incidental take will occur:

1. *Piping plover* – Available information does not address the biological and ecological requirements of this species during migration. The reasonable and prudent measures and terms and conditions will provide valuable information about the behavior and habitat requirements of the piping plover during its migration through the Tennessee River Valley. If the information obtained indicates that adequate amounts of suitable habitat are not available at the time when the species migrates through the Tennessee River Valley, appropriate measures will be implemented to provide suitable resting and foraging habitat at the appropriate time of the year. Annual counts of shorebirds in the Tennessee River Valley reveal that few piping plovers are observed. Assuming that 25 piping plovers migrate through the action area, incidental take of piping plovers that might result from operation and maintenance activities is anticipated to be 2 individuals.

…

7. *Cumberlandian combshell* – Implementation of the reasonable and prudent measures and terms and conditions should secure the population of this species in Bear Creek and its critical habitat. In time, the population should expand in Bear Creek into areas in which the species occurred historically. Incidental take of the Cumberlandian combshell should not exceed individuals in a total of two miles of suitable habitat in Bear Creek.

8. *Oyster mussel* – Incidental take of this species is not anticipated. If the habitat in Bear Creek is secured by implementation of the reasonable and prudent measures and terms and conditions, a population may be reestablished in Bear Creek through reintroduction of propagated individuals.

If, during the course of the action, incidental take exceeds the levels presented above, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Tennessee Valley Authority must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

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Appendix B – Comments and TVA Responses

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Appendix B - Comments Received on the Draft Environmental Impact Statement

Comments from the Public

Written comments were present by five persons at the public meeting held at Red Bay, Alabama, on June 19, 2007. These comments are reproduced below. The name of the person making the comment is provided in parentheses following the comment.

> "We need the dam repaired. It is important for our economic development, recreational opportunities and for safe drinking water. This is a top priority for our entire area. Thank you." (Roger Bedford, Jr., State Senator, District 6)

> "We need the dam repaired as it was initially intended for sake of flood control, water level and the Franklin County Water Treatment Plant." (Brad Bolton, Board Member Franklin County Water Board)

> "Please go ahead with your plans to repair the dam." (Delton Gene Graham, Franklin County Commissioner)

> "This dam must be replaced for the economic vitality of Franklin County. This dam must also be replaced for the tourism potential of the region." (James Keith Jones, Executive Director, Northwest Alabama Council of Local Governments)

> "The dam needs to be fixed for the betterment of Red Bay. The economic impact in the future will be greatly increased if the dam is fixed. There are homes built in the flood zone. If dam is not fixed these people will be hard pressed to get homeowner's insurance. Future development will be nil because there will be no lending source available because of the flood zone." (Jeff Reid, Mayor of Red Bay)

***Response**:*

Comments noted. The benefits of dam repair are discussed in the EIS, and TVA's preferred alternative is to repair the dam.

The following comments were received via mail on the comment form provided at the June 19 public meeting.

> "I feel the chart on page 28 is incorrect. Franklin County Water Authority is not listed as a purchaser of water, when they purchased 400,000 gals a day from Russellville Water & Sewer Board. All other water departments are listed as sellers or purchasers. We feel the study needs to reflect this issue. As Russellville water rep. I feel this needs to be shown to be a correct reflection of the water needs in this county. This Dept. thinks the dam rebuilding is a great project. We just want all the numbers to be correct." (Doug Clement, Russellville Utilities)

> "I feel the chart on Page 28 incorrect. It does not show Franklin County as a purchaser. When they purchased 400,000 a day from Russellville Water. All other water departments are listed as sellers or purchasers. I feel the Impact study needs to reflect this for Franklin County also. As a Water Rep. for Russellville Water I feel the study needs to reflect an accurate account of the water needs in this county. I also feel the

amount of water the chart on page 28 shows that Franklin County is pumping (2.5) mgd is far from accurate. I would ask that you contact ADEM for more accurate amount." (Garry Lee Parker, Jr., Russellville Utilities)

Response:

The information provided in Table 7 in the draft EIS reflected the maximum permitted water withdrawal, not necessarily the amount of water being withdrawn or pumped. Table 7 in the final EIS has been updated to clarify this information.

FRANKLIN COUNTY WATER SERVICE AUTHORITY

PO Box 278 • Russellville • Alabama • 35653
256.332.1496 • 256.332.1499 (fax) • fcwater@hiwaay.net (e-mail)

June 26, 2007

Mr. James F. Williamson, Jr.
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

RE: Environmental Impact Statement
Bear Creek Dam Leakage Resolution
Franklin County, Alabama

Dear Mr. Williamson:

After review of the above referenced document in correlation to our water treatment facility, we hereby request an increase in the winter pool level by 2 feet or more if possible. An increase of this amount or more would greatly improve the water quality and our ability to treat it. Lower pool levels result in higher turbidities and a more involved and costly treatment process.

We appreciate TVA's commitment to restoring the Bear Creek Dam and securing a water supply for the area. We feel assured that every consideration will be given to this request. Feel free to contact me with any questions.

Sincerely,

FRANKLIN COUNTY WATER SERVICE AUTHORITY

Douglas C. Aaron

Douglas C. Aaron
Superintendent of Operations

Response:

TVA has considered the request to increase winter pool elevation by 2 feet. TVA comprehensively studied reservoir levels and the potential effects of changing them in the Reservoir Operations Study EIS, which included operations at Bear Creek Dam. Modeling results indicate that a 2-foot increase in the winter pool would result in an unacceptable increase in the flood risk. However, an increase of 1 foot in the winter

pool level would be acceptable. TVA would increase the operating guide to accommodate this request as part of Alternative 2, its preferred alternative. Also see the response to Comment 1 from the U.S. Department of Interior.

STATE OF MISSISSIPPI
DEPARTMENT OF FINANCE AND ADMINISTRATION

MEMORANDUM

TO: TENNESSEE VALLEY AUTHORITY
400 WEST SUMMIT HILL DRIVE
KNOXVILLE TN 37902 1401

DATE: JUN 13 2007

FROM: STATE CLEARINGHOUSE FOR FEDERAL PROGRAMS

SUBJECT: REVIEW COMMENTS - Activity:
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) ON PROPOSED DAM LEAKAGE RESOLUTION PROJECT AT BEAR CREEK DAM, FRANKLIN COUNTY, AL. ADDRESS COMMENTS/INQUIRIES TO JAMES WILLIAMSON AT ABOVE ADDRESS. (FAX NO. 865/632-3451 OR E-MAIL: JWILLIAMSON@TVA.GOV)

State Application Identifier Number MS070530-005

Location: MULTI COUNTY

Contact: JAMES WILLIAMSON

The State Clearinghouse, in cooperation with state agencies interested or possibly affected, has completed the review process for the activity described above.

INTERGOVERNMENTAL REVIEW PROCESS COMPLIANCE:

( ) We are enclosing the comments received from the state agencies for your consideration and appropriate actions. The remaining agencies involved in the review did not have comments or recommendations to offer at this time. A copy of this letter is to be attached to the application as evidence of compliance with Executive Order 12372 review requirements.

( ) Conditional clearance pending Archives and History's approval.

(✓) None of the state agencies involved in the review had comments or recommendations to offer at this time. This concludes the State Clearinghouse review, and we encourage appropriate action as soon as possible. A copy of this letter is to be attached to the application as evidence of compliance with Executive Order 12372 review requirements.

( ) The review of this activity is being extended for a period not to exceed 60 days from the receipt of notification to allow adequate time for review.

COASTAL PROGRAM COMPLIANCE (Coastal area activities only):

( ) The activity has been reviewed and complies with the Mississippi Coastal Program. A consistency certification is to be issued by the Mississippi Department of Marine Resources in accordance with the Coastal Zone Management Act.

( ) The activity has been reviewed and does not comply with the Mississippi Coastal Program.

1301 Woolfolk Building, Suite E • Jackson, Mississippi 39201 • (601) 359-6762 • Fax (601) 359-6758
"An Equal Opportunity Employer M/F/H"

No response necessary.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

9043.1
ER 07/479

June 26, 2007

Jim Williamson
TVA NEPA Administration
400 West Summit Hill Drive
Knoxville, Tennessee 37902

RE: Comments Draft Environmental Impact Statement (DEIS), Bear Creek Dam Leakage Resolution Project (ER 07/0479)

Dear Mr. Williamson:

The Department of the Interior (Department) has reviewed the Draft Environmental Impact Statement (DEIS) for the Bear Creek Dam Leakage Resolution Project. We are submitting the following comments and recommendations.

Background

Bear Creek Reservoir is one of four reservoirs located in northwest Alabama that comprise the Bear Creek Project. The Project was authorized by Congress in 1964 for the primary purposes of flood control, recreation, and economic development, including water supply. No electricity is generated at these four reservoirs. The Bear Creek Dam is an earthen dam with a maximum height of 68 feet and is 1,385 feet in length. The dam impounds a reservoir with a maximum length of 12 miles, summer pool of 690 acres, and approximately 39 miles of shoreline. The Tennessee Valley Authority (TVA) owns and manages the majority of the shoreline and the Bear Creek Development Authority (BCDA), a State agency, owns much of the adjacent land. Currently, development along the shoreline consists of an environmental education center and two public recreation areas with campgrounds and other facilities operated by BCDA, as well as a municipal water intake and treatment plant operated by Franklin County Water Service Authority approximately 2.3 miles upstream from the dam.

Comments

We acted as a consulting agency in the consulting stage of the development of the Environmental Impact Statement, however, we have found that some important issues and concerns have not been adequately addressed in the DEIS. We have repeated our original comments provided during the scoping process by heading section.

Environmental Consequences

#1 Paragraph 1. It is unclear why alternatives 2 and 3 would not be equivalent w.r.t. benefiting listed species if the same minimum flows could be achieved under either alternative. Please clarify.

#2 Also, indicate whether there would be any differences in exceedance of critical maximum flows under any of the alternatives. Rapid reservoir releases of large water volumes have been identified as causing severe stream bank and streambed erosion in Bear Creek (McGregor and Cook 2004). These authors do not believe that maintenance of greater minimum flows, per the biological opinion, will solve the downstream sedimentation problem in mussel habitat (personal discussions with authors). However, TVA and FWS resolved this problem in our April 2007 meeting by agreeing that TVA would, in the future, conduct step-down releases

- for winter drawdowns and in anticipation of flood events whenever possible rather than conducting instantaneous large-scale releases.

#3 Paragraph 6. It is presumed that "elimination of the dam could lead to periods of no flow." Clarify why minimum flows for Upper Bear Creek Dam could or could not be used to provide a constant flow if Alternative 4 was implemented.

Chapter 1.0 Purpose of and Need for Action

#4 Figure 1. Recommend that Figure 1 show the entire Bear Creek watershed (i.e., from its headwaters down to the confluence with the Tennessee River)

4 The Scoping Process

#5
- Table 2. The Alabama Department of Environmental Management is listed twice. Geological Survey of Alabama is not listed, despite prior hydrological and biological studies in the watershed. [We strongly recommend providing GSA with a copy of the DEIS for review.]

2.0 Alternatives Including the Proposed Action

#6
- Recommend including the estimated cost associated with each alternative. This information was discussed at the 1st agency scoping meeting.

2.1.2 Alternative 2 – Modify Dam ….

#7
- Characterize downstream flow conditions (in cfs) during the nine months of construction activities for 2a, 2b, and 2c.

#8
- Describe how TVA will deal with any flood conditions occurring during construction?

#9
- A key concern will be preventing additional sedimentation downstream during construction activity including heavy equipment movements, coffer dam construction, etc. Please identify best management practices in addition to the coffer to reduce downstream sedimentation.

Table 4

#10
- Groundwater: under Alternatives 1-3, the reservoir likely inundates many large springs. Recommend more discussion on how this has no effect on groundwater recharge. Explain under Alternative 4 how aquifers will decline approximately 20 feet.

#11
- Aquatic Ecology: Under Alternative 3, does a 25 percent reduction in reservoir habitat equal a 75 percent increase in potential riparian stream habitat?

#12
- Endangered and Threatened species: Under Alternatives 3&4, clarify how flows will equal zero if release from Upper Bear Creek Dam are utilized or other intervening streams.

#13
As discussed above, adverse effects to critical habitat and listed mussels depend not only on higher minimum flows, but also on lower critical maximum flows, which result in sedimentation. The negotiated changes in minimum flows should enhance water quality and provide the flow needed to facilitate mussel filter-feeding. However, the new minima are unlikely to cure the erosion and sedimentation problems occurring during instantaneous large-volume releases of water from the Bear Creek Reservoir. Graduated step-down flows over several days are needed, as opposed to rapid releases, to reduce effects on listed mussels. If any of the alternatives will result in increased sedimentation downstream during the construction phase, this needs to be identified here and in the text. We suggest that an array of BMPs be adopted to minimize sedimentation during construction. The coffer dam will partially limit sediment inputs from upstream. Release of top water rather than bottom water from the reservoir, if this is not already occurring, might also assist in reducing sediment loading downstream and increasing dissolved oxygen.

3.0 Affected Environment

3.1 Water Availability, ….

#14
- General Comment --The order of this discussion is Bear Creek Reservoir, Upper Bear Creek Reservoir, and then the Float way. We recommend starting with Upper Bear Creek and proceeding downstream, as a more logical progression. Upper Bear Creek and the Float way are not actually part of the affected environment, but discussion of their conditions influence Bear Creek Reservoir and conditions downstream and so we agree they should be included. However, why they are being discussed somehow needs clarifying.

#15
- 2nd Paragraph. The reservoir waters are actually very soft in comparison to many lake, river, and stream waters using limnological criteria, since "soft" typically refers to

waters of hardness 5 mg/L – 60 [or 75] mg/L. "Moderately soft" may be slightly misleading. Because Bear Creek waters are so soft and low in alkalinity, they are also likely to be poorly buffered, making them susceptible to diurnal pH changes related to photosynthetic activity, as well as the effects of acid mine drainage, acid rain, and other pollutant impacts…something developers and local residents need to understand. Low hardness also increases the toxicity of cations like mercury, zinc, copper, and cadmium, some of which are indicated as present.

#16

- Nonpoint sources are not identified, but could be. Former coal mining in the watershed obviously led to surface disturbances and represents an important nonpoint source of both contaminants and sediment to Bear Creek and Bear Creek Reservoir. Coal fines usually contain cations such as iron and manganese in enriched amounts and are/were potential sources of nonpoint pollution via general surface runoff and drainage features. Depending on the coal formation, enrichments in arsenic, mercury, selenium and other metals and metalloids in streams from coal fines have been documented to occur in AL (Goldhaber, see http://pubs.usgs.gov/mf/2000/mf-2333/mf2333po.pdf), although coal in the Bear Creek area has apparently not been characterized. Logging and agricultural activities have also contributed to erosion and sedimentation. Bear Creek Reservoir fish were subject to a mercury fish consumption advisory by Alabama Public Health officials in 2004. Any new flooding of terrestrial vegetated areas may also temporarily increase mercury in fish.

#17

Last Paragraph. Please appendix the results of FCWSA's water quality testing.

#18

Under Anticipated Land Use Trends. While we agree that the affected area will remain essentially rural and low in growth, there is a trend toward increasing poultry production in Alabama, a key agricultural activity in Franklin County http://www.aces.edu/counties/Franklin/pages/Success.tmpl). Is this activity increasing in or adjacent to the affected area?

#19

- Under Sediment Toxicity. The interpretation of the TCLP test results in this paragraph is overly broad and misleading. The TCLP test results showed that the tested material did not meet the hazard thresholds necessary to require disposal of the sediment in a RCRA-approved disposal site. The results do not in any way provide assurance of lack of toxicity to aquatic organisms if the sediment remains in place, nor can TCLP data be used to suggest which contaminants pose a risk to aquatic species, since pathways of exposures (food, water, bioaccumulation) are different for each metal and depend on a variety of factors including the metal species and sediment characteristics. Please see: http://www.epa.gov/waterscience/library/sediment/managingcs.pdf, particularly pages 43-45, for recommended methods of determining toxicity to aquatic species and assessing bioaccumulation potential. For a more detailed discussion of risk assessment of metals in sediment, also see: http://www.epa.gov/OSA/metalsframework/pdfs/metals-risk-assessment-final-3-8-07.pdf.

#20

- Under Erosion and Sedimentation: Again, we recommend proceeding from upstream to downstream, summarizing conditions in each segment since upstream conditions influence downstream ones. In addition to the existing description, we recommend a brief description of sedimentation problems related to agricultural, coal mining, and timbering practices (some historic) in the watershed. Also, we recommend modifying this section with the additional information from McGregor and Cook (2004) on the effects of critical maximum flows on erosion and sedimentation patterns in Bear Creek downstream of the dam. These authors showed that, because of exceedances in critical flow maxima, dam retention of sediments and increased erosion below dams have not cancelled each other out as far as effects on mussel habitat downstream. Rather, the exceedances have increased sedimentation threats to existing threatened and endangered mussel species and critical habitat. The new step-down procedures for flow release referred to earlier should reduce this threat in the future.

#21

Reservoir Operations: Under the description of Bear Creek Reservoir operations, please indicate what kinds of valves or release devices are contemplated in the future to operate this dam (gate or butterfly valve, top or bottom water releases?) Will aeration occur?

#22

- Water Quantity (Hydrology): As discussed in the April 11th meeting with the Departmer in Daphne, attempts were going to be made to decrease the slope of the drawdown perio on the rule curve (Nov-Dec).

4.0 Environmental Consequences

4.1 Water Availability, quality, ….

#23

- Under Alternatives 3&4: discuss how/if inflows from Upper Bear Creek Dam and intervening stream/spring discharges could influence outflows from Bear Creek Dam. Although flows could drop as low as 7 cfs during dry years as indicated in the text, it woul by no means be a frequent event. Our review of the Bear Creek flow data (Hackleburg Gage) shows that flows only decreased to that point once in over 20 years (Oct 1963), and it has never approached that low of flow at the Red Bay gage.

#24

- Summary: Although it does appear that Alternatives 1&2 could provide the "most consistent" means of providing a minimum Q, Alternatives 3-4 should not be ruled-out because it is not clear that discharges from Upper Bear Creek Dam have been adequately represented in the analysis.

4.2 Aquatic Ecology

#25

- Under Alternative 3, reiterate that conditions will likely improve downstream of Bear Creek Dam. Also recommend clarifying that aquatic ecology not only refers to the reservoir fishery (created by humans) but also the native warm-water stream fishery that existed in the basin prior to construction of the dam.

We appreciate the opportunity to provide these comments, and look forward to working further

with the Tennessee Valley Authority as this project develops. If you have any questions or need additional information, please contact Mr. Jeff Powell of the Daphne Alabama Field Office at (251) 441-5858

Sincerely,

Gregory Hogue
Regional Environmental Officer

cc: FWS Region 4 – Atlanta
FWS Daphne Alabama Field Office
OEPC – WASH

Response to Comment #1

Under Alternative 2, the dam would be repaired, and summer and winter pools would return to their previous levels (i.e., 576 and 565 feet, respectively). TVA would establish the minimum flow targets shown in Figure 10 of the draft EIS. Because of the additional storage capacity under Alternative 2, there would be more flexibility in meeting the target minimum flows, compared to the current situation or to operations under Alternative 3. Under Alternative 3, the maximum reservoir level would be 565 feet, as a portion of the dam would be removed, effectively creating a spillway at elevation 565. Under Alternative 3, the flood storage capacity of the reservoir would be reduced as compared to Alternative 2. Thus, the flexibility in operating the dam to maintain reservoir elevations and to provide target minimum flows downstream would be reduced under Alternative 3. Under Alternative 3, TVA would provide a minimum flow of 21 cfs. Following periods of heavy rainfall or extended rainfall, excess inflow would likely go over the spillway until the reservoir returns to elevation 565. The net effect of these differences include reduced water storage capacity and retention time under Alternative 3, resulting in improved downstream water quality, and less regulated, more natural, downstream flows. Consequently, implementation of Alternative 3 could have more beneficial effects on listed species than Alternative 2 would.

Because of the reduced residence time of reservoir water under Alternative 3, DO levels in the discharge are likely to be higher than under Alternative 2. Thus potential effects and benefits to listed species would not be the same under these two alternatives.

Response to Comment #2

There would be a difference in the exceedances of critical maximum flows under the four alternatives. Under Alternative 1, the operating guide would return to that used prior to the current drawdown until the dam failed. Exceedances would be comparable to historical frequencies. Under Alternative 2, TVA would alter the operating guide for the winter drawdown period. Thus, for this period, the likelihood of exceeding critical

maximum flow downstream would be reduced as compared to historical conditions. Under Alternative 1 or 2, exceedances are likely to occur under flood conditions. Because of the decreased flood storage capacity of the reservoir under Alternative 3, exceedances under flood conditions are likely to have greater magnitude but perhaps, shorter duration as compared to Alternatives 1 or 2. Under Alternative 4, flow rates would depend on the outflow from Upper Bear Creek Dam. There would be no mechanism to control additional inflows below Upper Bear Creek Dam. Thus, during periods following high precipitation or flood events, exceedances would occur.

Response to Comment #3

Except for highly unusual circumstances, flows from Upper Bear Creek Dam would occur in accordance with the current operating guide. TVA has not proposed nor has plans to alter that operating guide. The water reaching Bear Creek Dam depends on the incidental inflow from small creeks, springs, and tributaries as well as the inflow from Upper Bear Creek Dam. Under Alternative 4, a retaining basin would likely be built to accommodate withdrawals by the Franklin County Water Service Authority (FCWSA). If the amount of water withdrawn by FCWSA meets or exceeds the inflow to the retaining basin, flow at Bear Creek Dam could approach a "zero flow" condition. However, inflows from streams downstream of Bear Creek Dam, including Cedar Creek, would likely provide flow to that reach of Bear Creek occupied by listed mussel species.

Response to Comment #4

The original Figure 1 has been replaced with one that shows the entire Bear Creek Watershed.

Response to Comment #5

Table 2 has been corrected accordingly. A copy of the draft EIS was sent to Marlon Cook at the Geological Survey of Alabama (see Chapter 6 of the draft EIS).

Response to Comment #6

As stated in Section 2.1, implementation of any of the action alternatives would cost an estimated $25,000,000 to $35,000,000. Direct costs incurred under the No Action Alternative would be comparable to current operating costs.

Response to Comment #7

Releases at the dam during construction under Alternative 2a, 2b or 2c would be virtually the same as current releases. The target reservoir elevations would remain at 568 feet (summer) and 565 feet (winter) during construction. Thus, during construction, downstream flow conditions are expected to be approximately the same as those occurring currently. However, if modifications to the outlet structure are required, a flow not less than 21 cfs, the existing minimum flow requirement, would be maintained.

Response to Comment #8

In the event of a flood during construction, TVA would attempt to return the reservoir level to 568 feet as soon as possible. However, in rare circumstances, such as in the case of an extended period of very heavy rainfall, TVA might not be able to maintain the reservoir at or below this level. In this event, TVA would take emergency actions such as making immediate, temporary repairs to sections of the dam weakened by excavation for foundation work. Any construction equipment would be removed from areas that could be flooded.

Response to Comment #9

Appropriate construction best management practices would be used during construction to prevent erosion of exposed soil and sediment from entering surface waters. These measures include installation of silt dams, construction of catchment basins, and establishment of grass cover on exposed soil. Additionally, measures will be taken to prevent, control, and contain spills of fuels and lubricants. Any additional best management practices required by the Stormwater Pollution Prevention Plan would be implemented.

Response to Comment #10

A spring is a location where water issues from the ground (i.e., a place where groundwater becomes surface water). The source of the spring water is surface water that recharges the groundwater system at elevations higher than the elevation at the spring itself (i.e., water seeps down gradient from the recharge area to the spring). Inundating a spring does not affect recharge because the recharge area is at a higher elevation than the inundated area.

The groundwater surface elevation in the immediate area of Bear Creek is controlled by the water surface elevation in Bear Creek. Surface water enters the groundwater system at elevations higher than Bear Creek and then moves toward Bear Creek at a rate proportional to the difference in groundwater surface elevation and the elevation in Bear Creek. If there were sufficient groundwater pumping near Bear Creek that caused the water surface elevation near the well to fall below the Bear Creek elevation, the pumping would induce recharge to the aquifer. In this case, water would flow from Bear Creek into the aquifer in order to bring the groundwater surface elevation near the well back into equilibrium with the elevation in Bear Creek. Likewise, the groundwater elevation near Bear Creek Reservoir is controlled by the elevation of the water surface in Bear Creek Reservoir. Should Bear Creek Dam be removed (Alternative 4), the groundwater level near the former reservoir would be controlled by the elevation of the water in Bear Creek. Groundwater levels near the reservoir would revert to pre-impoundment levels, or about 20 feet lower than they would be with the reservoir in place.

Response to Comment #11

Under Alternative 3, the level of the reservoir would be reduced to 565 feet (i.e., 11 feet lower than normal summer pool of 576 feet) by removing a section of the dam and creating a spillway at elevation 565. At normal summer pool level, the reservoir contains approximately 685 surface water acres. Lowering of the pool level would reduce the surface area to about 375 acres, a reduction of about 45 percent. Under Alternative 3, about 2.5 miles of Bear Creek between elevation 576 and 565 would become stream habitat.

Response to Comment #12

As stated above in the response to Comment #3, under low flow conditions, withdrawals of large volumes of water by the Franklin County Water Service Authority could equal or exceed the inflow at the intake point. In this event, flow at the dam would be virtually zero.

Response to Comment #13

Comment noted. These issues have been addressed in the final EIS.

Response to Comment #14

The sequence of the discussion has been altered accordingly. Text in the final EIS has been supplemented to better explain the relationship of Upper Bear Creek Reservoir and the Floatway to the proposed action.

Response to Comment #15

Information about water hardness has been added to section 3.1 in the final EIS.

Response to Comment #16

Nonpoint sources are described in the "Anticipated Land-Use trends" subsection of Section 3.1. Under the preferred alternative, Bear Creek Dam would be returned to its original operating capability. Normal summer pool would return to 576 feet. Except for flood events, no additional flooding within the reservoir area is anticipated. A return to normal operations would provide improved flood protection downstream.

Response to Comment #17

The Franklin County Water Supply Authority water quality testing results have been included in the final EIS as Appendix J.

Response to Comment #18

According to the information provided by the referenced website, there were over 165 poultry farms, 2 dairies, and one swine farm in Franklin County in 2005. However, this number is larger than the number recorded in the most recent (2002) Census of Agriculture. According to Tim Reed, Franklin County Extension Coordinator, the number of poultry operations in the Bear Creek watershed is not expected to increase in the next few years. Also, the amount of poultry litter spread as fertilizer within the watershed has declined markedly in recent years, as out-of-state markets for litter have developed.

