

# **Water Supply Assessment for Etowah River Dam No. 1 Forsyth County, Georgia**



Prepared for:  
**Georgia State Soil and Water Conservation  
Commission**

Prepared by:  
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## **EXECUTIVE SUMMARY**

The Georgia Soil and Water Conservation Commission (GSWCC), in partnership with the Natural Resources Conservation Service (NRCS) and the Georgia Environmental Protection Division (EPD) initiated a study to evaluate whether or not any of the existing watershed dams, designed and constructed under federal laws PL 544 and PL 566, could be modified to serve as water supply reservoirs. The evaluation process went through several iterations, the most recent of which can be found in the Finding Report dated December, 2007 on file with the GSWCC. The Finding Report identified 20 structures that had sufficient potential for relatively high yields with relatively small environmental and infrastructural impacts, when compared to the other projects evaluated. The selected twenty dams were further evaluated to identify project parameters.

The following report summarizes the evaluation of the Etowah River Dam Number 1 located in Forsyth County, Georgia. For the purposes of this report, the existing normal pool will be raised to impound a water supply pool having a surface area of approximately 663 acres.

For convenience, the following summary lists the major findings of this evaluation. This summary should not be utilized as a separate document or in lieu of reading the entire report, including the Appendix.

- Approximately 1055 acres of land will be impacted by the proposed reservoir and dam raising
- Approximately 83 structures will be impacted by the proposed reservoir and dam raising
- Nine county roads will be impacted.
- For the modeled conditions, the drought of record in the Etowah River basin is the period 1986-1988. For a water supply storage of approximately 6,900 million gallons and supplementation of natural reservoir inflow by pumped diversions (maximum 50 million gallons per day, mgd) from nearby Etowah River, the safe yield of the reservoir is estimated to be 24.3 mgd.
- Approximately 18 acres of palustrine wetlands will be impacted by the proposed reservoir and dam raising
- Approximately 29 acres of lacustrine/palustrine open waters will be impacted by the proposed reservoir and dam raising
- Approximately 37,334 linear feet of lower perennial streams will be impacted by the proposed reservoir and dam raising
- Approximately 16,585 linear feet of intermittent streams will be impacted by the proposed reservoir and dam raising
- Review of existing threatened and endangered species information identified nine protected species documented from Forsyth County, Georgia and consists of six faunal and three floral species.
- Review of available information did not indicate any cultural resources, primary or secondary trout streams, or 303(d) / 305(b) listed streams occurring within the maximum reservoir pool limits of Etowah River No. 1.
- Project cost is estimated in 2007 dollars at \$256,000,000.

## **PREFACE**

The results of the analyses presented herein are based in part upon United States Geological Survey (USGS) quadrangle maps and, therefore, should be utilized for planning purposes only. If the subject project is identified as having a possibility of progressing past this analysis, additional studies will be required. These studies will include but not be limited to detailed environmental evaluations, detailed yield analyses, preliminary engineering design, and detailed cost estimating. These additional studies will be required prior to beginning detailed design work and/or land acquisition. The level of study presented herein shall be considered as a screening tool to evaluate the proposed project relative to other projects. Until further studies are performed, actual yield and costs associated with the entire project cannot be readily determined.

## **TABLE OF CONTENTS**

EXECUTIVE SUMMARY	
PREFACE	
INTRODUCTION .....	1
BACKGROUND .....	1
INSERT PLAN NEEDS AND DEMAND EVALUATION .....	2
NEEDS AND DEMAND EVALUATION .....	3
ENGINEERING FACTORS .....	6
SAFE YIELD ANALYSIS .....	9
RESULTS .....	13
ENVIRONMENTAL CONSIDERATIONS .....	16
PROJECT CONSTRUCTION COST ESTIMATE NARRATIVE.....	24
APPENDIX.....	32

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## **INTRODUCTION**

The project team of Schnabel Engineering South, LLC (Schnabel), Jordan Jones and Golding (JJ&G), Joe Tanner and Associates, and the Law Office of William Thomas Craig were retained by the Georgia State Investment and Financing Commission as the agent for the Georgia Soil and Water Conservation Commission to evaluate 166 existing flood control structures. The subject structures were originally designed and constructed under Federal laws PL 544 and PL 566 to control storm water runoff (flooding) and collect sediment. The goal of this evaluation was to identify impoundments that could be enlarged to provide a relatively reliable water supply. The results of the evaluation were utilized to select twenty of the dams and reservoirs that had potential for relatively high yields with relatively small environmental and infrastructural impacts, when compared to the other projects evaluated. The selected twenty dams were further evaluated to identify project parameters. The additional evaluation included the following:

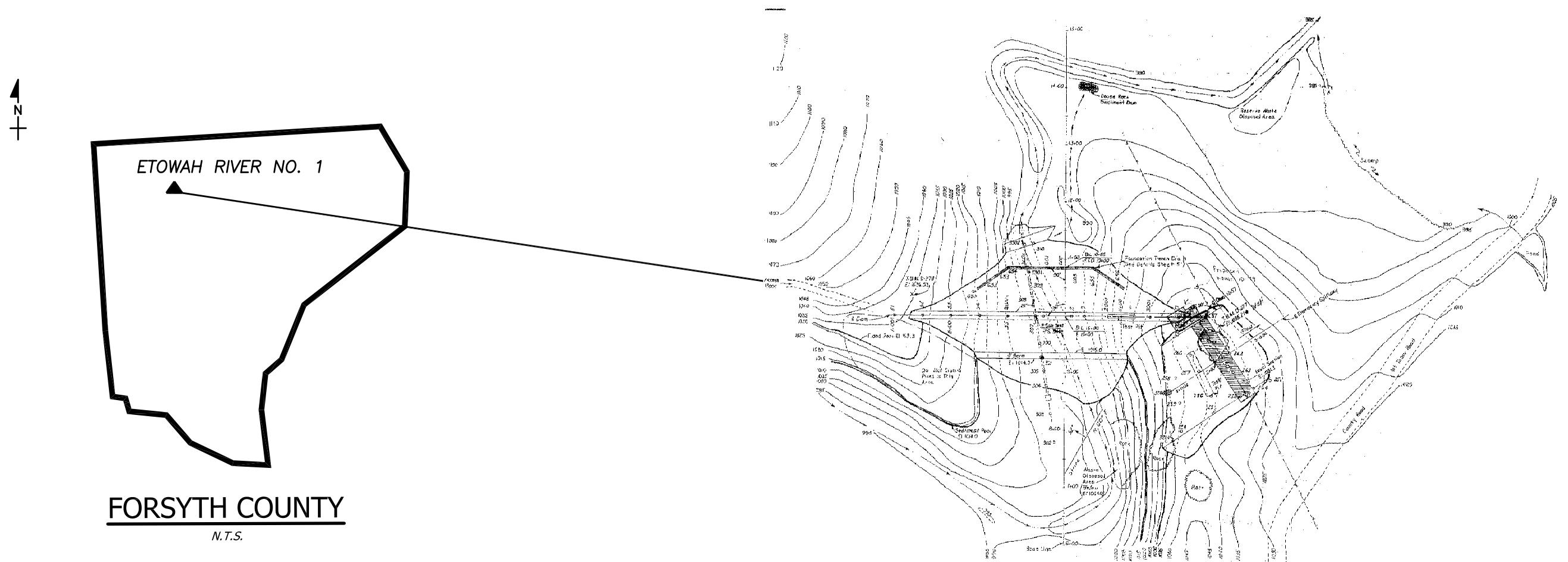
- More detailed yield analyses
- More detailed environmental evaluation
- Cost estimation of proposed modifications

The Etowah River Dam Number 1 in Forsyth County, Georgia was one of the structures selected for further evaluation.

## **BACKGROUND**

The subject dam, Etowah River Sub-Watershed Coosa River Watershed Dam Number 1 (Etowah River Dam No. 01), is located approximately 9 miles northwest of Cumming, Georgia in Forsyth County. More specifically, the dam is located on Brewton Creek just upstream of Mount Tabor Road.

The existing dam was designed in 1969 and constructed in 1969. As designed, the dam had a crest elevation of 1034.0 feet and impounded a reservoir that had a surface area of approximately 38 acres at a normal pool elevation of 1014 feet. The crest of the emergency spillway was designed to be at elevation 1031.3 feet. According to the Soil Conservation Service (SCS), now known as the Natural Resources Conservation Service (NRCS), Dam Inventory sheet, the dam was originally designed and constructed as a Class ‘a’ or low-hazard dam. However, the classification of the dam is currently Class ‘c’ or high-hazard according to the NRCS. The state Safe Dams program classifies the existing dam as a Category 1 structure. When designed, the emergency spillway (now referred to as an auxiliary spillway) had a 4 percent chance of operating in any given year. This results in the auxiliary spillway operating during storm events equal to and greater than the 25-year event. Not including engineering, land acquisition, or project administration, the dam was completed for a cost of approximately \$81,000.



## EXISTING SITE PLAN

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## NRCS WATERSHED DAM ASSESSMENT ETOWAH RIVER DAM NO. 1

## SITE LOCATION MAP

PROJECT NO. 07170030.01  
FIGURE 1

## NEEDS AND DEMAND EVALUATION

Population projections through the year 2025 were obtained from the Forsyth County Community Assessment (published in 2006). Projections to 2057 were extrapolated based on the assumption of the same constant growth rate that was shown in the Community Assessment. These projections can be seen in Table 1.

**Table 1**  
**Population Projection**

<b>Year</b>	<b>Population Projection</b>
2000	98,407
2005	131,569
2010	160,219
2015	185,019
2020	206,419
2025	227,819
2030*	249,219
2035*	270,619
2040*	292,019
2045*	313,419
2050*	334,819
2055*	356,219
2057*	364,779

*Data Source: from Forsyth County Community Assessment*

*\*Population calculated based on yearly % growth from 2000-2025*

Water demand projections were calculated based on population projections and water withdrawal data for Forsyth County in 2000. According to the US Census, the population of Forsyth County was 98,407 in 2000, while the water withdrawal was 18 million gallons per day (MGD) based on the document “Water Use in Georgia by County for 2000”, (Information Circular 106, Julia Fanning, USGS, Atlanta, 2003). The Forsyth County Water Department currently holds a surface water withdrawal permit from Lake Lanier for 14 MGD. Additionally, the City of Cumming holds a surface water permit for 18 MGD also from Lake Lanier (all numbers are reported in permitted monthly average).

The overall usage was calculated to be 187 gallons per day (gpd) per person. This number was used as a constant through 2057 to create water withdrawal projections. The water withdrawal projection for 2057 was calculated to be approximately 68 MGD. This figure includes all unaccounted for water (UAW), and the assumption that industrial usage would increase with the increase in Forsyth County population. Water withdrawal projections are shown in Table 2.

**Table 2**  
**Water Withdrawal Projection**

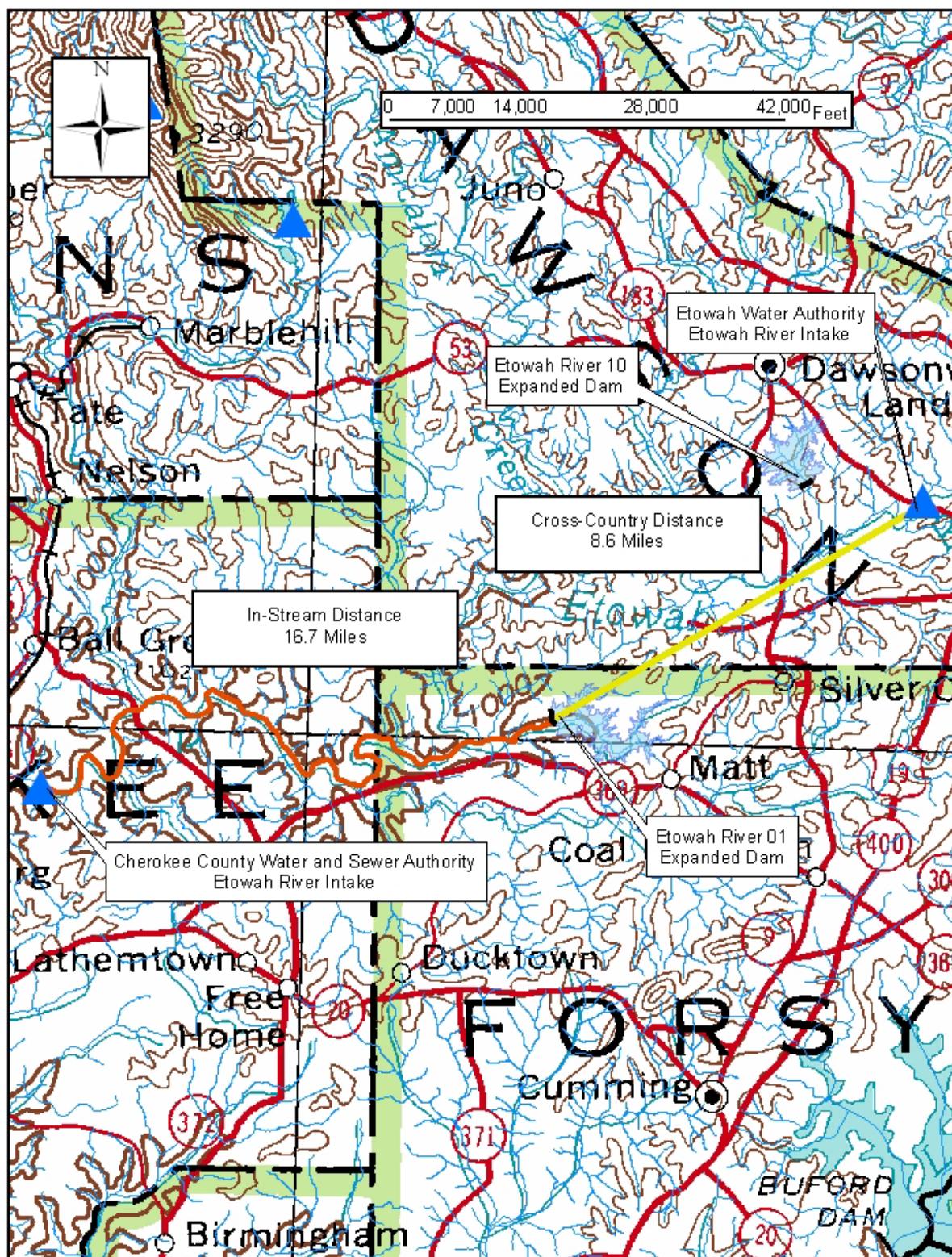
<b>Year</b>	<b>Water Withdrawal Projection (MGD)</b>
2000	18
2005	25
2010	30
2015	35
2020	39
2025	43
2030	47
2035	51
2040	55
2045	59
2050	63
2055	67
2057	68

### **Proximity to Surface Water Intakes**

Based on the GIS database developed for this project, the closest downstream surface water intake structure is 16.7 miles downstream of the dam on the Etowah River. This structure is operated by the Cherokee County Water and Sewer Authority. The Etowah River is approximately 1.7 miles from the dam along Brewton Creek. The remaining 15.0 miles is along the Etowah River.

There is an intake structure approximately 8.6 miles to the northeast operated by the Etowah Water Authority, also on the Etowah River. Figure 2 illustrates the location of the nearest surface water intakes to Etowah River 01.

**Figure 2**  
**Distance to Nearest Intake**



## **ENGINEERING FACTORS**

### **Proposed Dam**

The proposed dam, which will incorporate the existing dam, has a crest elevation of 1100 feet, an auxiliary spillway elevation of 1090 feet, and a normal pool elevation of 1088 feet. The proposed dam will impound a reservoir that has a surface area of approximately 663 acres and storage volume of approximately 6,800 million gallons (MG). A plan view of the proposed reservoir is shown in Figure 3.

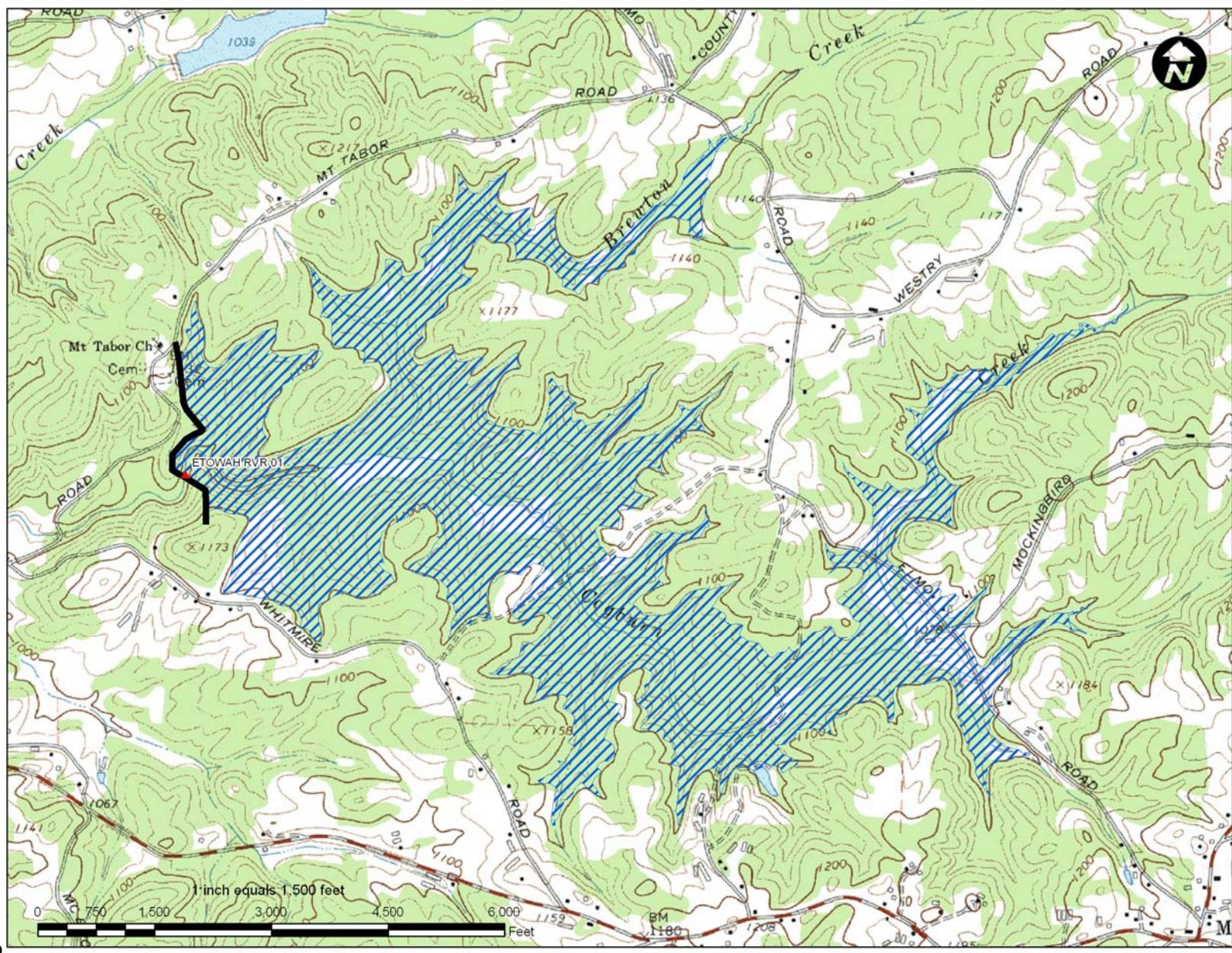
Several engineering assumptions were made pertaining to spillway configuration. The spillway system for the proposed dam was assumed to consist of a principal spillway in the form of a 2'-6" by 7'-6" interior dimension reinforced concrete riser with a 30-inch diameter reinforced concrete low-level outlet pipe and an auxiliary spillway in the form of a 280-foot wide reinforced concrete chute spillway with ogee crest. The intent of the proposed principal spillway is to approximate the flows that are being discharged by the current spillway system during the two through 100-year storm events. The size of the auxiliary spillway was approximated by estimating the peak inflow that would occur during the Probable Maximum Precipitation (PMP) event and computing the spillway width that would be required to pass the estimated inflow with a given amount of hydraulic head. The available hydraulic head was determined by comparing the drainage basin area to lake surface area. The structures that had a drainage basin area to lake surface area ratio equal to or in excess of ten were allotted 15 feet of hydraulic head to pass the PMP inflows, while the structures that had a ratio of less than ten were allotted ten feet of hydraulic head to pass the PMP inflows. The assumption that the dam would be required to pass the inflow resulting from the PMP storm event is based on the history of the Georgia Department of Natural Resources Environmental Protection Division Safe Dams Program (Safe Dams) reviewing plans for water supply reservoir dams regardless of classification. As such, the dam would generally be required to comply with the engineering guidelines established by Safe Dams. Based upon the height of the dam (approximately 120 feet), the dam would be required to store and/or pass the inflows from the full PMP event safely.

The proposed dam and flood pool will:

- Impact 83 structures
- Require the purchase of 835 acres from 401 parcels
- Require the purchase of 220 acres of easement area for state required buffer
- Impact nine local/county roads

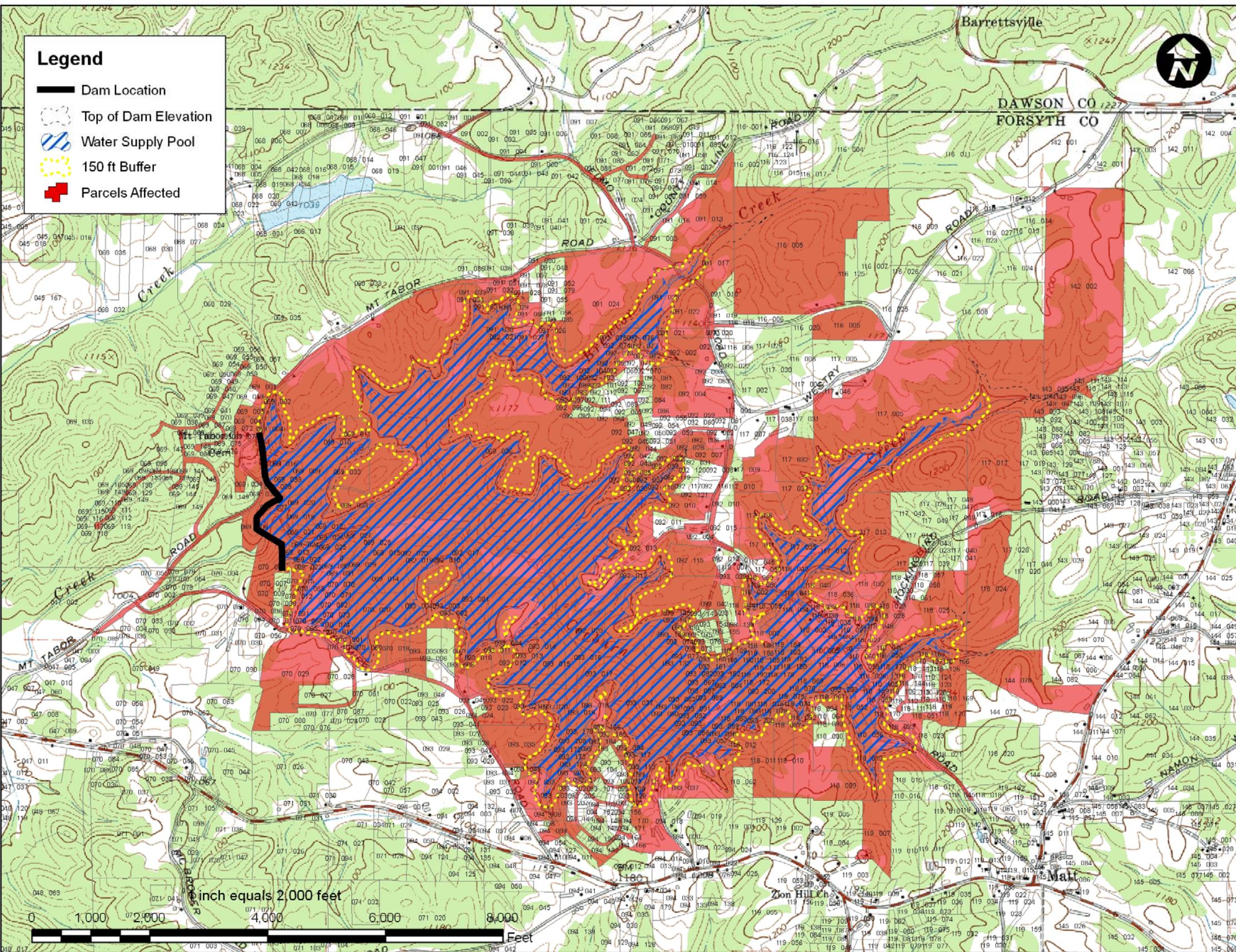
Figure 4 displays the proposed reservoir area as well as the buffer and affected parcels. The 83 affected structures were identified from aerial photographs. The types of structures were not identified on the ground and could be houses, barns, trailers, etc. A more detailed ground survey will be required to determine the type of each structure and the corresponding purchase price of each structure.

**Figure 3**  
**Proposed Reservoir Area**



Map

**Figure 4**  
Land Acquisition and Buffer Areas



## SAFE YIELD ANALYSIS

### Definition

Reservoir safe yield is generally defined as the reliable withdrawal rate of water with acceptable quality that can be provided by reservoir storage through the critical drought period. The critical drought period in the State of Georgia is defined as the drought of record and in any given drainage basin can vary depending on reservoir size and other factors. This study was based on the critical drought period from 1986-1989; however, the current drought could possibly exceed the existing drought of record. If this were to occur, the computed yields detailed herein would be reduced. Safe yield in this study was simulated using a constant average annual demand. The justification for this is that while total water demands after declaration of a drought condition are usually less than normal, this situation is typically offset by higher than average demands prior to declaration of the drought condition. Safe yield is dependent upon the storage and hydrologic (rainfall/runoff/evaporation) characteristics of the source and source facilities, the selected critical drought, upstream and downstream permitted withdrawals, and the minimum in-stream flow requirements.

The proposed reservoir is a “pumped-storage” reservoir, where natural inflow into the reservoir is supplemented with pumped diversions from a nearby larger stream or river. Water is pumped from a larger river when runoff is plentiful, and is stored in the reservoir for times of drought. Pumped diversions increase safe yield, and generally result in fewer environmental impacts compared with reservoirs on main-stem rivers.

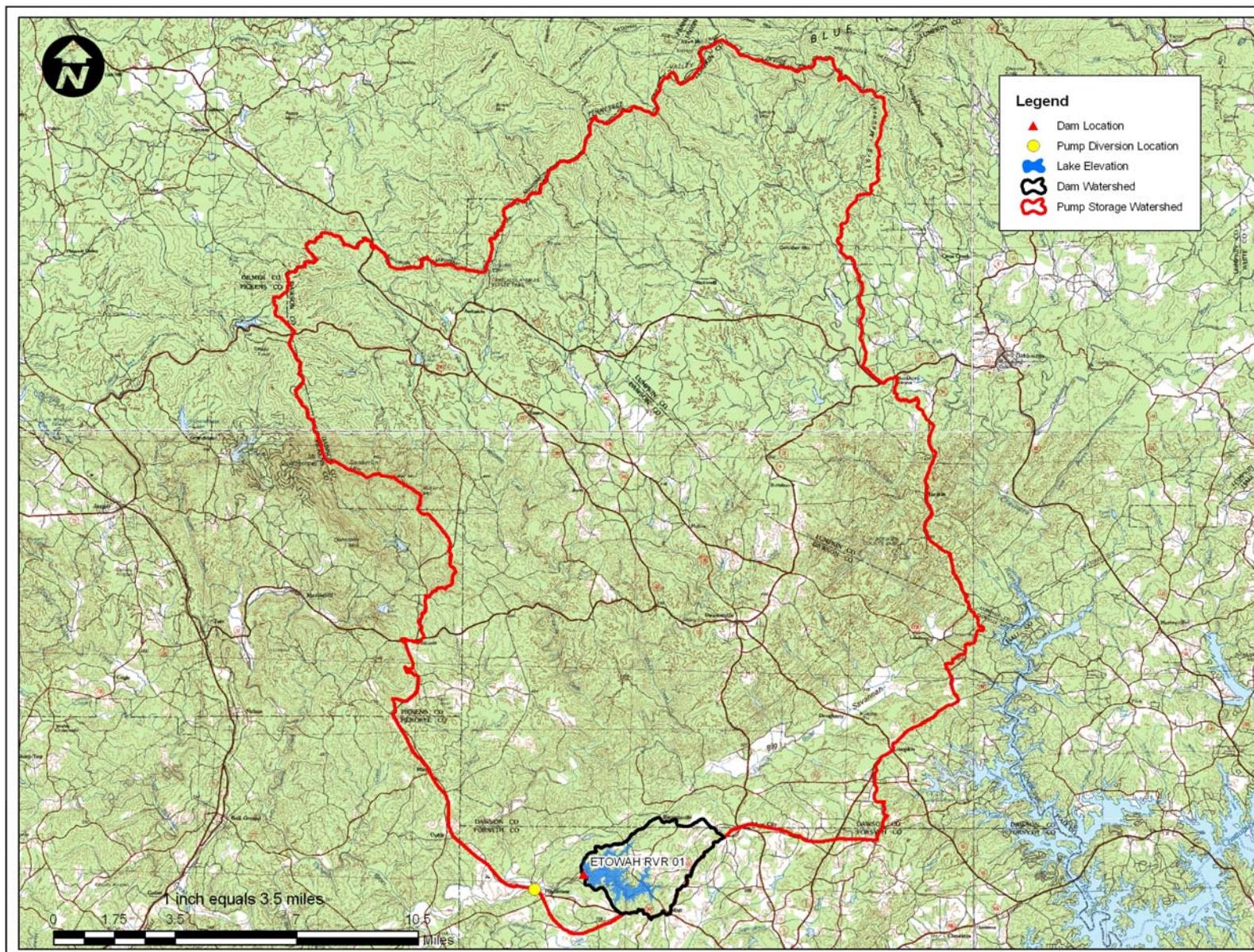
### Analysis Method

The Etowah River near Dawsonville gage (USGS 02389000) was preferred for use in this analysis; however its record period only extends from March 1940 to September 1976. Therefore, a correlation of the Dawsonville gage with the Etowah River near Canton, GA gage (USGS 02392000) was performed, and a regression-based adjustment was applied to the Canton gage flows (Figure A-1, Appendix) to lengthen the simulation period. The adjusted flows from the Etowah River near Canton, GA gage were then used to simulate stream flows in the Etowah River and Brewton Creek Basins. The record period for the Etowah River near Canton gage (adjusted) extends from October 1936 to present and includes three major droughts (1954-56, 1986-88, and 1999-2002), plus the current drought. The diversion pump station was assumed to be located just upstream of the confluence of Brewton Creek and the Etowah River. The straight line pipe distance between the dam and diversion location was estimated at 1.5 miles. The following drainage areas were used in the analysis:

- |                             |                      |
|-----------------------------|----------------------|
| • Dam Site (Brewton Creek): | 6.74 mi <sup>2</sup> |
| • Diversion (Etowah River): | 310 mi <sup>2</sup>  |

The pumped diversion location and watershed is shown in Figure 5. The maximum estimated pool level at top of dam was selected during the initial screening phase based on USGS topographic mapping. Subsequently more detailed GIS topographic mapping was obtained for calculation of reservoir storage. A freeboard allowance of 10 feet between the top of dam and the auxiliary spillway was incorporated to pass the spillway design flood (assumed to be the probable maximum flood).