Response to Comment #19

As stated in the final EIS, the TCLP test was performed to determine if sediments removed from the reservoir (primarily, under Alternative 4) would require disposal in a RCRA-approved landfill. Results indicated that the sediment would not have to be treated as hazardous waste.

There could be potential effects to aquatic life from sediment under Alternatives 1, 3, and 4. Normal operations under Alternative 1 are not expected to disturb in-reservoir or downstream sediments. However, if the dam were to fail, large amounts of sediment from the reservoir could be transported downstream. Sediment disturbance under Alternative 2 would be minimal, if any. Under Alternative 3, disturbance of in-reservoir sediments is unlikely. However, under Alternative 3, the reservoir would not serve as efficiently as a sediment trap; thus, there would be some transport of suspended sediment downstream. Actions under Alternative 4 would disturb large amounts of in-reservoir sediment, and over time, upland sediment would move downstream. If Alternative 3 or 4 were adopted, further analysis of sediment contamination may be appropriate.

Response to Comment #20

The order of the discussion currently is from upstream to downstream. Additional discussion has been added to the final EIS on the contributions of agriculture, coal mining, and timber harvesting to stream sedimentation, as well as on the role of high

flow rates in downstream erosion and sedimentation is provided in the final EIS. TVA agrees that "staged" releases (i.e., controlled releases spread out over a period of time) are likely to reduce the potential for adverse effects to threatened and endangered mussels by reducing the potential for downstream bank erosion and sediment transport.

Response to Comment #21

A 20-inch water quality slide gate valve for higher elevation releases was part of the original dam design and would remain in use used after repairs are made. The 7-foot by 7-foot slide gate at the bottom of the intake tower at elevation 545 is used for maintaining target pool elevations and provides larger flows. At the present time, aeration is not planned. This information has been incorporated into the final EIS.

Response to Comment #22

The operating guide curve for Bear Creek Reservoir under Alternative 2 has been modified to incorporate an extended drawdown period. The revised curve is shown as Figure 10 in the final EIS.

Response to Comment #23

Flows from Upper Bear were included in the analysis, as were withdrawals by the two water intakes. A flow of 7 cfs is a rare event and was stated as a "worst case" situation for comparison.

Response to Comment #24

As stated in the response to Comment #23, flows from Upper Bear Creek Reservoir were included in our analyses. Currently, TVA does not plan on altering the operational guidelines at Upper Bear Creek Dam.

Response to Comment #25

Section 4.2 of the final EIS has been amended to reflect these points. Also, see the response to Comment #1

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
3701 Bell Road
NASHVILLE, TENNESSEE 37214

JUL - 9 2007

Doc. Type:_____
Index Field:_____
Project Name:_____
Project No.:_____

REPLY TO ATTENTION OF:

June 27, 2007

Regulatory Branch

SUBJECT: File No. 200402237; Coordination on DEIS for Bear Creek Dam Leakage Resolution Project, Franklin County, AL (Bear Creek Mile 74.6, TRM 225L)

Mr. Jon M. Loney
Manager NEPA Policy
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902-1499

Dear Mr Loney

This is in response to your May 23, 2007, request for Corps of Engineers review and comment on the subject draft environmental impact (DEIS). For your consideration, we make these recommendations.

On January 10, 2005, we authorized minor repairs to the Bear Creek Dam, pursuant to Section 404 of the Clean Water Act under authority of Nationwide Permit #3. The preferred alternative described in this DEIS as well as the other alternatives would likely also meet the criteria for authorization under Nationwide Permit #3. It is recommended that the DEIS list the dimensions and cubic yardage of waters of the US to be impacted with the placement of fill material for each alternative. If needed, we are available to participate in onsite inspections for the proposed activity in an effort to identify areas of the work that would be subject to the Corps Regulatory authority. Once the plans are finalized, this office will review and provide final guidance pursuant to Section 404.

Thank you for the opportunity to participate in the planning process. If you have any questions or comments contact me at the above address or phone (615) 369-7504.

Sincerely,

Lisa R. Morris

Lisa R. Morris
Project Manager
Operations Division

Response:

Following a conversation with USACE, TVA determined that no fill would be placed into waters of the U.S. under any of the alternatives.

STATE OF ALABAMA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
WILDLIFE AND FRESHWATER FISHERIES DIVISION
64 NORTH UNION STREET, SUITE 567
POST OFFICE BOX 301456
MONTGOMERY, ALABAMA 36130-1456
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BOB RILEY
GOVERNOR

M. BARNETT LAWLEY
COMMISSIONER

M. N. "CORKY" PUGH
DIRECTOR

FRED R. HARDERS
ASST. DIRECTOR

The mission of the Wildlife and Freshwater Fisheries Division is to manage, protect, conserve, and enhance the wildlife and aquatic resources of Alabama for the sustainable benefit of the people of Alabama.

July 13, 2007

Mr. James F. Williamson, Jr.
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

RE: Draft EIS for Bear Creek Dam Leakage Resolution

Dear Mr. Williamson:

The Fisheries Section of the Alabama Wildlife and Freshwater Fisheries Division (AWWF) has reviewed the Draft Environmental Impact Statement (DEIS) for the Bear Creek Dam Leakage Resolution Project. The following comments are submitted by the Fisheries Section of AWFF for your consideration.

COMMENTS

2.0 Alternatives Including the Proposed Action

1 2.1.2 Alternative 2
Information is lacking which describes how minimum flows will be regulated to protect aquatic wildlife and how sedimentation will be addressed during construction.

2 2.1.3 Alternative 3
An instream flow plan should be addressed under this Alternative. The Tennessee Valley Authority (TVA) has recognized the importance of protecting and restoring aquatic wildlife in Bear Creek through an instream flow plan for Alternative 2. The same should be done for Alternative 3.

3.0 Affected Environment

3 3.1 Water Availability, Quantity, and Off-Stream Use
Water Quantity (Hydrology)
Information is lacking as to the discussion in the meeting on April 11, 2007, concerning the slope of the rule curve in November and December.

Mr. Williamson
Page 2
July 13, 2007

4.0 Environmental Consequences

4

4.1 Water Availability, Quantity, and Off-Stream Use
Instream flow plans for Alternatives 3 and 4 have not been fully explored. Basin inflows and flow support from Upper Bear Dam could result in an acceptable I nstream flow plan to protect and restore aquatic wildlife.

Thank you for providing us this opportunity to comment. Our agency looks forward to working with TVA in this endeavor. If you have any questions or comments, please contact me at 334-242-3471 or Stan.Cook@dcnr.alabama.gov.

Sincerely yours,

WILDLIFE & FRESHWATER FISHERIES

Stanley F. Cook
Chief of Fisheries

Response to Comment #1

During construction under any of the three options under Alternative 2, TVA would retain a reservoir pool target elevation of 565 feet in order to prevent water intake problems for the Franklin County Water Service Authority. The water intake structure would remain operational during construction. A minimum flow in the tailwater immediately downstream of the dam of at least 21 cubic feet per second (the current minimum flow requirement) would be maintained during construction. Movement of sediment from areas of earth exposed by construction would be controlled by the implementation of best management practices as described in Section 4.1.

Response to Comment #2

Under Alternative 3, the target reservoir pool would be 565 feet. Excess inflow would spill over the lowered dam face. The flood storage associated with the current dam would be eliminated. However, the intake tower and facilities would remain operational, and TVA would have the flexibility to release water through the discharge chute. Water level would not be allowed to go below 560, the critical level for the Franklin County Water Service Authority intake. Under Alternative 3, stream flow immediately downstream of the dam would approximate inflow to the reservoir. Because of TVA's limited ability to regulate stream flow under Alternative 3, the minimum seasonal flow requirements established in the consultation with the U.S. Fish and Wildlife Service would not apply under this alternative. As described in Section 4.6, if Alternative 3 were

selected, TVA would reinitiate consultation with the U.S. Fish and Wildlife Service and implement other actions necessary to protect and restore aquatic wildlife in Bear Creek.

Response to Comment #3

The modified guide curve, i.e., the graph of the target operating reservoir levels, is incorporated into Alternative 2 and is shown as Figure 10 in the final EIS.

Response to Comment #4

Under Alternative 3, TVA would have a reduced ability to regulate downstream flows from Bear Creek Dam due to the decreased reservoir (and hence, flood storage) capacity, as compared to Alternative 1 or 2. Under Alternative 4, there would be even less ability. Under Alternative 4, flow downstream of Upper Bear Creek Dam would be a function of releases from Upper Bear Creek Dam and all the inflow from various tributaries to Bear Creek downstream of Upper Bear Creek Dam. Upper Bear Creek Dam would by necessity continue to be operated as a flood control dam.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

July 16, 2007

Mr. James F. Williamson, Jr.
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

SUBJ: EPA's NEPA Review of TVA's DEIS for the "Bear Creek Dam Leakage Resolution Project"; Franklin County, Alabama

Dear Mr. Williamson:

The U.S. Environmental Protection Agency (EPA) has reviewed the subject Tennessee Valley Authority (TVA) Draft Environmental Impact Statement (DEIS) in accordance with our responsibilities under Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. TVA proposes to repair or remove Bear Creek Dam in compliance with federal dam requirements and resolve a public safety concern stemming from continued leakage through the dam. As a consequence to this proposed action, the pool elevation of the Bear Creek Reservoir and associated downstream flows would be modified which in turn would affect shoreline wetlands.

Bear Creek Dam and Reservoir are part of the overall Bear Creek Project that involves four dams and reservoirs within the Bear Creek Watershed. The project was designed for flood control, recreation, economic development and water supply. Bear Creek Dam is a 68-ft high and 1,385-ft long earthen dam constructed in 1967-1969 using compacted clays and existing rock formations. Bear Creek Reservoir is a 630-acre lake that impounds 9,600 acre-feet of water at full pool (576 ft). The ecological health of the Bear Creek Reservoir has been rated as only "fair" or "poor" in the categories of dissolved oxygen (DO), algal chlorophyll, fish and benthos (sediments were rated as "good"). These parameters in turn affect recreational fishing success, although the reservoir rating for fish was recently upgraded from "fair" to "good" in 2005. Among its diverse inhabitants, the system contains three federally-protected mussel species and one candidate for listing as well as other state-protected and common mussel species that require flowing water.

Historically, Bear Creek Dam has leaked excessively through its foundation (karstic limestone) despite several TVA attempts to grout the dam. As such, the downstream communities are at risk of dam failure during summer rainy periods when pool levels rise well above desired levels (a 576-ft summer pool, which has been lowered by TVA to a working level of 568 ft for safety, and a 565-ft winter pool). Since this unacceptable risk is inconsistent with the federal dam safety requirements to safely pass

the probable maximum flood (PMF), TVA is proposing several dam repair or removal alternatives to provide a long-term solution to the continuing leakage problem.

In contrast to the rainy season, flows from the dam during drier and drought periods (including periods of essentially no flows) can be insufficient for downstream endangered and common species of mussels and other aquatic biota. In a Biological Opinion, the U.S. Fish and Wildlife Service (FWS) has recently established seasonal minimum flows for Bear Creek Dam. TVA would operate the dam to implement these minimum flows (with a default to 21 cfs during severe droughts) for some alternatives while others would operate in the run-of-river mode.

EPA agrees with TVA that a long-term solution to the continuing leakage issue is appropriate from a federal compliance and flood protection safety perspective. Although we have offered some comments below, we will defer to TVA engineers regarding the best alternative to achieve that end. We will also primarily defer to the FWS regarding minimum flows, wetted areas, and other requirements of downstream federally-protected mussels and other aquatic species and to the Alabama Department of Environmental Management (ADEM) for minimum flows to meet downstream water quality standards. We have therefore concentrated our comments on the effects of the preferred and other presented alternatives on reservoir and downstream wetlands/water quality, which are of more direct concern to EPA and its mandates than TVA's engineering, economic and safety mandates.

Alternatives Description

In addition to the NEPA No Action Alternative (1), three action alternatives were presented in the DEIS (2, 3 & 4). We note that TVA has selected Alternative 2 as its preferred alternative in the DEIS, although a preference for one of three options to implement Alternative 2 (2a, 2b or 2c) was not identified. Alternative descriptions are as follows:

* Alternative 1 (*No Action*) – This alternative would not resolve the leakage and safety problem of Bear Creek Dam but would incorporate the new FWS minimum downstream flows in an attempt to prevent periods of no flows.

* Alternative 2 (*Modify Dam and Maintain Summer Pool Level of 576 feet*) – This alternative would not only implement the new FWS minimum flows but also proposes to repair the dam at or slightly downstream of the existing site. Alternative 2 is TVA's preferred alternative. All repairs would involve construction of a vertical cutoff wall down to bedrock, with the top of the dam being 618-631ft. The summer pool would return to the original 576-ft design as opposed to the current 568 ft pool.

Subalternatives 2a, 2b and 2c differ by engineering design. All include a vertical cutoff wall to bedrock, but 2a and 2b also include possible earthen fill in the tailrace area and 2a additionally includes a rolled concrete dam in the tailrace area. We will defer to TVA

regarding which design option is appropriate, but note that 2a appears to be the most substantial because of the concrete dam addition.

* Alternative 3 (*Lower Dam and Maintain Summer Pool Level of 565 feet*) – Alternative 3 proposes to armor the top of the existing dam as a PMF modification and allow overtopping of the dam (565 ft). Alternative 3 would therefore operate the dam at run-of-river rather than minimum flows, which would result in a lower summer pool of 565 ft (same as winter pool) and provide more water downstream for mussels and other aquatics (but also allow some possible downstream flooding). However, the lower pool would make the access of the public water supply intake at 560 ft less certain as well as its water quality of the source water since it would be close to the surface (i.e., surface water quality is reduced by algal growth and minerals in the photic zone). The reduced surface water quality of the source water would impact the performance of the new water treatment plant.

* Alternative 4 (*Remove the Dam and Restore the Former Creek Channel*) – This alternative proposes to decommission the dam and allow the return to a free-flowing riverine system along the original Bear Creek channel. Sediments that have accumulated at the forebay would need to be removed (dredged) and properly disposed prior to decommissioning. There would be agricultural and structural flooding consequences to this alternative. Structurally, a weir would need to be constructed to allow continued functioning of the water intake as well as a bridge over Bear Creek to replace the county road over the top of the to-be-removed dam.

Environmental Impacts & Significance

Based on the above physical descriptions of dam repair or removal alternatives, EPA makes the following observations on the environmental impacts associated with the alternatives, with emphasis on their significance on water quality and wetlands:

* Alternative 1 – This alternative would not resolve the leakage problem, although minimum flows would nevertheless be implemented to benefit downstream aquatics. *Significance (Alt. 1) – Implementation of increased new FWS minimum flows, but the same unacceptable risk of dam failure would remain.*

* Alternative 2 – Alternative 2 would repair the leakage through the dam and operate the reservoir at its original summer pool of 576 ft. However, returning to this design elevation would likely inundate some reservoir fringe wetlands (77 ac) since the working level of the summer pool has been lowered to 568 ft. This could also affect forested wetlands in the upper (inflow) portion of the reservoir (because the reservoir is steep-banked, this may not be as significant). Compliance with the new FWS minimum flows might also inundate some downstream wetlands. However, it is likely that wetlands would regenerate at the new pool level and stream flows over time. Nevertheless, there would at least be an unavoidable temporal loss in wetland function until such new wetlands are re-established. Also, since the reservoir would return to a 576-ft summer pool instead of a 568-ft pool (8-ft difference), Alternative 2 would likely impound a

greater volume of low-DO water (i.e., the reverse of Alternative 3 below, which would lower the pool to 565 ft and reduce the volume of low-DO water). *Significance (Alt. 2) Return to original reservoir pool design in addition to implementation of new FWS minimum flows, but some actual and/or temporal impacts to reservoir fringe wetlands are expected due to a higher pool.*

* Alternative 3 – This alternative would have the environmental benefit of providing more downstream flows that would benefit mussels and other aquatics. The lower pool and reduced residence time would also minimize low-DO reservoir waters. However, unlike Alternative 2, the dam would be armored and remain at a lower elevation (565 ft) and allowed to overtop, which could result in some downstream flooding. Environmentally, however, this run-of-river mode of operation is beneficial since it mimics more natural riverine conditions. *Significance (Alt. 3) – Change to a run-of-river mode operation resulting in the beneficial shorter periods of low-DO water in the reservoir and greater flows and more riverine conditions downstream, but at some risk of downstream flooding due to a lower pool and run-of-river flows.*

* Alternative 4 – This alternative would change the current lake (lentic) system to its original riverine (lotic) system (even more so than Alternative 3). Returning to a riverine system is generally favorable for downstream aquatics such as mussels and other assemblages requiring flows. However, reservoir fringe wetlands would be desiccated (77 ac) including forested wetlands in the inflow reservoir. This alternative would also require dredging of sediments that have accumulated over time at the forebay of the dam. While these sediments were determined to be generally clean (with the exception of some lead hot spots), these sediments would require proper disposal. Some downstream sedimentation would still be likely within the original Bear Creek channel, Bear Creek Floodway, and Bear Creek margins. The risk of flooding would also greatly increase without the presence of a dam, affecting agricultural croplands and overtopping structures. Also, the absence of an impoundment would affect groundwater recharge. *Significance (Alt. 4) – Return to a dam-free system with the associated benefits of a natural riverine system along the original Bear Creek channel, but at the expense of downstream flooding of agricultural areas and overtopping of structures, desiccation of reservoir fringe and forested wetlands, probable lowering of the water table (potentially affecting wetlands and remaining local wells), and some downstream sedimentation if prerequisite dredging at the forebay is insufficient.*

Informational Requests

The Final EIS (FEIS) should provide the following additional information

#1

* Wetland Impacts – The FEIS should clarify if the 77 acres of wetlands that would be lost for Alternative 2 and 4 includes referenced forested wetlands in the inflow reservoir area, or just fringe wetlands along the reservoir shoreline in general. Downstream wetland losses or gains should also be reasonably estimated for each alternative.

#2 For each alternative, it should be determined if there would be an overall net loss or gain of wetlands at the final pool level and downstream flows. At a minimum, there would be an interim temporal loss of wetland function since some wetlands would be inundated or desiccated and time would be needed for wetlands to be re-established (regenerated) along the new shoreline.

#3 * Wetland Mitigation – TVA should coordinate closely with their cooperating agency, the U.S. Army Corps of Engineers (COE), regarding the probable need for wetland compensation for this proposed action. Section 404 permitting should be summarized in the FEIS.

#4 * Working 568-ft Pool – The FEIS should indicate how long Bear Creek Reservoir has been operating at 568-ft pool as opposed to the 576-ft design level. Similarly, how long did it take for wetlands to regenerate at the new 568-ft shoreline?

#5 * Shoreline Re-vegetation – We request that a brief summary regarding the reasons to believe that wetlands will naturally regenerate with a change in pool elevation and downstream flows. Elements to consider include shoreline topography (slope), magnitude of the changes in elevation (ft), changes in downstream flows (cfs) and potential for soil erosion.

#6 * Construction Times – The FEIS should provide approximate construction timeframes for the repair or removal of the dam for each action alternative proposed. This timeframe relates to the magnitude of possible water quality impacts to Bear Creek during construction.

In addition to these requests for information, the FEIS should be responsive to the following recommendations.

EPA Recommendations

* Avoidance & Minimization – Whatever alternative is selected by TVA, EPA recommends that net losses of wetlands within the project area be avoided, and that unavoidable temporal losses be minimized. Best Management Practices for water quality controls during construction and any reservoir dredging (Alt. 4) should also be part of project implementation. Therefore, wetland regeneration and water quality controls should be considered along with project engineering, economics and flood control mandates.

#7 * Wetland Compensation – As suggested above, the wetlands lost due to the implementation of an action alternative should be determined by alternative (at a minimum, for the preferred alternative). Compensation for actual and/or temporal wetland losses should be compensated through coordination with the COE (Section 404 permitting agency) and the FWS, EPA and other resource agencies.

#8

* Shoreline Erosion & Re-vegetation – Until fringe wetland and riparian vegetation naturally regenerate along new shorelines through maintenance of more stable pool elevations, shoreline buffers may need to be artificially provided for soil erosion control. We recommend that TVA assess this and provide such artificial structures as needed. During this transitional period of regeneration, we also recommend that TVA monitor the natural regeneration process and promote success where necessary.

#9

* Watershed Management Team – Referring to water quality issues, page 34 indicates that "[o]ngoing issues stemming from the presence of the floodway and from land- and water-use practices downstream of Bear Creek Dam would continue at current levels under any alternative." While the purpose and need of the project centers on Bear Creek Dam operation more so than water quality improvements, operation of the dam and Bear Creek water quality are related. Given the reservoir's water quality issues of low-DO and non-point source runoff, we suggest that this project could offer an excellent opportunity to enhance reservoir and downstream water quality. That is, TVA and local entities within the Bear Creek Watershed could collectively form a "Bear Creek Watershed Management Team". This watershed team that would seek to reduce non-point source runoff from agricultural, silvicultural and other sources and promote natural buffer areas surrounding the reservoir (fringe wetlands and riparian vegetation) to reduce soil erosion of the reservoir shoreline and shorelands. Such measures would involve coordination of agricultural Best Management Practices and might include land use changes such as cropland conversion back to natural successional areas in strategic drainage areas of the watershed. Overall, these measures should improve the water quality of the Bear Creek system.

Summary

From a safety, flood control and PMF compliance perspective, EPA supports this project and gives deference to TVA regarding the appropriate engineering alternative for implementation. Environmentally, we support the fact that all alternatives (even the no action) would provide greater downstream flows that would benefit mussels and other aquatics and essentially eliminate no-flow conditions. However, there would be some unavoidable temporal functional losses of reservoir fringe wetlands and possibly downstream wetlands due to changes in reservoir pool elevations and downstream flows. There could also be a net wetland loss (or gain) and overall environmental benefits/losses would vary by alternative. Actual and/or temporal wetlands losses should be documented and compensated through coordination with the COE, FWS, EPA and other resource agencies. We also recommend that TVA monitor the regeneration of wetlands and riparian vegetation along the reservoir and downstream shorelines and provide interim soil erosion control measures as needed and promote the success of the re-vegetation process. We further suggest that a Bear Creek Watershed Team be formed to include TVA and other local entities for the overall water quality improvement of the Bear Creek system.

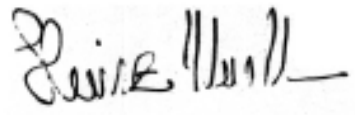
7

EPA DEIS Rating

EPA rates this DEIS as "EC-2" (Environmental Concerns, additional information requested in the FEIS). Although EPA fully supports compliance with federal dam safety requirements, we base this rating on the actual and/or temporal losses of wetlands due to the changes in reservoir pool elevations and downstream flows.

We appreciate the opportunity to review this DEIS. Should you have questions on our comments, please contact Chris Hoberg of my staff at 404/562-9619 or hoberg.chris@epa.gov.

Sincerely,



Heinz J. Mueller, Chief
NEPA Program Office
Office of Policy and Management

Response to Comment #1

The 77 acres of wetlands referenced in the DEIS include scrub-shrub, emergent, and aquatic bed wetlands located along the reservoir fringe area. This does not include forested wetlands.

Given the seasonal variations in flood events, an accurate quantification of downstream losses or gains in wetlands is difficult. Based on the historical flood data available for the Bear Creek watershed below the dam, the highest water levels occur in winter and spring. If water levels are held higher during these times due to periodic flood events, there may be some minor shifts in wetland type or function, but overall there will be no significant wetland loss or gain downstream associated with the various alternatives.

Response to Comment #2

See Table 4 in the final EIS. Under Alternatives 1 and 2, normal summer pool elevations would be reestablished, and approximately 77 acres of wetlands that have become established along the shoreline of the current pool would be inundated. However, under these two alternatives, wetlands are expected to develop along the shoreline of the summer pool. This is expected to require two to three years. Thus, under Alternative 1 or 2 there would be minor net loss of in-reservoir wetlands. However, if the dam were to fail under Alternative 1, established wetlands in the reservoir would likely be lost due to the loss of hydrologic regime, but new wetlands would become established around the margins of the residual pool. Under Alternative 3, there would be a decrease in reservoir pool of about 3 feet. Thus, those recently established wetlands would likely persist, and any net change in wetland acreage would be minor. Implementation of Alternative 4 would result in a loss of the 77 acres of

recently established wetlands. However, new wetlands would likely become established in the creek channel within the former reservoir.

Absent dam failure, wetland acreages downstream of the dam are not expected to change from current conditions under Alternative 1 or 2. Because of slightly increased flows expected under Alternative 3, adoption of this alternative could result in a minor increase in downstream wetlands. Dam failure under Alternative 1 or adoption of Alternative 4 would likely result in the development of some additional wetlands in the floodplain downstream.

Response to Comment #3

Input from the COE indicates no 404 permits would be needed for wetland impacts, although there may be a need for a Nationwide Permit 3 with specific conditions for dam repair. This permit covers fill in waters of the United States; however, there would be no fill placed in wetlands that would require a permit and possible mitigation. Additionally, the wetlands that have recently developed along the shoreline of the reservoir have not had sufficient time to develop hydric soil characteristics, and they do not qualify as jurisdictional wetlands.

Response to Comment #4

The Bear Creek Reservoir has been operated at its current reduced-pool level since spring of 2005. This information has been included in the final EIS. Scrub-shrub and emergent wetlands present along the reservoir fringe regenerated over the past three growing seasons.

Response to Comment #5

Based on the shoreline revegetation observations during fieldwork conducted in August 2006, we expect similar revegetation in subsequent years. Under current reservoir operations, the plants along the exposed reservoir shoreline have become established naturally, and wetland habitats have re-established.

Response to Comment #6

The preferred repairs under Alternative 2 are estimated to take 9 to 15 months. Dredging under Alternative 4 could require a considerably longer time. However, actual removal of the dam structure under Alternative 4 is expected to take a few months.

Response to Comment #7

See response to Comment #3 regarding U.S. Army Corps of Engineers Section 404 discussion. As discussed in the EIS, there may be some loss of wetlands associated with the preferred alternative (Alternative 2). The context and the intensity of the temporary loss of wetland function are not significant enough to require mitigation.

Response to Comment #8

As described on page 72 and 73 of the DEIS, natural revegetation and the use of best management practices in construction areas would be sufficient to prevent significant shoreline erosion in most areas. With the exception of those areas with steep slopes or bluffs, typical shoreline vegetation is expected to return naturally.

Response to Comment #9

Water quality in the Bear Creek watershed has long been a concern to TVA. TVA has prepared approximately 55 technical publications relating to water quality and its

improvement in the watershed. Many of these studies and water quality improvement projects were cooperative efforts with landowners, local soil and water conservation districts, the Soil Conservation Service, the Agricultural Stabilization and Conservation Service, Alabama Extension Service, USDA Forest Service, and the Alabama universities. Improvement projects include efforts to reclaim strip mines, to enhance oxygen concentration in reservoirs to improve reservoir and release water quality, and to control agricultural runoff. TVA would welcome participation by additional agencies and stakeholder groups.

Through its Clean Water Initiative, begun in 1992, TVA builds partnerships with community residents, businesses, and government agencies to promote watershed protection. TVA's Watershed Teams are responsible for carrying out the program. TVA's Pickwick-Wheeler Watershed Team covers the Bear Creek area.

Also, an interagency watershed improvement team is beginning an additional effort to address non-point source pollution and water quality issues through cooperative projects with private landowners in the lower Bear Creek and Yellow Creek areas. Projects include stream bank stabilization, logging road stabilization and restoration, animal exclusion, and riparian buffer restoration. Public outreach/education is also a major component of this effort. Partners will work with interested local residents and property owners to increase water quality awareness and improve water quality. Routine and periodic monitoring, both chemical and biological, will be conducted to track results.

Numerous activities will be conducted to increase public awareness of water quality issues in Yellow and Bear Creek watersheds. These activities will include forestry seminars to discuss timber harvest best management practices (BMPs), potential problems with timber harvest in the watersheds, Forestry Commission regulations and guidelines and preventative measures to reduce risk of water quality impairment during timber harvests. Field exercises with students from area schools will be used to present water quality information and increase awareness of potential local water quality problems. Hands-on exercises will be used to demonstrate the need for water quality protection and improvement in both Yellow and Bear Creeks.

Agricultural BMPs will be established throughout the watersheds to reduce sediment and organic enrichment of the streams. Animal exclusion, riparian buffer establishment, alternative water supplies, field restoration, and grade stabilization will be used to protect streams from agricultural run-off and direct impacts. Forestry BMPs, including logging road restoration, log deck revegetation, stream crossing protection and riparian buffer revegetation will be used to protect streams from immediate impacts from logging operations. If needed, incentives may be given to landowners to increase participation in identified priority areas.

The cooperating agencies involved in this effort are:

Environmental Protection Agency, Region 4
Geological Survey of Alabama
Mississippi Department of Environmental Quality
Mississippi Department of Health

Mississippi Forestry Commission
Mississippi Rural Water Association
Mississippi Soil and Water Conservation Commission
Natural Resources Conservation Service
The Nature Conservancy
Tennessee Valley Authority
U.S. Fish and Wildlife Service

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Appendix C – Bear Creek Reservoir Data

Table C-1. Raw Water Characteristics at 12-Foot Depth

Characteristic	Minimum	Maximum	Average
pH	5.6	6.8	6.3
Dissolved Oxygen (mg/L)	0.1	10.9	5.9
Specific Conductance (µS/cm)	36.0	72.0	59.2
Temperature (°C)	5.9	27.6	18.1
REDOX Potential (mV)	0.0	594.0	405.6
Total Iron (mg/L as Fe)	0.1	1.8	0.6
Dissolved Iron (mg/L as Fe)	0.1	1.6	0.3
Total Manganese (mg/L as Mn)	0.1	4.9	0.4
Dissolved Manganese (mg/L as Mn)	0.0	2.2	0.3
Total Organic Carbon (mg/L)	2.1	73.2	6.1
Total Coliform (colonies/100 mL)	20.0	12,000.0	1,709.8
E. coli (colonies/100 mL)	0.0	3,260.0	161.8
Total Alkalinity (mg/L)	5.8	20.5	12.8
Turbidity (NTU)	4.7	68.1	14.1

Source: Patterson Candy, Inc. 2003

Abbreviations and symbols:

°C = degree Celsius
Fe = iron
mg/L = milligrams per liter
mL = milliliter
Mn = manganese
mV = millivolt
NTU = nephelometric turbidity units
µS/cm = microSiemens/centimeter

Table C-2. Bear Creek Monitoring 2006 Hydrolab Results

River Mile	Date	Temperature (°C)	pH	Conductivity	Percent Saturation	Dissolved Oxygen (mg/L)	Depth (m)
BCM 75.0	04/25/2006	24.86	6.76	54.3	105.7	8.53	0.30
BCM 75.0	04/25/2006	23.64	6.59	54.5	86.7	7.15	1.50
BCM 75.0	04/25/2006	23.29	6.57	54.5	85.3	7.08	3.00
BCM 75.0	04/25/2006	21.70	6.45	59.0	57.2	4.90	5.00
BCM 75.0	04/25/2006	17.29	6.37	63.8	31.6	2.96	7.00
BCM 75.0	04/25/2006	15.92	6.42	69.4	14.2	1.37	8.46
BCM 75.0	05/22/2006	24.96	8.99	58.2	139.5	11.27	0.30
BCM 75.0	05/22/2006	23.24	8.13	57.7	132.7	11.07	1.50
BCM 75.0	05/22/2006	19.65	6.88	55.4	84.0	7.51	3.00
BCM 75.0	05/22/2006	18.94	6.75	56.0	66.2	6.00	4.00
BCM 75.0	05/22/2006	18.59	6.94	57.2	59.6	5.44	5.00
BCM 75.0	05/22/2006	18.38	7.12	65.8	52.4	4.81	7.00
BCM 75.0	05/22/2006	18.31	7.27	80.8	45.3	4.16	8.00
BCM 75.0	05/22/2006	18.15	7.56	94.1	31.0	2.86	8.93
BCM 75.0	06/26/2006	30.00	7.79	61.4	120.9	8.89	0.30
BCM 75.0	06/26/2006	29.29	7.35	60.8	108.9	8.11	1.50
BCM 75.0	06/26/2006	28.87	7.19	61.1	98.9	7.42	2.00
BCM 75.0	06/26/2006	28.46	6.81	65.2	36.6	2.77	3.00
BCM 75.0	06/26/2006	26.98	6.76	66.1	1.5	0.11	4.00
BCM 75.0	06/26/2006	25.97	6.81	74.4	1.4	0.11	5.00
BCM 75.0	06/26/2006	25.09	6.94	87.6	1.6	0.12	6.00
BCM 75.0	06/26/2006	21.46	6.98	102.7	1.9	0.17	7.00
BCM 75.0	06/26/2006	19.93	6.98	121.6	1.6	0.14	8.00
BCM 75.0	06/26/2006	19.09	7.13	133.1	2.5	0.22	9.00
BCM 75.0	06/26/2006	18.54	7.20	144.9	2.8	0.26	10.23
BCM 75.0	07/24/2006	30.06	7.02	61.3	88.4	6.52	0.30
BCM 75.0	07/24/2006	29.57	6.92	61.2	72.8	5.42	1.50
BCM 75.0	07/24/2006	29.37	6.87	61.2	65.7	4.90	2.00
BCM 75.0	07/24/2006	29.17	6.72	62.2	32.5	2.44	3.00
BCM 75.0	07/24/2006	28.81	6.67	68.6	1.2	0.09	4.00
BCM 75.0	07/24/2006	28.05	6.82	81.0	1.3	0.10	5.00
BCM 75.0	07/24/2006	26.85	6.93	94.9	1.4	0.11	6.00
BCM 75.0	07/24/2006	24.47	7.01	115.7	1.4	0.12	7.00
BCM 75.0	07/24/2006	21.97	7.03	153.7	1.4	0.12	8.00
BCM 75.0	07/24/2006	20.92	7.11	169.6	1.9	0.16	9.00
BCM 75.0	07/24/2006	21.26	7.06	181.6	3.8	0.33	9.70
BCM 75.0	08/28/2006	30.53	8.40	61.5	118.0	8.60	0.30

River Mile	Date	Temperature (°C)	pH	Conductivity	Percent Saturation	Dissolved Oxygen (mg/L)	Depth (m)
BCM 75.0	08/28/2006	30.25	7.89	60.8	113.4	8.30	1.50
BCM 75.0	08/28/2006	29.78	7.22	60.5	93.5	6.90	2.00
BCM 75.0	08/28/2006	29.11	6.81	61.2	35.0	2.61	3.00
BCM 75.0	08/28/2006	28.52	6.75	64.4	3.0	0.22	4.00
BCM 75.0	08/28/2006	27.56	6.80	80.2	1.4	0.11	5.00
BCM 75.0	08/28/2006	26.48	6.87	92.1	1.4	0.11	6.00
BCM 75.0	08/28/2006	25.28	6.90	100.6	1.6	0.12	7.00
BCM 75.0	08/28/2006	24.49	6.99	118.1	1.6	0.13	8.00
BCM 75.0	08/28/2006	23.64	7.01	151.6	2.0	0.16	9.00
BCM 75.0	08/28/2006	22.63	7.09	187.6	3.9	0.33	9.80
BCM 75.0	09/25/2006	24.17		60.3	92.5	7.67	0.30
BCM 75.0	09/25/2006	23.86		59.7	89.4	7.46	1.50
BCM 75.0	09/25/2006	23.79		60.6	76.3	6.37	3.00
BCM 75.0	09/25/2006	23.75		60.8	70.5	5.89	4.00
BCM 75.0	09/25/2006	23.63		62.4	40.2	3.37	5.00
BCM 75.0	09/25/2006	23.49		63.7	37.1	3.11	6.00
BCM 75.0	09/25/2006	23.34		66.7	33.9	2.85	7.00
BCM 75.0	09/25/2006	23.01		74.2	23.1	1.95	8.00
BCM 75.0	09/25/2006	22.90		83.1	4.3	0.37	9.20
BCM 75.0	10/23/2006	15.87		54.9	77.7	7.62	0.30
BCM 75.0	10/23/2006	15.84		55.2	77.1	7.57	1.50
BCM 75.0	10/23/2006	15.82		55.2	75.7	7.44	3.00
BCM 75.0	10/23/2006	15.78		54.9	73.9	7.27	5.00
BCM 75.0	10/23/2006	15.71		55.4	72.6	7.15	7.00
BCM 75.0	10/23/2006	15.68		55.4	73.2	7.21	8.54
BCM 89.4	04/25/2006	20.02	6.85	50.3	98.7	8.74	0.30
BCM 89.4	05/23/2006	20.75	7.16	46.0	94.2	8.27	0.20
BCM 89.4	06/27/2006	23.41	7.38	59.1	91.2	7.54	0.61
BCM 89.4	07/25/2006	24.46	7.16	58.6	91.6	7.47	0.95
BCM 89.4	08/29/2006	25.80	7.35	59.5	88.5	6.99	0.82
BCM 89.4	09/26/2006	20.30		59.9	98.2	8.78	0.40
McKelly Spring Branch	04/25/2006	20.24	6.60	27.4	103.0	9.08	0.09
McKelly Spring Branch	05/23/2006	19.76	7.48	26.7	95.8	9.30	0.20
McKelly Spring Branch	06/27/2006	21.91	7.20	24.4	99.7	8.48	0.49
McKelly Spring Branch	07/25/2006	21.93	7.01	22.0	100.7	8.63	0.58
McKelly Spring Branch	08/29/2006	23.26	6.71	23.4	80.8	6.69	0.30
McKelly Spring Branch	09/26/2006	17.88		30.2	94.6	8.88	0.12

River Mile	Date	Temperature (°C)	pH	Conductivity	Percent Saturation	Dissolved Oxygen (mg/L)	Depth (m)
BCM 76.8	04/25/2006	24.76	6.85	51.4	111.6	9.03	0.30
BCM 76.8	04/25/2006	23.48	6.51	51.2	89.3	7.40	1.50
BCM 76.8	04/25/2006	22.54	6.35	51.1	69.7	5.88	3.00
BCM 76.8	04/25/2006	21.51	6.26	52.5	49.8	4.28	5.00
BCM 76.8	04/25/2006	20.86	6.23	56.8	21.1	1.84	6.25
BCM 76.8	05/22/2006	25.06	9.05	56.1	142.8	11.51	0.30
BCM 76.8	05/22/2006	24.42	8.59	55.9	134.0	10.94	1.00
BCM 76.8	05/22/2006	21.93	7.03	53.0	102.1	8.73	2.00
BCM 76.8	05/22/2006	20.04	6.93	52.8	70.7	6.27	3.00
BCM 76.8	05/22/2006	19.01	7.02	55.3	60.5	5.48	4.00
BCM 76.8	05/22/2006	18.65	7.18	56.2	56.7	5.17	5.00
BCM 76.8	05/22/2006	18.87	7.40	57.4	45.9	4.17	6.00
BCM 76.8	05/22/2006	18.62	7.84	60.0	43.4	3.97	6.75
BCM 76.8	06/26/2006	30.49	8.35	59.8	128.6	9.38	0.30
BCM 76.8	06/26/2006	30.29	7.66	59.3	118.8	8.69	1.50
BCM 76.8	06/26/2006	29.96	6.97	59.1	80.6	5.93	2.00
BCM 76.8	06/26/2006	27.88	6.58	64.9	2.3	0.18	3.00
BCM 76.8	06/26/2006	26.91	6.66	68.6	1.7	0.13	4.00
BCM 76.8	06/26/2006	26.43	6.76	74.4	1.9	0.15	5.00
BCM 76.8	06/26/2006	25.32	6.88	98.7	2.2	0.17	6.00
BCM 76.8	06/26/2006	25.15	7.02	106.6	3.3	0.26	7.03
BCM 76.8	07/24/2006	30.13	6.95	59.5	97.2	7.16	0.30
BCM 76.8	07/24/2006	29.39	6.70	60.2	68.6	5.12	1.50
BCM 76.8	07/24/2006	29.34	6.68	60.3	62.4	4.66	2.00
BCM 76.8	07/24/2006	29.27	6.71	59.8	65.7	4.91	3.00
BCM 76.8	07/24/2006	28.85	6.48	69.3	8.6	0.65	4.00
BCM 76.8	07/24/2006	27.96	6.62	87.0	1.4	0.11	5.00
BCM 76.8	07/24/2006	26.97	6.70	113.3	1.4	0.11	6.00
BCM 76.8	07/24/2006	26.04	6.75	141.2	1.4	0.11	7.00
BCM 76.8	07/24/2006	26.25	6.77	133.3	3.8	0.30	8.48
BCM 76.8	08/28/2006	30.28	7.12	60.1	101.5	7.43	0.30
BCM 76.8	08/28/2006	29.22	6.97	59.8	80.3	5.99	1.50
BCM 76.8	08/28/2006	29.19	6.86	60.6	65.2	4.86	2.00
BCM 76.8	08/28/2006	28.92	6.66	63.3	15.7	1.17	3.00
BCM 76.8	08/28/2006	28.71	6.64	66.6	1.6	0.12	4.00
BCM 76.8	08/28/2006	28.22	6.66	81.3	1.6	0.12	5.00
BCM 76.8	08/28/2006	27.66	6.74	92.3	2.1	0.16	6.00
BCM 76.8	08/28/2006	26.77	6.82	114.9	4.4	0.34	7.22
BCM 76.8	09/25/2006	24.15		56.9	99.4	8.24	0.30

River Mile	Date	Temperature (°C)	pH	Conductivity	Percent Saturation	Dissolved Oxygen (mg/L)	Depth (m)
BCM 76.8	09/25/2006	23.98		57.0	91.0	7.57	1.50
BCM 76.8	09/25/2006	23.96		56.7	88.5	7.37	2.00
BCM 76.8	09/25/2006	23.90		56.8	74.6	6.22	3.00
BCM 76.8	09/25/2006	23.79		56.7	60.5	5.05	4.00
BCM 76.8	09/25/2006	23.64		57.5	48.2	4.03	5.00
BCM 76.8	09/25/2006	23.63		58.0	43.0	3.60	6.00
BCM 76.8	09/25/2006	23.64		59.6	36.9	3.09	6.79

°C = Degrees Celsius
BCM = Bear Creek Mile
m = meters
mg/L = milligrams per liter

Table C-3a. Bear Creek 2006 Water Quality Monitoring Results

		Alkalinity, Total (mg/L)	Ammonia as N (mg/L)	Ammonia as N, Dissolved (mg/L)	Apparent Chlorophyll A (mg/m^3)	BOD_5 (mg/L)	Ca & Mg Calculated Hardness (mg/L $CaCO_3$)	Calcium, Total (mg/L)	Chlorophyll B (mg/m^3)	Chlorophyll C (mg/m^3)
Location	**Date**	1	0.01	0.01	1	2	1	0.1	1	1
Bear Creek BCM 75.0	04/25/2006	12	0.04		12				<1	2
	05/22/2006	13	0.05		23				<1	2
	06/26/2006	17	0.08		17				<1	<1
	07/24/2006		0.02		27				3.9	8
	08/28/2006	21	0.08		19				<1	1
Bear Creek BCM 76.8	04/25/2006	12			11				<1	1
	05/22/2006				17				<1	1
	06/26/2006				10				1.4	<1
	07/24/2006				19				4.9	8
	07/24/2006	17								
	07/24/2006	18								
	07/24/2006	20								
	07/24/2006	16								
	08/28/2006				16				<1	<1
	08/28/2006	19								
	08/28/2006	21								
	08/28/2006	24								
	08/28/2006	19								
	09/25/2006				20				<1	<1
	09/25/2006									
	09/25/2006									
	09/25/2006									
	09/25/2006									
Bear Creek BCM 89.4	04/25/2006	9	0.02	0.02	3	0	17	3.7	<1	<1
	05/23/2006	10	0.06	0.02	1	0	15	3.4	<1	<1
	06/27/2006	14	0.03	0.03	<1	0	21	4.6	<1	<1
	07/25/2006	14	0.03	0.03	4	0	20	4.4	4.2	6
	08/29/2006	16	0.03	0.04	2	0	21	4.6	<1	<1
	09/26/2006	16	0.02	0.02	2	0	23	5.9	<1	<1

BOD = Biochemical Oxygen Demand
Ca = Calcium
$CaCO_3$ = Calcium Carbonate
Mg = Magnesium
mg/L = milligrams per liter
mg/m^3 = milligrams per cubic meter
N = Nitrogen

Table C-3b. Bear Creek 2006 Water Quality Monitoring Results

		Chlorophyll Phaeo Index	Corrected Chlorophyll A (mg/m^3)	Corrected Phaeo A (mg/m^3)	Filterable Residue (mg/L)	Iron, Dissolved (mg/L)	Iron, Total (mg/L)	Magnesium, Dissolved (mg/L)	Magnesium, Total (mg/L)	Manganese, Dissolved (mg/L)
Location	**Date**	0.1	1	1.0	10	0.03	0.03	0.03	0.03	0.005
Bear Creek BCM 75.0	04/25/2006	1.6	10	1.8						
	05/22/2006	1.7	22	<1						
	06/26/2006	1.8	18	<1						
	07/24/2006	1.6	22	6.0						
	08/28/2006	1.6	17	2.5						
Bear Creek BCM 76.8	04/25/2006	1.6	9	1.9						
	05/22/2006	1.7	17	<1						
	06/26/2006	1.7	10	<1						
	07/24/2006	1.5	14	7.6						
	07/24/2006					0.05	0.87			0.048
	07/24/2006					0.04	1.50			0.610
	07/24/2006					2.40	6.90			1.800
	07/24/2006					<0.03	0.62			<0.005
	08/28/2006	1.6	14	3.0						
	08/28/2006					<0.03	0.61			0.009
	08/28/2006					<0.03	1.40			0.610
	08/28/2006					1.80	5.80			1.300
	08/28/2006					<0.03	0.42			<0.005
	09/25/2006	1.6	18	2.2						
	09/25/2006					<0.03	0.47	2.10	2.20	
	09/25/2006					<0.03	0.71	2.10	2.20	
	09/25/2006					0.04	1.40	2.20	2.30	
	09/25/2006					<0.03	0.39	2.10	2.20	
Bear Creek BCM 89.4	04/25/2006	1.4	2	1.4	40				1.80	
	05/23/2006	1.4	<1	<1	<10				1.70	
	06/27/2006	0	<1	<1	60				2.20	
	07/25/2006	1.2	2	4.8	50				2.20	
	08/29/2006	1.4	1	<1	50				2.40	
	09/26/2006	1.6	2	<1	50				2.00	

BCM = Bear Creek Mile mg/L = milligrams per liter mg/m^3 = milligrams per cubic meter

Table C-3c. Bear Creek 2006 Water Quality Monitoring Results

		Manganese, Total (mg/L)	Nitrate-Nitrite as N (mg/L)	Total Suspended Solids (mg/L)	Organic Carbon, Dissolved (mg/L)	Organic Carbon, Total (mg/L)	Organic Nitrogen, Total (mg/L)	Organic Nitrogen, Dissolved (mg/L)	Ortho Phosphorus (mg/L)
Location	**Date**	0.005	0.01	1	0.2	0.2	0.01	0.01	0.002
Bear Creek BCM 75.0	04/25/2006		0.44	8	1.9	2.0			
	05/22/2006		0.40	6	2.7[1]	2.5			
	06/26/2006			10	2.9	3.0			
	07/24/2006		<0.01	12	2.9	2.9			
	08/28/2006		<0.01	12	3.5[1]	3.3			
Bear Creek BCM 76.8	04/25/2006								
	05/22/2006								
	06/26/2006								
	07/24/2006								
	07/24/2006	0.220							
	07/24/2006	0.700							
	07/24/2006	1.700							
	07/24/2006	0.130							
	08/28/2006								
	08/28/2006	0.110							
	08/28/2006	0.650							
	08/28/2006	1.300							
	08/28/2006	0.088							
	09/25/2006								
	09/25/2006								
	09/25/2006								
	09/25/2006								
	09/25/2006								
Bear Creek BCM 89.4	04/25/2006		0.63	6	2.1[1]	2.0	0.17	0.12	0.003
	05/23/2006		0.74	3	2.2	2.2	0.17	0.18	0.004
	06/27/2006		0.50	5	2.6[1]	2.5	0.23	0.22	0.005
	07/25/2006		0.35	1	2.5[1]	2.4	0.22	0.20	0.003
	08/29/2006		0.34	3	2.5	2.6	0.19	0.21	0.004
	09/26/2006		0.74	9	4.2	4.3	0.25	0.23	0.018

[1]Dissolved fraction greater than total. BCM = Bear Creek Mile mg/L = milligrams per liter

Table C-3d. Bear Creek 2006 Water Quality Monitoring Results

Location	Date	Phosphorus, Total, Low Level (mg/L)	Sulfate, Total (mg/L)	Suspended Volatile Solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Kjeldahl Nitrogen, Dissolved (mg/L)	Total Volatile Solids (mg/L)
		0.002	1.0		0.02		
Bear Creek BCM 75.0	04/25/2006	0.024	6.0		0.26		
	05/22/2006	0.023	7.5		0.36		
	06/26/2006	0.041	6.0		0.30		
	07/24/2006	0.046	5.9		0.47		
	08/28/2006	0.042	5.3		0.50		
Bear Creek BCM 76.8	04/25/2006						
	05/22/2006						
	06/26/2006						
	07/24/2006						
	07/24/2006						
	07/24/2006						
	07/24/2006						
	07/24/2006						
	08/28/2006						
	08/28/2006						
	08/28/2006						
	08/28/2006						
	08/28/2006						
	09/25/2006						
	09/25/2006						
	09/25/2006						
	09/25/2006						
	09/25/2006						
Bear Creek BCM 89.4	04/25/2006			1.6	0.19		21
	05/23/2006			0.4	0.23		26
	06/27/2006			0.8	0.26		7
	07/25/2006			0.8	0.25		12
	08/29/2006			4.4	0.22		16
	09/26/2006			1.6	0.27	0.26	36