**Figure 5**  
**Watershed Location Map**

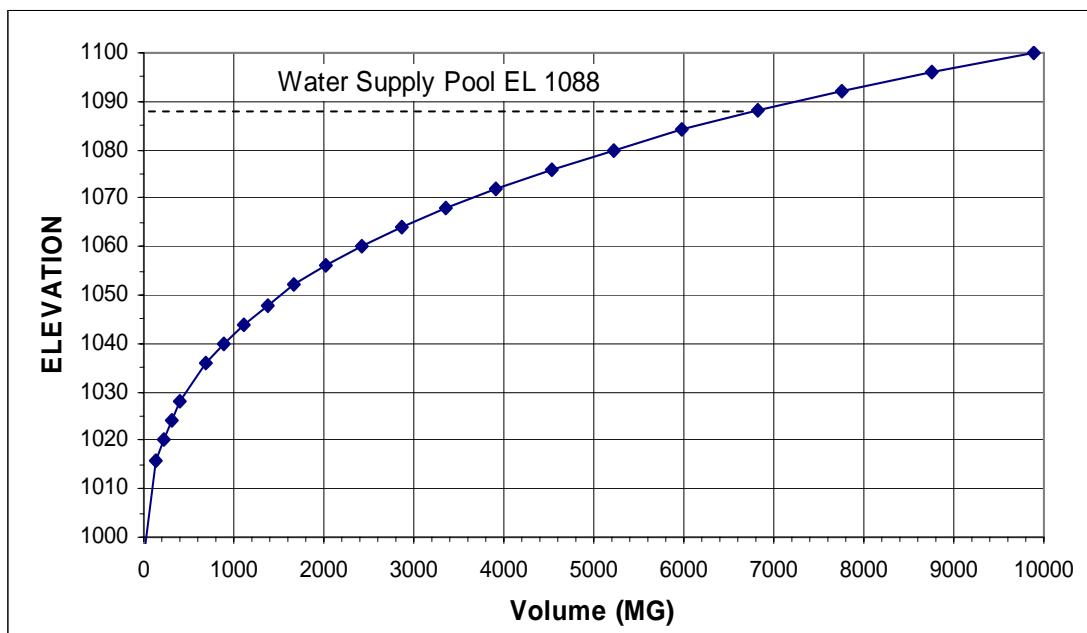


Additional depth to maintain existing flood storage volume (1116 Ac-ft, or 364 MG) was subtracted from the auxiliary spillway elevation to compute the water supply pool elevation used in the analysis of safe yield. Table 3 summarizes the various reservoir elevations and approximate storage volumes. Calculation of stage-area and stage-storage curves is presented as Figures A-2a and A-2b in the Appendix. Figure 6 below is the stage-storage curve for the reservoir.

**Table 3**  
**Summary of Reservoir Data**

Stage	Elevation	Volume (Million Gallons)
Maximum Pool (Top of Dam)	1100	9,900
Flood Pool (Auxiliary Spillway Crest)	1090	7,300
Water Supply Pool	1088	6,900

**Figure 6**  
**Stage-Storage Curve**



A reservoir operations model was developed to incorporate daily gage data from the selected USGS gage and reservoir shape parameters for estimation of evaporation. The following assumptions were incorporated into the analysis for the estimation of safe yield:

## **Assumptions:**

1. Dead storage of 20% of gross reservoir storage was incorporated to allow for sediment storage and poor water quality in lower reservoir strata.
2. Usable water supply storage was assumed to be the water supply pool storage (calculated as noted above) less dead storage.
3. Pump station diversions were assumed to be from Etowah River at the location previously described. Diversions were assumed to occur whenever the reservoir level fell below full water supply pool. Pumped diversions were assumed to be bounded by pumping capacity and by flow restrictions on Etowah River (noted below).
4. A minimum in-stream flow (MIF) of 30% AAF at the diversion pump station (Etowah River) was used.
5. Allowance for downstream withdrawals (between the proposed diversion and Lake Allatoona) by Cherokee County Water & Sewerage Authority (CCWSA), City of Canton and the Cobb County – Marietta Water Authority (CCMWA), and Gold Kist Inc. would reduce available flow in the stream. In addition to the MIF, the model provided for prorated let-bys with the following characteristics:

<b>Permittee:</b>	<u>CCWSA</u>	<u>Canton/CCMWA</u>	<u>Gold Kist Inc.</u>
<b>Downstream Withdrawal:</b>	36 mgd	55.45 mgd*	4.5 mgd
<b>Drainage Area:</b>	503 mi <sup>2</sup>	610 mi <sup>2</sup>	580 mi <sup>2</sup>
<b>Prorated Let-by:</b>	22.19 mgd	28.18 mgd	2.41 mgd

\*The withdrawal by Canton/CCMWA is a sum of the following withdrawals: Canton existing (5.45 mgd); Canton anticipated (11 mgd); and anticipated diversion to Hickory Log Creek Dam (39 mgd).

6. Proposed increases in upstream withdrawals in Etowah River basin by the Etowah Water and Sewer Authority would reduce available flow in the stream. The model incorporated the upstream withdrawals with the following characteristics:

	<b>Diversion to Proposed Russell Cr. Reservoir</b>	<b>EWSA Proposed Water Supply Withdrawal</b>
<b>Upstream Withdrawal:</b>	15 mgd	11.5 mgd
<b>Drainage Area:</b>	100.8 mi <sup>2</sup>	113 mi <sup>2</sup>
<b>MIF</b>	M7Q10	55 mgd

7. For the dam site, minimum in-stream flow of 30/60/40 percent average annual flow (AAF) was used. This MIF applies as follows: 30% AAF for July through November; 60% AAF for January through April; and 40% AAF for May, June and December.
8. Return flow from wastewater discharges or septic systems was not considered in the analysis.
9. Evaporation loss was based upon net historical evaporation rates (maximum average day) for each month as recorded at Allatoona Dam (Station No. 181) in Bartow County. Lake evaporation was assumed to be equal to 70% of pan evaporation during each month. Surface area was approximated by a regression

- equation relating storage to surface area (Figure A-3, Appendix).
10. Streamflow data from the USGS gage was applied in direct proportion of drainage areas to simulate flow into the reservoir and at the diversion location.
  11. Total seepage losses would be less than the MIF requirements and, therefore, did not need to be separately considered.
  12. Safe yield is that quantity of water that can be provided to meet water demands during the critical drought period.

The attainable safe yield during the analyzed period was found by iteration of the daily mass balance equation:

$$\text{Ending Storage} = (\text{Beginning Storage}) + (\text{Natural Inflow}) + (\text{Pumped Inflow}) - (\text{Water Supply}) - (\text{Evaporation}) - (\text{MIF})$$

The trial safe yield value was varied until the reservoir level just reached the dead storage value, and recovery of the reservoir was computed.

## RESULTS

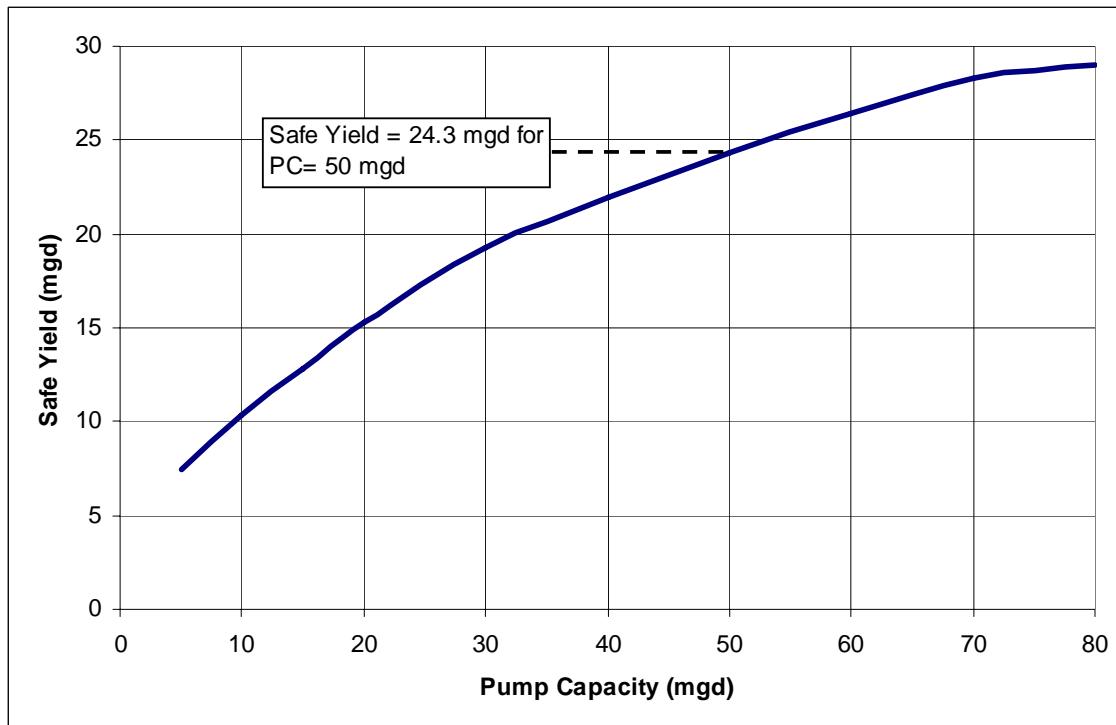
Incorporating the above assumptions, the estimated safe yield of the site was computed. The results of the safe yield analysis are presented in Table 4 and Figure 7. It should be noted that these estimated safe yield values are based on USGS topographic mapping. The estimates could vary significantly based on more detailed mapping, which would be required as part of a final safe yield analysis. The table below presents the estimated safe yield and refill time for a range of pump capacities. Refill time of 4 to 5 years was assumed as the maximum refill duration for selection of pump capacity (PC).

**Table 4**  
**Safe Yield Summary**

Pump Capacity (MGD)	Estimated Safe Yield (mgd)	Refill Time* (years)
10	10.3	7
20	15.3	4
30	19.3	2
40	21.9	2
50	24.3	2
60	26.4	2
80	29.0	1

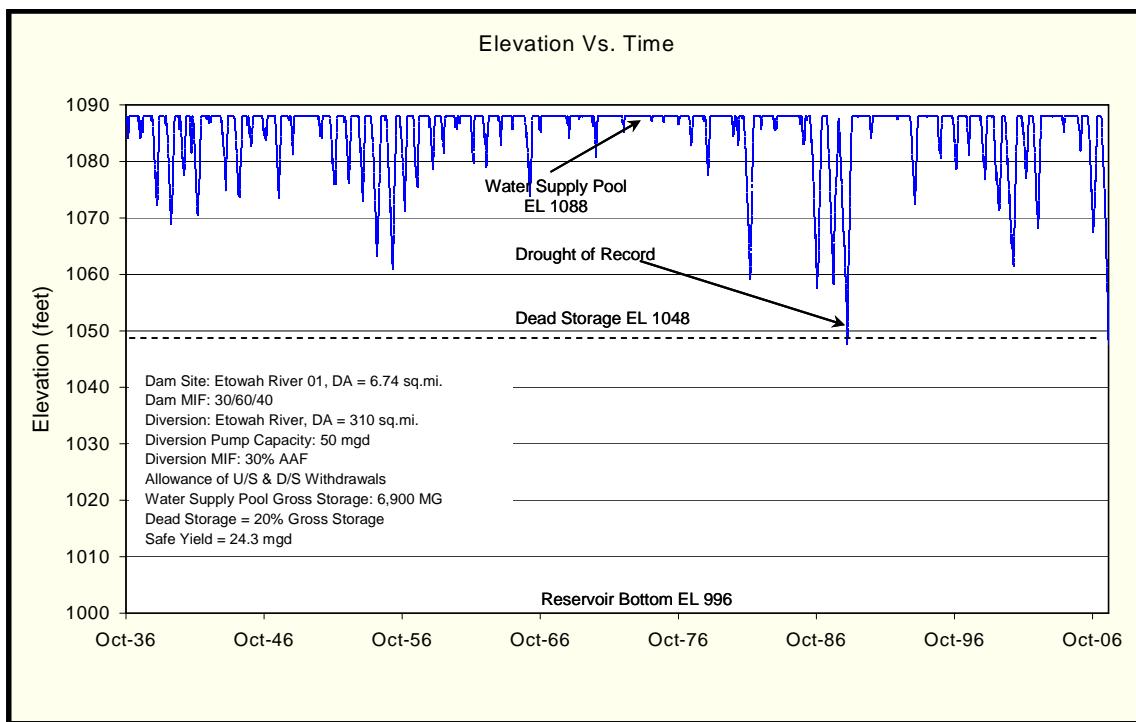
\*Refill time is the time from start of drawdown until complete refill to water supply pool

**Figure 7**  
**Estimated Safe Yield vs Pump Capacity**



As can be seen in Figure 7, there is diminishing return (safe yield) with increasing pump capacity (reflecting pump station and pipeline cost). For the purposes of this analysis, an estimated economical safe yield & pump capacity combination were selected from the above graph. The estimated safe yield for this project is approximately 24.3 mgd for a pump capacity of 50 mgd. These values were used to size and cost out the diversion facilities detailed later in this report. The variation of reservoir elevation over time for the above assumed safe yield and pump capacity is reflected in Figure 8.

**Figure 8**  
**Reservoir Elevation vs. Time**



## **ENVIRONMENTAL CONSIDERATIONS**

To evaluate the potential environmental impacts, permitting and compensatory mitigation associated with Etowah River 01, preliminary ecological studies were conducted by JJG. These studies consisted of a desktop survey and wetland approximation field surveys to estimate wetlands and streams occurring within the project area. While this evaluation is not sufficient for Clean Water Act Section 404 permitting, field surveys add increased confidence to the desktop evaluation. All estimates of jurisdictional waters, permitting requirements, and compensatory mitigation requirements/cost estimates presented herein are very general and preliminary in nature. Detailed studies would be necessary to definitively determine permitting requirements.

Prior to conducting field surveys, desktop evaluations were performed with available data resources including the U.S. Geological Survey 7.5-minute topographic maps and U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps. JJG ecologists then performed a reconnaissance-level site visit to Etowah River 01 site to verify and supplement the desktop evaluation. Subsequent to field surveys, observations were transcribed into an ArcView GIS database for analysis. Preliminary estimates of jurisdictional waters (i.e., wetlands, streams, open waters) occurring within the Etowah River 01 project area are provided below.

### **Wetlands**

The *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin Classification System) defines the Palustrine System as all nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity is less than 0.5 percent. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: 1) area less than 20-acres; 2) the lack of active wave-formed or bedrock shoreline; 3) water depth in the deepest part of basin less than 6.6 feet at low water; and 4) salinity due to ocean-derived salts less than 0.5 percent.

The Lacustrine System includes wetlands and deepwater habitats with all of the following characteristics: 1) situated in a topographic depression or a dammed river channel; 2) lacking trees, shrubs, persistent emergent vegetation, emergent mosses or lichens with greater than 30-percent areal coverage; and 3) total area exceeds 20 acres. Wetlands and deepwater habitats less than 20-acres are also included in this system if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 6.6 feet at low water.

Office and field reviews determined that approximately 18 acres of palustrine wetlands and approximately 29 acres of lacustrine/palustrine open waters exist within the Etowah River 01 project area. These systems are primarily associated with Brewton Creek, Cogburn Creek, and unnamed tributaries within the proposed reservoir pool limits. Cowardin classifications of the wetland systems range from palustrine forested to palustrine emergent with hydrologic regimes ranging from saturated to seasonally flooded.

## **Streams**

The Cowardin Classification System defines lower perennial streams as low gradient streams with slow water velocities and substrates comprised mainly of sand and mud. Intermittent streams are defined as streams flowing for only part of the year. When water is not flowing, it may remain in isolated pools or surface water may be absent. Ephemeral streams flow only in direct response to precipitation and do not receive groundwater contributions.