BCM = Bear Creek Mile
mg/L = milligrams per liter

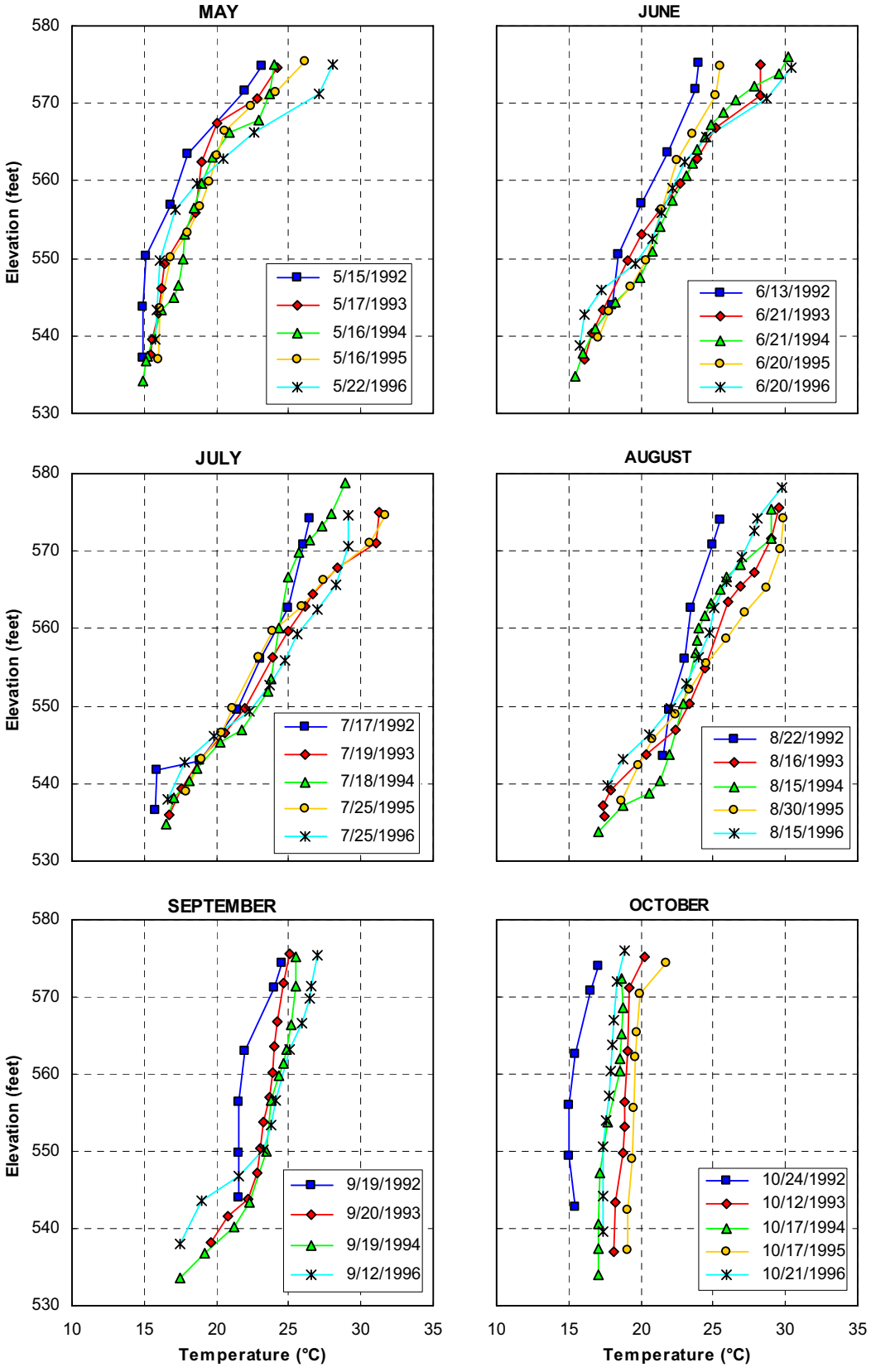

Figure C-1. Bear Creek Reservoir Water Temperature Profiles at BCM 75.0

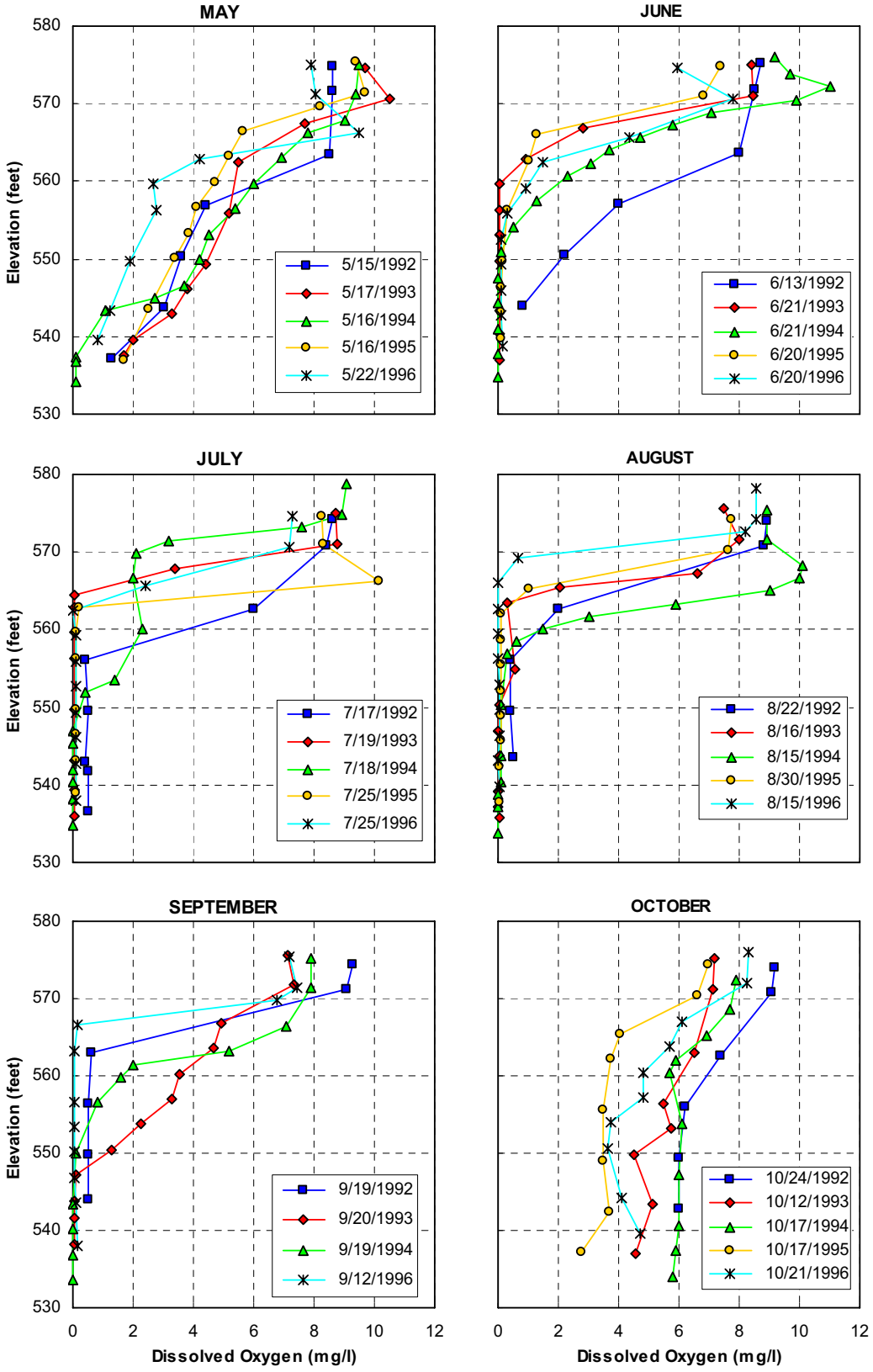

Figure C-2. Bear Creek Reservoir Dissolved Oxygen Profiles at BCM 75.0

Table C-4. Bear Creek Sediment Monitoring – Description of Core Sample Strata

River Mile	Total Depth of Water (feet)	Total Depth of Sediment (feet)[1]	Description of Top Strata	Description of Middle Strata	Description of Bottom Strata
75.8	12	3.5	2 feet of dark gray clay	0.5 foot of dark gray clay mottled with black streaks	1 foot of dark gray clay mottled with black streaks and roots
81.6	9	3	3 inches of brown sand with dead vegetation	9 inches of dark gray clay	2 feet of dark gray clay
87.1	0.33	1.083	3 inches of light brown sand	4 inches of tan sand	6 inches of light brown sand

[1]Sediment depth presented here represents the depth at the sample site and is not indicative of the depth of sediment in the reservoir as a whole.

Table C-5. Bear Creek Mile 75.8, Top Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	12,000	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	440	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	13	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	6.5	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	11,000	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	8.5	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	830	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	220	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	10	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	32	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-6. Bear Creek Mile 75.8, Middle Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	19,000	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	470	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	18	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	9.0	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	16,000	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	11	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	1300	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	250	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	15	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	46	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-7. Bear Creek Mile 75.8, Bottom Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	16,000	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	440	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	17	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	8.5	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	14,000	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	9.4	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	1,200	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	230	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	14	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	42	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-8. Bear Creek Mile 81.6, Top Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	2,000	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	240	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	3.2	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	1.5	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	2,900	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	< MDL	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	140	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	94	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	< MDL	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	8.9	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-9. Bear Creek Mile 81.6, Middle Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	14,000	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	700	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	16	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	8.4	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	14,000	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	9.4	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	1,000	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	500	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	14	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	41	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-10. Bear Creek Mile 81.6, Bottom Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	13,000	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	590	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	14	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	8.0	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	14,000	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	8.6	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	1,000	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	360	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	12	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	40	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-11. Bear Creek Mile 87.1, Top Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	670	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	60	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	< MDL	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	< MDL	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	1600	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	< MDL	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	38	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	110	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	< MDL	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	5.3	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-12. Bear Creek Mile 87.1, Middle Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	640	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	45	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	< MDL	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	< MDL	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	1300	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	< MDL	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	36	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	94	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	< MDL	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	3.8	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-13. Bear Creek Mile 87.1, Bottom Sediment Section, Center of Main Channel

Analyte	CAS Number[1]	Result	Units	MDL[2]	Method Reference
Aroclor 1016	12674-11-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1221	11104-28-2	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1232	11141-16-5	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1242	53469-21-9	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1248	12672-29-6	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1254	11097-69-1	< MDL	mg/kg	0.025	EPA 8082
Aroclor 1260	11096-82-5	< MDL	mg/kg	0.025	EPA 8082
Aldrin	309-00-2	< MDL	mg/kg	0.010	EPA 8081
alpha-BHC	319-84-6	< MDL	mg/kg	0.010	EPA 8081
beta-BHC	319-85-7	< MDL	mg/kg	0.010	EPA 8081
gamma-BHC (Lindane)	58-89-9	< MDL	mg/kg	0.010	EPA 8081
delta-BHC	319-86-8	< MDL	mg/kg	0.010	EPA 8081
Chlordane - not otherwise specified	57-74-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDD	72-54-8	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDE	72-55-9	< MDL	mg/kg	0.010	EPA 8081
4,4'-DDT	50-29-3	< MDL	mg/kg	0.010	EPA 8081
Dieldrin	60-57-1	< MDL	mg/kg	0.010	EPA 8081
Endosulfan alpha	959-98-8	< MDL	mg/kg	0.010	EPA 8081
Endosulfan beta	33213-65-9	< MDL	mg/kg	0.010	EPA 8081
Endosulfan sulfate	1031-07-8	< MDL	mg/kg	0.010	EPA 8081
Endrin	72-20-8	< MDL	mg/kg	0.010	EPA 8081
Endrin aldehyde	7421-93-4	< MDL	mg/kg	0.010	EPA 8081
Heptachlor	76-44-8	< MDL	mg/kg	0.010	EPA 8081
Heptachlor epoxide	1024-57-3	< MDL	mg/kg	0.010	EPA 8081
Methoxychlor	72-43-5	< MDL	mg/kg	0.010	EPA 8081
Toxaphene	8001-35-2	< MDL	mg/kg	0.5	EPA 8081
Mercury, RCRA Total	7439-97-6	< MDL	mg/kg	0.1	EPA 7470
Aluminum, Total	7429-90-5	690	mg/kg	2.5	EPA 6010
Cadmium, Total	7440-43-9	< MDL	mg/kg	0.25	EPA 6010
Calcium, Total	7440-70-2	61	mg/kg	5.0	EPA 6010
Chromium, Total	7440-47-3	< MDL	mg/kg	2.5	EPA 6010
Copper, Total	7440-50-8	< MDL	mg/kg	0.50	EPA 6010
Iron, Total	7439-89-6	1,800	mg/kg	0.50	EPA 6010
Lead, Total	7439-92-1	< MDL	mg/kg	2.5	EPA 6010
Magnesium, Total	7439-95-4	40	mg/kg	0.50	EPA 6010
Manganese, Total	7439-96-5	88	mg/kg	0.25	EPA 6010
Nickel, Total	7440-02-0	< MDL	mg/kg	2.5	EPA 6010
Zinc, Total	7440-66-6	4.6	mg/kg	0.50	EPA 6010

< MDL = Less than method detection limit
EPA = U.S. Environmental Protection Agency
Calcium results are potentially 5 milligrams per kilogram (mg/kg) biased high
[1] Chemical Abstracts Service registry number
[2] Method detection limit

Table C-14. Maximum Concentration Levels for Toxicity Determination

HW[1] Number	Contaminant	CAS Number[2]	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5
D005	Barium	7440-39-3	100
D0018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100
D022	Chloroform	67-66-3	6
D007	Chromium	7440-47-3	5
D023	o-Cresol	95-48-7	200.0
D024	m-Cresol	108-39-4	200.0
D025	p-Cresol	106-44-5	200.0
D026	Cresol	----------	200.0
D016	2,4-D	94-75-7	10
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13
D012	Endrin	72-20-8	0.02
D031	Heptachlor	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3
D008	Lead	7439-92-1	5
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10
D035	Methyl ethyl ketone	78-93-3	200
D036	Nitrobenzene	98-95-3	2
D037	Pentachlorophenol	87-86-5	100
D038	Pyridine	110-86-1	5.0
D010	Selenium	7782-49-2	1
D011	Silver	7740-22-4	5
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400
D042	2,4,6-Trichlorophenol	88-06-2	2
D017	2,4,5-TP (Silvex)	93-72-1	1
D043	Vinyl Chloride	74-01-4	0.2

[1]HW = headwater
[2]CAS = Chemical Abstracts Service registry number
mg/L = milligrams per liter

Appendix D – Franklin County Water Service Authority Water Quality Data

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Appendix D

FRANKLIN COUNTY WATE

BIG BEAR CREEK RAW

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	02-Jul-01 8 feet	09-Jul-01 8 feet	26-Jul-01 12 feet	26-Jul-01 20 feet	26-Jul-01 33 feet	02-Aug-01 12 feet	02-Aug-01 20 feet	02-Aug-01 33 feet	10-Aug-01 Surface	10-Aug-01 12 feet	10-Aug-01 20 feet	10- 3
ph, units	7.02	6.2	6.37	6.43	6.71	6.4	6.58	6.79	7.31	6.37	6.61	
Dissolved Oxygen, mg/L			1.11	0.51	0.25	0.13	0.06	0.06	7.26	0.21	0.17	
Specific Conductance, umpos/cm			64	82	167	72	91	186	60	66	102	
Temperature, C			25.3	22.7	19.9	25.5	22.5	19.8	28.4	26.8	22.6	
REDOX Potential, mV			405	381	346	317	297	295	277	287	216	
Total Iron, mg/L as Fe	0.15	0.28	0.24	3.39	137	1.76	4.57	39.5		0.73	6.22	
Dissolved Iron, mg/L as Fe			0.06	2.87	12.2	1.12	3.97	14.6		0.13	5.06	
Total Manganese, mg/L as Mn	0.17	0.16	1.61	2.46	17.1	2.21	2.74	9.73		1.24	2.92	
Dissolved Manganese, mg/L as Mn			1.57	2.41	6.44	2.22	2.69	9.1		1.14	2.75	
Total Organic Carbon, mg/L			3.4	4.8	149							
Total Coliform, coionies/100 mL	>2,419	921	1990	>2,420	>2,420	>2,420	>2,420	>2,420		1,467	1,835	>
E-Coli, colonies/100 mL	0	0	1	3	4	2	3	1		10	0	

	07-Sep-01 Surface	07-Sep-01 12 feet	07-Sep-01 20 feet	07-Sep-01 33 feet	13-Sep-01 Surface	13-Sep-01 12 feet	13-Sep-01 20 feet	13-Sep-01 33 feet	20-Sep-01 Surface	20-Sep-01 12 feet	20-Sep-01 20 feet	20- 3
ph, units	8.87	6.46	6.24	6.21	8.39	6.39	6.22	6.3	8.12	6.39	6.37	
Dissolved Oxygen, mg/L	10.2	5.87	4.99	4.22	9.72	3.92	1.04	0.1	9.53	0.93	0.23	
Specific Conductance, umpos/cm	55	48	42	42	53	57	52	63	75	62	73	
Temperature, C	28.9	23.2	22.2	21.9	28.5	24	22.7	21.7	26.3	23.9	23	
REDOX Potential, mV	364	383	386	386	364	382	387	375	362	374	375	
Total Iron, mg/L as Fe		1.1	0.93	20.8		0.9	1.14	2.94		0.73	1.44	
Dissolved Iron, mg/L as Fe		0.91	0.7	2.51		0.62	0.8	0.93		0.51	0.81	
Total Manganese, mg/L as Mn		0.15	0.22	2.89		0.19	0.46	1.64		0.44	1.07	
Dissolved Manganese, mg/L as Mn		0.05	0.11	1.91		0.03	0.33	1.27		0.32	1	
Total Organic Carbon, mg/L						3.4	3.9	4.5				
Total Coliform, coionies/100 mL		3,654	2,602	4,352		933	645	2,755		857	1616	
E-Coli, colonies/100 mL		52	86	73		41	20	52		10	74	

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Appendix D

FRANKLIN COUNTY WAT

BIG BEAR CREEK R

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	18-Oct-01 Surface	18-Oct-01 12 feet	18-Oct-01 20 feet	18-Oct-01 33 feet	26-Oct-01 Surface	26-Oct-01 12 feet	26-Oct-01 20 feet	26-Oct-01 33 feet	29-Oct-01 Surface	29-Oct-01 12 feet	29-Oct-01 20 feet
ph, units	6.39	6.31	6.31	6.52	7.01	6.82	6.08	6.05	6.52	6.3	6.26
Dissolved Oxygen, mg/L	6.82	6.56	6.54	4.24	10.5	9.97	5.92	5.33	9.06	7.89	7.36
Specific Conductance, umpos/cm	51	50	51	55	57	58	67	69	67	66	66
Temperature, C	17.9	17.4	17.4	17.3	17.8	17.6	15.1	14.9	17.5	15.3	15.3
REDOX Potential, mV	408	412	411	404	434	433	438	435	422	424	422
Total Iron, mg/L as Fe		0.35	0.33	0.8		0.14	0.34	4.61		0.23	0.21
Dissolved Iron, mg/L as Fe		0.19	0.21	0.34		0.06	0.1	0.72		<0.05	0.05
Total Manganese, mg/L as Mn		0.07	0.66	0.24		0.05	0.22	1.89		0.15	0.13
Dissolved Manganese, mg/L as Mn		<.01	0.01	0.12		<0.01	0.12	1.14		0.12	<0.01
Total Organic Carbon, mg/L		5.4	5.2	20.9						3.8	3.5
Total Coliform, coionies/100 mL		2,050	1,920	2,050		419	228	12,033		416	488
E-Coli, colonies/100 mL		20	50	40		0	10	121		0	0
Total Alkalinity										14.6	15.4
Turbidity, NTU										8.1	8.73

	02-Nov-01 Surface	02-Nov-01 12 feet	02-Nov-01 20 feet	02-Nov-01 33 feet	08-Nov-01 Surface	08-Nov-01 12 feet	08-Nov-01 20 feet	08-Nov-01 33 feet	15-Nov-01 Surface	15-Nov-01 12 feet	15-Nov-01 20 feet
ph, units	6.81	6.48	6.35	6.32	6.88	6.57	5.97	5.91	6.63	6.6	6.03
Dissolved Oxygen, mg/L	8.78	7.38	7.27	7.48	10.1	9.33	6.46	5.22	9.42	9.06	5.1
Specific Conductance, umpos/cm	66	66	64	63	66	66	65	67	66	66	67
Temperature, C	16.2	14.8	13	12	17.3	14.5	13.1	12.7	14.3	13.7	13.4
REDOX Potential, mV	368	357	352	354	663	532	473	445	416	407	406
Total Iron, mg/L as Fe		0.18	0.28	0.4		0.11	0.25	0.49		<0.05	<0.05
Dissolved Iron, mg/L as Fe		0.08	0.11	0.16		<0.05	0.07	0.12		<0.05	<0.05
Total Manganese, mg/L as Mn		0.11	0.16	0.2		0.05	0.11	0.42		0.07	0.18
Dissolved Manganese, mg/L as Mn		<0.01	0.04	0.14		<0.01	<0.01	0.32		<0.01	0.01
Total Organic Carbon, mg/L		4.2	3.7	3.5						5.8	3.8
Total Coliform, coionies/100 mL		1,900	2,500	2,900		73	85	218		216	122
E-Coli, colonies/100 mL		0	0	0		0	0	0		0	0
Total Alkalinity		13.3	13.2	14						13	13.3
Turbidity, NTU		5.23	7.97	14.3						4.76	7.36

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Appendix D

FRANKLIN COUNTY WAT

BIG BEAR CREEK R

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	13-Dec-01 Surface	13-Dec-01 12 feet	13-Dec-01 20 feet	13-Dec-01 33 feet	19-Dec-01 Surface	19-Dec-01 12 feet	19-Dec-01 20 feet	19-Dec-01 33 feet	27-Dec-01 Surface	27-Dec-01 12 feet	27-Dec-01 20 feet	27-Dec-01 33 feet	10-Jan-02 Surface
ph, units	5.81	5.81	5.82	5.62	6.09	6.09	6.09	6.02	6.04	6.08	6.1	6.09	6.19
Dissolved Oxygen, mg/L	7.13	7.13	7.16	7.13	8.95	8.8	8.9	8.55	10.3	10.9	10.2	10.2	10.8
Specific Conductance, umpos/cm	60	60	60	61	60	60	60	59	57	57	57	57	59
Temperature, C	13.3	13.3	13.3	13.3	13.3	13.3	13.3	13.3	7.17	7.12	7.11	7.15	5.93
REDOX Potential, mV	474	474	470	469	578	555	539	538	502	483	466	453	540
Total Iron, mg/L as Fe		1.18	1.18	1.12		0.35	0.37	0.37		0.32	0.9	0.34	
Dissolved Iron, mg/L as Fe		0.36	0.33	0.32		0.2	0.22	0.21		0.14	0.42	0.13	
Total Manganese, mg/L as Mn		0.65	0.62	0.64		0.07	0.07	0.07		0.14	0.44	0.15	
Dissolved Manganese, mg/L as Mn		0.58	0.53	0.56		<.01	<.01	<.01		0.12	0.16	0.13	
Total Organic Carbon, mg/L		2.1	2.3	2.3		3.3	3.7	4		3.1	3.2	3.1	
Total Coliform, coionies/100 mL		2909	2224	4106		3654	5475	5172		4907	6867	8164	
E-Coli, colonies/100 mL		285	313	364		175	256	131		228	269	240	
Total Alkalinity		15.5	10.3	11.5		10.1	9.5	7.6		20.5	9.4	11.1	
Turbidity, NTU		62.9	53.7	52.7		5.21	5.7	7.22		12.7	1100	8.72	

	21-Mar-02 Surface	21-Mar-02 12 feet	21-Mar-02 20 feet	21-Mar-02 33 feet	29-Apr-02 Surface	29-Apr-02 12 feet	29-Apr-02 20 feet	29-Apr-02 33 feet	19-Jun-02 Surface	19-Jun-02 12 feet	19-Jun-02 20 feet	19-Jun-02 33 feet	20-Jun-02 RAW	20-Jun-02 MIEX
ph, units	6.54	6.31	6.26	6.05	6.8	6.61	5.97	6.62	8.27	5.77	6	6.86	6.40	6.42
Dissolved Oxygen, mg/L	9.15	8.29	7.73	6.8	6.52	6.55	3.45	1.14	10.6	7.67	4.38	2.27		
Specific Conductance, umpos/cm	46	46	46	49	56	56	61	68	55	57	68	26		
Temperature, C	15.2	14.9	14.7	11.7	22.3	20.6	18	14.5	27.8	24.6	22.6	16.6		
REDOX Potential, mV	458	426	383	384	479	476	471	444	445	443	410	235		
Total Iron, mg/L as Fe		0.31	0.34	34.5		0.07	0.3	1.39		0.57	1.16	9.11	.34	.14
Dissolved Iron, mg/L as Fe		0.18	0.19	0.26		<.05	<0.05	<0.05		0.09	0.24	7.89		
Total Manganese, mg/L as Mn		0.09	0.1	7.75		0.08	0.29	0.64		0.76	2.86	7	.66	.33
Dissolved Manganese, mg/L as Mn		0.07	0.07	0.14		0.03	0.22	0.91		0.5	2.35	5.69		
Total Organic Carbon, mg/L		2.6	2.8	23.9		3	1.7	5.6		3.3	3.4	7.9	3.3	1.2
Total Coliform, coionies/100 mL		650	556	8164		959	17300	1250		1370	4110	17300		
E-Coli, colonies/100 mL		109	74	432		0	85	10		10	0	52		
Total Alkalinity		8.8	8.3	5.1		10.8	10.7	12.1		14.9	21.4	44.8		
Turbidity, NTU		7.62	12.4	550		4.71	35.6	202		12.7	41	106	10.7	2.79
Sulfate, mg/l as SO4													5.19	<.5
Color, units													50	15

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Appendix E – Exotic and Invasive Species Information

NONNATIVE, NONINVASIVE SPECIES SUITABLE FOR PUBLIC USE AREAS, EROSION CONTROL/STABILIZATION AND WILDLIFE HABITAT PLANTINGS

KENTUCKY 31 AND OTHER FESCUES - for dam reservations, public use areas, and other facilities; transmission line construction stabilization where fescue is currently present as forage or lawn grasses or when landowners request it. Not to be used in wildlife plantings or in agricultural license areas.

ZOYSIA VARIETIES - for dam reservations, public use areas, and other facilities.

BERMUDAGRASS - for dam reservations, public use areas, and other facilities.

ANNUAL RYEGRASS - suitable for all sites.

FOXTAIL, BROWNTOP, AND JAPANESE MILLETS - suitable for all sites.

BUCKWHEAT - suitable for wildlife plantings.

WINTER WHEAT - suitable for wildlife plantings.

OATS - suitable for wildlife plantings.

ORCHARDGRASS - suitable for all sites.

PERENNIAL RYEGRASS - suitable for all sites.

REDTOP - suitable for all sites.

RYE - suitable for all sites.

TIMOTHY - suitable for all sites.

WEEPING LOVEGRASS - for erosion control use only.

COMMON, KOBE, KOREAN LESPEDEZA - suitable for all sites.

CRIMSON, RED, AND LADINO CLOVERS - suitable for all sites.

SOYBEANS - suitable for wildlife plantings.

SORGHUM-MILO - suitable for wildlife plantings.

Invasive Species of High Priority to TVA

Plants:
Common privet, *Ligustrum sinense*
Autumn olive, *Elaeagnus umbellata*
Japanese honeysuckle, *Lonicera japonica*
Kudzu, *Pueraria montana*
Multiflora rose, *Rosa multiflora*
Sericea lespedeza, *Lespedeza cuneata*
Oriental Bittersweet, *Celastrus orbiculatus*
Tree of heaven, *Alianthus altissima*
Hairy jointgrass, *Arthraxon hispidus*
Amur bush honeysuckle, *Lonicera mackii* (and other closely related species)
Japanese/Nepal grass, *Microstegium vimineum*
Alligatorweed, *Alternathera philoxeroides*
Japanese broomegrass, *Bromus japonicus*
Common cucklebur, *Xanthium strumarium*
Tall fescue, *Festuca elatior*
Johnson grass, *Sorghum halapense*
Japanese wisteria, *Wisteria floribunda*
Purple loosestrife, *Lythrum salicaria*
Common reed, *Phragmites australis*
Japanese knotweed, *Polygonum cuspidatum*
Eurasian watermilfoil, *Myriophyllum spicatum*
Spinyleaf naiad, *Najas minor*
Hydrilla, *Hydrilla verticillata*
Princess tree, *Paulownia tomentosa*

Watch List:
Giant salvinia, *Salvinia molesta*
Water hyacinth, *Eichhornia crassipes*

January 2002

Invasive Exotic Pest Plants of Tennessee

Rank 1 — Severe Threat: Exotic plant species that possess characteristics of invasive species and spread easily into native plant communities and displace native vegetation.

Scientific Nomenclature	Common Name
Ailanthus altissima (Mill.) Swingle	Tree of heaven
Albizia julibrissin Durz.	Mimosa
Alliaria petiolata (Bieb.) Cavara & Grande	Garlic-mustard
Celastrus orbiculata Thunb.	Asian bittersweet
Dioscorea oppositifolia L.	Air-potato
Elaeagnus umbellata Thunb.	Autumn olive
Elaeagnus pungens Thunb.	Thorny-olive
Euonymus fortunei (Turcz.) Hand.-Mazz.	Winter creeper
Hedera helix L.	English ivy
Lespedeza cuneata (Dum.-Cours.) G. Don	Sericea lespedeza
Ligustrum sinense Lour.	Chinese privet
Ligustrum vulgare L.	Common privet
Lonicera fragrantissima Lindl. & Paxton	January jasmine
Lonicera japonica Thunb.	Japanese honeysuckle
Lonicera mackii (Rupr.) Maxim.	Amur bush honeysuckle
Lonicera morrowii A. Gray	Morrow's bush honeysuckle
Lonicera tatarica L.	Tartarian honeysuckle, twinsisters
Lonicera x bella Zabel	Bush honeysuckle
Lythrum salicaria L. [all varieties and cultivars]	Purple loosestrife
Microstegium vimineum (Trin.) A.	Camus Nepalgrass, Japanese grass
Myriophyllum spicatum L.	Eurasian water milfoil
Paulownia tomentosa (Thunb.) Sieb. & Zucc. ex Steud	Princess tree
Phragmites australis (Cav.) Trin. ex Steud.	Common reed
Polygonum cuspidatum Seib. & Zucc	Japanese knotweed, Japanese bamboo
Pueraria montana (Lour.) Merr.	Kudzu
Rosa multiflora Thunb.	Multiflora rose
Solanum viarum Dunal	Tropical soda apple
Sorghum halepense (L.) Pers.	Johnson grass
Spiraea japonica L.f.	Japanese spiraea

Rank 2 — Significant Threat: Exotic plant species that possess characteristics of invasive species but are not presently considered to spread as easily into native plant communities as those species listed as Rank 1— Severe Threat.

Scientific Nomenclature	Common Name
Alternanthera philoxeroides (Mart.) Griseb.	Alligatorweed
Artemisia vulgaris L.	Mugwort, common wormwood
Arthraxon hispidus (Thunb.) Makino	Hairy jointgrass
Berberis thunbergii DC.	Japanese barberry
Bromus commutatus Schrad.	Meadow brome
Bromus japonicus Thunb. ex Murray	Japanese bromegrass
Bromus secalinus L.	Rye brome
Bromus tectorum L.	Thatch bromegrass, cheat grass
Carduus nutans L.	Musk thistle, nodding thistle
Centaurea biebersteinii DC.	Spotted knapweed
Cirsium arvense L. (Scop.)	Canada thistle
Cirsium vulgare (Savi) Ten.	Bull thistle
Clematis ternifolia DC.	Leatherleaf clematis
Conium maculatum L.	Poison hemlock
Coronilla varia L.	Crown vetch
Daucus carota L.	Wild carrot, Queen Anne's-lace
Dipsacus fullonum L.	Fuller's teasel
Dipsacus laciniatus L.	Cutleaf teasel
Euonymus alata (Thunb.) Sieb.	Burning bush
Festuca arundinacea Schreb.	Tall fescue
Festuca pratensis Huds.	Meadow fescue
Hesperis matronalis L.	Dame's rocket
Hydrilla verticillata (L.f.) Royle	Hydrilla, water thyme
Lespedeza bicolor Turcz.	Bicolor lespedeza, shrubby bushclover
Ligustrum japonicum Thunb.	Japanese privet
Lysimachia nummularia L.	Moneywort, creeping Jenny
Mahonia bealei (Fortune) Carriere	Oregon grape
Melilotus alba Medik.	White sweet clover
Melilotus officinalis (L.) Lam.	Yellow sweet clover
Miscanthus sinensis Andersson	Zebra grass, Chinese silver grass
Murdannia keisak (Hassk.) Hand.-Mazz.	Asian spiderwort
Myriophyllum aquaticum (Vell.) Verdc.	Parrot's feather, water milfoil
Nandina domestica Thunb.	Nandina, sacred-bamboo
Rorippa nasturtium-aquaticum (L.)	Hayek Watercress
Polygonum caespitosum Blume	Bunchy knotweed, oriental lady's-thumb
Populus alba L.	White poplar
Potamogeton crispus L.	Curly pondweed
Setaria faberi R.A.W. Herrm.	Nodding foxtail-grass, Japanese bristle-grass
Setaria italica (L.) P. Beauv.	Foxtail-millet
Setaria pumila (Poir.) Roem. & Schult.	Yellow foxtail, smooth millet
Setaria viridis (L.) P. Beauv.	Green millet
Torilis arvensis (Huds.) Link	Spreading hedge-parsley
Tussilago farfara L.	Coltsfoot
Verbascum thapsus L.	Common mullein
Vicia sativa L.	Garden vetch
Vinca minor L.	Common periwinkle
Wisteria sinensis (Sims) DC.	Chinese wisteria
Wisteria floribunda (Willd.) DC.	Wisteria
Xanthium strumarium L.	Common cocklebur, rough cocklebur

Rank 3 — Lesser Threat: Exotic plant species that spread in or near disturbed areas and are not presently considered a threat to native plant communities.

Scientific Nomenclature	Common Name
Allium vineale L.	Field garlic
Arundo donax L.	Giant reed, elephant grass
Bromus catharticus Vahl	Bromegrass, rescue grass
Bromus inermis Leyss.	Smooth bromegrass
Broussonetia papyrifera (L.) L'Her. ex Vent.	Paper mulberry
Lithospermum arvense (L.) I. M. Johnston	Corn gromwell
Cardiospermum halicacabum L.	Balloonvine, love-in-a-puff
Centaurea cyanus L.	Bachelor's button, cornflower
Chrysanthemum leucanthemum L.	Ox-eye daisy
Cichorium intybus L.	Chicory
Egeria densa Planch.	Brazilian elodea, Brazilian water-weed
Elaeagnus angustifolia L.	Russian olive
Eschscholzia californica Cham.	California poppy
Fatoua villosa (Thunb.) Nakai	Hairy crabweed
Glechoma hederacea L.	Gill-over-the-ground, ground ivy
Iris pseudacorus L.	Pale-yellow iris
Kummerowia stipulacea (Maxim.) Makino	Korean clover
Kummerowia striata (Thunb.) Schindl.	Japanese clover
Melia azedarach L.	Chinaberry
Ornithogalum umbellatum L.	Star of Bethlehem
Pastinaca sativa L.	Wild parsnip
Polygonum persicaria L.	Lady's thumb
Rubus phoenicolasius Maxim.	Wineberry
Senna obtusifolia (L.) H. S. Irwin & Barneby	Sicklepod senna
Tragopogon dubius Scop.	Yellow goat's-beard
Tribulus terrestris L.	Puncturevine
Urtica dioica L.	Stinging nettle
Xanthium spinosum L.	Spiny cocklebur

Watch List A: Exotic plants that naturalize and may become a problem in the future; includes species that are or could become widespread in Tennessee. At this time, more information is needed, and there is no consensus about their status.

Scientific Nomenclature	Common Name
Agrostis stolonifera L.	Weeping love grass
Alnus glutinosa (L.) Gaertn.	Sticky alder
Bromus hordeaceus L.	Soft brome
Bromus sterilis L.	Poverty brome
Buddleia davidii Franch.	Butterfly bush
Bupleurum rotundifolium L.	Hound's-ear, hare's-ear
Cosmos bipinnatus Cav.	Garden cosmos
Cosmos sulphureus Cav.	Sulpher cosmos
Echium vulgare L.	Viper's bugloss
Hibiscus syriacus L.	Rose of Sharon
Hypericum perforatum L.	Goatweed, St. John's-wort
Mentha spicata L.	Spearmint
Mentha x piperita L.	Peppermint
Muscari atlanticum Boiss. & Reut.	Grape hyacinth
Muscari botryoides (L.) Mill.	Common grape hyacinth
Najas minor All.	Water nymph
Phalaris canariensis L.	Canary grass
Pyrus calleryana Decne.	Bradford pear
Rhamnus frangula L.	Alder buckthorn
Rhodotypos scandens (Thunb.) Makino	Jetbead
Senecio vulgaris L.	Ragwort
Setaria verticillata (L.) P. Beauv.	Bur-foxtail
Solanum dulcamara L.	Bittersweet
Stachys floridana Shuttlew. ex Benth.	Hedge nettle

Watch List B: Exotic plant species that are severe problems in surrounding states but have not been reported in Tennessee.

Scientific Nomenclature	Common Name
Ampelopsis brevipedunculata (Maxim.) Trautv.	Amur peppervine
Polygonum perfoliatum L.	Mile-a-minute, Asiatic tear-thumb
Rhamnus cathartica L.	European buckthorn
Rottboellia cochinchinensis (Lour.) Clayton	Itchgrass
Salvinia molesta Mitchell	Aquarium water-moss
Sapium sebiferum (L.) Roxb.	Chinese tallowtree

Appendix F – Threatened and Endangered Species Narratives

Plants

Allegheny spurge is a low-growing perennial typically found in rich woods on slopes in calcareous soils.

American ginseng, a species exploited commercially for medicinal use, is typically found in deciduous, mesic woodlands.

Appalachian bristle fern is usually found on moist sandstone outcrops and one population is recorded from within the Bear Creek flood zone.

Appalachian quillwort is a submersed or immersed tufted perennial typically found in open sun in shallow bodies of water, pond margins, and ditches.

Boott's sedge is a perennial typically found in rich hardwood forests.

Brook saxifrage is a perennial typically found in deciduous, mesic woodlands, especially along gentle slopes, ravines, or ledges along streams.

Carolina willow is a small perennial tree typically found in marshes, rocky soil along riverbanks, swales, ponds, and lakes.

Crested fringed orchid is an erect, leafy perennial typically found in moist, swampy areas.

Drooping sedge is a perennial typically found in wet, mucky soils near swamps.

Dwarf larkspur is a perennial herb typically found in damp to dry woods and barrens, preferring calcareous soils.

Giant chickweed is a tall, thinly spreading, hairy perennial typically found in rich woods and shaded bluffs.

Greek valerian is a perennial herb typically found in rich, moist woods and along stream banks.

Hairy lipfern is a perennial typically found on rock faces or rocky slopes.

Heartleaf foamflower is an erect perennial herb typically found in rich woodlands.

Horse-gentian is a perennial herb typically found in rich, low woods.

Leather-flower is a perennial vine typically found in wet woods.

Little flowered alumroot is a short perennial herb typically found on moist, shaded ledges and cliffs.

Lobed tickseed is a hairy perennial herb typically found in open woods.

Maidenhair spleenwort is a small evergreen fern typically found on shaded limestone, moss covered outcrops.

Mountain camellia is a small tree typically found in woodlands and along stream banks.

Mountain holly is a small deciduous tree typically found at high elevations in understory and in openings in hardwood forests.

Nettle-leaf sage is a perennial typically found in dry woods and barrens on calcareous soils.

Pinnatifid spleenwort is a hybrid spleenwort typically found in crevices in sandstone, quartzite, and cliffs containing relatively high levels of quartz and feldspar usually in the vicinity of both parents.

Poppy-mallow is a low-growing perennial typically found in hot and dry areas with well-drained sandy soils.

Purple cliff-brake is a perennial fern typically found in crevices of limestone and dolomite outcrops, bluffs, boulders, and sinkholes.

Ribbed sedge is a perennial sedge typically found in dry woods and clearings.

Sicklepod is a biennial mustard typically found in wooded areas.

Slender toothwort is a perennial mustard typically found in rich alluvial woods.

Smoother sweet-cicely is an erect perennial member of the carrot family typically found in moist woods.

Three-birds-orchid is a small perennial typically found in rich, damp woodland humus.

Turk's cap lily is a perennial herb typically found in moist woods, meadows, and balds.

Two-leaf toothwort is a perennial mustard typically found on rich wooded slopes and in ravines.

Upright sedge is a perennial typically found in partly shaded, wet soils.

Virginia pine is typically found in upland fields and dry woods.

Walking fern is a perennial fern with simple fronds typically found on shaded, moist, rocky outcrops, rarely on trees.

Weak stellate sedge is typically found in wet, moist habitats.

White turtlehead is a smooth, unbranched perennial herb typically found on moist ground along streams.

Wild hyacinth is a perennial herb typically found in rich, shady coves and slopes, wet woods, and usually on calcareous or basic soils.

Wood anemone is a small, delicate perennial typically found in fresh/moist hardwood and mixed-wood forest habitats.

Woodrush is a member of the sedge family, typically found in bluff forests and moist woods.

Animals

Green salamanders are found on sandstone cliffs and rock faces. This salamander has been recorded in rock formations in Tishomingo State Park, downstream from the Bear Creek Dam. Extensive populations have also been found on Upper Bear Creek Reservoir in sandstone outcrops and cliffs. Although this species has not been recorded from Bear Creek Reservoir, similar exposed rock features provide suitable habitat along the north shore of the reservoir.

Eastern hellbenders require well-oxygenated waters, usually larger streams with turbulence and a fast current. This large, aquatic salamander has been recorded in Bear Creek near Tishomingo State Park and was more common in Bear Creek before the dams were built. Suitable habitat occurs within the park and sections of Bear Creek between the dam and Pickwick Reservoir.

Cave salamanders and **southern zigzag salamanders** occur in forested habitat near or in caves or other rocky substrates. Suitable habitat for these species exists in caves in or near the project area and Tishomingo State Park.

Two salamanders as associated with fish-free aquatic habitats such as springs, seepages, and headwaters of small streams. **Spring salamanders** tend to be aquatic, and **red salamanders** are both terrestrial and aquatic. Suitable habitat for these salamanders exists throughout the project area.

Four-toed salamanders inhabit forests around fish-free aquatic habitats such as swamps, bogs, marshes, and vernal pools. Suitable habitat exists for this species throughout the project area, but particularly within the forested areas around Tishomingo State Park and a bottomland forest approximately 25 miles downstream of Bear Creek Dam.

Mountain chorus frogs occur in woodland habitats, often on forested slopes. This frog can be found long distances from water, but requires fishless, vernal pools for breeding. Previously recorded in Tishomingo State Park, suitable forested habitat occurs primarily in and around this park, but also in the forests surrounding Bear Creek Reservoir.

Southern coal skinks prefer wooded hillsides near springs and rock faces. Previously recorded in Tishomingo State Park, suitable habitat for this species occurs throughout the project area, but predominantly in the park and forests surrounding Bear Creek Reservoir.

Ouachita map turtles occur primarily in rivers and reservoirs. Suitable habitat for this species occurs in Bear Creek Reservoir. It is a common species in Pickwick Reservoir and the lower portions of Bear Creek.

Queen snakes occur in stony streams and rivers with abundant crayfish, their preferred prey. Previously recorded in Tishomingo State Park, habitat occurs in streams throughout the project area.

Bewick's wrens are found largely in disturbed, early successional habitat, especially those having brushy tickets, brush piles, and hedgerows. Only one historical record of this bird is reported from Eastport. Ample suitable habitat exists in the floodplain farmland and especially in the windrows left from the harvesting of pine plantations.

Northern long-eared bats forage in forested habitats near ponds and streams, roost in trees, under sloughing bark, or in human-made structures. During hibernation, they roost in caves or mines. This species has been reported from a cave on Little Bear Creek Reservoir (Best and Caesar 2000; Hilton and Best 2000) and along a creek on Upper Bear Creek Reservoir. Ample suitable habitat for this species exists in the forested habitats around the Bear Creek Reservoir and Tishomingo State Park and area caves.

Two beetle species of the genus *Batrisodes* and one species of the genus *Catops* are known to inhabit caves in the general area of Bear Creek. Of the three caves with records of one or more of these beetles, only one occurs within either flood zone. McCluskey Cave is within the 100-year flood zone, approximately 30 river miles downstream of the dam, and has records of all three beetle species. Caves in the area provide suitable habitat for these beetles.

Appendix G – Bear Creek Discharge Duration Analyses

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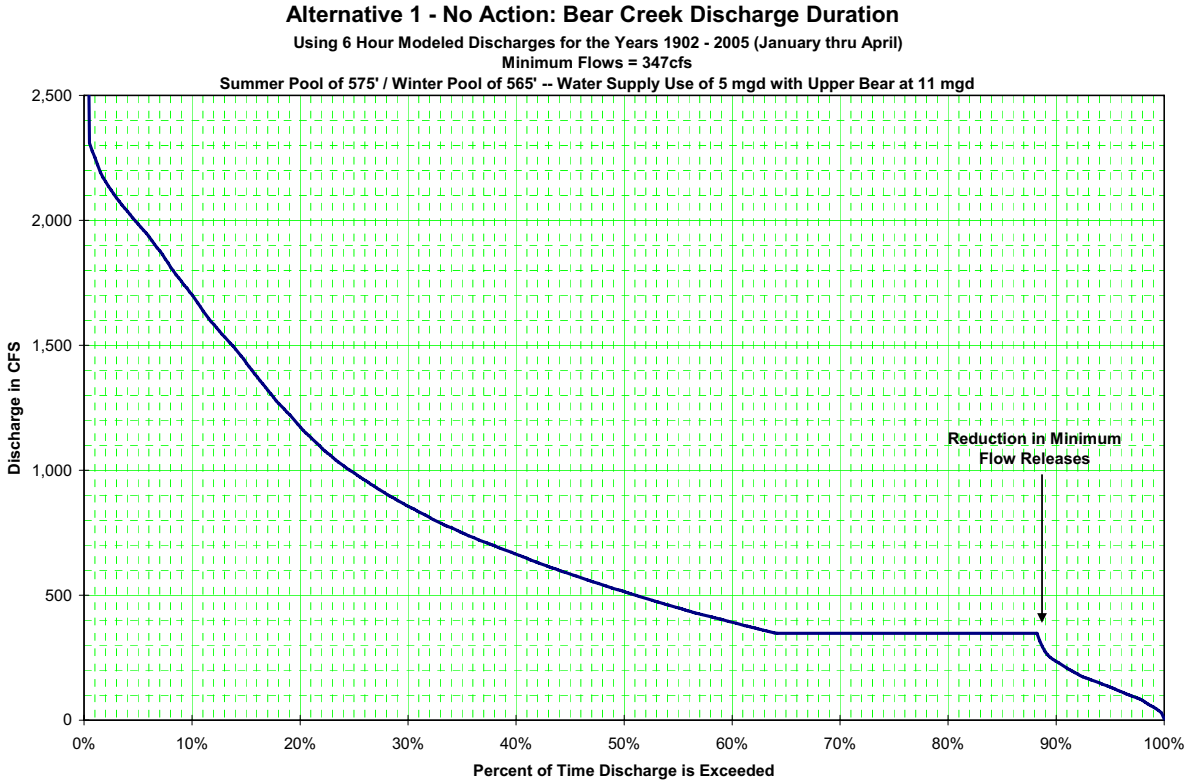

Figure G-1. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (January-April) – Alternative 1

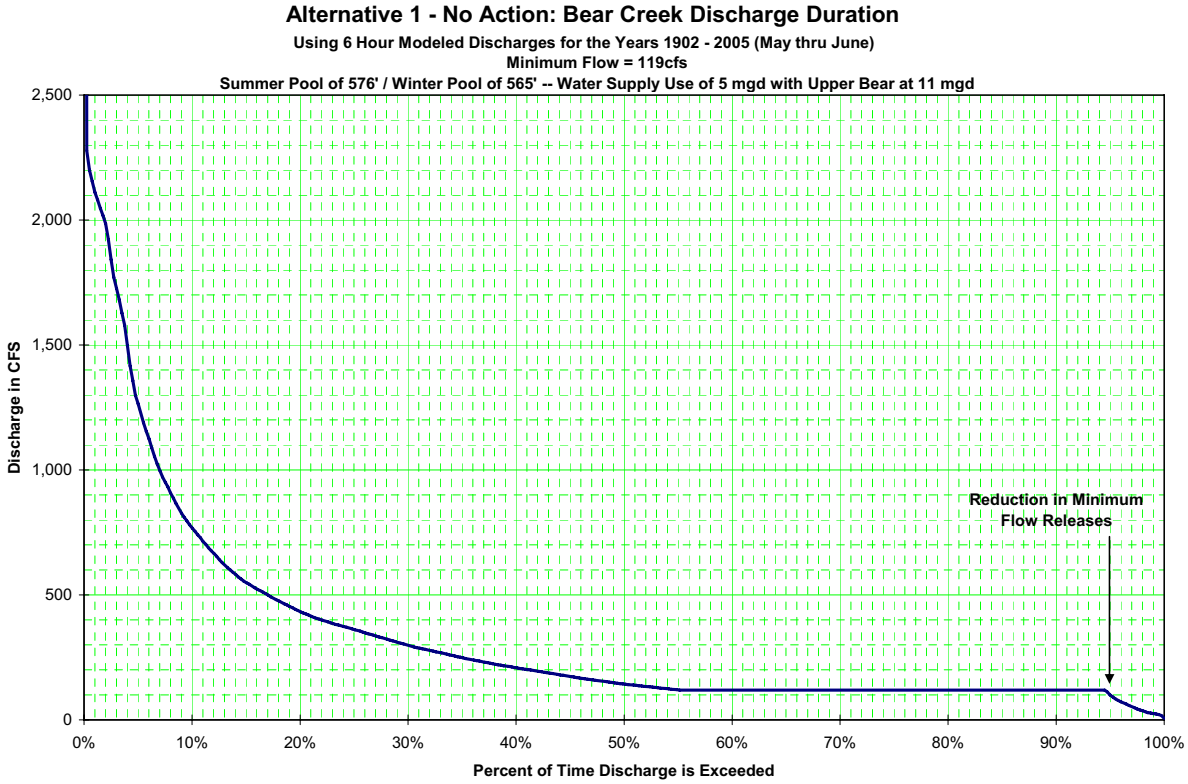

Figure G-2. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (May-June) – Alternative 1

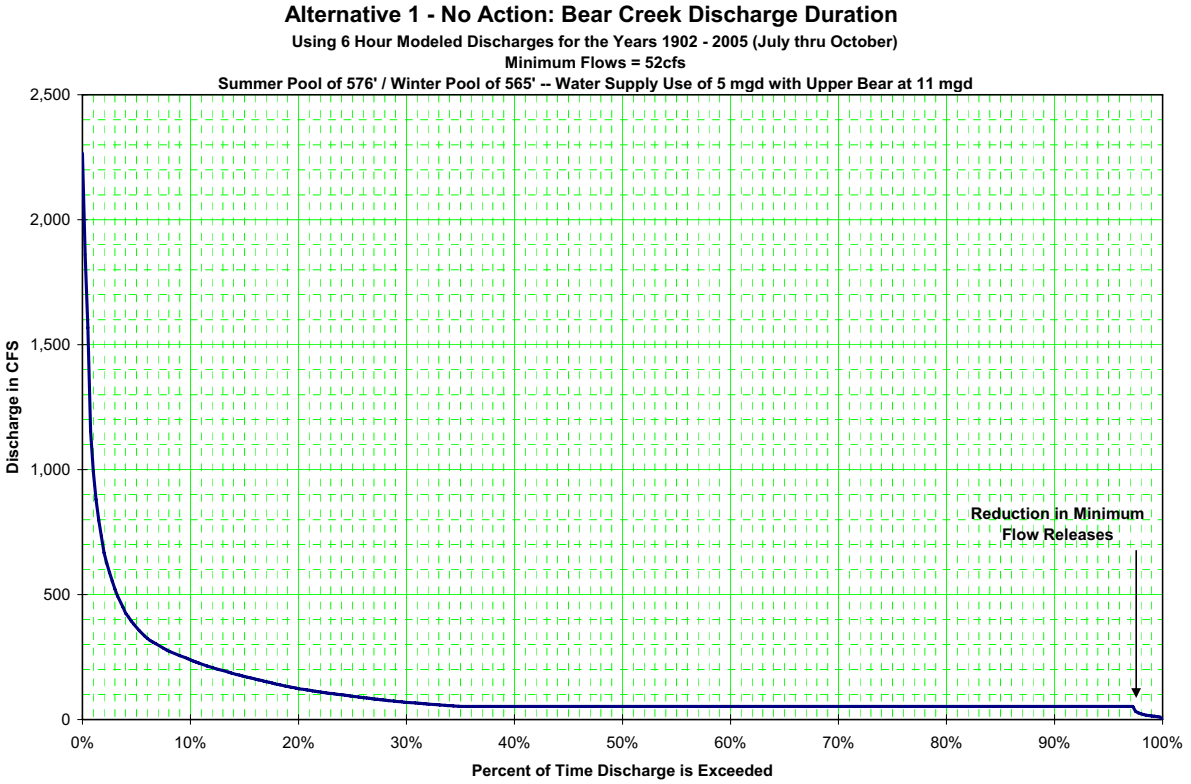

Figure G-3. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (July-October) – Alternative 1

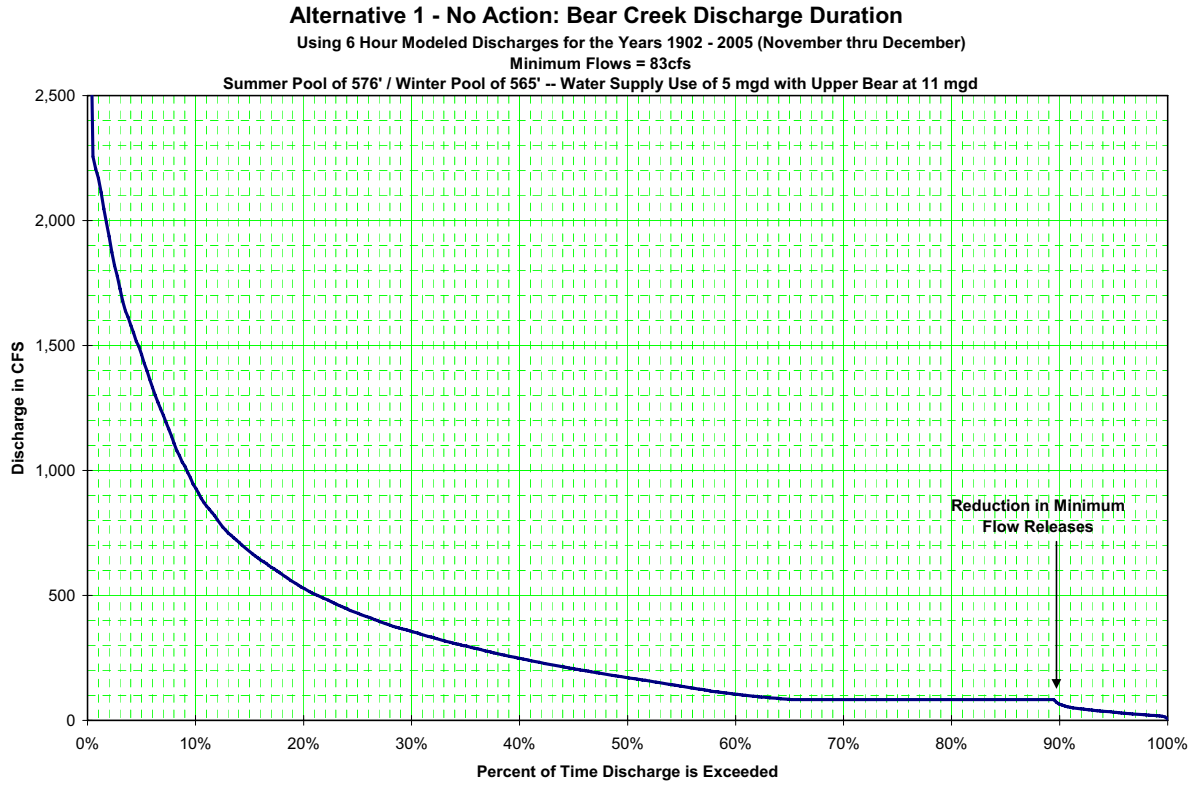

Figure G-4. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (November-December) – Alternative 1