Office and field reviews indicate that approximately 37,334 linear feet of lower perennial streams and approximately 16,585 linear feet of intermittent streams are located within the maximum reservoir pool limits of Etowah River 01. Ephemeral streams were not identified due to the preliminary nature of the studies. Refer to Figure 9 for locations of these jurisdictional features.

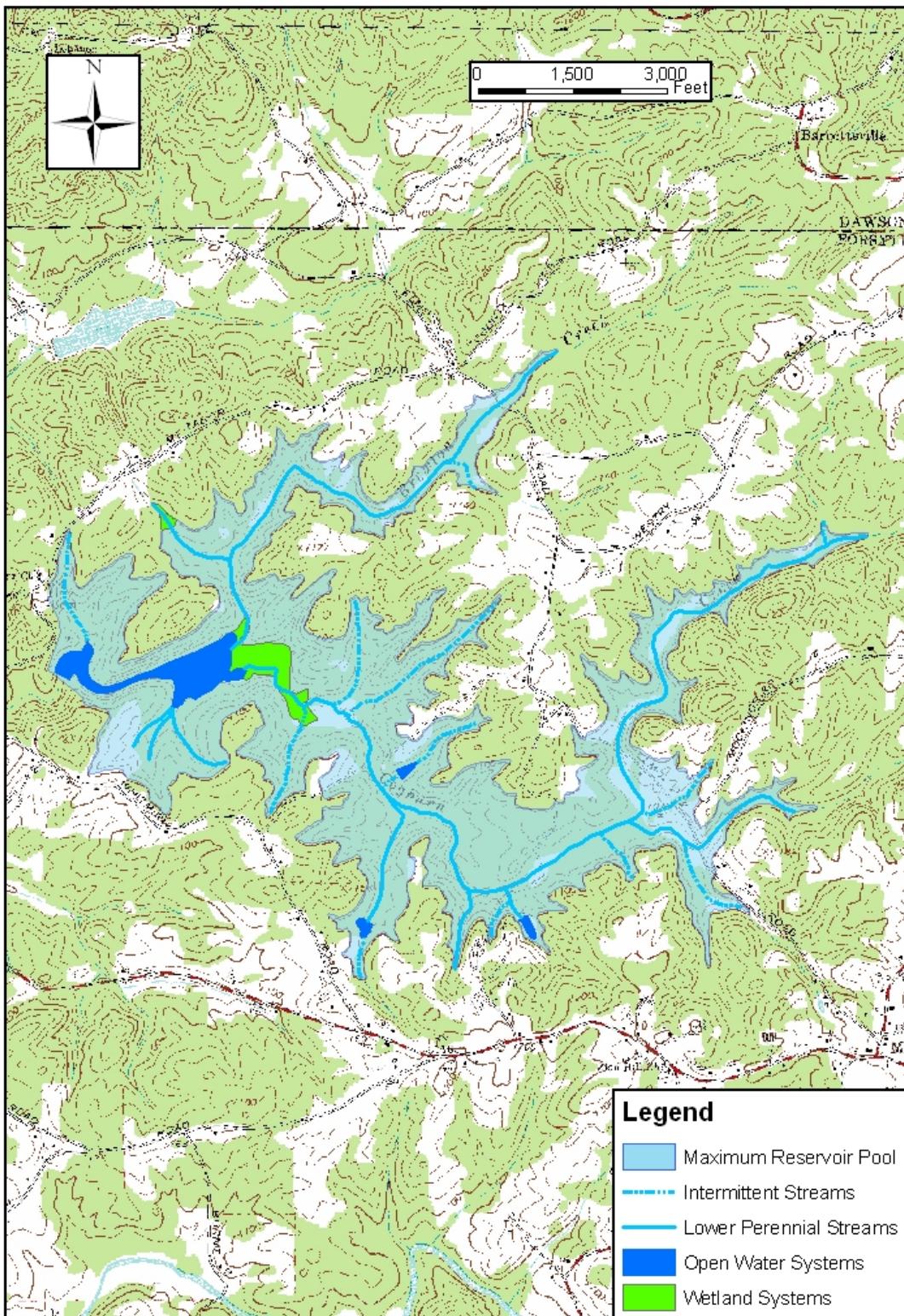
## **Cultural Resources**

Review of existing cultural resources information did not indicate any identified cultural resources within the maximum reservoir pool limits of Etowah River 01. It should be noted that the absence of recorded Cultural Resources does not mean that they do not exist; in fact, a Phase I Cultural Resources Survey (conducted to the standards of Section 106 of the National Historic Preservation Act) would be required to determine the presence or absence of Cultural Resources as part of permitting for any proposed reservoir project.

## **Threatened and Endangered Species**

Review of existing threatened and endangered species information identified nine protected species documented from Forsyth County, Georgia and consists of six faunal and three floral species. The Georgia Department of Natural Resources – Non-game Conservation Section lists the occurrence of two federally endangered species, Etowah darter (*Etheostoma etowahae*) and amber darter (*Percina antesella*), and a state threatened species, frecklebelly madtom (*Noturus munitus*) within the maximum reservoir pool limits of Etowah River 01. Specialized aquatic surveys would be required to definitively determine the presence/absence of these species within the project area. Refer to Table 5 for a summary of protected species located in Forsyth County and potential habitat for these species within the maximum reservoir pool limits.

**Figure 9**  
**Jurisdictional Areas Location Map**



**Table 5**  
**Summary of Protected Species for Forsyth County, Georgia**

Scientific Name	Vernacular Name	Federal Status	State Status	Habitat Present (Yes/No)	Preferred Habitat
<b>Faunal</b>					
<i>Cambarus howardi</i>	Chattahoochee crayfish	NA	T	Yes	moderate to swiftly flowing streams with gravel or cobble substrate
<i>Etheostoma etowahae</i>	Etowah darter	E	E	Yes	riffles of clear water streams with moderate to strong current over gravel or cobble substrate; typically associated with swiftest portion of riffles; species is intolerant of impoundment
<i>Etheostoma scotti</i>	Cherokee darter	T	T	Yes	shallow water in small to medium creeks with rocky bottoms in the Coosa River Basin
<i>Haliaeetus leucocephalus</i>	bald eagle	NA	T	No	forages along rivers, estuaries, and impoundments
<i>Noturus munitus</i>	frecklebelly madtom	NA	E	Yes	coarse rocky riffles and runs in large creeks and small rivers of the Etowah River basin
<i>Percina antesella</i>	amber darter	E	E	Yes	riffle areas comprised of cobble-gravel substrates with moderate to swift currents of the Etowah River basin and its larger tributaries
<b>Floral</b>					
<i>Platanthera integrilabia</i>	white fringeless orchid	C	T	Yes	red maple-blackgum swamps; sandy, damp stream margins; seepy, rocky, thinly vegetated slopes

**Table 5**  
**Summary of Protected Species for Forsyth County, Georgia**

Scientific Name	Vernacular Name	Federal Status	State Status	Habitat Present (Yes/No)	Preferred Habitat
<i>Symphyotrichum georgianum</i>	Georgia aster	C	T	Yes	post oak savannah/prairie communities; roadside or utility rights-of-way or other disturbed areas
<i>Waldsteinia lobata</i>	Piedmont barren strawberry	NA	T	Yes	rocky acidic woods along streams with mountain laurel; rarely in drier upland oak-hickory-pine woods

T= threatened, E= endangered, C= candidate species, NA= not applicable

## Trout Streams

Review of available resources indicated no primary or secondary trout streams are located within the maximum reservoir pool limits of Etowah River 01.

## 303(d) and 305(b) Listed Streams

Review of available resources did not indicate any 303(d) or 305(b) listed streams within the maximum reservoir pool limits of Etowah River 01.

## Section 404/401 Permitting

The U.S. Army Corps of Engineers (USACE) regulates the discharge of dredged or fill material into the Nation's Waters under Section 404 of the Clean Water Act. Construction of an impoundment and flooding jurisdictional streams/wetlands is regulated by the USACE. Two types of permits are available through the USACE: Nationwide and Individual Permits. Nationwide Permits (NWP) have been established previously by the Chief of Engineers for projects that have minimal cumulative impacts to the Nation's Waters. Examples of the most commonly used NWPs include site development, minor road crossings, maintenance activities, and utility line discharges. Specific criteria and conditions were established that must be satisfied prior to obtaining authorization of a NWP from the USACE. In addition, the Savannah District of the USACE issued Final Nationwide Permit Regional Conditions effective May 11, 2007.

Individual Permits (IP) are required for projects having more than minimal cumulative adverse impacts on the Nation's waters. The development of a water supply reservoir would typically require an IP. IPs involve significantly more information, documentation, and coordination with

regulatory agencies and are considerably more difficult to acquire than a NWP. Prior to coordination with the USACE regarding the construction of an impoundment, required information would consist of, but not be limited to, the following information:

- Justification of Purpose and Need for the project
- Alternatives analysis of other water supply options evaluated to meet the need
- Wetland delineation with surveyed boundaries of USACE jurisdictional waters
- Phase I cultural resources and protected species surveys
- Detailed description of proposed project and proposed impacts to jurisdictional waters
- Detailed analysis of flow releases documented with population analysis and system modeling
- Avoidance and minimization of jurisdictional waters analysis
- Identification of adjacent property owners
- Development of a conceptual compensatory mitigation plan

Following completion of these items, a complex project meeting would typically be scheduled with the USACE Northern Area Section Office (Morrow, GA) to present the proposed project. Subsequent to the meeting, and if a project is tentatively accepted by the regulatory agencies, formal application and preparation of an IP would start. Following submittal of an IP, the application must be advertised for public comment. The USACE prepares the public notice, which includes detailed applicant information such as site location, proposed impacts, cultural resources, protected species, and proposed mitigation. The public notice would be advertised for 30 days and is also submitted to regulatory agencies including the Environmental Protection Agency (EPA) and the United States Fish and Wildlife Service, adjacent property owners, and to the USACE general mailing list. Applicants will be required to respond to inquiries received during the public notice process. Public hearings could be required if substantial adverse comments are received from the coordinating agencies or the public. Additional information and permitting required would consist of a Section 401 Water Quality Certification from the Georgia Environmental Protection Division (EPD). This certification must be issued for an IP to be valid. Depending on the level of impacts associated with the proposed reservoir, an Environmental Assessment or Environmental Impact Statement could be required by the USACE as well. Based on previous project experience, the level of controversy and environmental issues raised during agency and public review, a typical new reservoir project may require permitting times of 5 years or more.

The expansion of an existing reservoir could potentially facilitate the Section 404 permitting process when compared to the construction of a new impoundment. This is especially true for issues such as alternatives analysis, avoidance and minimization, and aquatic organism passage in that many or most potential impacts have already occurred. However, the steps of the overall Section 404 permitting process would still need to be followed, and historically reservoirs have encountered significant regulatory and public challenges, regardless of the presence/absence of an existing impoundment.

## **Compensatory Mitigation**

To determine the amount mitigation potentially required for jurisdictional impacts within the Etowah River 01, the USACE's Standard Operating Procedure (SOP) for Compensatory Mitigation (March 2004) was utilized. The SOP uses a series of factors such as location, type, existing condition, type of impact, etc. to generate a multiplying "factor." That factor is then multiplied by the impact area (acreage or linear footage) to calculate the required mitigation credits. To determine an average factor for jurisdictional areas associated with the Etowah River 01, various conditions observed during the field surveys were utilized. *However, it is imperative to note that this document only serves as a guideline if impacts do not exceed 5,000 linear feet of stream or ten acres of wetland impacts.* Potential impacts for the Etowah River 01 would significantly exceed this threshold and actual compensatory mitigation requirements would likely be substantially different from SOP estimates. Currently, the USACE Savannah District Office is developing a new SOP for large-scale projects focused on reservoirs. It is anticipated that this SOP would be issued mid-2008.

Utilizing the 2004 SOP and the approximated acreage and linear feet of jurisdictional waters located within the Etowah River 01 project area, an estimate of compensatory mitigation credits can be determined. Multiplying factors used for this analysis include: 6.7 for wetland systems, 5.7 for open waters, 12.7 for lower perennial streams, and 7.6 for intermittent streams. This factor was then multiplied by the acreage/ linear footage to determine an estimated number of mitigation credits required. The number of credits was then multiplied by an average credit price to estimate the final estimated compensatory mitigation cost associated with the Etowah River 01. Refer to Table 6 contained in the following section entitled "Project Construction Cost Estimate Narrative" for estimated impacts to jurisdictional waters and an estimate of mitigation credits required and associated costs.

## **Stream Buffer Variance**

The Georgia Erosion and Sedimentation Act of 1975 (GESA), as amended, requires that a 25-foot vegetated buffer be maintained along all state waters. Any land disturbing activities within the buffer would require obtaining a stream buffer variance from the EPD. The local issuing authority is responsible for determining if state waters are on-site and is responsible for determining if a stream buffer variance is required.

The GESA has a number of activities that are considered for stream buffer variances, including public water system reservoirs. Based on current regulations, reservoir construction would likely qualify for a variance. Attendant features such as pipelines and roadways, would likely be exempt from GESA regulations if stream crossings are constructed nearly perpendicular.

## **EPD Water Withdrawal Permit**

Georgia EPD requires a permit for withdrawal of 100,000 gallons per day or more of either surface water or ground water. In addition to justification of need for water for up to 50 years in the future, water withdrawal permits typically require the preparation of water conservation, drought contingency, water supply/watershed protection, and reservoir management plans. A public hearing may be required as part of the withdrawal permitting process. EPD requires that

its comments on the component plans be addressed before moving forward with issuing the water withdrawal permit. Based on previous permitting experience, a water withdrawal permit can be obtained within five to seven months, depending on EPD's review time and the extent of their comments.

### **Source Water Protection Plan**

Amendments to the Federal Safe Drinking Water Act (SDWA) have brought about a new approach for ensuring clean and safe drinking water served by public water supplies in the United States. Management of a drinking water source now requires a Source Water Protection Plan. This plan basically defines watershed management strategies for ensuring that the water supply is not compromised by potential pollutant sources. Typically these sources are unmanaged development, but they can also include industrial sources that can potentially contaminate the water supply. The entity that operates this reservoir for water supply would be required to produce and implement the Plan. The Plan should also address any source water from outside the reservoir watershed that would be used to fill the reservoir, i.e., pumped/storage sources. The cost and schedule for producing a Source Water Assessment and the corresponding Source Water Protection Plan have not been included in any of the estimates presented in the report.

## **PROJECT CONSTRUCTION COST ESTIMATE NARRATIVE**

### **Dam and Reservoir**

The construction cost estimate for the proposed dam was based upon the general description provided in the background section of the report. Additionally, the following assumptions were made regarding the geometry of the dam.

- Upstream slope of 3H to 1V
- Downstream slope of 3H to 1V
- Upstream slope wave action protection in the form of riprap from 30 feet below the crest of the dam to 5 feet below the crest of the dam. Riprap supported by a berm located 30 feet below top of dam.
- Downstream slope having nearly horizontal 12-foot wide berms at 30-foot vertical intervals to control surface water runoff and erosion
- Crest of dam having a width of 25-feet

In addition to the above geometric considerations, the following internal drainage configurations were also considered in the estimation of construction costs.

- Chimney drain located at the downstream edge of the crest
- Trench drain located at 1/3 the distance from the downstream toe to the crest

A plan view and cross section of the proposed dam is provided in Figures 10 and 11.

Contained below are the items estimated to develop the construction cost estimate. We caution that the quantities and associated prices are based upon limited engineering evaluation and will likely change as the project proceeds into detailed evaluation and design.