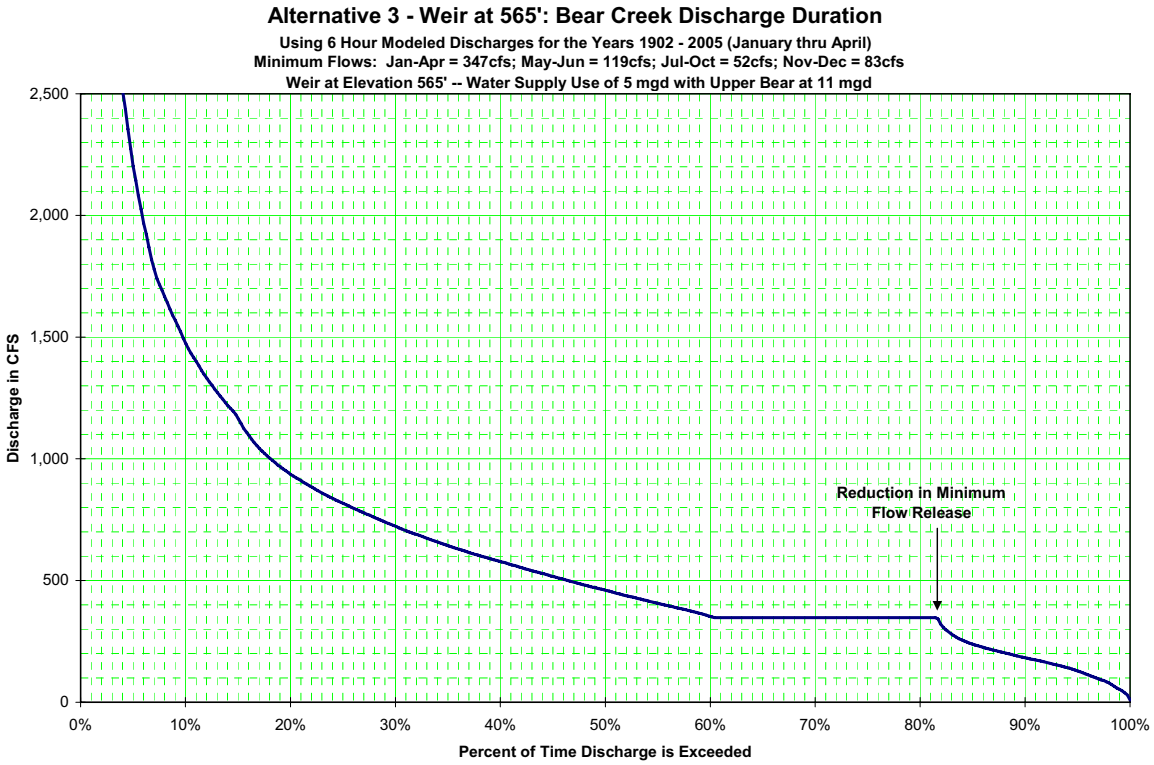

Figure G-5. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (January-April) – Alternative 3

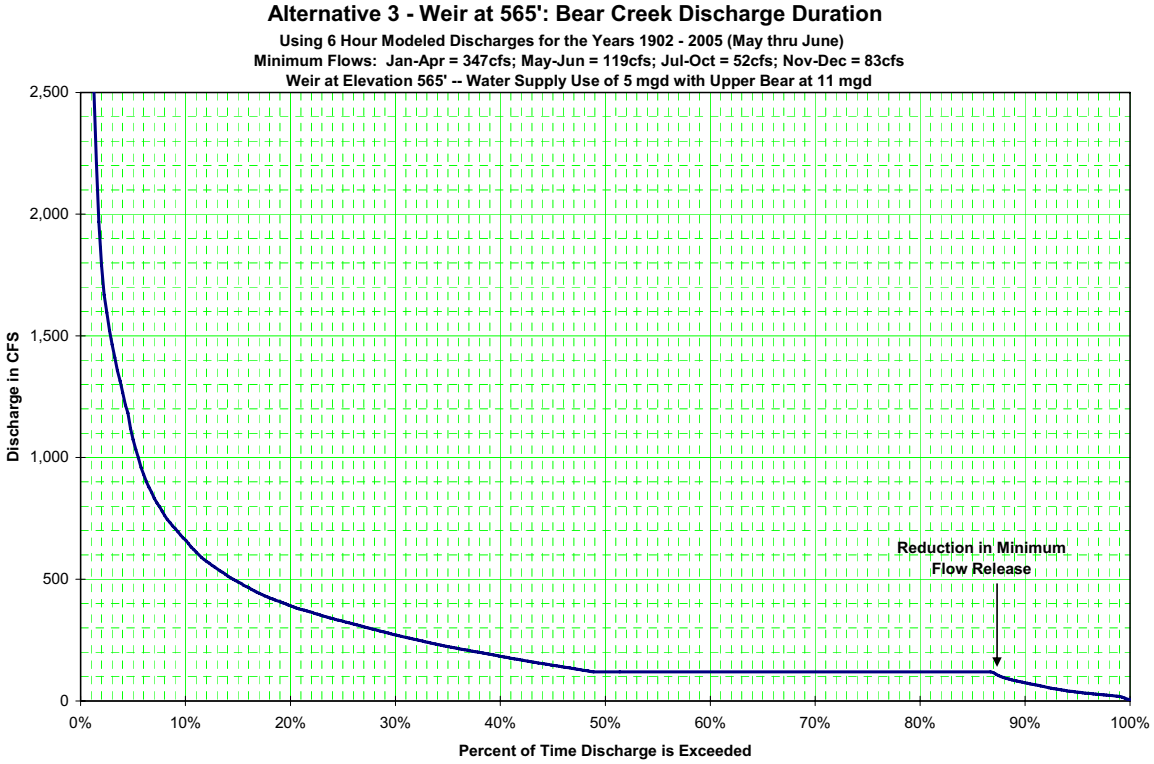

Figure G-6. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (May-June) – Alternative 3

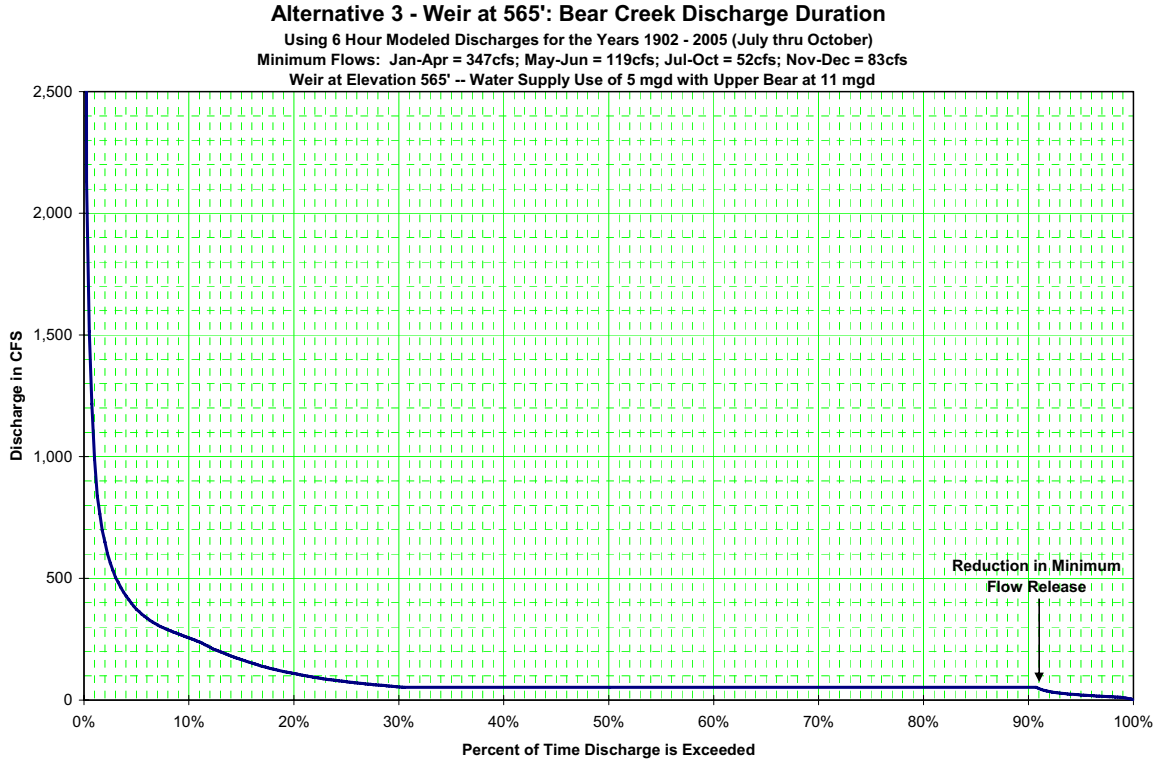

Figure G-7. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (July-October) – Alternative 3

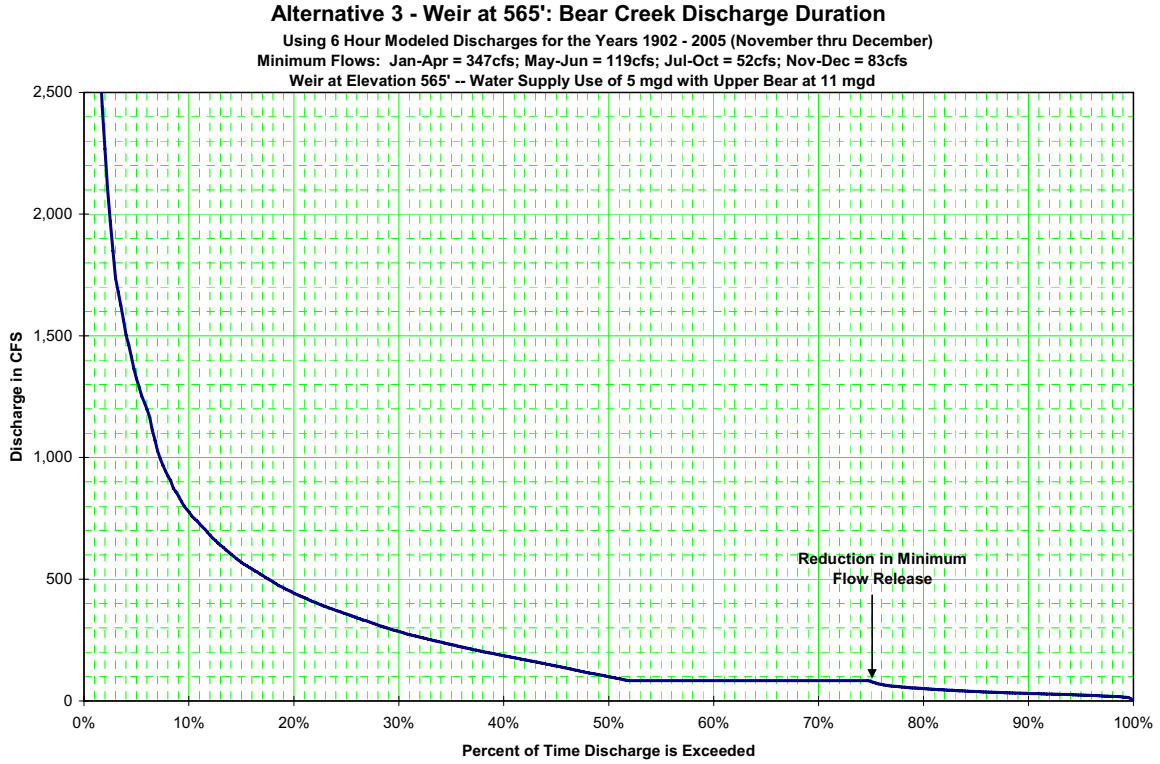

Figure G-8. Bear Creek Reservoir Discharge Duration Under New Minimum-Flow Release Schedule (November-December) – Alternative 3

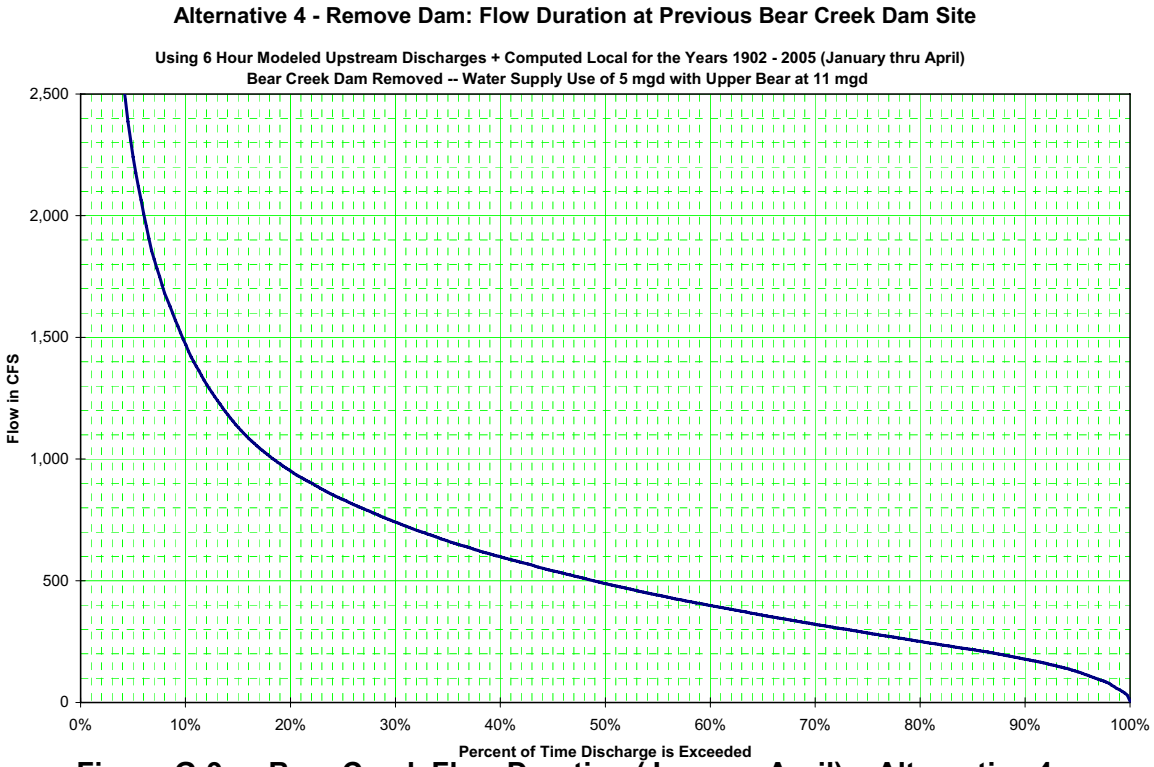

Figure G-9. Bear Creek Flow Duration (January-April) – Alternative 4

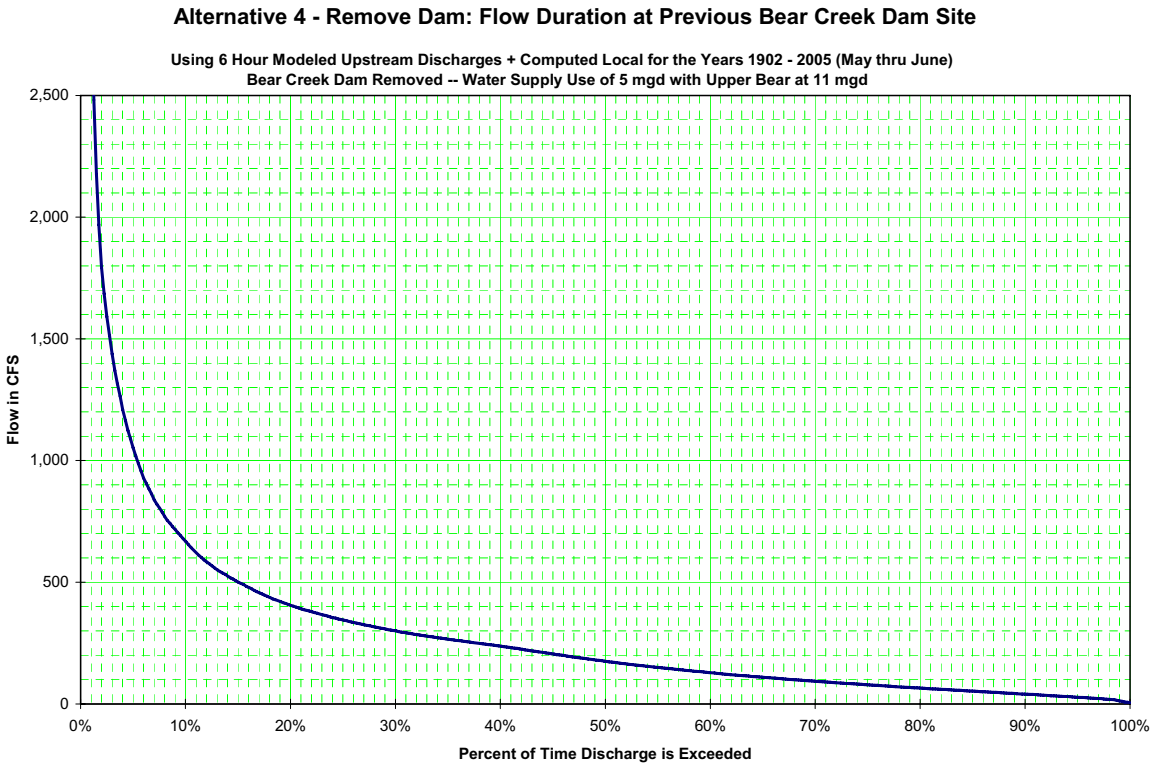

Figure G-10. Bear Creek Flow Duration (May-June) – Alternative 4

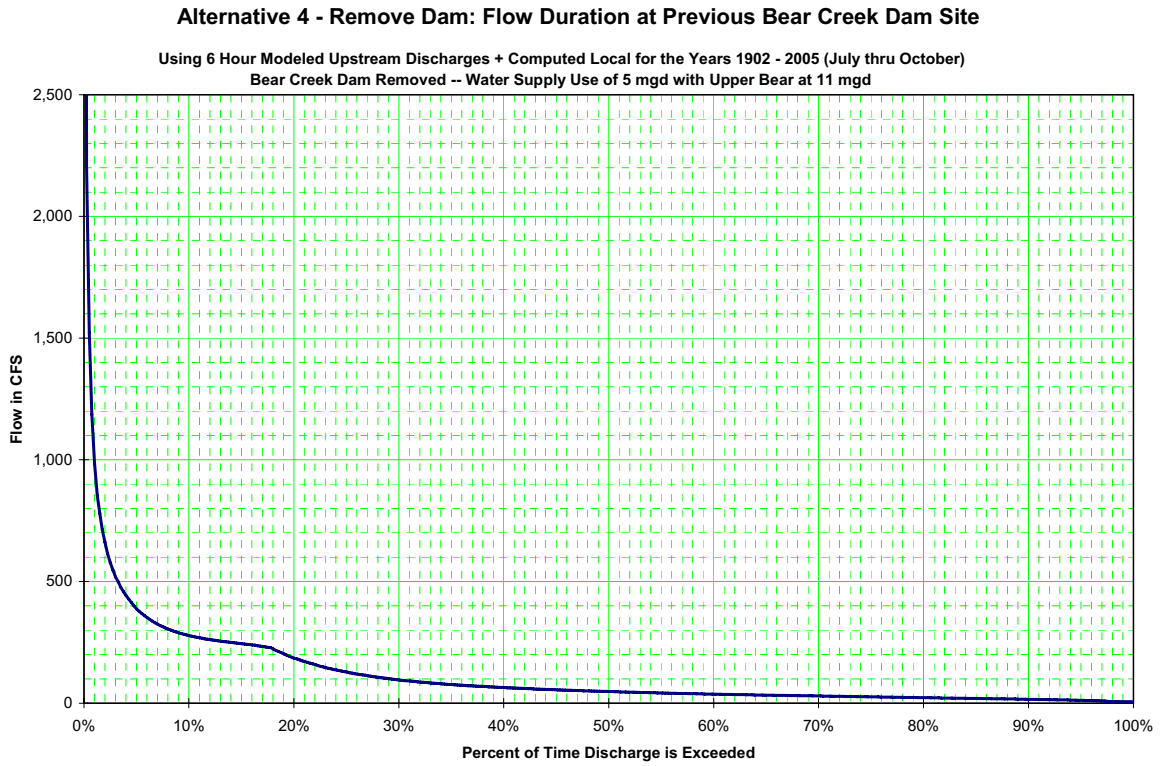

Figure G-11. Bear Creek Flow Duration (July-October) – Alternative 4

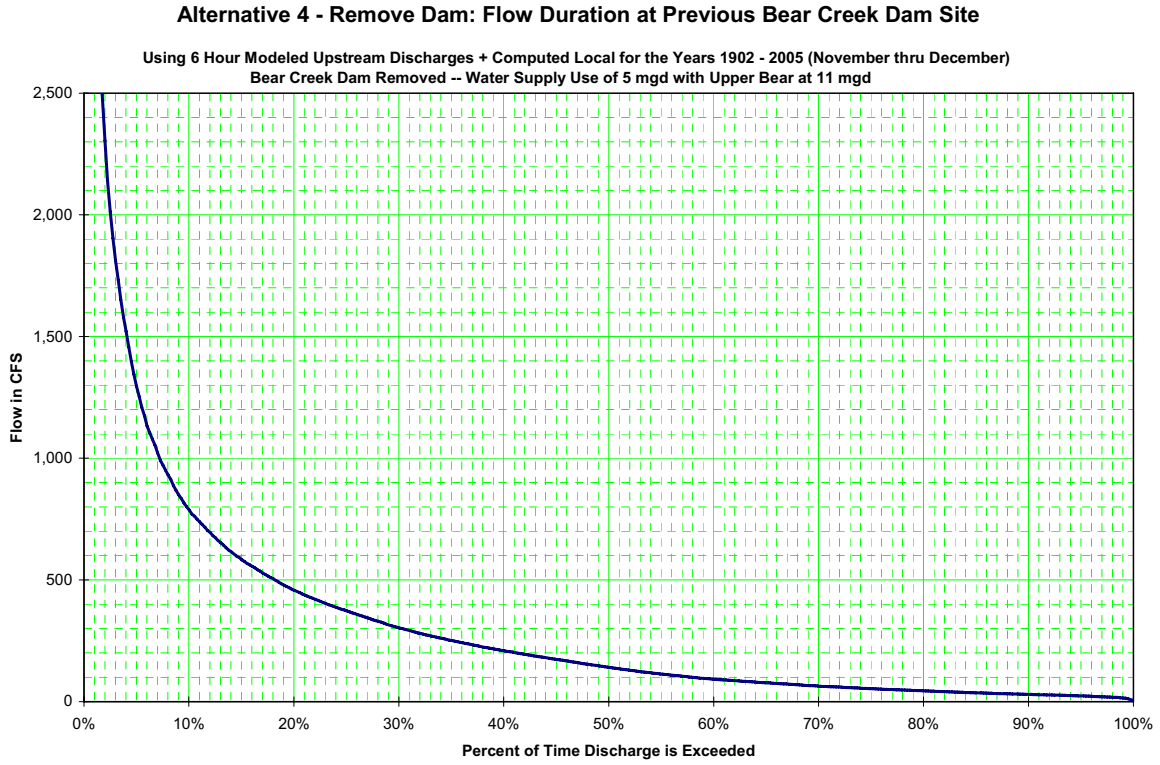

Figure G-12. Bear Creek Flow Duration (November-December) – Alternative 4

Appendix H – Water Quality Model Description

CE-QUAL-W2 is a two-dimensional (longitudinal-vertical) water quality and hydrodynamic model developed by USACE for estuaries, lakes, reservoirs, and river basin systems. It may be used to model basic eutrophication processes such as temperature-nutrient-algae-DO-organic matter and sediment relationships, water surface elevations, velocities, and several water quality constituents, such as water temperatures, DO, algae, and pH, in stratified and nonstratified systems. The most significant limitation on CE-QUAL-W2 is the assumption of lateral homogeneity. Reservoirs in which lateral variations in velocities, temperatures, and constituents are considered to be negligible are well suited to modeling with CE-QUAL-W2. In addition, vertical momentum is not included; therefore, inaccurate results may be obtained where vertical acceleration is substantial (Cole and Buchak 1995).

Data required for water quality modeling include channel geometry (cross-section) information, meteorology data, reservoir elevations, inflows to the reservoir, outflows (dam releases), water withdrawals, inflow temperature, and water quality information for all tributaries. Reservoir models often span an entire year to replicate accurately the natural processes in the reservoir associated with the stratification cycle. Once the model is developed and all the input files are generated, the model must be calibrated so that it produces results that match actual data as closely as possible. For Bear Creek, there were only two years (1992 and 1999) where sufficient flow, water temperature, and water quality data were available to construct a water quality model. Additionally, water quality data collected during 2006 were used to refine the model calibration. The hydrology of 2006 was drier than median conditions; therefore, the model results represent water quality conditions expected in dry-year scenarios.

As part of the calibration process, simulated temperature, pH, and DO results were compared to measured data. The model calibration was adjusted to approximate observed conditions for these parameters as closely as possible. Generally, modeled temperatures were within 1°F of those measured; modeled DO was within 1 mg/L for most measurement dates, and modeled pH was consistent with observed values.