#### Mobilization and Demobilization

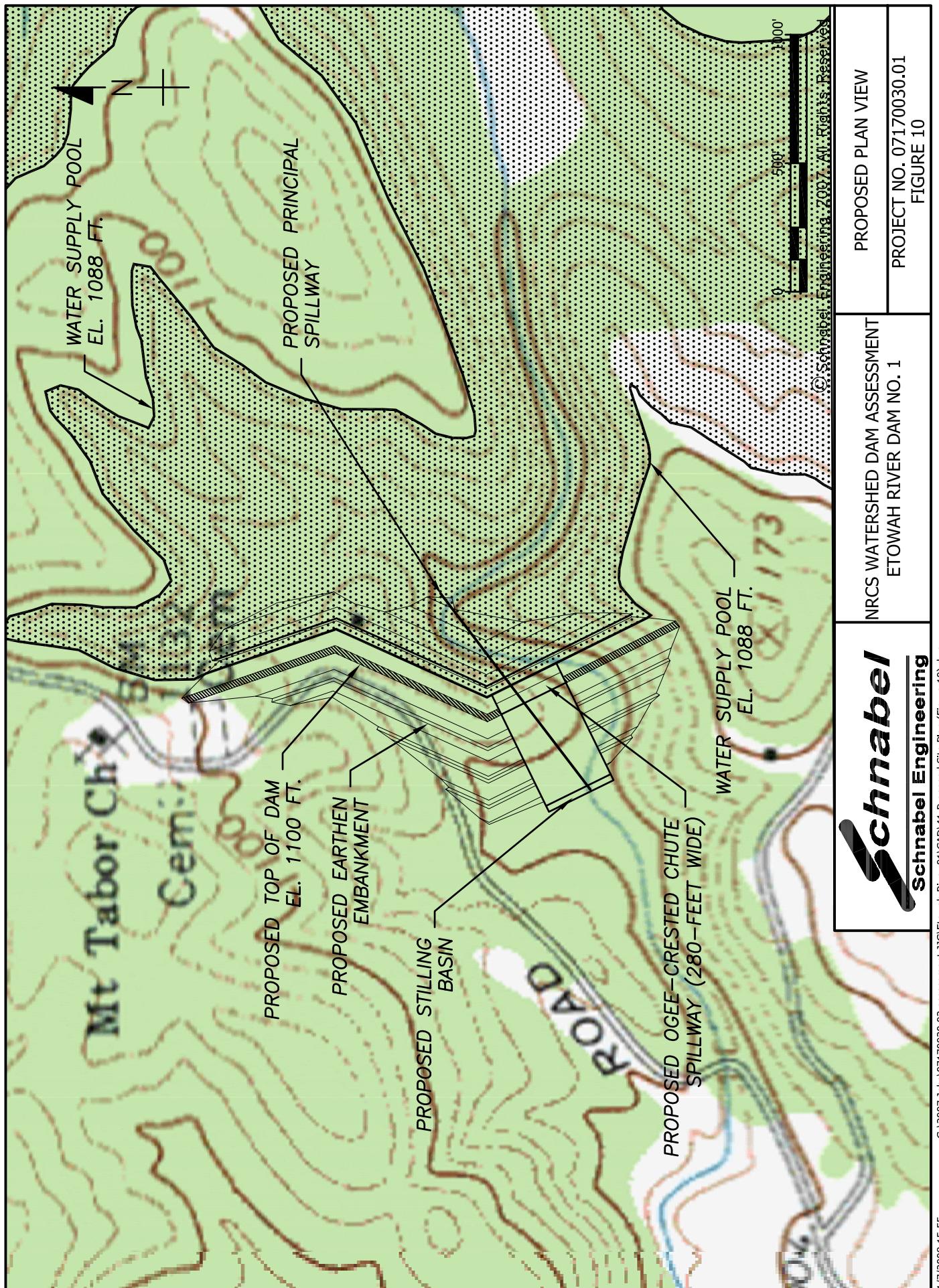
Mobilization and demobilization is a lump sum item estimated at 6 percent of the unit rate sum of the construction items.

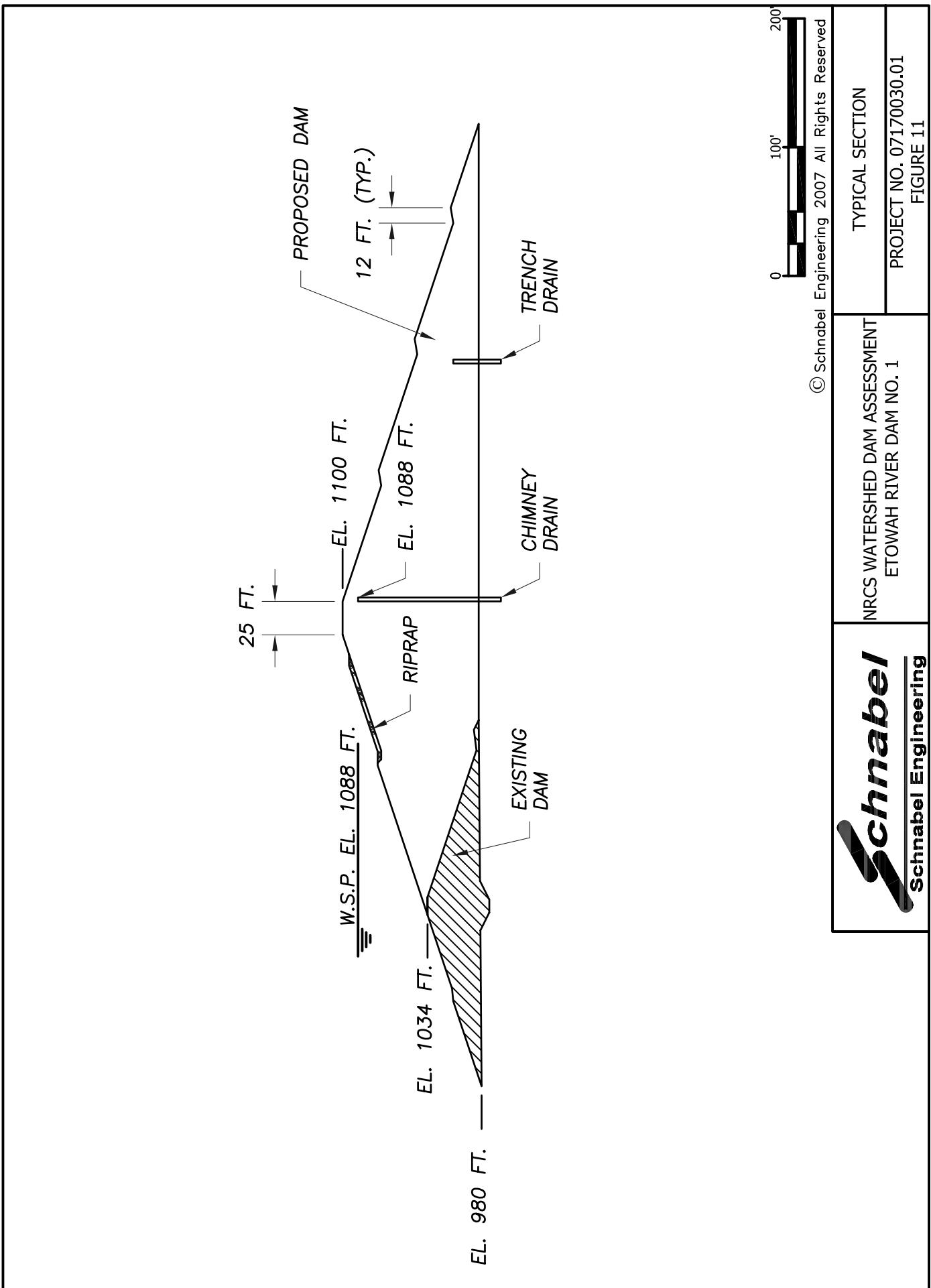
#### Erosion and Sedimentation Control

Erosion and sedimentation control is a lump sum item estimated at 2 percent of the sum of unit rate construction items.

#### Control of Water

Control of water is a lump sum item estimated at 3 percent of the sum of unit rate construction items. This item includes the control of both surface water and groundwater and will likely consist of stream diversion, cofferdam construction and maintenance, pumping, and well points, as well as any other means of controlling water during construction.





## Clearing

Clearing is a unit rate item measured in acres associated with the removal of trees and other vegetation from the reservoir. The estimated area of clearing was assumed to be equal to the surface area of the reservoir at the normal pool elevation.

## Clearing and Grubbing

Clearing and grubbing is a unit rate item measured in acres associated with the removal of trees, other vegetation, and associated root mats in the areas to receive structural fill or concrete. The estimated area of clearing and grubbing was assumed to be equal to the footprint of the proposed dam plus an additional 50-foot perimeter around the proposed dam.

## Earth Fill

Earth Fill is a unit rate item measured in cubic yards. The computed volume of earth fill represents the estimated quantity required to construct the dam as described herein. The estimated quantity was computed using an AutoCad Civil 3D computer model based on the proposed grading and existing topography. In addition to the proposed embankment earth fill, foundation excavation backfill was calculated (see Excavation, Common for details) and added to the embankment earth fill to determine the total quantity of earth fill.

## Drain Fill

Drain Fill is a unit rate item measured in cubic yards. The computed volume of drain fill represents the estimated quantity of fine and coarse-grained drain material required to construct the internal drainage system as described herein. For the purposes of this study, no differentiation was made between fine and coarse drain fill. In addition, the quantity for the trench drain was assumed to be equal to half of the chimney drain quantity. The chimney drain was assumed to have a top elevation equal to the proposed normal pool elevation and a bottom elevation approximated at the limits of the foundation excavation. The chimney drain was assumed to have a width of three feet and run the length of the dam from one abutment, into the floodplain, and up the other abutment tying into residual soils.

## Excavation, Common

Excavation, Common is a unit rate item measured in cubic yards associated with the removal of unsuitable material (soils) within and adjacent to the footprint of the proposed dam. The volume of common excavation was calculated by approximating the surface area of the floodplain within the limits of clearing and grubbing as well as the depth of excavation within the same area. The surface area of the floodplain was approximated using available topographic maps. The depth of excavation was estimated from the boring data included in the design plans for the existing dam.

### Riprap

Riprap is a unit rate item measured in tons. The computed weight of riprap represents the estimated quantity required to construct the wave-action berm as described herein. Riprap was assumed to be placed on the upstream slope of the dam. The section of riprap was assumed to extend 30 vertical feet, have a thickness of about 2-¾ feet, and traverse the length of the proposed dam.

### Permanent Turf Establishment

Permanent Turf Establishment is a unit rate item measured in acres associated with the establishment of a permanent turf at the conclusion of construction activities for the proposed dam. The estimated area of permanent turf establishment was assumed to be equal to the estimated area of clearing and grubbing.

### Concrete, Class 4000

Concrete, Class 4000 is a unit rate item measured in cubic yards associated with the construction of the reinforced concrete auxiliary chute spillway. The volume of concrete was estimated by comparing the proposed auxiliary spillway drop in elevation and width to the drops in elevation and widths of constructed reinforced concrete chute spillways. A relationship was developed between the drop in elevation and width of the constructed spillways and the required quantity of concrete. This relationship was applied to the proposed dam to estimate the quantity of concrete.

### Principal Spillway Reinforced Concrete Pressure Pipe

Reinforced Concrete Pressure Pipe (RCPP) is a unit rate item measured in feet. The computed length of RCPP represents the estimated quantity required to construct the principal spillway conduit described herein. The RCPP was assumed to be placed through the base of the proposed dam from the upstream toe to the downstream toe. The diameter of the pipe was assumed to be equal to the diameter of the pipe in the existing dam.

### Concrete, Class 3000 (mass)

Concrete, Class 3000 is a unit rate item measured in cubic yards associated with the construction of the concrete cradle beneath the principal spillway pipe. The concrete cradle was assumed to be designed as a Soil Conservation Service Type A2 cradle and run the length of the principal spillway pipe minus ten feet.

### Reinforced Concrete Riser

The Reinforced Concrete Riser is a lump sum item associated with the construction of the reinforced concrete principal spillway structure. The cost was estimated by comparing the proposed principal spillway riser height to the heights of constructed reinforced concrete riser structures. A relationship was developed between the height of the constructed spillways and the

cost to construct them. This relationship was utilized to estimate the cost of the proposed riser structure.

## **Land Acquisition**

The costs associated with land acquisitions are unit rate items based upon the number of acres that will need to be purchased at the top-of-dam elevation, the number of acres that will need to be managed for a 150-foot buffer around the normal pool, and the number of houses that will need to be purchased. For the purposes of the buffer management, only the portions of the buffer above top-of-dam elevation were considered. The costs to purchase the land were estimated based upon available records of recent land sales. The cost to manage the buffer was assumed to be 60 percent of the land purchase cost. The cost of each structure impacted was assumed to be \$200,000.

## **Roadway Relocation**

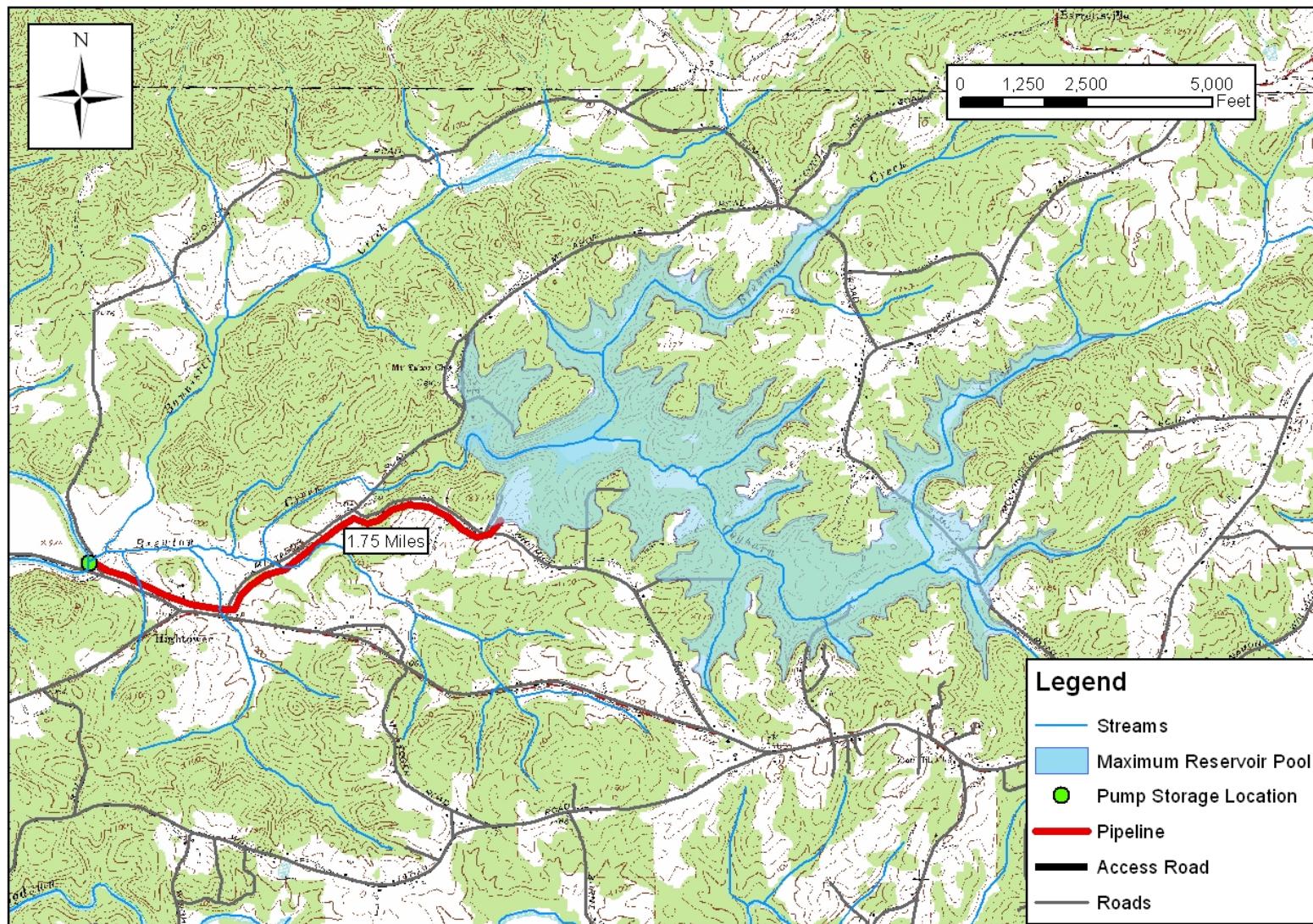
To construct the proposed project, nine roads will be impacted. These roads may need to be raised, relocated, or modified to accommodate the new reservoir; however, no consideration was given to the relocation of the roads in this study. A more detailed evaluation would need to be performed to evaluate the impact on existing roadways and the associated cost.

## **Pump Station and Pipeline Cost Estimation**

The pump storage location for the Etowah River Reservoir 01 is located on the Etowah River, at its confluence with Brewton Creek as shown in Figure 12. The reservoir is located along Brewton Creek, approximately 1.75 miles upstream of the confluence with the Etowah River. With a water supply pool elevation of 1088 feet, Reservoir 01 has an average day yield of approximately 26 MGD. A 54-inch ductile iron pipe (DIP) was selected to carry water from the pump storage location to the reservoir. This pipeline is approximately 1.75 miles in length and will pump water from the storage location elevation of 955 feet, to the 1088 feet height of the reservoir water surface. A cascading structure will need to be constructed where the pipe comes into the reservoir to provide aeration and erosion control.

Six 10-MGD pumps were selected at the pump storage location to pump water to the reservoir. This gives a firm pumping capacity of 50-MGD, which is roughly twice the daily yield of the reservoir, the standard assumption for pump capacity. This pumping capacity will allow the reservoir to remain stable during times of peak water demand, as well as give redundancy in the case of failure in one of the pumps. A short access road will need to be constructed from either Nicholson Road or Old Federal Road to the pumping station at the Etowah River in order to construct and maintain the station. The cost opinion for these components is found in the appendix.

**Figure 12**  
**Project Location Map**



## **Compensatory Mitigation**

The simplest mitigation option is typically purchasing credits from a bank. Compensatory mitigation credits may be purchased from an approved mitigation bank or through the Georgia Land Trust Service Center if a bank is not available within the project area. Based on recent projects, wetland credits range from \$7,000-\$10,000 per credit and stream credits range from \$70-\$110 per credit. An option to purchasing credits is to obtain credits by conducting on-site restoration or preservation of jurisdictional waters.

**Table 6**  
**Etowah River 01 Estimated Impacts and Overall Mitigation Banking Cost Analysis**

<b>Impact Type</b>	<b>Estimated Impact Acres/Linear Feet</b>	<b>Projected Credits Needed</b>	<b>Projected Cost*</b> \$90/stream credit \$7,500/wetland credit
Wetland	18.32 A.	123	\$922,500
Intermittent Stream	16,585 l.f.	126,046	\$11,344,140
Lower Perennial Stream	37,334 l.f.	474,142	\$42,672,780
Open Water	29.11 A.	166	\$1,245,000
<b>Total</b>	<b>47.43 acres / 53,919 l.f.</b>	<b>289 wetland / 600,188 stream**</b>	<b>\$56,184,420</b>

\*Cost is based on recent quotes from banks within the Etowah River Basin. Actual banking price may be higher or lower than estimated depending on the date of purchase and credit availability. \*\*Total required credits calculated using the March 2004 Standard Operating Procedure mitigating guidelines established by the US Army Corps of Engineers.

## **Estimated Project Construction Cost**

The total project cost is estimated at \$256,000,000. Table A-5, located in the appendix, shows an itemized breakdown of the costs associated with enlarging the existing dam and reservoir. These costs are estimates and are based on multiple assumptions.

## **APPENDIX**

### **FIGURES**

- Figure A-1 Gage Station Flows – Regression Analysis
- Figure A-2a Calculation of Stage Storage / Stage Area Curves
- Figure A-2b Stage Storage / Stage Area Curves
- Figure A-3 Regression Equations for Area to Storage and Depth to Storage
- Figure A-4 Storage vs. Time and Elevation vs. Time for Assumed Safe Yield

### **TABLES**

- Table A-1 Summary of Opinion of Probable Construction Costs for Pumping Facilities and Pipelines
- Table A-2 Opinion of Probable Construction Costs – River Intake and Pump Station
- Table A-3 Opinion of Probable Construction Costs – 30-inch Raw Water Line
- Table A-4 Opinion of Probable Construction Costs – Reservoir Inlet Structure
- Table A-5 Total Project Opinion of Cost

Figure A-1

Etowah River near Dawsonville (USGS 02389000) vs.  
Etowah River near Canton (USGS 02392000)

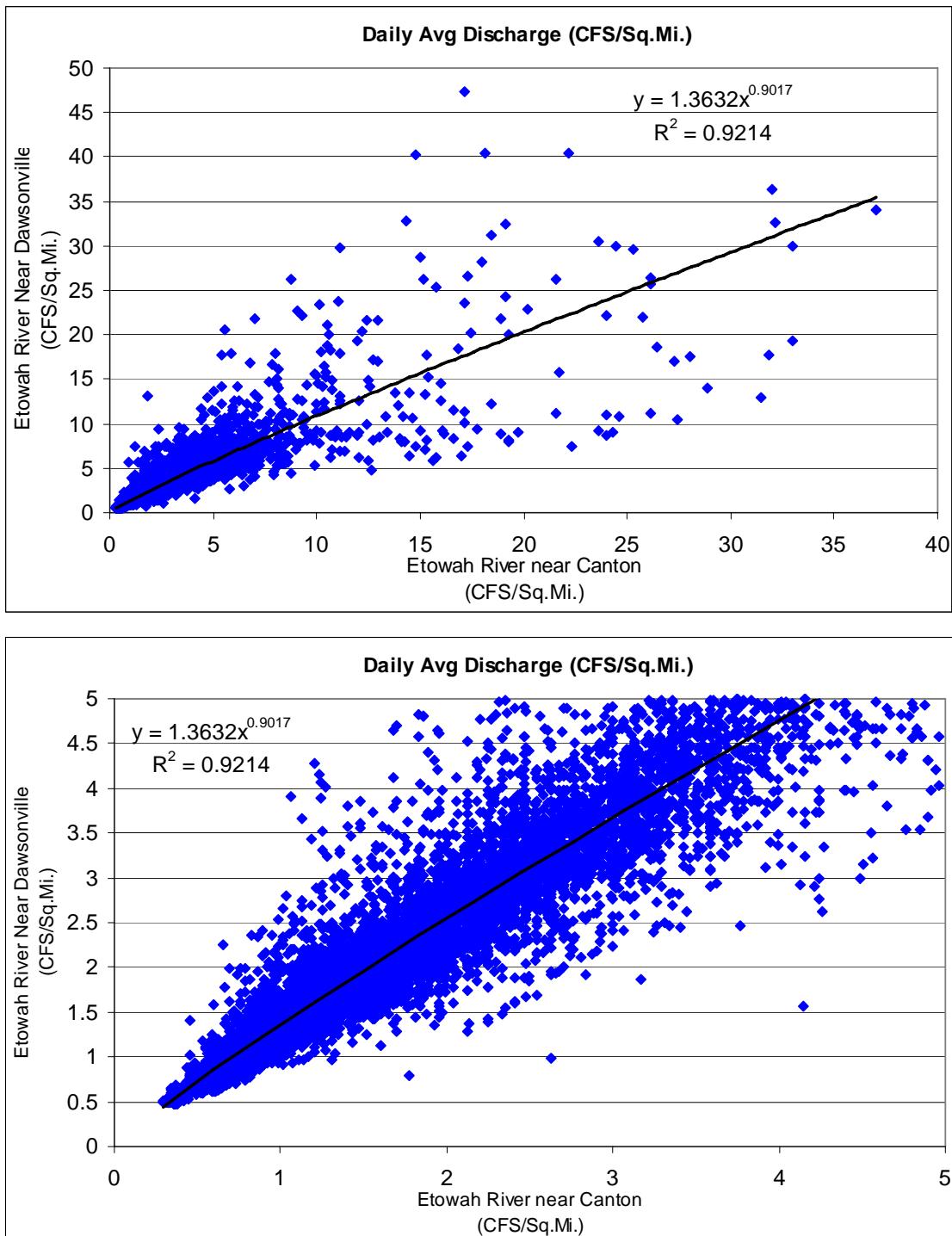


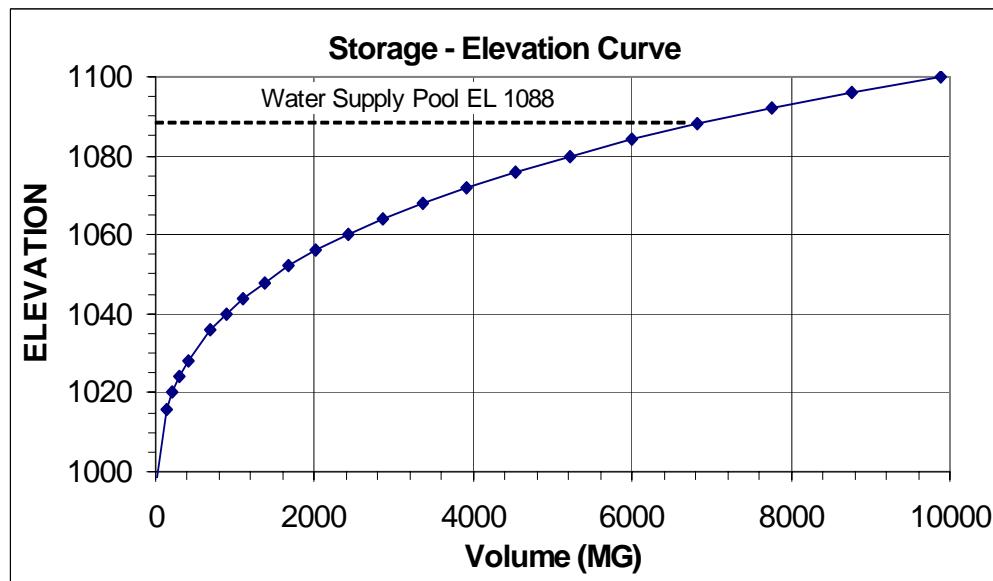
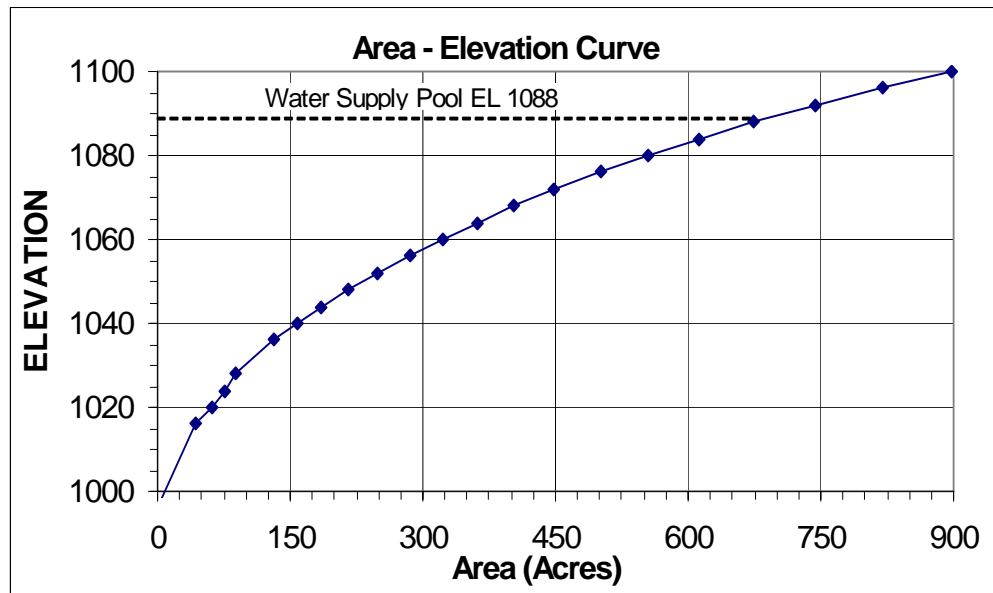
Figure A-2a

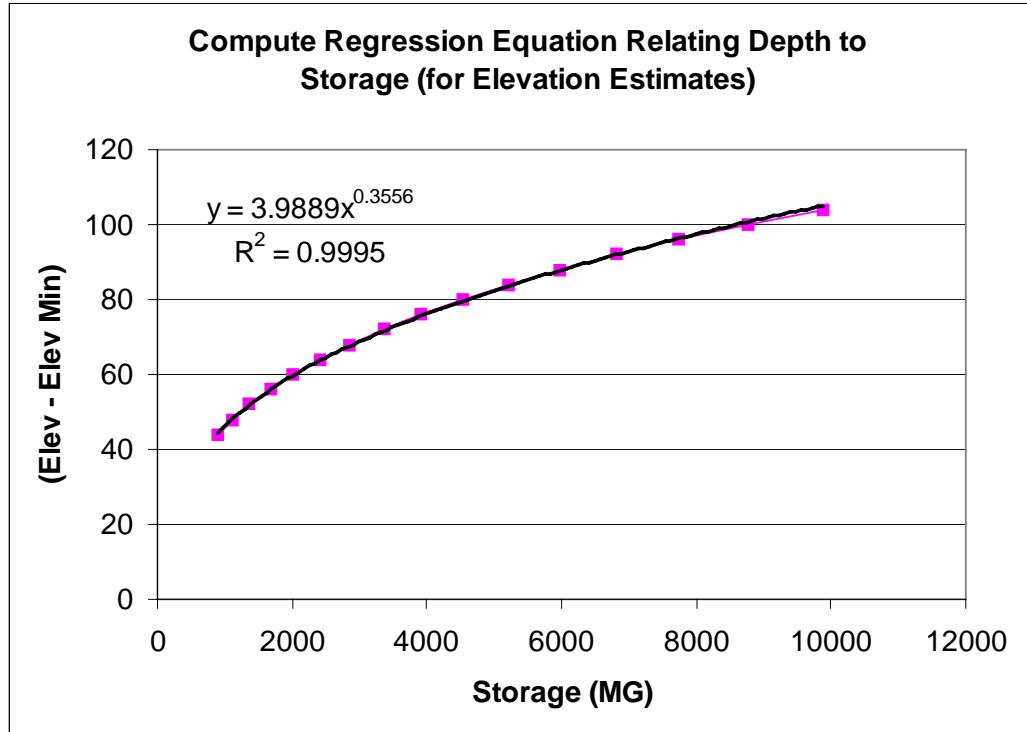
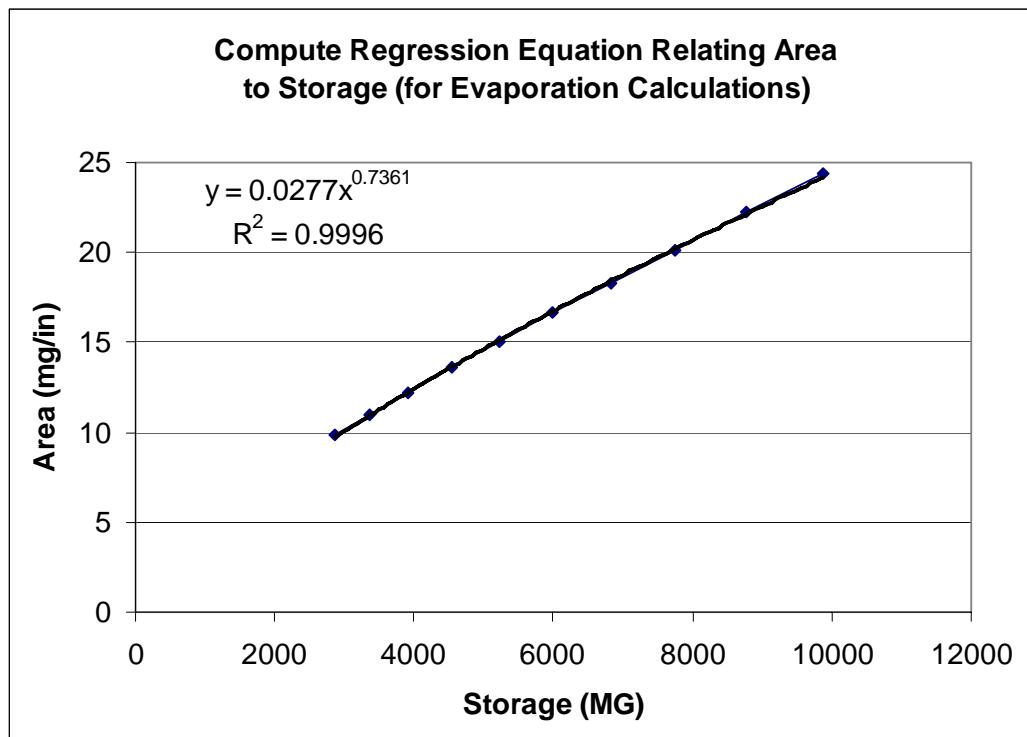
**Etowah River 01**  
**Calculation of Area and Storage Curves**