The CE-QUAL-W2 model was used to simulate and evaluate conditions under three of the alternatives in order to examine the effects of changes in the reservoir operations policy under these alternatives. This was done by adjusting the inflow, elevation, and outflow files to reflect the conditions present under each alternative. Water quality under Alternatives 1 and 2 would be the same because the reservoir would be operating following the same guide curve. The dam removal alternative could not be evaluated with the CE-QUAL-W2 model, because there is no reservoir from which to model water quality conditions in this alternative.

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Appendix I – Bear Creek Flood Elevations

Creek Mile	Current Conditions		Alternative 2		Alternative 3		Alternative 4		Landmark
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	
18.35	427.0	430.0	427.0	430.0	428.9	431.9	429.2	432.2	Lower End of Study
18.87	427.8	430.7	427.8	430.7	429.6	432.5	429.9	432.7	
19.30	429.4	433.0	429.4	433.0	431.7	435.2	432.1	435.5	
21.00	432.2	435.9	432.2	435.9	434.5	438.1	434.9	438.4	
22.39	433.7	437.3	433.7	437.3	436.0	439.5	436.4	439.8	
23.57	435.5	438.9	435.5	438.9	437.7	441.0	438.0	441.3	
24.47	437.6	440.6	437.6	440.6	439.5	442.6	439.8	442.9	
25.68	440.1	443.1	440.1	443.1	442.0	445.0	442.4	445.3	
26.58	441.6	444.6	441.6	444.6	443.5	446.5	443.8	446.8	
27.26	443.2	446.0	443.2	446.0	445.0	447.8	445.3	448.0	
27.58	445.5	448.8	445.5	448.8	447.6	450.8	447.9	451.1	
28.31	447.1	450.8	447.1	450.8	449.5	453.1	449.9	453.4	
29.65	448.1	451.9	448.1	451.9	450.8	454.6	451.2	454.9	
30.39	449.0	452.8	449.0	452.8	451.8	455.6	452.2	456.0	
31.20	451.7	455.0	451.7	455.0	454.4	457.9	454.7	458.2	
31.83	453.9	457.0	453.9	457.0	456.5	459.8	456.9	460.2	
32.04	454.4	457.5	454.4	457.5	457.1	460.4	457.4	460.8	
33.75	457.0	460.2	457.0	460.2	459.9	463.3	460.2	463.7	
34.20	459.9	463.3	459.9	463.3	462.9	466.5	463.3	466.9	
34.45	461.3	464.6	461.3	464.6	464.3	467.8	464.7	468.2	
34.62	462.3	465.8	462.3	465.8	465.5	469.2	465.9	469.6	
35.57	465.6	469.4	465.6	469.4	469.1	472.9	469.5	473.3	
37.18	472.2	476.0	472.2	476.0	475.7	479.6	476.1	480.0	
38.20	476.1	480.0	476.1	480.0	479.7	483.6	480.1	484.0	
39.10[1]	479.6	484.4	479.6	484.4	484.0	488.9	484.6	489.4	County Road 75
39.10[2]	480.6	486.9	480.6	486.9	486.4	490.9	487.1	491.3	
39.90	483.0	488.9	483.0	488.9	488.4	493.1	489.1	493.6	
41.64	485.7	491.0	485.7	491.0	490.6	495.3	491.4	495.9	
41.72[1]	485.9	491.1	485.9	491.1	490.8	495.5	491.5	496.0	County Road 86
41.72[2]	486.1	491.5	486.1	491.5	491.1	495.4	491.8	496.5	
41.96	486.4	491.7	486.4	491.7	491.4	496.3	492.1	496.8	Downstream end of floodway
43.41	486.8	482.1	486.8	482.1	491.9	496.7	492.5	497.2	
46.09	487.8	492.6	487.8	492.6	492.4	497.1	493.1	497.6	
47.18[1]	489.6	493.1	489.6	493.1	492.9	497.3	493.5	497.8	County Road 993
47.18[2]	492.5	494.1	492.5	494.1	494.0	497.5	494.4	498.0	
48.40	494.0	495.7	494.0	495.7	495.6	498.5	496.0	499.0	
49.56	496.9	498.3	496.9	498.3	498.3	500.3	498.6	500.7	
50.25	499.0	500.4	499.0	500.4	500.4	502.0	500.6	502.3	
52.70	504.9	506.4	504.9	506.4	506.4	508.0	506.7	508.2	
54.50	508.2	509.9	508.2	509.9	509.9	511.6	510.2	511.9	
55.40	509.3	510.9	509.3	510.9	510.8	512.6	511.1	512.8	

Creek Mile	Current Conditions		Alternative 2		Alternative 3		Alternative 4		Landmark
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year	
56.54	511.7	513.0	511.7	513.0	513.0	514.5	513.5	514.8	
56.65	512.3	513.6	512.3	513.6	513.6	515.0	513.8	515.3	
56.75[1]	512.8	514.2	512.8	514.2	514.2	515.7	513.8	514.4	County Road 11
56.75[2]	513.5	515.3	513.5	515.3	515.3	517.8	515.7	518.2	
56.86	513.9	515.9	513.9	515.9	515.9	518.4	516.2	518.8	
59.00	515.4	517.0	515.4	517.0	516.9	519.1	517.2	519.5	
59.57	519.0	520.2	519.0	520.2	520.1	521.6	520.4	521.9	Red Bay
60.20	519.9	521.2	519.9	521.2	521.2	522.7	521.4	522.9	
61.00	521.6	522.8	521.6	522.8	522.8	524.2	523.1	524.4	
61.30[1]	523.6	524.8	523.6	524.8	524.8	526.0	525.0	526.2	State Route 24
61.30[2]	524.1	525.5	524.1	525.5	525.5	526.9	525.7	527.1	
61.40	524.8	526.2	524.8	526.2	526.2	527.7	526.5	528.0	
62.80	526.6	527.8	526.6	527.8	527.8	529.2	528.0	529.4	
64.00	529.7	530.7	529.7	530.7	530.7	531.9	530.9	532.1	
65.18	537.2	538.7	537.2	538.7	538.7	540.2	539.0	540.4	
66.44	542.5	544.5	542.5	544.5	544.5	546.9	544.9	547.3	
67.24	545.1	547.2	545.1	547.2	547.2	549.7	547.6	550.1	
68.78[1]	549.9	552.7	549.9	552.7	552.7	555.5	553.2	556.0	County Road 23
68.78[2]	550.3	553.5	550.3	553.5	553.6	558.2	554.2	557.1	
69.11	551.0	554.4	551.0	554.4	554.4	559.1	555.1	558.2	
70.05	553.7	557.3	553.7	557.3	557.4	561.9	558.1	561.8	
71.50	557.8	561.8	557.8	561.8	561.8	566.8	562.6	567.1	
71.89	558.7	562.9	558.7	562.9	563.0	568.5	563.8	568.9	Old Cotton Gin Road
71.89	559.3	564.5	559.3	564.5	564.6	569.3	565.5	569.8	
74.00	567.1	572.7	567.1	572.7	572.8	578.7	574.1	579.3	
74.22	567.8	573.4	567.8	573.4	573.5	579.4	574.8	580.1	
74.55	568.3	574.0	568.3	574.0	574.1	580.2	575.5	580.9	
74.60	568.7	574.5	568.7	574.5	574.6	580.7	575.9	581.5	Immediately downstream of dam

[1]Downstream at bridge
[2]Upstream at bridge

Appendix J – Correspondence

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
1208-B Main Street
Daphne, Alabama 36526

IN REPLY REFER TO:

June 28, 2007

2006-FA-0268
2006-I-1196

Ms. Peggy Shute
Manager, Heritage Resources
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

Dear Ms. Shute:

This responds to your May 24, 2007, letter requesting the Service's concurrence on TVA's determinations with the preferred alternative for the Bear Creek Dam Leakage Resolution Project. Our comments are provided in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.), the National Environmental Policy Act of 1969 (as amended) and the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

It is our understanding, that TVA prefers to modify the dam and restore the 576-foot operating pool (Alternative 2 in the Draft EIS), because it would continue to provide benefits for the region, including water supply. As you know, and in accordance with the Biological Opinion (BO) issued on October 17, 2006, TVA has agreed to provide a seasonal minimum flow under this alternative. These minimum flows are intended to conserve and enhance aquatic resources, including listed species and their designated critical habitat, in the lower Bear Creek system.

We concur with your determination that the preferred action would improve habitat conditions in designated critical habitat for the Cumberland combshell and oyster mussel and would not result in adverse modification of this designated critical habitat, as long as TVA is willing to accept the ramp-up and ramp-down rates that were presented to us during the April 11, 2007 meeting in Daphne. We suggest including the final proposed rates in TVA's description of its proposed action, either in the Environmental Assessment (EA) or in a separate document forwarded to our office.

www.fws.gov

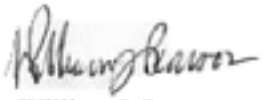
PHONE: 251-441-5181

TAKE PRIDE IN AMERICA

FAX: 251-441-6222

If you have any questions or need additional information, please contact Jeff Powell at the above address or by telephone at (251) 441-5858.

Sincerely,



William J. Pearson
Field Supervisor

cc:
Regional Office, FWS, ATTN: Jeff Weller

APPENDIX K – MEMORANDUM OF AGREEMENT

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MEMORANDUM OF AGREEMENT BETWEEN THE TENNESSEE VALLEY AUTHORITY AND THE ALABAMA STATE HISTORIC PRESERVATION OFFICER

WHEREAS, the Tennessee Valley Authority (TVA) is preparing an Environmental Impact Statement that considers alternatives to address an on-going seepage problem at Bear Creek Dam in Franklin County, Alabama, which is depicted on the maps attached to this agreement as Appendix A; and

WHEREAS, a description of these alternatives has been provided in this agreement as Appendix B; and

WHEREAS, TVA has previously documented approximately 137 archaeological resources within the Bear Creek Reservoir and additional resources may be present in those areas that have not been systematically surveyed; and

WHEREAS, the alternatives being considered have the potential to adversely affect historic properties eligible for listing in the National Register of Historic Places (NRHP); and

WHEREAS, this Memorandum of Agreement (MOA) sets forth the process for Section 106 Compliance for the identification, evaluation, and treatment of historic properties that may be affected by these alternatives; and

WHEREAS, one of these alternatives is expected to be adopted by TVA as its preferred alternative to address the seepage problem at Bear Creek Dam; and

WHEREAS, TVA has consulted with the Alabama State Historic Preservation Officer (SHPO) regarding this undertaking; and

WHEREAS, TVA and SHPO are the signatories to this agreement; and

WHEREAS, TVA has consulted with the Chickasaw Nation, Cherokee Nation, Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians in Oklahoma, Absentee-Shawnee Tribe of Oklahoma, Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe, Muscogee (Creek) Nation of Oklahoma, Kialegee Tribal Town, Thlopthlocco Tribal Town, Alabama Quassarte Tribal Town, Alabama-Coushatta Tribe of Texas, Jena Band of Choctaw Indians, Choctaw Nation of Oklahoma, Seminole Indian Tribe, Seminole Nation of Oklahoma, and Poarch Band of Creek Indians, regarding the potential for this undertaking to affect historic properties that may have traditional religious or cultural significance to their respective tribe; and

WHEREAS, the aforementioned Indian tribes were invited to concur in this agreement; and

WHEREAS, TVA has consulted with the City of Russellville, City of Phil Campbell, City of Hodges, City of Red Bay, and the City of Vina, regarding the potential for this undertaking to affect historic properties,

NOW, THEREFORE, TVA and the SHPO agree that the undertaking shall be implemented in accordance with the following stipulations to satisfy TVA's Section 106

responsibilities. The TVA Federal Preservation Officer, or the designee thereof, shall act for TVA in all matters concerning the administration of this Agreement.

Stipulations

TVA, in consultation with the SHPO, and other consulting parties will ensure that the stipulations of this agreement are carried out prior to the commencement of any ground-disturbing activities within the APE referenced below. This agreement allows phased identification, evaluation, and treatment of the historic properties located within the APE.

I. DETERMINATION OF AREA OF POTENTIAL EFFECTS:

The area of potential effects (APE) varies with each alternative. TVA has determined the APE for each alternative to be the following:

Alternative	APE for Archaeology
1. No Action	Floodzone and drawdown zone
2. Repair/Reconstruct Dam	Contruction zone and temporary drawdown zone
3. Modify Dam	Construction zone, drawdown zone
4. Restore Creek Channel	Floodzone, dam reservation

Construction zone - all areas where ground disturbing activity will occur as a result of alterations or removal of the dam
Dam Reservation - all TVA fee-owned land associated with the Bear Creek reservoir
Drawdown Zone - The area between approximately 100 feet horizontally beyond the maximum pool elevation and the lowest pool elevation (different for each alternative - see Appendix B)
Floodzone - Area below dam that would be subject to flooding as a result of dam failure or dam removal

II. IDENTIFICATION OF POTENTIAL HISTORIC PROPERTIES WITHIN THE APE:

TVA, in consultation with the SHPO, shall cause to be conducted a survey to identify all previously unrecorded historic properties within the APE of the preferred alternative. The survey shall be carried out in a manner consistent with the Secretary of the Interior's Standards and Guidelines for Identification (48 FR 44720-23) and the minimum requirements established by the Alabama Historical Commission Policy for Archaeological Survey and Testing in Alabama (2002). TVA will submit the survey report to the SHPO and the Federally recognized Indian tribes for review allowing thirty (30) days for comment. Existing information such as previous survey data, photographs, maps, drawings, etc. shall be incorporated into the report along with new data.

III. EVALUATION:

TVA, in consultation with the SHPO, shall cause to be conducted, in accordance with 36CFR part 800.4(c), investigations to evaluate the significance of historic properties identified through the survey. TVA shall conduct a Phase II evaluation for National

Register eligibility of all historic properties within the APE that TVA and the SHPO agree are potentially eligible for the NRHP. The evaluation will be conducted in a manner consistent with the Secretary of the Interior's Standards and Guidelines for Identification (48 FR 44720-23) and the "Alabama Historical Commission Policy for Archaeological Survey and Testing in Alabama" (2002). TVA will prepare a scope of work (SOW), in coordination with SHPO, prior to the implementation of the Phase II investigations. TVA will submit a written report of the Phase II evaluation to the SHPO and the Federally recognized Indian tribes for review allowing thirty (30) days for comment.

Properties which have been evaluated and have been found to meet one or more National Register criteria for eligibility shall be considered historic properties. Should a dispute arise on the eligibility of a historic property, TVA will consult with the SHPO to resolve the objection. If TVA and the SHPO do not agree, or if the Council or the Secretary of the Interior (Secretary) so request, TVA shall obtain a determination of eligibility from the Secretary pursuant to 36 CFR Part 63. If an Indian tribe that attaches religious and cultural significance to a property off tribal land, does not agree, it may ask the Council to request the TVA Federal Preservation Officer to obtain a determination of eligibility from the Secretary.

. TREATMENT PLAN:

A. AVOIDANCE:
TVA shall ensure, to the fullest extent practicable, that all sites determined eligible for listing in the NRHP are avoided by any activities that could affect the characteristics of a site that qualify it for listing in the NRHP. In the design of the preferred alternative, every consideration to avoid adversely affecting archaeological sites eligible for the NRHP will be exhausted. All archaeological sites, subsequently discovered or identified and determined eligible for the NRHP by the evaluation process under Stipulation III, that are avoided will be protected by a buffer zone of adequate dimensions as determined by TVA, in consultation with the SHPO and the Federally recognized Indian tribes.

B. DATA RECOVERY:
When historic properties will be adversely affected by unavoidable physical destruction or damage and all practicable avenues of avoidance have been exhausted, data recovery excavations or other means of recordation will be implemented as appropriate to each such historic property. Any determination of unavoidable adverse effect shall be made by TVA, in consultation with the SHPO and other consulting parties. In each such instance, a treatment plan shall be developed by TVA, in consultation with the SHPO and other consulting parties for the recovery of historic and archaeological data from sites that are determined to be eligible for inclusion in the NRHP. Because of the unique nature of each archaeological site, requirements for mitigation at any particular site will be determined by TVA, in consultation with the SHPO. TVA shall develop a data recovery plan in consultation with the SHPO and the Federally recognized Indian tribes to resolve adverse effects through recovery of significant information from adversely affected historic or archaeological sites.

The data recovery plan (the Plan) shall be formulated by TVA in consultation with the SHPO and the Federally recognized Indian tribes. The Plan will be consistent with the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (48 FR 44734-37) and shall consider the recommendations in the Council's publication, Treatment of Archaeological Properties (Advisory Council on Historic Preservation, [draft] 1980). All data recovery will be carried out in a manner consistent with the Plan. The Plan shall specify, at a minimum:

1. The property, properties, or portions of properties where data recovery is to be carried out;

2. Any property, properties, or portions of properties that will be destroyed without data recovery;

3. The results of previous research relevant to the project;

4. Research problems or questions to be addressed with an explanation of their relevance and importance;

5. The field and laboratory analysis methods to be used, along with an explanation of how they apply to the property in question and how they will address the above research needs;

6. Explicit provisions for disseminating the research findings to professional peers in a timely manner;

7. Arrangements for presenting findings to the public and other interested parties that have vested interests in the results;

8. The curation of recovered materials and records resulting from the data recovery in accordance with 36 CFR Part 79, including temporary and permanent repositories;

9. Procedures for evaluating and treating discoveries of unexpected remains or newly identified archaeological resources during the course of the project, including required consultation with other parties; and

10. A timeline for the field and laboratory analyses, completing a technical report on the investigation, disseminating the findings to professional peers, and presenting interpretive documents or other interpretive media to the public; and

11. TVA shall provide all signatories an opportunity to monitor the implementation of the data recovery plan; and

V. POST REVIEW DISCOVERIES:

Previously unidentified historic properties inadvertently discovered during the implementation of the preferred alternative will be subject to the evaluation process under Stipulation III and treated according to the process under Stipulation IV.

VI. REPORTS

TVA, in consultation with the SHPO and other signatories, shall ensure that all historical and archaeological investigations undertaken for compliance with this agreement are recorded in formal written reports that meet the Secretary of the Interior's Standards and Guidelines for Identification (48 FR 44720-23) and the "Alabama Historical Commission Policy for Archaeological Survey and Testing in Alabama" (2002). The SHPO and the Federally recognized Indian tribes shall be afforded thirty (30) days to review and comment on any archaeological or historical reports submitted as compliance with this agreement.

VII. INADVERTENT DISCOVERY OF HUMAN REMAINS

TVA shall ensure that the treatment of any human remains discovered within the project area complies with all relevant state and federal laws concerning archeological sites and treatment of human remains. Should human remains be encountered during historic property investigations, or should there be a post-review discovery of such remains, all ground disturbing activity in the immediate area of the discovery will be ceased immediately, and, at a minimum, a ten (10) foot buffer will be established protecting the remains. Further, TVA shall immediately notify the appropriate law enforcement officers and the SHPO.

If Native American human remains, funerary objects, sacred objects, or objects of cultural patrimony are encountered as a result of this undertaking, TVA will comply with Section 3 of the Native American Graves Protection and Repatriation Act (NAGPRA) and its implementing regulations at 43 CFR Part 10, Subpart B. TVA shall be responsible for notifying culturally affiliated Federally recognized Indian tribes and initiating consultation with such Indian tribes. When appropriate, any Native American human remains encountered during the undertaking will be treated in accordance with Memoranda of Understanding between TVA and Federally recognized Indian tribes having a cultural affiliation to the remains. Copies of MOUs currently in place are included in this agreement as Appendix C. Additional MOUs may be executed during the implementation of this agreement.

VIII. TIMETABLES FOR COMPLIANCE:

A. TVA shall ensure that the stipulations of this agreement document are met prior to commencement of any ground-disturbing activities. If implementation of the preferred alternative is implemented in phases, the stipulations of this agreement may be satisfied separately for each phase.

B. Throughout this agreement, unless otherwise stated, the SHPO and other consulting parties shall have thirty (30) days to review and comment on all reports concerning investigations of historic properties and proposed data recovery plans provided by TVA. Comments received from the signatories shall be taken into consideration in preparing final reports and plans. A copy of the final reports and data recovery plans shall be provided to the signatories.

IX. PHASED COMPLIANCE:

Consistent with 36 CFR § 800.4(b)(2), this agreement allows phased identification, evaluation, and treatment of historic properties to meet the requirements of Section 106 of the National Historic Preservation Act (NHPA).

X. LAND TRANSFER OF PROPERTY RIGHTS:

The instrument of conveyance for the transfer, lease or sale, of any parcel containing or that may contain a historic property eligible for inclusion in the NRHP from TVA to a third party, will include provisions to ensure that all requirements of Section 106 of the NHPA and its implementing regulations (36 CFR Part 800) are met. The instrument of conveyance shall contain, when necessary to protect historic properties, a legally binding preservation covenant for the protection of such properties prepared in consultation with the SHPO and other signatories. TVA may release the grantee from the preservation covenant in whole or in part, as appropriate, pursuant to the terms of the covenant and after consultation with the SHPO and other signatories. The covenant may be enforced by TVA or the United States of America.

XI. ADMINISTRATIVE CONDITIONS:

A. If Stipulations I-X have not been implemented within four (4) years, this agreement shall be considered null and void, unless the signatories have agreed in writing as provided in Paragraph XI.B below to an extension for carrying out its terms. If no agreement is reached on an extension at the end of this four-year period, TVA, the SHPO, and other consulting parties will resume consultation pursuant to 36 CFR Part 800.

B. If Stipulations I-X have not been implemented within two (2) years from the date of this agreement's execution, the signatories shall review the agreement to determine whether the agreement should be extended. If an extension is deemed necessary, TVA, the SHPO, and other consulting parties will consult in accordance with 36 CFR Part 800.6(c) to make appropriate revisions to the agreement.

C. The signatories to this agreement may agree to amend the terms of the agreement. Such amendment shall be effective upon the signatures of all signatory parties to this agreement. The amendment shall be appended to the agreement and will become a part thereof.

D. Should any signatory object regarding any action carried out or proposed with respect to the undertaking covered by this agreement or to implementation of this agreement, TVA shall consult with the objecting party to resolve the objection. If TVA determines that the objection cannot be resolved, TVA shall request the further comments of the Council by submitting all pertinent documentation to the Council. TVA shall allow the Council 30 days to review the documentation. Any comments provided by the Council during this 30-day review period will be taken into account by TVA in resolving the objection of the signatory. TVA's responsibility to carry out all other actions under this agreement that are not the subjects of the dispute will remain unchanged.

E. If any signatory to this agreement determines that the terms of the agreement cannot be carried out, the signatory shall consult to seek an amendment to the agreement. If the agreement is not amended, any signatory may terminate the agreement. TVA shall either execute a new agreement pursuant to 36 CFR Part 800.6(c)(1) or request the comments of the Council pursuant to 36 CFR Part 800.7(a).

EXECUTION OF MEMORANDUM OF AGREEMENT

Execution of this Memorandum of Agreement by the Tennessee Valley Authority and the Alabama State Historic Preservation Officer, and implementation of its terms evidence that the Tennessee Valley Authority has, in accordance with Section 106, taken into account the effects of the project on historic properties and afforded the Council an opportunity to comment.