Elev.	Area Acres	Area mg/in	Inc. Vol. A-FT	Cumulative Vol	
				A-FT	M Gal.
996	0	0	0	0	0
1016	44.1	1	441	441	144
1020	61.5	2	211	652	212
1024	76.9	2	277	929	303
1028	89.3	2	332	1261	411
1036	130.9	4	881	2142	698
1040	157.4	4	576	2718	886
1044	184.8	5	684	3402	1109
1048	215.5	6	800	4203	1370
1052	249.0	7	929	5132	1672
1056	285.6	8	1069	6201	2021
1060	322.8	9	1217	7418	2417
1064	361.8	10	1369	8787	2864
1068	403.3	11	1530	10317	3362
1072	448.0	12	1703	12020	3917
1076	501.1	14	1898	13918	4536
1080	554.3	15	2111	16029	5224
1084	612.9	17	2334	18363	5984
1088	674.6	18	2575	20938	6824
1092	743.0	20	2835	23773	7748
1096	819.2	22	3124	26897	8766
1100	898.6	24	3436	30333	9886

Figure A-2b

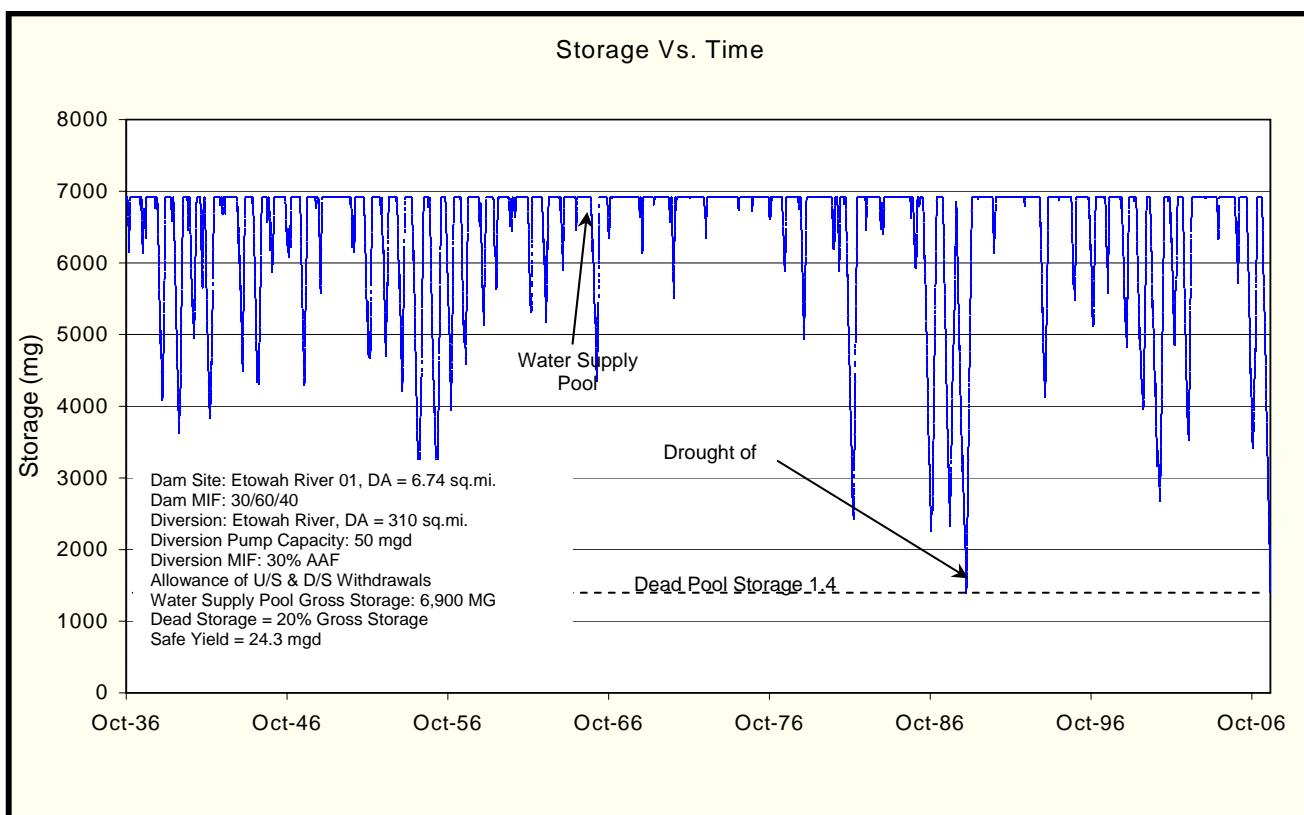
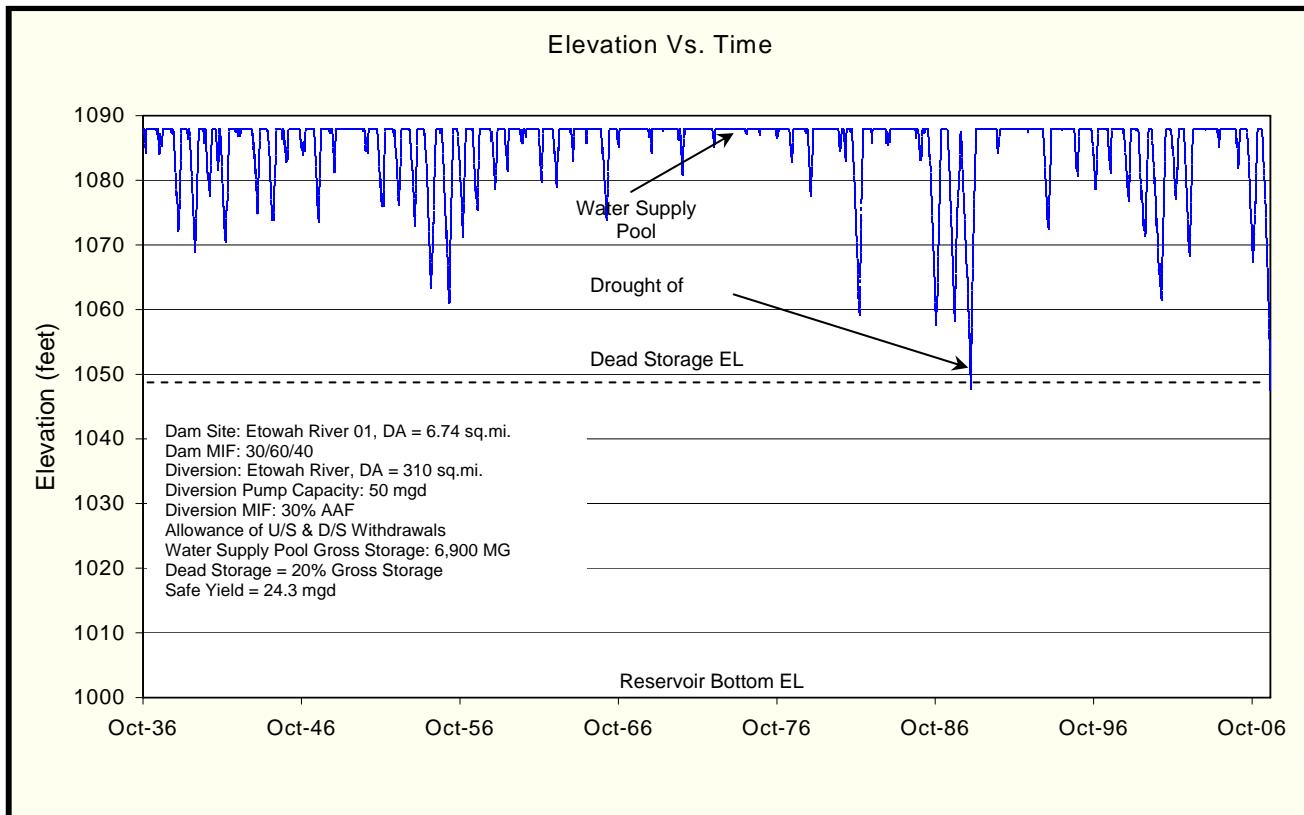
Etowah River 01





Etowah River 01

Figure A-4



WATERSHED DAM ASSESSMENT - ETOWAH RIVER 01

## **Forsyth County, Georgia (7194-001)**

## **OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE - CONCEPTUAL LEVEL**

## **Summary by Division**

TABLE A-1

Division		01 - River Intake and Pump Station and Access Road	02 - 54 - inch Raw Water Force Main and Venturi Vault	03 - Reservoir Inlet Structure	TOTAL	% of Total
1		\$0.71	\$0.37	\$0.05	\$1.12	8.58%
2		\$0.60	\$0.00	\$0.04	\$0.65	4.93%
3		\$0.93	\$0.02	\$0.27	\$1.22	9.28%
4		\$0.09	\$0.00	\$0.00	\$0.09	0.70%
5		\$0.02	\$0.00	\$0.00	\$0.02	0.17%
6		\$0.00	\$0.00	\$0.00	\$0.00	0.00%
7		\$0.02	\$0.00	\$0.00	\$0.02	0.17%
8		\$0.03	\$0.00	\$0.00	\$0.03	0.23%
9		\$0.05	\$0.00	\$0.00	\$0.05	0.38%
10		\$0.00	\$0.00	\$0.00	\$0.00	0.00%
11		\$2.10	\$0.00	\$0.06	\$2.16	16.50%
12		\$0.00	\$0.00	\$0.00	\$0.00	0.00%
13		\$0.00	\$0.00	\$0.00	\$0.00	0.00%
14		\$0.09	\$0.00	\$0.00	\$0.09	0.70%
15		\$0.45	\$3.65	\$0.01	\$4.11	31.40%
16		\$0.68	\$0.08	\$0.00	\$0.75	5.73%
17		\$0.20	\$0.03	\$0.00	\$0.23	1.78%
Structure Contingency		\$0.60	\$0.00	\$0.00	\$0.60	4.57%
Markup		\$1.15	\$0.71	\$0.09	\$1.95	14.89%
<b>Structure Total (without Contingency)</b>		<b>\$7.73</b>	<b>\$4.84</b>	<b>\$0.53</b>	<b>\$13.10</b>	<b>100.00%</b>
Project Contingency		\$2.32	\$1.45	\$0.16	\$3.93	30.00%
<b>Structure Total (with Contingency)</b>		<b>\$10.04</b>	<b>\$6.30</b>	<b>\$0.68</b>		
<b>All Figures are in Millions</b>					<b>PROJECT TOTAL</b>	<b>\$17.03 M</b>

## WATERSHED DAM ASSESSMENT - ETOWAH RIVER 01

Forsyth County, Georgia (7194-001)

01  
DECEMBER 2007

## OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE - CONCEPTUAL LEVEL

01 - River Intake and PS

TABLE A-2

No.	Spec. Sect.	Description	Unit	Qty	Labor \$		Material \$		Equipment \$		Subcontractor \$		Total	
					Unit	Total	Unit	Total	Unit	Total	Unit	Total		
<b>01 - Etowah River 01: River Intake and Pump Station</b>					<b>6 - Channel Intake Pump Station</b>					<b>Pump Station Firm Capacity is 50MGD</b>				
		<b>Div 1</b>												
1	1000	General Conditions	LS	1		\$253,000		\$200,300		\$253,000		\$0	\$706,300	
		<b>Div 2</b>												
2	2200	Earth Work	LS	1	\$25,200.00	\$25,200	\$15,700.00	\$15,700	\$6,479.00	\$6,480	\$345,400.00	\$345,400	\$392,780	
3		Access Road	LF	50		\$0		\$0		\$0		\$110.00	\$5,500	\$5,500
4		Creek Crossing	EA	0		\$0		\$0		\$0		\$50,000.00	\$0	\$0
5	2831	10' Galv. Chain Link Fence	LF	100		\$0		\$0		\$0		\$30.00	\$3,000	\$3,000
6	2831	Dewatering / Pre-Excavation Preparation	LS	1	\$50,000.00	\$50,000	\$20,000.00	\$20,000	\$100,000.00	\$100,000	\$30,000.00	\$30,000	\$200,000	
		<b>Div 3</b>												
7	3250	Water Stop	LF	500	\$1.25	\$630	\$2.00	\$1,000		\$0		\$0	\$1,630	
8	3300	Concrete Bridge	SF		\$2.00	\$0		\$0	\$3.50	\$0	\$20.00	\$0	\$0	
9	3300	Concrete	LS	1	\$297,188.00	\$297,190	\$543,900.00	\$543,900	\$87,690.00	\$87,690	\$0.00	\$0	\$928,780	
		<b>Div 4</b>												
10	4210	Brick Veneer	SF	4200		\$0		\$0		\$0		\$14.50	\$60,900	\$60,900
11	4220	Concrete Masonry Unit - Reinforced	SF	4200		\$0		\$0		\$0		\$7.25	\$30,450	\$30,450
		<b>Div 5</b>												
10	5524	Aluminum Handrail	LF	200	\$6.00	\$1,200	\$35.00	\$7,000	\$2.90	\$580		\$0	\$8,780	
11		Ladder	VF	20	\$50.00	\$1,000	\$150.00	\$3,000	\$15.00	\$300		\$0	\$4,300	
12	5530	Aluminum Grating Landing	SF	32	\$10.00	\$320	\$45.00	\$1,440	\$10.00	\$320		\$0	\$2,080	
13	5530	Aluminum Grating	SF	240	\$10.00	\$2,400	\$20.00	\$4,800		\$0		\$0	\$7,200	
		<b>Div 6</b>												
		<b>Div 7</b>												
14		Membrane Roofing	SF	2450		\$0		\$0		\$0		\$5.00	\$12,250	\$12,250
15		Dampproofing - Walls	SF	4200		\$0		\$0		\$0		\$0.56	\$2,350	\$2,350
16		1" Rigid Insulation - Walls	SF	4200		\$0		\$0		\$0		\$1.07	\$4,490	\$4,490
17	7210	Walls - Core Fill Foam Insulation (12" CMU)	SF	4200		\$0		\$0		\$0		\$0.61	\$2,560	\$2,560
		<b>Div 8</b>												
18	8120	Hollow Metal Doors, Hardware, and Frames - Single	EA	10	\$150.00	\$1,500	\$400.00	\$4,000		\$0		\$0	\$5,500	
19	8120	Hollow Metal Doors, Hardware, and Frames - Double	EA	2	\$150.00	\$300	\$800.00	\$1,600		\$0		\$0	\$1,900	
20		Windows	LS	1	\$3,000.00	\$3,000	\$8,000.00	\$8,000	\$1,000.00	\$1,000		\$0	\$12,000	
21	8331	Roll Up Aluminum Door (10'x12')	EA	2	\$800.00	\$1,600	\$4,500.00	\$9,000	\$50.00	\$100		\$0	\$10,700	
		<b>Div 9</b>												
22	9900	Painting	LS	1		\$0		\$0		\$0		\$50,000.00	\$50,000	\$50,000
		<b>Div 10</b>												
		<b>Div 11</b>												
23		Screens	EA	6	\$3,500.00	\$21,000	\$200,000.00	\$1,200,000	\$500.00	\$3,000		\$0	\$1,224,000	
24		Eductors	EA	30	\$200.00	\$6,000	\$2,500.00	\$75,000	\$50.00	\$1,500		\$0	\$82,500	
25		Pumps (10 MGD, 145 Feet Static Head)	EA	6	\$12,000.00	\$72,000	\$120,000.00	\$720,000	\$1,000.00	\$6,000		\$0	\$798,000	
		<b>Div 12</b>												
		<b>Div 13</b>												
		<b>Div 14</b>												
26		Bridge Crane	LS	1	\$5,000.00	\$5,000	\$85,000.00	\$85,000	\$1,500.00	\$1,500		\$0	\$91,500	
		<b>Div 15</b>												
27	15062	Ductile Iron Pipe	LS	1	\$11,195.00	\$11,200	\$197,359.83	\$197,360	\$2,840.00	\$2,840	\$0.00	\$0	\$211,400	
28		PVC Piping	LS	1	\$1,250.00	\$1,250	\$8,000.00	\$8,000	\$750.00	\$750		\$0	\$10,000	
29		Valves	LS	1	\$10,000.00	\$10,000	\$100,000.00	\$100,000	\$2,000.00	\$2,000	\$0.00	\$0	\$112,000	
30		HVAC and Plumbing	LS	1		\$0		\$0		\$0		\$120,000.00	\$120,000	
		<b>Div 16</b>												
31	16000	Electrical	LS	1		\$0		\$0		\$0		\$600,000.00	\$600,000	
32		CCTV Allowance	LS	0		\$0		\$0		\$0		\$0	\$0	
33		Ductbank	LF	500		\$0		\$0		\$0		\$150.00	\$75,000	
		<b>Div 17</b>												
34	17000	Instrumentation	LS	1		\$0		\$0		\$0		\$200,000.00	\$200,000	
		Contingency	LS	10%		\$76,000		\$321,000		\$47,000		\$154,000	\$598,000	
		<b>Subtotals</b>				\$839,790		\$3,526,100		\$514,060		\$1,695,900	\$6,575,850	

**Assumptions:**

Sales Tax @ 7.0% \$246,800  
 Labor Burden @ 30.0% \$251,900  
 Bonds On Subs @ 1.5% \$25,400  
 Subtotal \$7,099,950  
 Fee @ 7.0% \$497,000  
 Insurance & Bonds @ 1.7% \$129,100  
**Estimated Construction Cost** \$7,726,050

Assumes that EPD will allow withdrawal from this source  
 15 foot wide Asphalt access road with 10-foot high fence  
 Pump Station firm capacity is 50MGD  
 Pump Station has a 6 channel intake  
 Pump Station footprint is approximately 96 feet by 70 feet  
 Pump Station main building footprint is approximately 74 feet by 100 feet  
 Pump Station main building also houses the electrical room and is made of brick and block  
 A Transformer is being provided by the Utility Company at the access road entrance  
 Estimate DOES NOT include easements acquisitions, land acquisitions, withdrawal permits or mitigations required to build the pump station

**WATERSHED DAM ASSESSMENT - (7194-001)**  
**ETOWAH RIVER 01**

02  
**DECEMBER 2007**

**OPINION OF PROBABLE CONSTRUCTION COST ESTIMATE - CONCEPTUAL LEVEL**  
02 - 54-inch Raw Water Line

TABLE A-3

No.	Spec. Sect.	Description	Unit	Qty	Labor \$S		Material \$S		Equipment \$S		Subcontractor \$S		Total					
					Unit	Total	Unit	Total	Unit	Total	Unit	Total						
<b>02 - 54-inch Raw Water Line with Venturi Vault</b>																		
		<b>Div 1</b>																
1	1000	General Conditions	LS	1		\$135,000		\$97,200		\$134,600		\$0	\$366,800					
		<b>Div 2</b>																
2	2125	Erosion and Sedimentation Control/Maintenance - with Unit Bid	MTH			\$0		\$0		\$0		\$0	\$0					
3		Dewatering	LS			\$0		\$0		\$0		\$0	\$0					
4	2510	Asphalt Concrete Pavement - with Unit Bid	LS			\$0		\$0		\$0		\$0	\$0					
5	2523	Concrete Sidewalk and Curbs - with Unit Bid	LS			\$0		\$0		\$0		\$0	\$0					
		<b>Div 3</b>																
6	3300	Miscellaneous Concrete (Venturi Vault)	LS	1	\$1,500.00	\$1,500	\$12,500.00	\$12,500	\$1,000.00	\$1,000	\$0.00	\$0	\$15,000					
		<b>Div 4</b>																
		<b>Div 5</b>																
		<b>Div 6</b>																
		<b>Div 7</b>																
		<b>Div 8</b>																
		<b>Div 9</b>																
		<b>Div 10</b>																
		<b>Div 11</b>																
		<b>Div 12</b>																
		<b>Div 13</b>																
		<b>Div 14</b>																
		<b>Div 15</b>																
7		<b>30" DIP</b>	<b>Depth</b>	<b>9</b>	<b>Depth of Cover</b>	<b>4</b>												
8		54" Pipe Excavation - Earth (compacted volume)	CY	16292	\$0.75	\$12,219		\$0	\$3.00	\$48,875		\$0	\$61,094					
9		54" Pipe Excavation - Trench Rock (compacted volume)	CY	5431		\$0		\$0		\$35.00		\$190,069	\$190,069					
10		Trench Box	LF	9200		\$0	\$1.00	\$9,200		\$0		\$0	\$9,200					
11		54" DIP Pressure Class 200	LF	7400	\$16.67	\$123,328	\$270.72	\$2,003,328	\$2.50	\$18,500		\$0	\$2,145,156					
12		54" Pipe Bedding (compacted volume)	CY	2556	\$1.00	\$2,556	\$13.00	\$33,222	\$1.00	\$2,556		\$0	\$38,333					
13		54" Pipe Backfill (compacted volume)	CY	13747	\$1.00	\$13,747		\$0	\$4.00	\$54,990		\$0	\$68,737					
14		Import Backfill Materials (loose volume, assume 10% swell)	CY	2799		\$0	\$13.00	\$36,383		\$0		\$0	\$36,383					
15		Haul off Rock (assume 15% swell) - with Unit Bid	CY	6245		\$0		\$0		\$0		\$15.00	\$93,677					
16		54" 90-degree Bend	EA	2	\$317.00	\$634	\$16,303.32	\$32,607	\$50.00	\$100		\$0	\$33,341					
17		54" 45-degree Bend	EA	4	\$317.00	\$1,268	\$12,755.35	\$51,021	\$50.00	\$200		\$0	\$52,489					
18		54" 22.5-degree Bend	EA	2	\$317.00	\$634	\$9,575.83	\$19,152	\$50.00	\$100		\$0	\$19,886					
19		54" 11.25-degree Bend	EA	4	\$317.00	\$1,268	\$8,313.12	\$33,252	\$50.00	\$200		\$0	\$34,720					
20		54" DIP Pressure Class 200 RJ	LF	1800	\$9.17	\$16,499	\$326.40	\$587,520	\$2.50	\$4,500		\$0	\$608,519					
21																		
22		Earthwork Calculations				\$0		\$0		\$0		\$0	\$0					
23		Pipe Excavation - Total Compacted Volume	CY	21722		\$0		\$0		\$0		\$0	\$0					
24		Rock - Total Compacted Volume (assume 25% of excavation)	CY	5431		\$0		\$0		\$37.00		\$200,931	\$200,931					
25		Pipe Bedding - Total Compacted Volume	CY	2556		\$0		\$0		\$0		\$0	\$0					
26		Pipe Backfill - Total Compacted Volume Needed	CY	13747		\$0		\$0		\$0		\$0	\$0					
27		On-Site Backfill Material Available - Compacted Volume	CY	16292		\$0		\$0		\$0		\$0	\$0					
28		Materials for Disposal - Compacted Volume	CY	2544	\$5.00	\$12,721		\$0	\$5.00	\$12,721		\$0	\$25,442					
29																		
30		Air Release Valve and Manhole (3 each)	LS	1	\$2,200.00	\$2,200	\$26,400.00	\$26,400	\$1,800.00	\$1,800	\$0.00	\$0	\$30,400					
31		<b>Div 16</b>																
32	16000	Electrical	LS	1		\$0		\$0		\$0		\$75,000.00	\$75,000					
		<b>Div 17</b>																
33	17000	Venturi Meter	LS	1	\$2,000.00	\$2,000	\$18,000.00	\$18,000	\$1,000.00	\$1,000		\$0	\$21,000					
34	17000	Instrumentation	LS	1		\$0		\$0		\$0		\$12,500.00	\$12,500					
		Contingency	LS	0%		\$0		\$0		\$0		\$0	\$0					
		<b>Subtotals</b>				\$325,574		\$2,959,785		\$281,141		\$572,177	\$4,138,678					
		Sales Tax @			7.0%		\$207,200											
		Labor Burden @			30.0%		\$97,700											
		Bonds On Subs @			1.5%		\$8,600											
		Subtotal					\$4,452,178											
		Fee @			7.0%		\$311,700											
		Insurance & Bonds @			1.7%		\$81,000											
		<b>Estimated Construction Cost</b>					\$4,844,878											
												\$527 per LF						

**Assumptions:**  
Estimate DOES NOT include easements acquisitions, land acquisitions or mitigations required to build the pump station  
Assumed 25% of the excavated material is rock

**WATERSHED DAM ASSESSMENT - (7194-001)**  
**ETOWAH RIVER 01**

03  
**DECEMBER 2007**

**OPINION OF PROBABLE CONSTRUCTION COST - CONCEPTUAL LEVEL**  
 03 - Reservoir Inlet Structure

TABLE A-4

No.	Spec. Sect.	Description	Unit	Qty	Labor SS		Material SS		Equipment SS		Subcontractor SS		Total
					Unit	Total	Unit	Total	Unit	Total	Unit	Total	
<b>03 - Reservoir Inlet Structure</b>													
		Div 1											
1	1000	General Conditions	LS	1		\$18,000		\$14,500		\$18,300		\$0	\$50,800
		Div 2											
2	2200	Earth Work	LS	1	\$5,000.00	\$5,000	\$2,639.00	\$2,640	\$4,926.00	\$4,930	\$31,300.00	\$31,300	\$43,870
		Div 3											
3	3250	Water Stop	LF	500	\$1.25	\$630	\$2.00	\$1,000		\$0		\$0	\$1,630
4	3300	Concrete	LS	1	\$82,952.00	\$82,950	\$159,839.00	\$159,840	\$26,200.00	\$26,200	\$0.00	\$0	\$268,990
		Div 4											
		Div 5											
7	5524	Aluminum Handrail	LF		\$6.00	\$0	\$35.00	\$0	\$2.90	\$0		\$0	\$0
8		Ladder	VF		\$50.00	\$0	\$150.00	\$0	\$15.00	\$0		\$0	\$0
9	5530	Aluminum Grating Landing	SF		\$10.00	\$0	\$45.00	\$0	\$10.00	\$0		\$0	\$0
10	5530	Aluminum Grating	SF		\$10.00	\$0	\$20.00	\$0		\$0		\$0	\$0
		Div 6											
		Div 7											
		Div 8											
		Div 9											
10	9900	Painting	LS			\$0		\$0		\$0		\$0	\$0
		Div 10											
		Div 11											
11		Sluice Gates and Operators	EA	2	\$2,500.00	\$5,000	\$25,000.00	\$50,000	\$1,000.00	\$2,000		\$0	\$57,000
		Div 12											
		Div 13											
		Div 14											
		Div 15											
12	15062	Ductile Iron Pipe	LS	1	\$1,000.00	\$1,000	\$8,500.00	\$8,500	\$500.00	\$500		\$0	\$10,000
		Div 16											
13	16000	Electrical	LS			\$0		\$0		\$0	\$70,000.00	\$0	\$0
		Div 17											
14	17000	Instrumentation	LS			\$0		\$0		\$0	\$25,000.00	\$0	\$0
		Contingency	LS	0%		\$0		\$0		\$0		\$0	\$0
		Subtotals				\$112,580		\$236,480		\$51,930		\$31,300	\$432,290
		Sales Tax @			7.0%		\$16,600						
		Labor Burden @			30.0%		\$33,800						
		Bonds On Subs @			1.5%		\$500						
		Subtotal					\$483,190						
		Fee @			7.0%		\$33,800						
		Insurance & Bonds @			1.7%		\$8,800						
		Estimated Construction Cost					\$525,790						

Table A-5

**Etowah River No. 1****TOTAL PROJECT OPINION OF COST**

<u>Item No.</u>	<u>Description of Work</u>	<u>Estimated Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Amount</u>
1.	Mobilization and Demobilization	1	Job	Lump Sum	\$1,313,333.04
2.	Erosion & Sediment Control	1	Job	Lump Sum	\$437,777.68
3.	Control of Water	1	Job	Lump Sum	\$656,666.52
4.	Clearing	663	Ac	2,500.00	\$1,657,500.00
5.	Clearing & Grubbing	28	Ac	\$5,000.00	\$140,000.00
6.	Earth Fill	1,285,751	Cu-Yd	\$4.00	\$5,143,004.00
7.	Drain Fill	20,277	Cu-Yd	\$75.00	\$1,520,775.00
8.	Excavation, Common	46,626	Cu-Yd	\$5.00	\$233,130.00
9.	Riprap	24,325	Ton	\$75.00	\$1,824,375.00
10.	Permanent Turf Establishment	28	Ac	\$2,000.00	\$56,000.00
11.	Concrete, Class 4000 (reinforced)	12,486	Cu-Yd	\$850.00	\$10,613,100.00
12.	Concrete, Class 3000 (mass)	180	Cu-Yd	\$400.00	\$72,000.00
13.	30-Inch RCP	960	Feet	\$400.00	\$384,000.00
14.	Principal Spillway Riser	1	Unit	\$245,000.00	\$245,000.00
<b><u>Dam Construction Cost Estimate</u></b>					<b><u>\$24,296,661.24</u></b>
15.	54-Inch Pipeline	1	Unit	\$4,840,000.00	\$4,840,000.00
16.	Cascading Structure	1	Unit	\$530,000.00	\$530,000.00

17.	Pumping Station (Including Raw Water Pumps and Access Road)	1	Unit	\$7,730,000.00	\$7,730,000.00
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**Pump Station and Pipeline Cost Estimate**

18.	Land Acquisition	835	Ac	\$75,000.00	\$62,625,000.00
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19.	Easement Acquisition	220	Ac	\$45,000.00	\$9,877,500.00
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20.	Building Acquisition	83	Buildings	\$200,000	\$16,600,000.00
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**Land Acquisition Cost Estimate**

21.	Wetland	123	Credits	\$7,500.00	\$922,500.00
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22.	Intermittent Stream	126,046	Credits	\$90.00	\$11,344,140.00
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23.	Lower Perennial Stream	474,142	Credits	\$90.00	\$42,672,780.00
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24.	Open Water	166	Credits	\$7,500.00	\$1,245,000.00
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**Impacts and Overall Mitigation Cost Estimate**

**Construction, Land Acquisition, Mitigation Estimate**

**\$182,683,581.24**

**Contingency at 25%**

**\$45,670,895.31**

**Professional Services at 15% \***

**\$27,402,537.19**

**Total Project Estimate**

**\$255,757,013.74**

**Suggested Project Estimate**

**\$256,000,000.00**

\*Professional services include but are not limited to engineering, construction management legal, appraisals, and environmental consulting.