SIGNATORIES:

TENNESSEE VALLEY AUTHORITY

By: _____ Date: 5.407
[Kathryn J. Jackson, Executive Vice President, RSO&E]

ALABAMA STATE HISTORIC PRESERVATION OFFICER

By: _____ Date: 3 Jun 07
[John Neubauer, Col USAF (RET.) State Historic Preservation Officer]

CONCURRENCE BY OTHERS:

By:_____ Date: _____

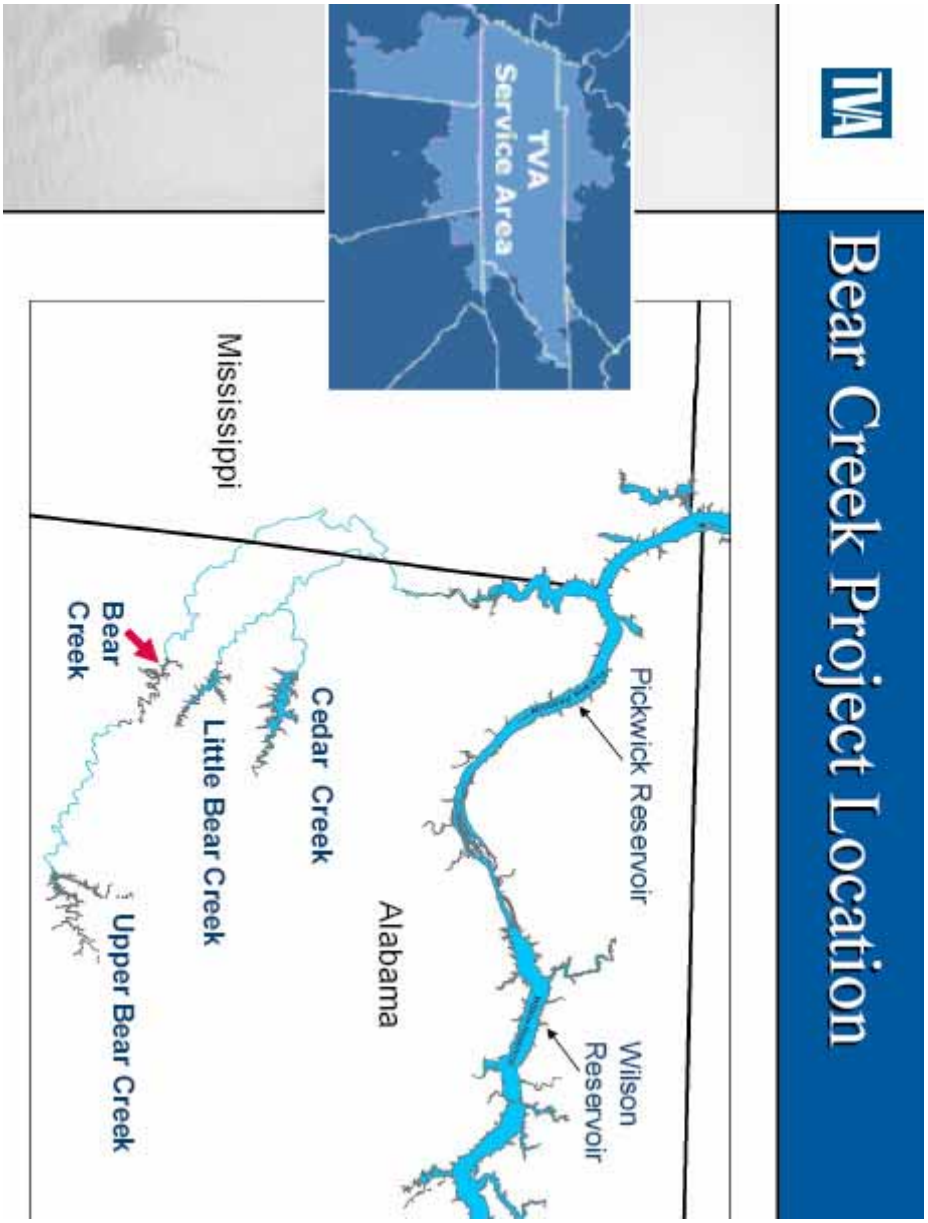
By:_____ Date:_____

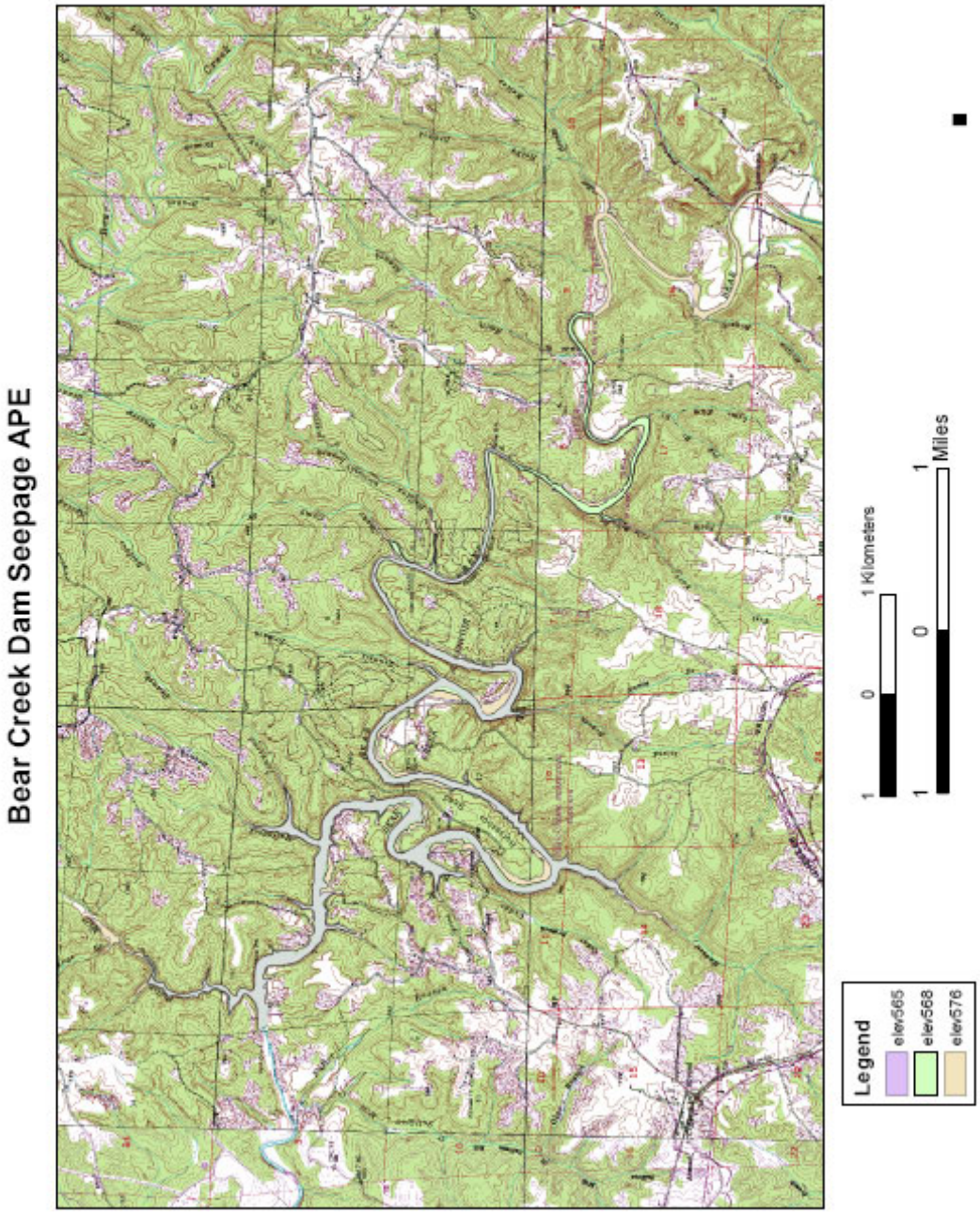
By:_____ Date:_____

By:_____ Date:_____

By:_____ Date:_____

APPENDIX A
PROJECT MAPS


TVA
Bear Creek Project Location
TVA Service Area
Mississippi
Alabama
Pickwick Reservoir
Wilson Reservoir
Cedar Creek
Little Bear Creek
Bear Creek
Upper Bear Creek


Bear Creek Dam Seepage APE
Legend
elev565
elev568
elev576
1 Kilometers
0
1
1 Miles
0
1

APPENDIX B
BEAR CREEK DAM SEEPAGE ALTERNATIVES

Alternative	Effects	Archaeological Assessment
No Action – Reservoir stays at 568 elevation	Archaeological sites between 568 and 576 are exposed year round	Conduct Phase I survey between 568 and 576 to identify sites being impacted and above pool to assess erosion concerns
Modify the dam to maintain a winter pool elevation of 565 feet and with a maximum rise of 5 feet	Archaeological sites between 565 and 576 are exposed	Conduct Phase I survey between 565 and 576 to identify sites being impacted and above pool to assess erosion concerns
Repair the dam by installing a grout curtain or by building a barrier to prevent flow through the dam	Drawdown will be necessary for repairs – sites will be exposed for extend period of time	Conduct Phase I survey down to elevation that will need to be reached in order to conduct repairs
Remove the dam and rebuild in approximately the same location with similar operating characteristics	Drawdown will be necessary for construction – sites will be exposed for extend period of time	Conduct Phase I survey down to elevation that will need to be reached in order to build new dam
Build a new weir dam (maintain reservoir pool elevation of 565 feet), remove Bear Creek Dam, and restore the former creek channel	Archaeological sites between existing dam and new weir dam, along with sites between 565 and 576 below weir dam will be permanently exposed	Conduct Phase I survey for weir construction, shoreline between 565 and 576 elevations and above pool to assess erosion concerns, and in between original creek channel and 576 following removal of dam
Remove the dam and restore the original creek channel.	All sites originally flooded by dam will be exposed	Conduct Phase I survey after the creek channel is restored – identify significant sites that will be impacted

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APPENDIX C
MOU's

16

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE TENNESSEE VALLEY AUTHORITY AND
THE UNITED KEETOOWAH BAND OF CHEROKEE INDIANS IN OKLAHOMA
REGARDING CONSULTATION PURSUANT TO SECTION 106
OF THE NATIONAL HISTORIC PRESERVATION ACT

WHEREAS, this agreement shall be known as the Government to Government Agreement between the United Keetoowah Band of Cherokee Indians in Oklahoma (UKB) and the Tennessee Valley Authority (TVA) regarding Section 106 Tribal Consultation; and

WHEREAS, TVA, an agency of the United States government, may have a need to engage in undertakings that may involve disturbance of sacred sites and/or historic properties that are culturally affiliated with the UKB; and

WHEREAS, pursuant to the National Historic Preservation Act, 16 U.S.C. 470 et seq. (hereinafter NHPA), TVA must consult with any Indian tribe that attaches religious or cultural significance to properties that may be affected by a TVA undertaking whether on federal or other lands (*See* 16 U.S.C. § 470a(d)(6)(B)); and

WHEREAS, the regulations of the Advisory Council on Historic Preservation implementing Section 106 of the NHPA specify that federal agencies provide Indian tribes a reasonable opportunity to identify their concerns about historic properties, advise on the identification and evaluation of historic properties, articulate their views on the undertaking's effects on such properties, and participate in the resolution of adverse effects (*See* 36 C.F.R. § 800.2(c)(2)); and

WHEREAS, the UKB is a Federally recognized Indian tribe, organized pursuant to the Indian Reorganization Act of 1934, with an inherent right of sovereignty in a government-to-government relationship with executive branch Departments and Agencies of the United States; and

WHEREAS, appropriate treatment of Native American sacred sites and/or historic properties of interest to the UKB requires a responsible balance between Native American cultural values, other public interests, and the mission of TVA;

NOW THEREFORE BE IT RESOLVED, that TVA and the UKB agree that the following procedures shall be instituted:

I. DEFINITIONS

For the purpose of this Memorandum of Understanding (MOU), the following definitions shall apply:

1. ***Consultation*** means the process of seeking, discussing, and considering the views of other participants, and, where feasible, seeking agreement with them regarding matters arising in the section 106 process. The Secretary of Interior's "Standards and Guidelines for Federal Agency Preservation Programs pursuant to the National Historic Preservation Act" provides further guidance on consultation. For activities subject to NAGPRA, consultation will be conducted in accordance with 43 CFR Part 10.
2. ***Cultural affiliation*** means that there is a relationship of shared group identity which can be reasonably traced historically or prehistorically between a present-day Indian tribe and an identifiable earlier group, as defined in 25 U.S.C. § 3001(2).
3. ***Day*** or ***days*** means calendar days.
4. ***Federal lands*** mean any land other than tribal lands which are controlled or owned by the United States. For this document, Federal lands mean fee simple lands of TVA.
5. ***Historic property*** means any prehistoric or historic district, site, building, structure, or object included on, or eligible for inclusion in the National Register of Historic Places, including artifacts, records, and material remains related to such a property, as defined in 16 U.S.C. § 470w(5).
6. ***Indian tribe*** means any tribe, band, nation, or other organized group or community of Indians, (including Alaska Native village (as defined in, or established pursuant to, the Alaska Native Claims Settlement Act),) which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians, as defined in 25 U.S.C. § 3001(7).
7. ***Preservation*** includes identification, evaluation, recordation, documentation, curation, acquisition, protection, management, rehabilitation, restoration, stabilization, maintenance, research, interpretation, conservation, and education and training regarding the foregoing activities or any combination of the foregoing activities, as defined in 16 U.S.C. § 470w(8).
8. ***Sacred site*** is any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe or Indian individual determined to be an appropriately authoritative representative by an Indian religion and sanctioned by a Federally recognized Indian tribe as a representative of that tribe, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has, after consultation, informed the agency of the existence of such a site after consultation, as defined in Executive Order 13007: Protection of American Indian Sacred Sites (May 24, 1996).
9. ***Traditional cultural property*** means a place that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community as defined in National Register Bulletin 38, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*.
10. ***Undertaking*** means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including
    a. Those carried out by or on behalf of the agency;
    b. Those carried out with Federal financial assistance; and
    c. Those requiring a Federal permit, license, or approval.

II. CLASSES OF UNDERTAKINGS NOT OF INTEREST TO UKB

The UKB has requested that there be no consultation for the following undertakings:

1. Practices or projects that do not have the potential to affect cultural resources because these undertakings do not involve any ground disturbance. Examples of these undertakings would include tree trimming, herbicide application, refuse management, and painting.

2. Practices or projects that do not have the potential to affect cultural resources because these undertakings do not involve new ground disturbance, and the installation of projects will not exceed the depth, extent, or kind of the previous undertaking. Examples include sign repair, guardrail replacement, and repaving.

III. PROCEDURES FOR CONSULTATION INITIATED BY TVA WITH THE UKB

Upon initiation by TVA of the planning for an undertaking within the UKB geographic area of interest delineated in Appendix A to this MOU (TVA/UKB Consultation Area), the following steps shall be pursued:

1. TVA shall operate within a government-to-government relationship with the UKB.

2. TVA shall work with the Point-of-Contact (POC) appointed by the UKB. If a new POC is appointed, then it shall be the responsibility of the UKB to notify TVA in writing within 30 days of any changes. TVA shall similarly notify the UKB of its POC or replacement POCs.

3. TVA shall issue a review notification to the UKB POC once an undertaking is planned.

4. The review notification shall include a description of the project, a map showing the location of the proposed undertaking, a description of how the undertaking shall impact the area, a schedule of when the undertaking shall take place, a list of all tribes contacted, the name of the POC for TVA, the specific input needed from the UKB, and a request for the names and addresses of other persons the UKB recommends be notified or consulted.

5. The UKB will agree or decline to consult on the proposed undertaking within 30 days of receipt of the review notification regarding the proposed undertaking. When necessary and appropriate, TVA will contact the UKB POC to further elaborate on the nature of the proposed undertaking. The UKB's decision to accept or decline the offer of consultation will be documented by TVA. Failure to respond to TVA's offer of consultation will be construed as UKB's declination of the offer, after TVA has made a second attempt of contact within the aforementioned 30-day period (or thereafter) to ensure the initial communication was in fact received.

6. TVA shall begin consultation within 30 days of receipt of statement of interest from the UKB.

7. Consultation shall be conducted to elicit the concerns of the UKB, and TVA shall take all concerns into full consideration to arrive at decisions that respect those concerns when possible.

8. TVA personnel shall consider the demands placed on the UKB by a compliance review process which spans multiple states and agencies and may amend consultation schedules and deadlines when feasible to allow the UKB time to respond or to attend consultation meetings.

9. The UKB shall recognize that TVA has time constraints on projects, and the UKB shall address responses in a timely manner to ensure participation in the compliance review process.

IV. PROCEDURES FOR CONSULTATION INTITIATED BY THE UKB WITH TVA

1. If the UKB has reason to believe that TVA is not addressing their concerns, the UKB can contact TVA's POC to discuss these concerns.

2. If the UKB has reason to believe that the TVA POC has not addressed their concerns, then the UKB POC may seek assistance from the next level of management.

V. RESPECT FOR RELIGIOUS AND OTHER CULTURAL BELIEFS

1. When a proposed undertaking shall affect a sacred site or a traditional cultural property of the UKB, TVA personnel shall respect such interests in accordance with the First Amendment to the U.S. Constitution.

2. TVA personnel shall understand that Native American religious practitioners may be unwilling to disclose information about a sacred site and/or traditional cultural properties so as not to violate their cultural values.

3. The UKB shall take into consideration that TVA shall need documentation or a testimonial statement from a tribally recognized cultural expert as to why a specific area is considered a sacred site and/or traditional cultural property, or TVA may not be able to prevent the adverse effect to the site.

4. When a proposed TVA undertaking shall affect human remains and/or associated funerary objects for which UKB may have a right of custody under the Native American Grave Protection and Repatriation Act (NAGPRA) or when human remains and/or associated funerary objects for which UKB may have a right of custody under NAGPRA are inadvertently discovered as a result of a TVA undertaking, such remains and objects shall be treated according to the regulations implementing NAGPRA (*See* 43 C.F.R. § 10).

VI. CONFIDENTIALITY

1. Participants in the compliance review process shall seek the minimal amount of information that is necessary to complete the undertaking.

2. TVA shall respect the UKB request and need for confidentiality of information regarding sacred sites and/or traditional cultural properties.

3. Any information divulged to TVA from any source, including traditional leaders or members of the tribe, shall be kept confidential to the extent such information is exempted from disclosure under TVA's regulations implementing the Freedom of Information Act. UKB recognizes that TVA may be obligated under the Freedom of Information Act or other applicable law to disclose all non-exempt information generated from discussions with UKB.

4. TVA and the UKB shall implement this MOU consistent with 36 CFR § 800.11(c)(1), regarding disclosure of sensitive information: "Section 304 of the [NHPA] provides that the head of a Federal agency…, after consultation with the Secretary, shall withhold from public disclosure information about the location, character, or ownership of a historic property when disclosure may cause a significant invasion of privacy; risk harm to the historic property; or impede the use of a traditional religious site by practitioners. When the head of a Federal agency…has determined that information should be withheld from the public pursuant to these criteria, the Secretary, in consultation with such Federal agency head or official, shall determine who may have access to the information for the purposes of carrying out the act."

5. TVA and the UKB recognize that non-location information on historic or archaeological properties may not necessarily be protected.

VII. TERM OF AGREEMENT

1. From the date of the last party signature, the MOU shall remain in effect for a term of three (3) years and may be amended only with the written consent of all parties hereto at the time of such amendment.

2. Any signatory party may terminate their participation in the MOU upon 30 days' written notice to the other signatories.

ON THIS 4TH DAY OF August, 2006, the parties herby acknowledge, by affixing hereto the signatures of their authorized representatives, that they have read and agree to abide by the statements of the Memorandum of Understanding.

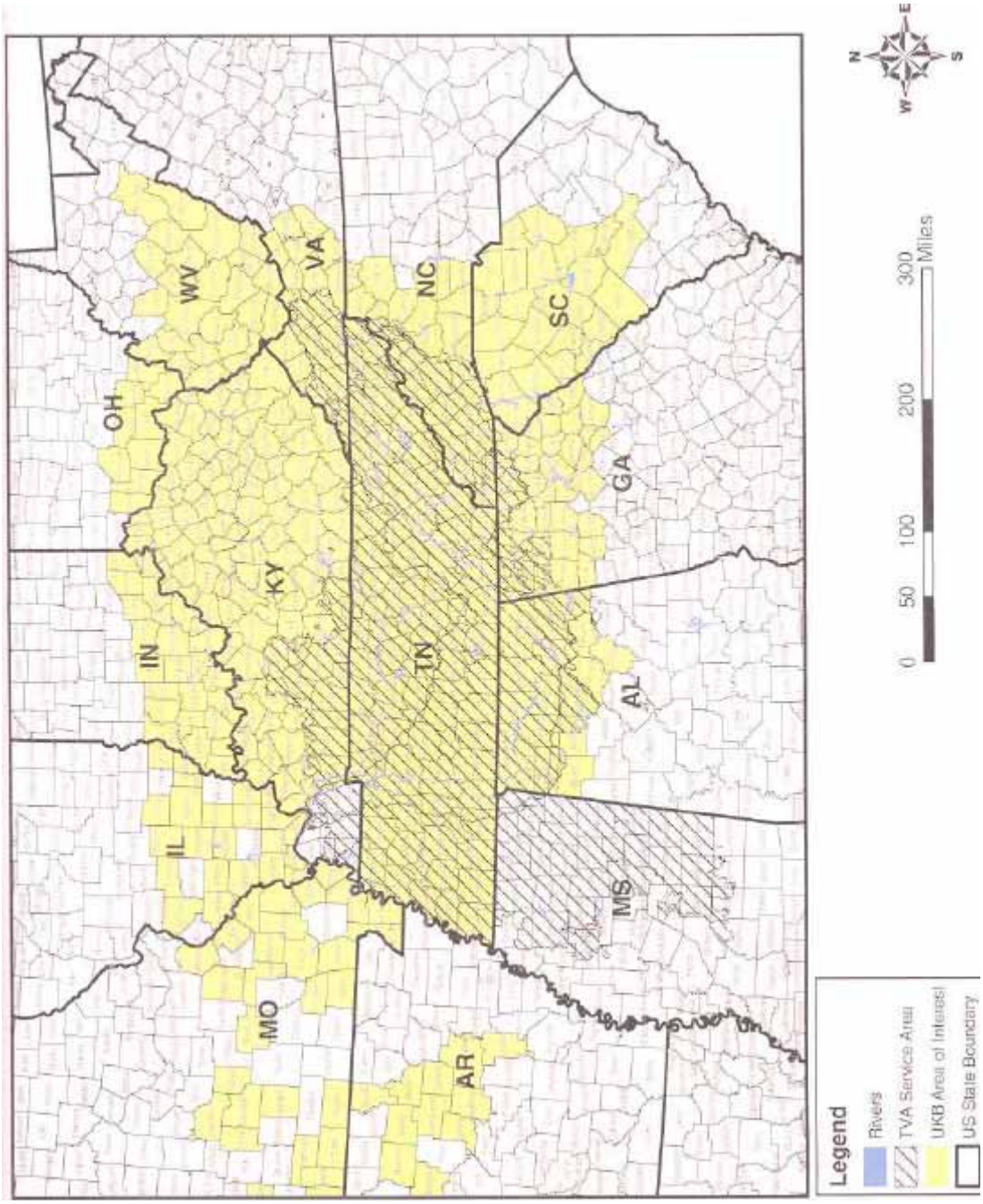
United Keetoowah Band of Cherokee Indians in Oklahoma

George G. Wickliffe
Chief

Tennessee Valley Authority

Tom Kilgore
President & Acting Chief Executive Officer

Appendix A
TVA/UKB Consultation Area


OH
WV
VA
NC
SC
GA
KY
IN
TN
AL
IL
MS
MO
AR
N
E
W
S
0
50
100
200
300
Miles
Legend
Rivers
TVA Service Area
UKB Area of Interest
US State Boundary

United Keetoowah Band of Cherokee Indians in Oklahoma

Areas of Historic Interest

including
Current Jurisdictional Area

Historic Preservation Program
Lisa Stopp
Acting Historic Preservation Officer
P.O. Box 746
Tahlequah, OK 74465

918.456.9200

lstopp@unitedkeetoowahband.org

updated June, 2006

www.ukb-nsn.gov

State and County Summary
of the United Keetoowah Band of Cherokee Indians in Oklahoma

ALABAMA

Blount
Cherokee
Colbert
Cullman
DeKalb
Etowah
Franklin
Jackson
Lauderdale
Lawrence
Limestone
Madison
Marion
Marshall
Morgan
St. Clair
Winston

WEST VIRGINIA

Boone
Cabell
Fayette
Kanawha
Lincoln
Logan
Mason
McDowell
Mercer
Mingo
Monroe
Putnam
Raleigh
Summers
Wayne
Wyoming

GEORGIA

Banks
Barrow
Bartow
Catoosa
Chattooga
Cherokee
Clarke
Cobb
Dade
Dawson
Elbert
Fannin
Floyd
Forsyth
Franklin
Gilmer
Gordon
Gwinnett
Habersham
Hall
Hart
Jackson
Lumpkin
Madison
Murray
Oconee
Oglethorpe
Paulding
Pickens
Polk
Rabin
Stephens
Towns
Union
Walker
White
Whitfield

NORTH CAROLINA

Alleghany
Ashe
Avery
Buncombe
Burke
Caldwell
Catawba
Cherokee
Clay
Cleveland
Gaston
Graham
Haywood
Henderson
Jackson
Lincoln
Macon
Madison
McDowell
Mitchell
Polk
Rutherford
Swain
Transylvania
Watauga
Wilkes
Yancey

SOUTH CAROLINA

Abbeville
Aiken
Anderson
Calhoun
Cherokee
Chester
Edgefield
Fairfield
Greenwood
Greenville
Kershaw
Lancaster
Laurens
Lexington
McCormick
Newberry
Oconee
Orangeburg
Pickens
Richland
Saluda
Spartanburg
Union
York

VIRGINIA

Bland
Buchannan
Carroll
Dickenson
Floyd
Giles
Grayson
Lee
Montgomery
Pulaski
Russell
Scott
Smyth
Tazewell
Washington
Wise
Wythe

KENTUCKY

Adair
Allen
Anderson
Barren
Bath
Bell
Boone
Bourbon
Boyd
Boyle
Bracken
Breathitt
Breckinridge
Bullitt
Butler
Caldwell
Campbell
Carroll
Carter
Casey
Christian
Clark
Clay
Clinton
Crittenden
Cumberland
Davies
Edmonson
Elliott
Estill
Fayette
Fleming
Floyd
Franklin
Galltin
Garrard
Grant
Grayson
Green
Greenup
Hancock
Hardin
Harlan
Harrison
Hart
Henderson
Henry
Hopkins
Jackson
Jefferson
Jessamine
Johnson
Kenton
Knott
Knox
LaRue
Laurel
Lawrence
Lee
Leslie
Letcher
Lewis
Lincoln
Livingston
Logan
Lyon
McCreary
McLean
Madison
Magoffin
Marion
Martin
Mason
Meade
Menifee
Mercer
Metcalfe
Monroe
Montgomery
Morgan
Muhlenburg
Nelson
Nicholas
Ohio
Oldham
Owen
Owsley
Pendleton
Perry
Pike

OKLAHOMA

Adair
Alfalfa
Blaine
Cherokee
Craig
Creek
Delaware
Dewey
Ellis
Garfield
Grant
Harper
Kay
Kingfisher
Logan
Mayes
Major
Muskogee
Noble
Nowata
Osage
Pawnee
Payne
Rogers
Sequoyah
Tulsa
Wagoner
Washington
Wood
Woodward

KANSAS

Barber
Bourbon
Chautauqua
Cherokee
Commanche
Clark
Cowley
Crawford
Harper
Labette
Linn
Meade
Montgomery
Morton
Seward
Stephens
Sumner

OHIO

Adams
Brown
Clermont
Gallia
Highland
Jackson
Lawrence
Pike
Scioto

WEST VIRGINIA

Boone
Braxton
Cabell
Clay
Fayette
Greenbrier
Kanawha
Lincoln
McDowell
Mercer
Mingo
Monroe
Nicholas
Pocahontas
Putman
Raleigh
Randolph
Roane
Wayne
Webster
Wyoming

MISSOURI

Barry
Barton
Bollinger
Butler
Camden
Cape Girardeau
Carter
Christian
Dade
Dallas
Dent
Dunklin
Iron
Jasper
Jefferson
Laclede
McDonald
Madison
Mississippi
New Madrid
Newton
Ozark
Pemiscot
Perry
Pulaski
Ripley
Scott
Ste. Genevieve
Stone
Taney
Washington
Wayne
Wright

ILLINOIS

Alexander
Clay
Clinton
Edwards
Franklin
Gallatin
Hamilton
Hardin

Jackson
Jefferson
Johnson
Lawrence
Marion
Massac
Pope
Perry
Pulaski
Randolph
Saline
St. Clair
Saline
Union
Wabash
Wayne
Wabash

INDIANA

Clark
Crawford
Davies
Dubois
Dearborn
Floyd
Gibson
Harrison
Jackson
Jefferson
Jennings
Knox
Lawrence
Martin
Ohio
Orange
Perry
Pike
Posey
Ripley
Scott
Spencer
Switzerland
Vanderburgh
Warrick
Washington

KENTUCKY

Powell
Pulaski
Robertson
Rockcastle
Rowan
Russell
Scott
Shelby
Simpson
Spencer
Taylor
Todd
Trigg
Trimble
Union
Warren
Washington
Wayne
Webster
Whitley
Wolfe
Woodford

TEXAS

Cherokee
Rusk
Smith

ARKANSAS

Arkansas
Baxter
Cleburne
Conway
Crittenden
Cross
Desha
Faulkner
Franklin
Johnson
Lincoln
Lonoke
Monroe
Newton
Phillips
Prairie
Searcy
St. Francis
Stone
VanBuren
White

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